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Neck Pain: Revision 2017

Clinical Practice Guidelines Linked to the International Classification of Functioning, Disability and Health From the Orthopaedic Section of the American Physical Therapy Association

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Summary of Recommendations*

PATHOANATOMICAL FEATURES/DIFFERENTIAL DIAGNOSIS

A Clinicians should perform assessments and identify clinical findings in patients with neck pain to determine the potential for the presence of serious pathology (eg, infection, cancer, cardiac involvement, arterial insufficiency, upper cervical ligamentous insufficiency, unexplained cranial nerve dysfunction or fracture), and refer for consultation as indicated.

IMAGING

A Clinicians should utilize existing guidelines and appropriateness criteria in clinical decision making regarding referral or consultation for imaging studies for traumatic and nontraumatic neck pain in the acute and chronic stages.

EXAMINATION – OUTCOME MEASURES

A Clinicians should use validated self-report questionnaires for patients with neck pain, to identify a patient's baseline status and to monitor changes relative to pain, function, disability, and psychosocial functioning.

EXAMINATION – ACTIVITY LIMITATIONS AND PARTICIPATION MEASURES

F Clinicians should utilize easily reproducible activity limitation and participation restriction measures associated with the patient's neck pain to assess the changes in the patient's level of function over the episode of care.

EXAMINATION – PHYSICAL IMPAIRMENT MEASURES

B When evaluating a patient with neck pain over an episode of care, clinicians should include assessments of impairments of body function that can establish baselines, monitor changes over time, and be helpful in clinical decision making to rule in or rule out (1) neck pain with mobility deficits, including cervical active range of motion (ROM), the cervical flexion-rotation test, and cervical and thoracic segmental mobility tests; (2) neck pain with headache, including cervical active ROM, the cervical flexion-rotation test, and upper cervical segmental mobility testing; (3) neck pain with radiating pain, including neurodynamic testing, Spurling's test, the distraction test, and the Valsalva test; and (4) neck pain with movement coordination impairments, including cranial cervical flexion and neck flexor muscle endurance tests. Clinicians should include algometric assessment of pressure pain threshold for classifying pain.

DIAGNOSIS/CLASSIFICATION

C Clinicians should use motion limitations in the cervical and upper thoracic regions, presence of cervicogenic headache, history of trauma, and referred or radiating pain into an upper extremity as useful clinical findings for classifying a patient with neck pain into the following categories:

- Neck pain with mobility deficits
- Neck pain with movement coordination impairments (including whiplash-associated disorder [WAD])
- Neck pain with headaches (cervicogenic headache)
- Neck pain with radiating pain (radicular)

INTERVENTIONS: NECK PAIN WITH MOBILITY DEFICITS

Acute

For patients with **acute** neck pain with mobility deficits:

B Clinicians should provide thoracic manipulation, a program of neck ROM exercises, and scapulothoracic and upper extremity strengthening to enhance program adherence.

C Clinicians may provide cervical manipulation and/or mobilization.

Subacute

For patients with **subacute** neck pain with mobility deficits:

B Clinicians should provide neck and shoulder girdle endurance exercises.

C Clinicians may provide thoracic manipulation and cervical manipulation and/or mobilization.

Chronic

For patients with **chronic** neck pain with mobility deficits:

B Clinicians should provide a multimodal approach of the following:

- Thoracic manipulation and cervical manipulation or mobilization
- Mixed exercise for cervical/scapulothoracic regions: neuromuscular exercise (eg, coordination, proprioception, and postural training), stretching, strengthening, endurance training, aerobic conditioning, and cognitive affective elements
- Dry needling, laser, or intermittent mechanical/manual traction

C Clinicians may provide neck, shoulder girdle, and trunk endurance exercise approaches and patient education and counseling strategies that promote an active lifestyle and address cognitive and affective factors.

INTERVENTIONS: NECK PAIN WITH MOVEMENT COORDINATION IMPAIRMENTS

Acute

For patients with **acute** neck pain with movement coordination impairments (including WAD):

B Clinicians should provide the following:

- Education of the patient to
  - Return to normal, nonprovocative preaccident activities as soon as possible
  - Minimize use of a cervical collar
  - Perform postural and mobility exercises to decrease pain and increase ROM
- Reassurance to the patient that recovery is expected to occur within the first 2 to 3 months.

Summary of Recommendations* *(continued)*

B Clinicians should provide a multimodal intervention approach including manual mobilization techniques plus exercise (eg, strengthening, endurance, flexibility, postural, coordination, aerobic, and functional exercises) for those patients expected to experience a moderate to slow recovery with persistent impairments.

C Clinicians may provide the following for patients whose condition is perceived to be at low risk of progressing toward chronicity:

- A single session consisting of early advice, exercise instruction, and education
- A comprehensive exercise program (including strength and/or endurance with/without coordination exercises)
- Transcutaneous electrical nerve stimulation (TENS)

F Clinicians should monitor recovery status in an attempt to identify those patients experiencing delayed recovery who may need more intensive rehabilitation and an early pain education program.

Chronic

For patients with **chronic** neck pain with movement coordination impairments (including WAD):

C Clinicians may provide the following:

- Patient education and advice focusing on assurance, encouragement, prognosis, and pain management
- Mobilization combined with an individualized, progressive submaximal exercise program including cervicothoracic strengthening, endurance, flexibility, and coordination, using principles of cognitive behavioral therapy
- TENS

INTERVENTIONS: NECK PAIN WITH HEADACHES

Acute

For patients with **acute** neck pain with headache:

B Clinicians should provide supervised instruction in active mobility exercise.

C Clinicians may provide C1-2 self-sustained natural apophyseal glide (self-SNAG) exercise.

Subacute

For patients with **subacute** neck pain with headache:

B Clinicians should provide cervical manipulation and mobilization.

C Clinicians may provide C1-2 self-SNAG exercise.

Chronic

For patients with **chronic** neck pain with headache:

B Clinicians should provide cervical or cervicothoracic manipulation or mobilizations combined with shoulder girdle and neck stretching, strengthening, and endurance exercise.

INTERVENTIONS: NECK PAIN WITH RADIATING PAIN

Acute

For patients with **acute** neck pain with radiating pain:

C Clinicians may provide mobilizing and stabilizing exercises, laser, and short-term use of a cervical collar.

Chronic

For patients with **chronic** neck pain with radiating pain:

B Clinicians should provide mechanical intermittent cervical traction, combined with other interventions such as stretching and strengthening exercise plus cervical and thoracic mobilization/manipulation.

B Clinicians should provide education and counseling to encourage participation in occupational and exercise activities.

*These recommendations and clinical practice guidelines are based on the scientific literature published prior to August 2016.

List of Abbreviations

ACR: American College of Radiology
AMSTAR: assessment of multiple systematic reviews
APTA: American Physical Therapy Association
CCFT: cranial cervical flexion test
CCR: Canadian cervical spine rule
CFRT: cervical flexion-rotation test
CI: confidence interval
CPG: clinical practice guideline
CROM: cervical range of motion
CT: computed tomography
GRADE: Grading of Recommendations Assessment, Development and Evaluation
ICC: intraclass correlation coefficient
ICD: International Classification of Diseases and Related Health Problems
ICF: International Classification of Functioning, Disability and Health

List of Abbreviations *(continued)*

ICON: International Collaboration on Neck Pain
IFOMPT: International Federation of Orthopaedic Manipulative Physical Therapists
***JOSPT*:** *Journal of Orthopaedic & Sports Physical Therapy*
LOINC: Logical Observation Identifiers Names and Codes
LR: likelihood ratio
MDC: minimal detectable change
MDT: Mechanical Diagnosis and Therapy
MRI: magnetic resonance imaging
MVC: motor vehicle collision
NDI: Neck Disability Index
NEXUS: National Emergency X-Radiography Utilization Study
NSAID: nonsteroidal anti-inflammatory drug
PAIVM: passive accessory intervertebral motion
PICOT-SD: population, problem, or patients (P), intervention (I), comparison or control (C), outcome (O), time (T), study design (SD)
PSFS: Patient-Specific Functional Scale
RCT: randomized controlled trial
ROM: range of motion
SEM: standard error of measurement
SF-36: Medical Outcomes Study 36-Item Short-Form Health Survey
SIGN: Scottish Intercollegiate Guidelines Network
SNAG: sustained natural apophyseal glide
SR: systematic review
TENS: transcutaneous electrical nerve stimulation
VAS: visual analog scale
WAD: whiplash-associated disorder

Introduction

AIM OF THE GUIDELINES

The Orthopaedic Section of the American Physical Therapy Association (APTA) has an ongoing effort to create evidence-based clinical practice guidelines (CPGs) for orthopaedic physical therapy evaluation and management of adult patients with musculoskeletal impairments described in the World Health Organization's International Classification of Functioning, Disability and Health (ICF).[242]

The purposes of these clinical guidelines are to:

- Describe evidence-based physical therapy practice including diagnosis, prognosis, intervention, and assessment of outcome for musculoskeletal disorders commonly managed by orthopaedic physical therapists
- Classify and define common musculoskeletal conditions using the World Health Organization's terminology related to impairments of body function and body structure, activity limitations, and participation restrictions
- Identify interventions supported by current best evidence to address impairments of body function and structure, activity limitations, and participation restrictions associated with common musculoskeletal conditions
- Identify appropriate outcome measures to assess changes resulting from physical therapy interventions in body function and structure as well as in activity and participation of the individual
- Provide a description of the practice of orthopaedic physical therapists to policy makers
- Provide information for patients, payers, and claims reviewers regarding the practice of orthopaedic physical therapy for common musculoskeletal conditions
- Create a reference publication for orthopaedic physical therapy clinicians, academic instructors, clinical instructors, students, interns, residents, and fellows regarding the best current practice of orthopaedic physical therapy

STATEMENT OF INTENT

These guidelines are not intended to be construed or to serve as a standard of medical care. Standards of care are determined on the basis of all clinical data available for an individual patient and are subject to change as scientific knowledge and technology advance and patterns of care evolve. These parameters of practice should be considered guidelines only. Adherence to them will not ensure a successful outcome in every patient, nor should they be construed as including all proper methods of care or excluding other acceptable methods of care aimed at the same results. The ultimate judgment regarding a particular clinical procedure or treatment plan must be made based on clinician experience and expertise in light of the clinical presentation of the patient, the available evidence, available diagnostic and treatment options, and the patient's values, expectations, and preferences. However, we suggest that significant departures from accepted guidelines should be documented in the patient's health records at the time the relevant clinical decision is made.

Methods

Content experts were appointed by the Orthopaedic Section of the APTA to conduct a review of the literature and to develop an updated neck pain CPG as indicated by the current state of the evidence in the field. The aims of the revision were to provide a concise summary of the evidence since publication of the original guideline and to develop new recommendations or revise previously published recommendations to support evidence-based practice. The authors of this guideline revision worked with research librarians possessing expertise in systematic reviews to perform a systematic search for concepts associated with neck pain in articles published from 2007 to August 2016 related to classification, examination, and intervention strategies for neck pain consistent with previous guideline development methods related to ICF classification.[29] Primary electronic search methods were performed using a standard structured approach from January 2007 to August 2016 in the following databases: PubMed, Cochrane Library, Web of Science, CINAHL, ProQuest Dissertations and Abstracts, PEDro, ProQuest Nursing and Allied Health Sources, and Embase, by research librarians. The search strategy guided by PICOT-SD (Population, problem, or patients [P], Intervention [I], Comparison or control [C], Outcome [O], Time [T], Study design [SD]) was designed to locate systematic reviews, meta-analyses, or narrative reviews that addressed 6 clinical areas (classification, examination, intervention, harms, prognosis, and outcome measures), when applicable contrasting with a control or comparison treatments, and used at least 1 measurement property of an outcome measure in adult patients with neck pain or musculoskeletal neck conditions in primary to tertiary settings from immediate posttreatment to long-term follow-up. The study designs included reviews on interventions and cohort/case-control trials for prognosis, diagnostic, and outcome measurement studies. Secondary reviews were identified through several grey literature sources (references within eligible citations screened for any additional references, personal files from the investigative team, and content experts). See **APPENDIX A** for example search strategies and **APPENDIX B** for example search dates and results, available at www.orthopt.org.

In addition, the guideline revision team worked with, and benefited greatly from, the efforts of members of the International Collaboration on Neck Pain (ICON), a multidisciplinary group currently producing an extensive review of the literature on neck pain.[179] Bridging methods and decision rules were guided by recommendations established by Whitlock et al[237] and Robinson et al.[173,174] Additionally, recent publications on the lived experiences of people with neck pain were reviewed[126] as part of our deliberations and implementation when creating the final recommendations. The potential organizational and implementation barriers in applying the recommendations were discussed and considerations were folded into the expert opinion section following each evidence table. The guideline has been piloted among end users through International Federation of Orthopaedic Manipulative Physical Therapists (IFOMPT) member organizations, and through APTA, Inc through a public posting.

The guideline development group members declared relationships and developed a conflict management plan that included submitting a Conflict of Interest form to the Orthopaedic Section, APTA, Inc. Articles that were authored by a group member were assigned to an alternate member for assessment. Partial funding was provided to the CPG development team for travel and expenses for CPG training and development; the content of this guideline was not influenced by this funding. The CPG development team maintained editorial independence. A list of competing interests, conflicts of interest, and author contributions is available at www.orthopt.org. Group members believe the guideline process and development of recommendations were free from influence from competing interests and conflicts of interest.

In the Impairment/Function-Based Diagnosis and the Examination sections, a narrative review is provided with emphasis placed on systematic reviews and meta-analyses when available. In the Interventions section, only systematic reviews and meta-analyses were considered in this revision. When there was a systematic review of reviews, those appraisals were used, and literature was searched for systematic reviews and meta-analyses published since the end date of the published review of reviews. If a systematic review or meta-analysis published prior to January 2007 and not included in the 2008 CPG, or published after August 2016, was identified by the authors during writing, then that article was also appraised and included using methods similar to those recommended by Robinson et al.[173] Articles contributing to recommendations were reviewed based on specified inclusion and exclusion criteria with the goal of identifying evidence relevant to physical therapist clinical decision making for adult persons with noncancer (neuromusculoskeletal) neck pain. The titles and abstracts of each article were reviewed independently by 2 members of the CPG development team for inclusion. See **APPENDIX C** for inclusion and exclusion criteria (available at www.orthopt.org). The full texts were then similarly appraised to obtain the final set of articles for contribution to recommendations. The team leader (P.R.B.) provided the final decision for rare (less than 10) discrepancies that were not resolved by the review team. The

Methods *(continued)*

ratings of the primary sources contained in the systematic reviews or meta-analyses were used by the team in making recommendations. If the systematic reviews or meta-analyses did not provide the necessary information (eg, study quality,[77] participant characteristics, stage of disorder) or there were discrepancies between the reviews, the reviewers obtained the information directly from the primary source. Quality ratings used in the systematic reviews came from a variety of tools (eg, Cochrane Risk of Bias, PEDro). Rating of the body of evidence came from other tools (eg, Grading of Recommendations, Assessment, Development and Evaluation [GRADE], Cochrane Collaboration Back and Neck Review Group[218]), and the CPG team calibrated these ratings into high, moderate, low, and very low quality. Very low-quality evidence was not considered in this revision. Ratings of systematic reviews came from 2 tools (AMSTAR[187] or the closely related SIGN[185]), and these ratings were also calibrated into high, acceptable, low, and very low categories. Very low-quality reviews and findings from very low-quality primary sources were not considered in this revision. See **APPENDIX D** for a flow chart of articles and **APPENDIX E** for articles included in recommendations (available at www.orthopt.org). Articles on topics that were not immediately relevant to the development of these recommendations, such as shockwave therapy or injection, were not subject to the systematic review process and were not included in the flow chart.

This guideline was issued in 2017 based on the published literature up to August 26, 2016. This guideline will be considered for review in 2021, or sooner if new evidence becomes available. Any updates to the guideline in the interim period will be noted on the Orthopaedic Section of the APTA website (www.orthopt.org).

LEVELS OF EVIDENCE

Since the original neck pain CPG was published in 2008, publication of the results of a large number of trials has coincided with an increased number of systematic reviews and reviews of reviews. The current update appraises high-level systematic reviews using updated criteria for levels of evidence and recommendations consistent with contemporary research methodology. The authors encourage the reader to note these changes in interpreting the guideline recommendations.

Individual systematic reviews, meta-analyses, and reviews of reviews were graded according to criteria adapted from the Centre for Evidence-Based Medicine, Oxford, United Kingdom for diagnostic, prospective, and therapeutic studies (www.cebm.net). In 4 teams of 2, each reviewer independently evaluated the quality of each article using a critical appraisal tool and assigned a level of evidence. A description of the grading system is provided in **TABLE 1**. See also **APPENDIX F** for evidence level criteria details on procedures used for assigning

TABLE 1 Levels of Evidence*

Level	Intervention/Prevention	Pathoanatomic/Risk/ Clinical Course/Prognosis/ Differential Diagnosis	Diagnosis/ Diagnostic Accuracy	Prevalence of Condition/ Disorder	Exam/ Outcomes
I	• High-quality SR† containing consistent findings from multiple high-quality primary sources‡	• SR of prospective cohort studies • High-quality prospective cohort study§	• SR of high-quality diagnostic studies • High-quality diagnostic study‖ with validation	• SR, high-quality cross-sectional studies • High-quality cross-sectional study¶	• SR of prospective cohort studies • High-quality prospective cohort study
II	• High- or acceptable-quality SR containing mostly consistent findings from generally high-quality primary sources, or • Consistent findings from at least 1 high-quality large (n>100 in each arm) RCT, or • Consistent findings from more than 1 small, high-quality RCT	• SR of retrospective cohort study • Lower-quality prospective cohort study • High-quality retrospective cohort study • Consecutive cohort • Outcomes study or ecological study	• SR of exploratory diagnostic studies or consecutive cohort studies • High-quality exploratory diagnostic studies • Consecutive retrospective cohort	• SR of studies that allows relevant estimate • Lower-quality cross-sectional study	• SR of lower-quality prospective cohort studies • Lower-quality prospective cohort study

Table continues on page A7.

Methods *(continued)*

TABLE 1 Levels of Evidence* (continued)

Level	Intervention/Prevention	Pathoanatomic/Risk/ Clinical Course/Prognosis/ Differential Diagnosis	Diagnosis/ Diagnostic Accuracy	Prevalence of Condition/ Disorder	Exam/ Outcomes
III	• High- or acceptable-quality SR containing mostly consistent findings from moderate primary sources, or • Mostly consistent findings from 1 high-quality RCT or more than 1 moderate-quality RCT	• Lower-quality retrospective cohort study • High-quality cross-sectional study • Case-control study	• Lower-quality exploratory diagnostic studies • Nonconsecutive retrospective cohort	• Local nonrandom study	• High-quality cross-sectional study
IV	• High- or acceptable-quality SR where higher-quality primary sources tend to favor a clear direction, or • Inconsistent findings from case-control studies or retrospective studies, or inconsistent findings from RCTs where the higher-quality trials tend to favor a clear direction (even when lower-quality trials favor the opposite), or • Consensus statements from content experts	• Case series	• Case-control study	...	• Lower-quality cross-sectional study
V	• Inconsistent evidence drawn from a low-rated (score of 5 or below on AMSTAR or SIGN scales) SR that may indicate the balance of evidence favoring one direction but with very low confidence, regardless of the quality of the primary sources, or • Case series or individual expert opinion, or direct or indirect evidence from physiology, bench research, or theoretical constructs	• Individual expert opinion	• Individual expert opinion	• Individual expert opinion	• Individual expert opinion

Abbreviations: AMSTAR, assessment of multiple systematic reviews; RCT, randomized clinical trial; SIGN, Scottish Intercollegiate Guidelines Network; SR, systematic review.

Adapted from Phillips B, Ball C, Sackett D, et al. Oxford Centre for Evidence-based Medicine - Levels of Evidence (March 2009). Available at: http://www.cebm.net/index.aspx?o=1025. Accessed August 4, 2009. See also* **APPENDIX F.

†SRs were rated using AMSTAR or SIGN criteria, where 8 or higher received a "high," 6 to 7 received an "acceptable," 4 to 5 received a "low," and below 4 received a " very low" score. Very low–quality reviews were not used.

‡Quality of the primary sources was calibrated to "high," "moderate," "low," and "very low" levels. Results from very low–quality primary sources were not used.

§Quality cohort study includes greater than 80% follow-up.

‖High-quality diagnostic study includes consistently applied reference standard and blinding.

¶High-quality prevalence study is a cross-sectional study that uses a local and current random sample or censuses.

levels of evidence (available at www.orthopt.org). Systematic review AMSTAR scores are available in **APPENDIX G**, and articles containing very low-quality primary sources are listed in **APPENDIX H** (available at www.orthopt.org).

The levels of evidence were assigned with alignment to the definitions contained in **TABLE 1**.

Weaker diagnostic criteria and reference standards, improper randomization, no blinding, and less than 80% follow-up may add bias and threats to validity.

When available, a second factor, the magnitude of effect versus harm, contributed to the recommendation, and was characterized according to **TABLE 2**.

Methods *(continued)*

TABLE 2 Magnitude of Effect Versus Harm: Grades of Recommendation

Beneficial Effect		Neutral Effect	Harmful Effect	
Strong	**Weak**	**None**	**Weak**	**Strong**
Desirable consequences clearly outweigh undesirable consequences. This considers the magnitude of effect (none, small, medium, large), numbers needed to treat, probability of harms, resources and patient burden, etc. A strong grade requires a medium to large effect with low risk of harms and low patient burden	Desirable consequences probably outweigh undesirable consequences (small to moderate effect, some risk of harms, higher burden)	Consequences equally balanced or uncertain (none or small effect, unclear harms, unclear burden)	Undesirable consequences probably outweigh desirable consequences (probability of harms likely outweighs any small-to-moderate effect, burden might be high)	Undesirable consequences clearly outweigh desirable consequences (small effect, clear probability of harms or high patient burden)

TABLE 3 Method of Assigning Confidence to Recommendations

Grade	Strength of Evidence	Basis of Strength Assignment
A	Strong	One or more level I systematic reviews support the recommendation, providing evidence for a strong magnitude of effect
B	Moderate	One or more level II systematic reviews or a preponderance of level III systematic reviews or studies support the recommendation, providing evidence for a mild to moderate magnitude of effect
C	Weak	One or more level III systematic reviews or a preponderance of level IV evidence supports the recommendation, providing minimal evidence of effect
D	Conflicting	Higher-quality studies conducted on this topic disagree with respect to their conclusions and effect. The recommendation is based on these conflicting studies
E	Theoretical/foundational evidence	A preponderance of evidence from animal or cadaver studies, from conceptual models or principles, or from basic science or bench research supports the recommendation, providing theoretical/foundational evidence of effect
F	Expert opinion	Best practice to achieve a beneficial effect and/or minimize a harmful effect, based on the clinical experience of the guidelines development team

GRADES OF RECOMMENDATION

The strength of the recommendation was graded according to the confidence in the evidence and the magnitude of effect as indicated in **TABLE 3**.

SYMPTOM STAGES AND FOLLOW-UP PERIODS

Following a review of included studies, results were assigned a stage related to symptom duration: acute (less than 6 weeks), subacute (6-12 weeks), or chronic (greater than 12 weeks). Time periods for follow-up results were characterized according to **TABLE 4**.

TABLE 4 Follow-up Periods

Follow-up	Time Interval
Immediate	Closest to immediately following intervention
Short term	Closest to 1 mo
Intermediate term	Closest to 6 mo
Long term	Closest to 12 mo or longer

Methods *(continued)*

GUIDELINE REVIEW PROCESS AND VALIDATION

Experts in neck pain reviewed these CPGs' content and methods for integrity, accuracy, and representation of the condition. The draft was also reviewed by: (1) representatives of member organizations of IFOMPT and members of the Orthopaedic Section of the APTA, Inc through a public posting, and (2) a panel of consumer/patient representatives and external stakeholders, such as claims reviewers, medical coding experts, academic educators, clinical educators, physician specialists, and researchers. All comments, feedback, and suggestions were considered for revision. Additionally, a panel of experts in physical therapy practice guideline methodology annually review the Orthopaedic Section of the APTA's ICF-based Clinical Practice Guidelines Policies and provide feedback and comments to the Clinical Practice Guidelines Coordinator and editors to improve the APTA's guidelines development and implementation processes.

DISSEMINATION AND IMPLEMENTATION TOOLS

In addition to publishing these guidelines in the *Journal of Orthopaedic & Sports Physical Therapy* (*JOSPT*), these guidelines will be posted on the CPG areas of both the *JOSPT* and the Orthopaedic Section of the APTA websites for free access and will be submitted for posting on the Agency for Healthcare Research and Quality's website (www.guideline.gov). The implementation tools planned to be available for patients, clinicians, educators, payers, policy makers, and researchers, and the associated implementation strategies, are listed in **TABLE 5**.

CLASSIFICATION

The primary International Classification of Diseases-10 (ICD-10) codes and conditions associated with neck pain include **M54.2 Cervicalgia**, **M54.6 Pain in the thoracic spine**, **R51 Cervicogenic headache**, **M53.0 Cervicocranial syndrome**, **M53.1 Cervicobrachial syndrome**, **M53.2 Spinal instability**, **S13.4 Sprain of ligaments of cervical spine**, **S13.8 Sprain of joints and ligaments of other parts of neck**, **M54.1x Dorsalgia with cervical radiculopathy**, **M47.2x Cervical spondylosis with radiculopathy**, **M47.1x Cervical spondylosis with myelopathy**, **M50.x Cervical disc disorders**, **M62.5 Muscle wasting and atrophy**, **M79.1 Myalgia**, and **M99.01 Segmental and somatic dysfunction**.[241]

Andelic et al[5] linked ICF categories to functional problems reported on the Patient-Specific Functional Scale (PSFS) by 249 participants with neck pain in Norway. Agreeing with a previous study by Tschiesner et al,[210] Andelic et al[5] found that categories linking to 10% or more functional problems were labeled as "more frequent" and that those linking to fewer

TABLE 5 Planned Strategies and Tools to Support the Dissemination and Implementation of This Clinical Practice Guideline

Tool	Strategy
"Perspectives for Patients"	Patient-oriented guideline summary available on www.jospt.org and www.orthopt.org
Mobile app of guideline-based exercises for patients/clients and health care practitioners	Marketing and distribution of app using www.orthopt.org and www.jospt.org
Clinician's quick-reference guide	Summary of guideline recommendations available on www.orthopt.org
Read-for-credit continuing education units	Continuing education units available for physical therapists and athletic trainers through *JOSPT*
Educational webinars for health care practitioners	Guideline-based instruction available for practitioners on www.orthopt.org
Mobile and web-based app of guideline for training of health care practitioners	Marketing and distribution of app using www.orthopt.org and www.jospt.org
Physical Therapy National Outcomes Data Registry	Support the ongoing usage of data registry for common musculoskeletal conditions of the head and neck region
Logical Observation Identifiers Names and Codes mapping	Publication of minimal data sets and their corresponding Logical Observation Identifiers Names and Codes for the head and neck region on www.orthopt.org
Non-English versions of the guidelines and guideline implementation tools	Development and distribution of translated guidelines and tools to *JOSPT*'s international partners and global audience via www.jospt.org

Methods *(continued)*

than 10% were labeled as "less frequent." The more frequent categories of body function to which they were linked included **b134 Sleep functions** (27.2%) and **b710 Mobility of joint functions** (26.2%). The most frequent categories of activity and participation were **d850 Remunerative employment** (15%), **d640 Doing housework** (14%), **d920 Recreation and leisure activities** (13%), and **d430 Lifting and carrying objects** (10%).[5]

Additional ICF body function codes associated with neck pain are (1) sensory functions related to pain, and (2) movement functions related to joint motion and control of voluntary movements. These body function codes include **b28010 Pain in neck and head**, **b2803 Radiating pain in a dermatome**, **b2804 Radiating pain in a segment or region**, **b7101 Mobility of several joints**, and **b7601 Control of complex voluntary movements**.

Additional ICF activities and participation codes associated with neck pain include **d4108 Changing a basic body position**, **d4158 Maintaining a body position**, and **d4452 Reaching**.

ICF body structure codes associated with neck pain include **s7103 Joints of head and neck**, **s7104 Muscles of head and neck region**, **s7105 Ligaments and fascia of head and neck region**, **s76000 Cervical vertebral column**, and **s1201 Spinal nerves**.

ICF codes can be accessed at http//apps.who.int/classifications/icfbrowser/. A comprehensive list of codes was published in the previous guideline.[29]

ORGANIZATION OF THE GUIDELINES

For each topic, the summary recommendation and grade of evidence from the 2008 guideline are presented, followed by a synthesis of the recent literature with the corresponding evidence levels. Each topic concludes with the 2017 summary recommendation and its updated grade of evidence.

CLINICAL GUIDELINES

Impairment/Function-Based Diagnosis

PREVALENCE

2008 Summary

Pain and impairment of the neck is common. It is estimated that 22% to 70% of the population will have neck pain some time in their lives.[16,18,37,38,57,123,159] In addition, it has been suggested that the incidence of neck pain is increasing.[153,243] At any given time, 10% to 20% of the population reports neck problems,[16,39,88,215] with 54% of individuals having experienced neck pain within the last 6 months.[37] Prevalence of neck pain increases with age and is most common in women around the fifth decade of life.[7,16,40,128,201]

Although the natural history of neck pain appears to be favorable,[48,99] rates of recurrence and chronicity are high.[12,90] One study reported that 30% of patients with neck pain will develop chronic symptoms, with neck pain of greater than 6 months in duration affecting 14% of all individuals who experience an episode of neck pain.[16] Additionally, a recent survey demonstrated that 37% of individuals who experience neck pain will report persistent problems for at least 12 months.[39] Five percent of the adult population with neck pain will be disabled by the pain, representing a serious health concern.[16,97] In a survey of workers with injuries to the neck and upper extremity, Pransky et al[162] reported that 42% missed more than 1 week of work and 26% experienced recurrence within 1 year. The economic burden due to disorders of the neck is high, and includes costs of treatment, lost wages, and compensation expenditures.[13,168] Neck pain is second only to low back pain in annual workers' compensation costs in the United States.[243] In Sweden, neck and shoulder problems account for 18% of all disability payments.[153] Jette et al[98] reported that individuals with neck pain make up approximately 25% of patients receiving outpatient physical therapy care. Additionally, patients with neck pain frequently are treated with nonsurgical interventions by primary care and physical therapy providers.[15,48,99]

EVIDENCE UPDATE

I The Global Burden of Disease Injuries and Risk Factors 2010 study measured population health through disability-adjusted life years and years of life lived in less than ideal health, measured as years lived with disability. Years lived with disability is the number of incident cases, multiplied by the average duration of the condition (average number of years that the condition lasts until remission or death), multiplied by the disability weight. In this large study, neck pain ranked 21st overall in global cause of disability-adjusted life years[144] and fourth overall in years lived with disability.[230] The 2013 data indicated a worsening problem, with neck pain ranking 19th overall in global cause of disability-adjusted life years.[143]

I In a systematic review by Haldeman et al,[80] prevalence depended on the definitions used; for neck pain, the 1-year prevalence ranged from 30% to 50% in the general population. For neck pain with associated disability, the 1-year prevalence ranged from 2% to 11% in the general population, and from 11% to 14% in workers who reported being limited in their activities because of neck pain.[80]

II March et al[129] reported on neck pain without referral into the upper limbs that lasted at least 1 day. The global point prevalence in 2010 was estimated to be 4.9% (females, 5.8%; males, 4.0%).[129]

II Hoy et al[91] published a systematic review of epidemiologic studies of activity-limiting neck pain, including neck-related upper-limb pain and head and/or trunk pain lasting at least 1 day. The 1-year incidence of neck pain was 10.4% to 21.3%. The 1-year remission rate ranged from 33% to 65%. The 1-year prevalence of neck pain in the general population was on average 25.8% (range, 4.8%-79.5%), with a point prevalence of 14.4% (range, 0.4%-41.5%).[91]

IV Goode et al[67] performed a telephone survey of 141 individuals in North Carolina, and found the estimated prevalence of chronic neck pain among non-institutionalized individuals for the state of North Carolina to be 2.2% (95% confidence interval [CI]: 1.7%, 2.6%). Individuals with chronic neck pain were largely middle aged (mean age, 48.9 years) and the majority were females (56%) and non-Hispanic whites (81%).[67]

2017 SUMMARY

Significant variation exists in the definition of neck pain and the research methods employed within the epidemiological

literature on neck pain. This variation limits the ability to compare or combine data across studies to arrive at consensus; however, there is agreement that neck pain is common and increasing worldwide in both the general population and in specific subgroups.

RISK FACTORS

2008 Recommendation

Clinicians should consider age greater than 40, coexisting low back pain, a long history of neck pain, cycling as a regular activity, loss of strength in the hands, worrisome attitude, poor quality of life, and less vitality as predisposing factors for the development of chronic neck pain. (Recommendation based on moderate evidence.)

For the purposes of this CPG, the term *risk* will be reserved specifically for risk factors for new onset of neck pain, while *prognosis* (discussed below) will refer to the predicted course of the condition after onset.

Evidence Update

McLean et al[137] conducted a systematic review of risk factors for the onset of new neck pain across different populations. Of 14 independent studies (13 rated high quality), the following risk factors for new-onset neck pain were identified: female sex, older age, high job demands, being an ex-smoker, low social or work support, and a previous history of neck or low back disorders. Paksaichol et al[158] conducted a similar review of 7 independent cohorts (5 rated high quality) focused on office workers,[158] with results indicating that only the female sex and prior history of neck pain were strong risk factors of new-onset neck pain in this population.

2017 Summary

Evidence from 2 recent systematic reviews indicates that the female sex and prior history of neck pain are the strongest and most consistent risk factors for new-onset neck pain in office workers and the general population. Older age, high job demands, smoking history, low social/work support, and prior history of low back pain may also be risk factors.

CLINICAL COURSE AND PROGNOSIS

Clinical Course

Risk and prognosis are ideally considered in the context of the "natural course" of a condition, assuming no intervention, or the "clinical course" a condition can be expected to take in response to a specific intervention. Clinical prognosis is based on 2 important pieces of information: what is known about the clinical course of the condition, and the presence or absence of factors that may lead to deviation from that course.

Evidence Update

Six systematic reviews addressed the clinical course of neck pain.[12,25,26,78,105,165] The reviews commonly included studies using observational research designs in which the type of intervention is not controlled; therefore, the individuals included in these reviews can be assumed to have participated in a range of interventions, including medical, surgical, physical therapy, and chiropractic treatments, among others. Results of this research can most logically be interpreted as "the average rate of recovery—in this cohort—under this clinical context." It is also worth noting that reported outcomes are rarely consistent across studies (eg, pain intensity, self-rated disability scale, work status, medication usage[232]), rendering meta-synthesis very difficult.

In general, the reviews in the field have arrived at a similar conclusion: the clinical course of neck pain is variable and not entirely favorable. Kamper et al[105] used a meta-analytic approach to synthesize recovery data following acute whiplash-associated disorder (WAD).[105] Their results indicate that recovery is slow when the outcome is pain intensity, requiring 6 months or more for average pain intensity to achieve the clinically meaningful reduction of 20%. When self-rated disability was the outcome, recovery fared no better. Standardized mean scores did not reach 20% improvement over the 12 months for which data were available. A similar conclusion was reached by Hush et al,[94] who focused on individuals with acute idiopathic neck pain, with the additional finding that idiopathic neck pain does not resolve further after the first 6.5 weeks.[94] Sterling et al[194] reported recovery trajectories for outcomes of neck disability and posttraumatic stress following acute traumatic neck pain. Three trajectories were identified: mild disability/posttraumatic stress (40% to 45% of individuals), initially moderate improving to mild (39% to 43% of individuals), and chronic severe problems (16% to 17% of individuals). For neck disability and posttraumatic stress, recovery appears to happen most rapidly within the first 6 to 12 weeks postinjury, with the rate of recovery slowing considerably after that critical window.[194] Casey et al[27] conducted a similar study and again found 3 trajectories for outcomes measured using the Functional Rating Index (low-moderate-severe continued disability for 47%, 31%, and 22% of individuals, respectively), Pain Catastrophizing Scale (55%, 32%, and 13%), and Mental Component Score of the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36) (40%, 42%, and 18%, respectively).[27] Casey et al[27] collected data at baseline, 12 months, and 24 months, so lacked the precision of the study by Sterling et al[194] to identify important inflection points in recovery, but reported no further recovery between 12 and 24 months.[27] The newer data generally appear consistent with earlier reviews from the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders that approximately 50%

will fully recover within 1 year following WAD.[24] It is worth noting that these estimates may be highly dependent on the definition of recovery used.[232]

Chronic or insidious neck pain follows a clinical course described best as "recurrent" or "episodic,"[78] suggesting that complete resolution of such symptoms is the exception rather than the rule. An early review by Borghouts et al[12] reported the median frequency of "general improvement" in people with nonspecific neck pain to be 47% (range, 37% to 95%, depending on outcome) within 6 months.

Rao[165] reported the results of a knowledge synthesis for cervical myelopathy with or without radiculopathy. While much of the evidence synthesis came from very early research of the 1950s and 1960s, the most recent evidence regarding cervical myelopathy suggested a course of neck pain that could show periods of functional stability (neither decreasing nor increasing) or a gradual worsening. That synthesis found that only 18% of individuals report improvements in neck disability, while 67% report progressive deterioration over time, regardless of intervention. Those who underwent surgical management showed better outcomes than those managed nonsurgically.[165]

Thoomes et al[208] reported that little is known about the natural course of cervical radiculopathy. They reported on a single 1963 study of 51 patients, reporting that 43% of cases had no further symptoms after a few months, with 29% and 27% having mild and more disabling pain, respectively, at a follow-up of up to 19 years.[121] Across several more recent studies, Thoomes et al[208] reported low-level evidence of a more favorable natural course, with resolution of symptoms over weeks to months.

2017 Summary

The overall balance of evidence supports a variable view of the clinical course of neck pain. In acute traumatic conditions, clinicians can expect individuals to follow 1 of 3 likely trajectories: mild problems with rapid recovery (approximately 45% of individuals depending on outcome), moderate problems with some but incomplete recovery (approximately 40% of individuals), and severe problems with no recovery (approximately 15% of individuals). Regardless of the outcome, recovery appears to occur most rapidly in the first 6 to 12 weeks postinjury, with considerable slowing after that and little recovery after 12 months.[194] Less evidence is available for acute nontraumatic (idiopathic) neck pain, but clinicians can still expect recovery to slow considerably after 6 to 12 weeks from onset. In chronic conditions, the course may be stable or fluctuating, but in most cases can be best classified as recurrent, characterized by periods of relative improvement followed by periods of relative worsening.[78] For many patients with acute cervical radiculopathy, the clinical course appears favorable, with resolution of symptoms occurring over weeks to months. As described below, monitoring for worsening of clinical status is advised during nonsurgical management.

CLINICAL PROGNOSIS

Evidence Update

In the context of neck pain, prognostic factors are most commonly evaluated in acute trauma-related conditions (eg, WAD). This is likely due to the ability to identify a clear start time (time of whiplash injury) for the onset of the condition and offers the potential to quantify the magnitude of the inciting event (eg, motor vehicle collision [MVC]). A derived and validated clinical prediction rule for prognosis for individuals with WAD exists.[170,171] Insidious-onset conditions, such as degenerative disc disease or postural syndromes, offer a less accurate onset date or magnitude of event, making prognostic research more difficult.

Since the Quebec Task Force monograph of 1995,[191] several primary research studies and systematic reviews on the topic of prognosis following WAD have been published. An overview of systematic reviews sought to identify consistencies in the pool of literature from January 2000 to March 2012 and quantify confidence in the prognostic value of more than 130 different factors.[233] The results of that procedure led to high or moderate confidence that each of the following were risk factors for persistent problems when captured in acute or subacute WAD (less than 6 weeks from injury): (1) high pain intensity, (2) high self-reported disability scores (Neck Disability Index [NDI]), (3) high posttraumatic stress symptoms, (4) strong catastrophic beliefs, and (5) cold hyperalgesia. In work-related or nonspecific neck pain, only older age and a prior history of other musculoskeletal disorders offered the same level of confidence.

Factors that were not supported as useful for establishing a prognosis were: (1) angular deformity of the neck (eg, scoliosis, flattened lordosis), (2) impact direction, (3) seating position in the vehicle, (4) awareness of the impending collision, (5) having a headrest in place at the time of collision, (6) stationary versus moving when hit, and (7) older age (note the difference between WAD and nonspecific neck pain). For nonspecific neck pain, a preinjury history of regular physical activity was not a useful prognostic factor.[233]

Walton et al[235] used meta-analytic techniques to quantify the prognostic utility of many of these factors as reported in previous primary evidence. Their results are presented in **TABLE 6** below, and indicate that high pain intensity and high self-reported disability offer the greatest prognostic value. However, this may simply be a function of research using

TABLE 6 Recommended Tools for Developing a Prognosis

Construct	Recommended Tool
High pain intensity	Numeric rating scale (0-10): consider score of 6 or greater a useful cut score for prognosis
High self-reported disability	Neck Disability Index, original[225] or shorter adaptations[1]: consider greater than 30% as a useful cut score for prognosis
High pain catastrophizing	Pain Catastrophizing Scale[198,214]: consider score of 20 or greater a useful cut score for prognosis
High acute posttraumatic stress symptoms	Impact of Events Scale-Revised: consider score of 33 or greater a useful cut score for prognosis.[199] High posttraumatic distress is not uncommon in acute injuries; here, this scale is used to predict symptom chronicity, not to assess for posttraumatic stress disorder
Cold hyperalgesia	The TSA-II – NeuroSensory Analyzer (Medoc Ltd, Ramat Yishai, Israel) is largely considered the gold standard. However, the cost of such equipment may render it impractical for clinicians. Alternatives include the cold pressor task as a test of cold endurance (similar but not identical to cold pain threshold), use of an ice cube,[133,166] or use of cold metal bars

pain and disability as the predicted outcomes, meaning that the predictive value of these factors may be different when the outcome to be predicted is something else, such as work status or health care usage.[235]

Two more narrowly focused systematic reviews in the area of traumatic neck pain prognosis were published, but not included in the overviews by Walton et al.[235] Goldsmith et al[66] reviewed the evidence for cold hyperalgesia as a prognostic variable, and found consistent moderate-grade evidence (4 cohorts) that cold hyperalgesia holds prognostic value. Daenen et al[43] conducted a systematic review of cervical motor dysfunction as a prognostic variable and found inconclusive results (4 cohorts), preventing endorsement of such tests as being prognostic.

A systematic review by Kelly et al[112] explored the readiness for clinical adoption of 15 formalized prognostic clinical prediction rules for early identification of the patient at risk of transitioning to chronic neck pain. Of those, 11 remained in the derivation stage, lacking external validation. Four had undergone some degree of external validation, but none were at the stage of readiness to be endorsed for widespread clinical adoption.[112,171]

For nontraumatic neck pain, Carroll et al[25] reported that between 50% and 85% of people who experience neck pain will report neck pain 1 to 5 years later, but it is unclear whether this is persistence of the initiating event, recurrence following a refractory period, or new-onset neck pain. Older age was a consistent but not strong predictor of neck pain at follow-up after an initial event. Generally, poor physical health showed moderate association with ongoing neck pain, but this was not a consistent finding. One study even found that regular cycling was associated with worse outcomes. Similar to that in WAD, poorer psychological health was a consistent predictor of neck pain at follow-up, as were lower social support and preference for passive coping strategies. Regarding neck pain in workers specifically, Carroll et al[24] found relatively little evidence upon which to base prognostic decisions. Workplace decision-making capacity (control over work) had a small but significant association with worse outcomes, and white collar workers generally fared better than their blue collar counterparts, but the evidence was not strong for either. Poor prior health (lack of exercise, prior neck pain, prior sick leave) showed some additional promise as a prognostic factor.[24]

2017 Summary

Moderate- to high-level evidence indicates that the female sex and/or prior history of neck pain are consistent risk factors for new-onset neck pain. Low- to moderate-level evidence suggests that older age, high job demands, being an ex-smoker, low support, and prior history of low back pain may also be risk factors.

Moderate- to high-level evidence indicates that clinicians should collect and consider pain intensity, level of self-rated disability, pain-related catastrophizing, posttraumatic stress symptoms (traumatic onset only), and cold hyperalgesia when establishing a prognosis for their patients. These constructs and related recommended tools are summarized in **TABLE 6**. Prior health, including regular exercise, neck pain, and sick leave, may offer some additional prognostic value, more so in nontraumatic neck pain in the general population or in workers. **TABLE 6** offers a list of sample tools that can be used to capture these variables. For nonspecific neck pain, age and prior history of musculoskeletal problems may offer prognostic value. There is still relatively little guidance regarding the combination of risk factors and how those should be interpreted and managed. New research focusing on more integrated complex models or prediction rules may shed light on this challenge in the near future.

PATHOANATOMICAL FEATURES/ DIFFERENTIAL DIAGNOSIS

2008 Summary

Although the cause of neck pain may be associated with degenerative processes or pathology identified during diagnostic imaging, the tissue that is causing a patient's neck pain is most often unknown. Thus, clinicians should assess for impaired function of muscle, connective, and nerve tissues associated with the identified pathological tissues when a patient presents with neck pain.

Evidence Update

There are numerous anatomical structures in the cervical region that can be sources of nociception, including zygapophyseal joints, vertebrae, muscles, ligaments, neural structures, and the intervertebral disc.[42,115,165,188,239] However, evidence is lacking to support the hypothesis that these pathoanatomical features are a primary source of mechanical neck pain across the age spectrum in the majority of patients.[86] The source of neck symptoms may on occasion be something more serious; therefore, screening for clinical conditions such as cervical myelopathy, cervical ligamentous instability, fracture, neoplasm, vascular insufficiency, or systemic disease is required.[80,183,239]

Space-occupying lesions (eg, osteophytosis or herniated cervical disc) are commonly associated with cervical spondylotic myelopathy and central canal stenosis.[206] These may be secondary to acquired degenerative processes, and can give rise to signs and symptoms in the neck and/or upper or lower quarter as well as potentially bowel or bladder problems or neurologic deficits. Congenital narrowing of the spinal canal may also increase the risk for developing spinal canal stenosis later in life.[106] Magnetic resonance imaging (MRI) is useful in determining the diagnosis of myelopathy.[114] Clinical tests used in the diagnostic process for cervical myelopathy generally have low sensitivity; therefore, they should not be used when screening for and diagnosing this condition.[35] While cervical disc herniation and spondylosis are most commonly linked to cervical myelopathy, the patient's ultimate presentation may reflect pain mechanisms beyond these discrete pathoanatomical findings.[2,80,106]

Little consensus exists on the definition of cervical radiculopathy related to the exact location, intensity, or duration of painful symptoms in patients. Therefore, it is suggested that pain radiating into the arm coupled with motor, reflex, and/or sensory changes in the upper limb, including paresthesia or numbness, be considered in making clinical determination for cervical radiculopathy.[207] Limited evidence suggests that neurodynamic testing of the median nerve, but not the radial nerve, is clinically useful in determining the presence/absence of cervical radiculopathy.[150]

The 2012 IFOMPT "International Framework for Examination of the Cervical Region for potential of Cervical Arterial Dysfunction prior to Orthopaedic Manual Therapy Intervention" provides a decision-making pathway for assessment of suspected arterial insufficiency and upper cervical ligamentous integrity.[177] Because clinicians cannot rely on the results of any single test, including imaging,[146] the framework provides a tool to guide assessment of both risk factors and clinical presentation, and to make patient-centered, evidence-driven decisions on management. One high-quality systematic review by Hutting et al[95] revealed poor diagnostic accuracy for all upper cervical ligament integrity tests evaluated. Generally, these tests have sufficient specificity and can rule in upper cervical ligamentous insufficiency, but extent of sensitivity varied.

The Valsalva maneuver, previously described in the Physical Impairment section of the 2008 neck pain guidelines, may also be a useful screen for serious intracranial pathology in patients presenting with headache that worsens with exertion, and may be used to assist in deciding whether referral for neuroimaging is appropriate (positive likelihood ratio [LR] = 2.3; 95% CI: 1.4, 3.8).[47] Clinicians should refer to the American College of Radiology (ACR) Appropriateness Criteria guidelines to decide which type of imaging to use.[3]

Clinicians should utilize the Canadian cervical spine rule (CCR)[32,196,197] and/or the National Emergency X-Radiography Utilization Study (NEXUS) criteria[85,160] (**APPENDIX H**) to rule out the need for radiographic study in clinical conditions of suspected trauma-related fracture.

The National Institute for Health and Care Excellence produced a guideline that lists signs, symptoms, and conditions that should be considered when deciding the need for additional screening in patients who present with a headache in addition to neck pain.[149]

2017 Summary

Direct pathoanatomical causes of mechanical neck pain are rarely identifiable. Clinicians should inquire and test for clinical findings (red flags) in patients with neck pain to help determine the potential for the presence of serious pathology, such as infection, cancer, and cardiac involvement,[65] and the need for referral. Clinicians should also be alert for and assess patients with neck pain for signs and symptoms of serious pathology, including suspected arterial insufficiency, upper cervical ligamentous insufficiency, unexplained cranial nerve dysfunction, and fracture. Clinicians should utilize existing guidelines and appropriateness criteria (CCR, NEXUS, and ACR recommendations) in clinical decision making regarding imaging studies for traumatic and nontraumatic neck pain in the acute and chronic stages.

2017 Recommendation

A Clinicians should perform assessments and identify clinical findings in patients with neck pain to determine the potential for the presence of serious pathology (eg, infection, cancer, cardiac involvement, arterial insufficiency, upper cervical ligamentous insufficiency, unexplained cranial nerve dysfunction, or fracture), and refer for consultation as indicated.

IMAGING STUDIES

As noted in the 2008 CPG, alert and stable adult patients with cervical pain precipitated by trauma should be classified for risk level based on the CCR[197] or the NEXUS criteria[69] (**APPENDIX H**). The ACR Appropriateness Criteria should also be used for suspected spine trauma and chronic neck pain.[148] According to the CCR, patients are considered high risk if they (1) are greater than 65 years of age, (2) have had a dangerous mechanism of injury, or (3) have paresthesias in the extremities. Those classified as high risk should undergo computed tomography (CT) or cervical radiography. Furthermore, the following low-risk factors indicate that safe cervical range of motion (ROM) assessment can be done: if the patient (1) is able to sit in the emergency department, (2) has had a simple rear-end MVC, (3) is ambulatory at any time, (4) has had a delayed onset of neck pain, or (5) does not have midline cervical spine tenderness. Finally, if able to actively rotate the head 45° in each direction, the patient is classified as low risk. Imaging in the acute stage is not required for those who are classified as low risk.

The NEXUS low-risk criteria suggest that cervical spine radiography is indicated for patients with trauma unless they meet the following: (1) no posterior midline cervical spine tenderness; (2) no evidence of intoxication; (3) a normal level of cognition, orientation, and alertness; (4) no focal neurologic deficit; and (5) no painful distracting injuries. A recent systematic review suggests that the CCR appears to have better diagnostic accuracy than the NEXUS criteria (**APPENDIX H**).[139]

While this section focuses on imaging in the adult population, noteworthy is the paucity of available literature to help guide decision making for imaging in the pediatric population. Adult risk classification features should be applied in children greater than 14 years of age. Due to the added radiation exposure of CT, the ACR recommends plain radiography (3 views) in those under 14 years of age, regardless of mental status.[148]

Guidelines on use of diagnostic imaging in patients with acute or chronic (traumatic or nontraumatic) neck pain exist.[148] However, in view of the frequency of abnormal findings, and the lack of prognostic value,[147] routine imaging, such as ultrasonography, CT, and MRI, in patients without neurologic insult (or deficits) or other disease processes may not be warranted.[147]

Following are issues in imaging specific to the subcategories of neck pain. Neck pain classification categories are discussed later in these clinical guidelines.

Neck Pain With Mobility Deficits

As this is described in terms of acute or chronic neck pain, in the absence of red flag signs, no imaging is indicated.[80]

Neck Pain With Radiating Pain

Patients with normal radiographs and with neurologic signs or symptoms should undergo cervical MRI that includes the cranial cervical junction and the upper thoracic region. If there is a contraindication to the MRI examination such as, but not limited to, a cardiac pacemaker or severe claustrophobia, CT myelography with multiplanar reconstruction is recommended.[3]

Magnetic resonance imaging is usually the preferred first imaging modality for patients with nonresolving radiculopathy or progressing myelopathy. Gadolinium contrast administration is preferred when oncological, infectious, inflammatory, or vascular causes of myelopathy are suspected.[148]

In the case of traumatic myelopathy, the priority is to assess mechanical stability of the spine. While radiographs are useful for this purpose, a higher probability of identifying bony injury or ligamentous disruption in the cervical spine is realized with CT.[148] Magnetic resonance imaging is usually appropriate for problem solving or operative planning, and is most useful when injury is not explained by bony fracture.[3]

Neck Pain With Movement Coordination Impairment

Johansson et al[100] investigated imaging changes in individuals with acute WAD from an MVC. They assessed whether the presence of a cervical spine kyphotic deformity on MRI in the acute stage (approximately 10 days following the MVC) was associated with greater severity of baseline symptoms and a worse 1-year prognosis as compared to lordotic or straight postures following a whiplash injury. Findings suggest that kyphotic deformity is not significantly associated with chronic whiplash-associated pain.

High-resolution proton density-weighted MRI has identified abnormal signal intensity (indicative of tissue damage) in both the alar and transverse ligaments in some individuals with chronic WAD.[117] Separate studies initially indicated a strong relationship between alar ligament damage, head position (turned) at time of impact, and disability levels (as measured with the NDI).[101,102,116] However, a 2011 study by

Vetti et al[227] demonstrated that alar and transverse ligament signal within 1 year of injury most likely reflected normal variation. More recent evidence suggests that MRI signal changes of alar and transverse ligaments are not caused by whiplash injury, and MRI examination of alar and transverse ligaments should not be used as the routine workup of patients with whiplash injury.[122,145,146,228]

Previous work in chronic WAD from an MVC demonstrated that female patients (18-45 years of age) with persistent WAD (grade II Quebec Task Force rating: neck pain, tenderness to palpation, and limited neck ROM) have increased fat infiltration of the neck extensors[50] and flexors[55] on conventional MRI. These changes in muscle structure were significantly less in individuals with chronic insidious-onset neck pain or healthy controls,[53] suggesting that traumatic factors may play a role. The differential development of neck muscle fatty infiltrates was observed in individuals with varying levels of functional recovery following whiplash injury. Findings identified longitudinal structural muscle pathology with T1-weighted MRI. These findings were used to differentiate between those with varying levels of functional recovery, establishing a relationship between muscle fat at 6 months postinjury, and initial pain intensity, as well as signs/symptoms of posttraumatic stress disorders. Posttraumatic stress disorders have been identified as a strong factor in the prediction of recovery following whiplash, and these findings were recently replicated in a separate longitudinal study in Australia.[52] In a later study, the receiver operating characteristic analysis indicated that muscle fat levels of 20.5% or above resulted in a sensitivity of 87.5% and a specificity of 92.9% for predicting level of recovery at 3 months.[54] These results provide further evidence that muscle degeneration occurs in tandem with known predictive risk factors (older age, pain-related disability, and posttraumatic stress). An independent cross-sectional replication study from Sweden suggests similar findings.[107] The mechanisms by which changes in muscle structure occur, or respond to rehabilitation strategies, remain largely unknown.

There remains uncertainty about whether changes in the relative cross-sectional area (square millimeters) of the cervical paraspinal musculature are related to functional recovery following whiplash injury. Elliott et al[51] observed a consistent pattern of larger cross-sectional area with MRI in the multifidus muscles of those with persistent WAD. The larger cross-sectional area was believed to represent larger amounts of fatty infiltrate. Effectively, removal of fat signal from the MRI measures in these patients revealed that the majority of the muscles were not larger; rather, they were atrophied when compared with healthy controls and those with idiopathic neck pain.[56] In contrast, others have shown that atrophy of the neck muscles with MRI is not associated with long-term functional outcomes.[6,131,213]

Longitudinal observations (10 years or more) of modic signs (degenerative changes of the vertebral bone marrow adjacent to the end plates) and degenerative changes in the cervical intervertebral discs are common in patients with WAD. However, they occur with a similar frequency in healthy controls and are not significantly associated with changes in clinical symptoms, suggesting they may be more the result of the physiological aging process rather than pathological findings related to the whiplash injury.[96,132]

2017 Summary

Clinicians should utilize existing guidelines and appropriateness criteria (CCR, NEXUS, and ACR recommendations) in clinical decision making regarding imaging studies for traumatic and nontraumatic neck pain in the acute and chronic stages. Imaging studies often fail to identify any structural pathology related to symptoms in patients with whiplash injury. Although MRI can easily visualize ligamentous structures in the upper cervical spine, there is little evidence that MRI examination of alar and transverse ligaments should be used as the routine workup of patients with whiplash injury. Evidence is available for changes in muscle morphology; however, more high-quality prospective and cross-sectional research is needed to confirm these changes and to identify potential underlying causes and influence on recovery rates.[46] Magnetic resonance imaging is the preferred choice of imaging in painful and traumatic myelopathy. In the absence of neurological signs or symptoms, patients with normal radiographic findings or evidence of spondylosis need no further imaging studies.

2017 Recommendation

A Clinicians should utilize existing guidelines and appropriateness criteria in clinical decision making regarding referral or consultation for imaging studies for traumatic and nontraumatic neck pain in the acute and chronic stages.

CLINICAL GUIDELINES

Examination

OUTCOME MEASUREMENT

2008 Recommendation

A Clinicians should use validated self-report questionnaires, such as the NDI and the PSFS, for patients with neck pain. These tools are useful for identifying a patient's baseline status relative to pain, function, and disability and for monitoring a change in a patient's status throughout the course of treatment.

Evidence Update

Outcome tools can be used for at least 3 purposes: (1) evaluation (including determining change over time), (2) prognosis, and (3) diagnosis. Tools for evaluation are addressed below, tools for prognosis are described in the section on risk, and tools for diagnosis are described in the section on diagnosis.

II Many patient-reported outcome tools for neck pain are described in the literature. For the most part, these are not validated and the measurement properties of these scales remain uncertain. A notable exception is the most commonly used patient-reported functional outcome tool, the NDI.[127] In a 2012 moderate-quality systematic review of patient-reported outcome measures, Schellingerhout et al[181] focused on 8 different tools. Of these, the NDI was the most extensively studied over a variety of neck pain conditions and has been translated into many languages.[180,181,224] The NDI was also extensively assessed for its psychometric properties. Schellingerhout et al[181] found the measurement properties of the NDI to be adequate, except for reliability, and provisionally recommended its use. In an earlier low-quality review, Holly et al[87] found the NDI, the PSFS, and the North American Spine Society scale to be reliable, valid, and responsive for assessing radiculopathy for nonsurgical interventions. Further, a high-quality clinical guideline strongly recommended the use of the NDI, SF-36, Medical Outcomes Study 12-Item Short-Form Health Survey (SF-12), and visual analog scale (VAS) for assessing treatment of cervical radiculopathy arising from degenerative disorders.[11] Other scales, including the modified Prolo, the Modified Million Index, the PSFS, the Health Status Questionnaire, the Sickness Impact Profile, the McGill Pain Scores, and the Modified Oswestry Disability Index, were rated lower, but were still recommended outcome measures for assessing treatment of cervical radiculopathy arising from degenerative disorders. An acceptable-quality review by Horn et al[89] found the PSFS to have greater reliability than the NDI in patients with cervical dysfunction or cervical radiculopathy. Ferreira et al[60] found that the NDI, along with the Neck Bournemouth Questionnaire and the Neck Pain and Disability scale, demonstrated a balanced distribution of items across the ICF components.

II Fairbairn et al[58] used a thematic analysis technique to map patient-generated items on the PSFS to ICF components. From 283 neck-related items on the PSFS, they classified 29.3% of the items into body functions and structures, 57.6% of the items into activity, 8.5% into participation, and 4.6% into a combination of activity and participation.

V While not a measure of function, pain has an effect on function and can be used as an evaluative tool. Fillingim et al[61] recommended assessing 4 components of pain: (1) pain intensity (eg, numeric pain-rating scale[84]), (2) other perceptual qualities of pain (eg, asking the patient to describe the character of the pain), (3) bodily distribution of the pain (eg, by using a body chart), and (4) temporal features of pain (eg, asking the patient how the pain fluctuates with activity and rest, and over a day, week, or month). In some patients, Fillingim et al[61] also recommended considering the use of a mechanism-based approach, such as screening tools for neuropathic pain. Quantitative sensory testing, including tuning forks, monofilaments,[61] and tools for cold hyperalgesia described earlier, also could play a role in the assessment of a patient's pain. Finally, Fillingim et al[61] recommended that pain assessment be combined with other domains such as physical and psychosocial functioning. A review by Turk et al[212] provides an overview of measures and procedures to assess a set of key psychosocial and behavioral factors that could be important in chronic pain.

2017 Recommendation

A Clinicians should use validated self-report questionnaires for patients with neck pain, to identify a patient's baseline status and to monitor changes relative to pain, function, disability, and psychosocial functioning.

ACTIVITY LIMITATION AND PARTICIPATION RESTRICTION MEASURES

Evidence Update

III The Spinal Function Sort tool is used to measure a person's perceived ability to engage in functional activities by rating his or her ability on a series of

50 functional tasks graphically depicted and simply described.[130] Each task is rated on a 0-to-4-point scale, yielding a range of scores from 0 to 200. Although the Spinal Function Sort tool shows promise in predicting return to work in people with chronic low back pain,[14,154] it was not useful in predicting return to work at follow-up periods longer than 1 month in people with subacute WAD.[209]

V The measures identified in the 2008 neck pain CPG continue to be options that a clinician may use to assess changes in a patient's level of function over an episode of care. In addition, clinicians may ascertain activity limitations or participation restrictions through a physical task analysis approach on activities associated with the individual's daily living, employment, and leisure pursuits.

2008 and 2017 Recommendation

F Clinicians should utilize easily reproducible activity limitation and participation restriction measures associated with the patient's neck pain to assess the changes in the patient's level of function over the episode of care.

PHYSICAL IMPAIRMENT MEASURES

Evidence Update

I In a high-quality review, Snodgrass et al[189] studied cervical ROM as an outcome measure following cervical mobilization/manipulation. Of 36 studies, they found the cervical range of motion (CROM) device (Performance Attainment Associates, Lindstrom, MN), the standard goniometer, and the inclinometer to be the most commonly used tools to measure cervical ROM. It was suggested, based on limited evidence, that cervical ROM assessment was potentially a valuable tool in the screening/diagnostic process related to cervicogenic headache, cervical radiculopathy, and cervical spinal injury.

I In a 2010 acceptable-quality review, Williams et al[238] reviewed 46 articles on reliability and 21 articles on validity of cervical ROM assessment, finding "good" reliability and validity for the CROM device, the single inclinometer method, and the Spin-T goniometer. However, it should be noted that 32 of the 46 articles included in this review used asymptomatic individuals; application of these results to patients with neck pain should be done cautiously.

I An acceptable-quality review by Rubio-Ochoa et al[176] included 9 studies that assessed diagnostic utility of physical examination measures in individuals with cervicogenic headache compared to asymptomatic controls or individuals with other headache types. The most commonly used measures were cervical active ROM, passive accessory intervertebral motion (PAIVM) from C0 to C3, and the cervical flexion-rotation test (CFRT), and the authors determined that all of these tests demonstrated good utility in differential diagnosis of headache. The CFRT exhibited the strongest diagnostic metrics; kappa values ranged from 0.67 to 0.85, and intraclass correlation coefficients (ICCs) were 0.95 (95% CI: 0.90, 0.98) for CFRT right and 0.97 (95% CI: 0.94, 0.99) for CFRT left. Sensitivity/specificity ranged from 0.70/0.70 to 0.91/0.91, with positive and negative LRs of 2.3 to 10.65 and 0.095 to 0.43. The authors suggest that given the high specificity and positive LR, clinicians should use the CFRT near the end of the examination to rule in cervicogenic headache. Reliability and diagnostic accuracy were also reported for C0-C3 PAIVM testing in identifying cervicogenic headache. Kappa values ranged from 0.53 to 0.72, and the most common symptomatic segment was C1-2. Values for sensitivity were between 0.59 and 0.65, specificity between 0.78 and 0.87, positive LR from 2.9 to 4.9, and negative LR from 0.43 to 0.49. Interestingly, 1 high-quality study in the review clustered cervical active ROM, PAIVMs, and the cranial cervical flexion test (CCFT), with a resulting sensitivity of 0.94 and specificity of 1.00.[176]

I A high-quality review by Stanton et al[192] examined evidence of impaired proprioception in individuals with chronic, idiopathic neck pain and concluded that these individuals are worse than asymptomatic controls at head-to-neutral repositioning tests. However, due to a lack of studies evaluating the diagnostic accuracy of the repositioning tests, the authors did not draw conclusions about these measures.[192]

II In an acceptable-quality systematic review of 7 articles,[217] the interexaminer reliability of determining passive intervertebral motion of the cervical spine was poor to fair, and assessment of C1-2 and C2-3 motion segments was fair. Reliability tended to be higher (percent agreement ranging from 68% to 90%) when assessed on symptomatic versus asymptomatic individuals.

II An acceptable-quality systematic review by Rubinstein et al[175] evaluated the Spurling test, neck distraction test, Valsalva test, shoulder abduction test, and the neurodynamic test [upper-limb tension test] for the median nerve. A positive Spurling test (sensitivity, 0.50; specificity, 0.86-0.93), traction/neck distraction test (sensitivity, 0.44; specificity, 0.90-0.97), and Valsalva test (sensitivity, 0.22; specificity, 0.94) may suggest cervical radiculopathy, while a negative neurodynamic test (sensitivity, 0.17-0.78; specificity, 0.72-0.83) may rule it out. Caution should be used when considering any of these physical impairment measures independently. Clinicians should look for patterns between patient-reported and physical examination findings that rule

in or rule out a particular diagnostic classification for a patient.

This revision of the neck pain CPGs adds 2 additional physical impairment measures to the list presented in the 2008 guidelines: the CFRT and algometric assessment of pressure pain threshold.

Cervical Flexion-Rotation Test

- ICF category: measurement of impairment of body function; movement of several joints
- Description: measurement of passive rotation ROM at the C1-2 segment
- Measurement method: the patient lies supine while the clinician passively flexes the cervical spine maximally to end range. The clinician then passively rotates the head left and right. The end ROM in rotation is determined either by patient report of onset of pain or firm resistance felt by the clinician, whichever comes first. The clinician quantifies the ROM either by visual estimate or use of the CROM device. A positive test has been defined as a restriction of rotation ROM with a cutoff of less than 32° of rotation,[81,155] or a 10° reduction in the visually estimated range to either side.[82]
- Nature of variable: continuous
- Units of measurement: degrees
- Measurement properties: mean ROM was 39° to 45° in healthy individuals and 20° to 28° in patients with cervicogenic headache.[81,82,155] Reliability was excellent, as indicated by interrater agreement (κ = 0.81)[155] and test-retest reliability ($ICC_{2,1}$ = 0.92).[82] The standard error of measurement (SEM) is 2 ° to 3°, with a minimal detectable change (MDC_{90}) of 4.7° to 7°.[82]
  - Sensitivity, 0.90-0.95[81,82,155]; negative LR = 0.11-0.27[81,155]
  - Specificity, 0.90-0.97[81,82,155]; positive LR = 9.0-9.4[81,155]
- Instrument variations: clinicians may use visual estimate or goniometry

Algometric Assessment of Pressure Pain Threshold

- ICF category: measurement of impairment of body function; pain in head and neck
- Description: measurement of local pressure pain threshold in the upper trapezius
- Measurement method: the patient is seated. A digital pressure algometer is applied perpendicular to the muscle at the angle of the upper fibers of the trapezius muscle (approximately 5 to 8 cm superomedial to the superior angle of the scapula), with pressure increasing at a rate of approximately 4 to 5 N/s (40-50 kPa/s). Patients are instructed to push a button or tell the examiner the precise moment the sensation changes from pressure to pain. The examiner then repeats the test on the opposite side, and 3 tests of each site are conducted, with a minimum 30-second interval between tests
- Nature of variable: continuous
- Units of measurement: pressure (eg, N/cm^2, psi, or kPa)
- Measurement properties: reference values are established for patients with acute and chronic neck pain. Lowered values seen locally (about the neck) suggest a local mechanical hypersensitivity. Widespread lowered values (eg, about the neck and lower extremity) raise the possibility of a central nociceptive processing disorder. Reliability is excellent for intrarater agreement ($ICC_{2,1}$ = 0.96; 95% CI: 0.91, 0.98),[236] interrater agreement (0.89; 95% CI: 0.83, 0.93),[234,236] and 2- to 4-day test-retest reliability (0.83; 95% CI: 0.69, 0.91)[234]
  - SEM intrarater, 20.5 kPa; interrater, 50.3 kPa[234,236]
  - MDC_{90} intrarater, 47.2 kPa; interrater, 117-156 kPa[236,234]

2017 Recommendation

B When evaluating a patient with neck pain over an episode of care, clinicians should include assessments of impairments of body function that can establish baselines, monitor changes over time, and be helpful in clinical decision making to rule in or rule out (1) neck pain with mobility deficits, including cervical active ROM, the cervical flexion-rotation test, and cervical and thoracic segmental mobility tests; (2) neck pain with headache, including cervical active ROM, the cervical flexion-rotation test, and upper cervical segmental mobility testing; (3) neck pain with radiating pain, including neurodynamic testing, Spurling's test, the distraction test, and the Valsalva test; and (4) neck pain with movement coordination impairments, including cranial cervical flexion and neck flexor muscle endurance tests. Clinicians should include algometric assessment of pressure pain threshold for classifying pain.

DIAGNOSIS/CLASSIFICATION

The 2008 neck pain clinical practice guidelines classified neck pain into 4 categories linked to the treatment-based model proposed by Fritz and Brennan[62]: (1) neck pain with mobility deficits, (2) neck pain with movement coordination impairments, (3) neck pain with headache, (4) neck pain with radiating pain. Classification/diagnostic criteria were described in the 2008 recommendations.

Evidence Update

II In a high-quality systematic review of 5 trials, Takasaki and May[202] compared the effectiveness of the Mechanical Diagnosis and Therapy (MDT) approach to other therapeutic approaches or a "wait and see" approach in a wide variety of types of neck pain. Treatments were provided by therapists who had moderate training in the MDT approach. Results on pain intensity and function had wide CIs, and the authors concluded that any benefit from the MDT approach over other therapeutic approaches

or a "wait and see" approach may not be clinically relevant for pain, and was not clinically relevant for function.[202]

III Bergström et al[9] studied the effectiveness of different types of intervention on patients with cervicothoracic or low back pain. They classified patients using the Swedish version of the Multidimensional Pain Inventory into the following categories: adaptive copers (n = 62), interpersonally distressed (n = 52), and dysfunctional (n = 80). The types of intervention were: (1) behavioral-oriented physical therapy for approximately 20 hours per week; (2) cognitive behavioral therapy for approximately 14 hours per week; (3) behavioral medicine rehabilitation, which was a combination of the other 2 interventions, for approximately 40 hours per week; and (4) treatment as usual, consisting of no treatment offered. The outcome measure was sickness absence measured in days. Overall attendance rate for treatment alternatives was 62%. Outcomes indicated that the multidisciplinary behavioral medicine rehabilitation intervention resulted in decreased sickness absence more than treatment as usual in the adaptive coper and interpersonally distressed groups.

III In a retrospective analysis, Verhagen et al[222] failed to find significant differences in outcomes or prognostic factors between nonspecific neck pain associated with traumatic (WAD) and nontraumatic neck pain. Patients with headache were included in both the WAD (prevalence, 49/63) and nontraumatic (prevalence, 268/395) groups. Patients received an individualized, nonstandardized program, which could include medication, advice, education, exercises, modalities, and/or manual therapy. Based on nonsignificant differences in outcomes or prognostic factors, Verhagen et al[222] concluded that patients postwhiplash should not be considered a separate subgroup from patients with nontraumatic neck pain.

V Similar to a previously developed classification system for WAD, Guzman et al[78] classified all neck pain into 4 categories depending on signs, symptoms, and the extent of interference with activities of daily living. Currently, this classification system does not have the level of specificity necessary to guide decisions on choice of interventions.[78]

TREATMENT-BASED CLINICAL PREDICTION RULES FOR NECK PAIN

Clinical prediction rules may prove helpful toward identifying patients who may respond well to a certain treatment. However, clinical prediction rules must go through a 3-step validation process before a clinician can use them with high confidence in clinical practice: (1) the rule must be derived properly, (2) it must be tested or validated, and (3) it must pass a clinical impact phase.[135] The 2008 neck pain CPG described clinical prediction rules at the derivation phase for manipulation of the cervical spine,[211] for manipulation of the thoracic spine,[31] and for the use of cervical spine traction.[164]

II A systematic review by Kelly et al[112] explored the readiness for adoption of 11 formalized prescriptive clinical prediction rules in the development or validation stage for early identification of patients response to a certain intervention for neck pain, including the 3 identified in the 2008 neck pain CPG. The authors concluded none of the identified prescriptive clinical prediction rules were at the stage of readiness to be endorsed for clinical adoption.[112]

2017 Recommendation

C Clinicians should use motion limitations in the cervical and upper thoracic regions, presence of cervicogenic headache, history of trauma, and referred or radiating pain into an upper extremity as useful clinical findings for classifying a patient with neck pain into the following categories:

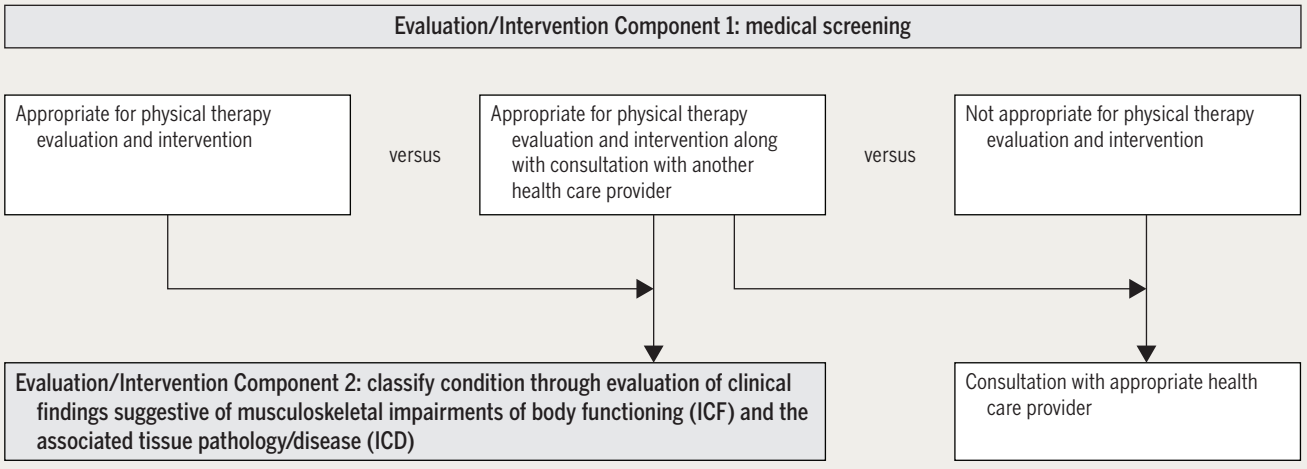
- Neck pain with mobility deficits
- Neck pain with movement coordination impairments (including WAD)
- Neck pain with headaches (cervicogenic headache)
- Neck pain with radiating pain (radicular)

With recognition that these categories will not be exclusive or exhaustive, the assignation of an individual patient into the category that "best fits" the patient's current clinical picture relies on clinical reasoning and judgment of the clinician.

The proposed model for examination, diagnosis, and treatment planning for patients with neck pain uses the following components[111]: (1) evaluation/intervention component 1, medical screening; (2) evaluation/intervention component 2, classify condition through evaluation of clinical findings suggestive of musculoskeletal impairments of body functioning (ICF) and associated tissue pathology/disease (ICD); (3) evaluation/intervention component 3, determination of condition stage (acute/subacute/chronic); (4) evaluation/intervention component 4, intervention strategies for patients with neck pain. This model is depicted in the **FIGURE.**

Component 1[111]

Medical screening incorporates the findings of the history and physical examination to determine whether the patient's symptoms originate from a condition that requires referral to another health care provider. The 2012 IFOMPT International Framework for Examination of the Cervical Region, the CCR, and the NEXUS criteria, all discussed earlier, are examples of tools that may be helpful in this decision-making process. In



Neck Pain With Mobility Deficits

Common symptoms
- Central and/or unilateral neck pain
- Limitation in neck motion that consistently reproduces symptoms
- Associated (referred) shoulder girdle or upper extremity pain may be present

Expected exam findings
- Limited cervical ROM
- Neck pain reproduced at end ranges of active and passive motions
- Restricted cervical and thoracic segmental mobility
- Intersegmental mobility testing reveals characteristic restriction
- Neck and referred pain reproduced with provocation of the involved cervical or upper thoracic segments or cervical musculature
- Deficits in cervicoscapulothoracic strength and motor control may be present in individuals with subacute or chronic neck pain

Neck Pain With Movement Coordination Impairments (WAD)

Common symptoms
- Mechanism of onset linked to trauma or whiplash
- Associated (referred) shoulder girdle or upper extremity pain
- Associated varied nonspecific concussive signs and symptoms
- Dizziness/nausea
- Headache, concentration, or memory difficulties; confusion; hypersensitivity to mechanical, thermal, acoustic, odor, or light stimuli; heightened affective distress

Expected exam findings
- Positive cranial cervical flexion test
- Positive neck flexor muscle endurance test
- Positive pressure algometry
- Strength and endurance deficits of the neck muscles
- Neck pain with mid-range motion that worsens with end-range positions
- Point tenderness may include myofascial trigger points
- Sensorimotor impairment may include altered muscle activation patterns, proprioceptive deficit, postural balance or control
- Neck and referred pain reproduced by provocation of the involved cervical segments

Neck Pain With Headache (Cervicogenic)*

Common symptoms*
- Noncontinuous, unilateral neck pain and associated (referred) headache
- Headache is precipitated or aggravated by neck movements or sustained positions/postures

Expected exam findings
- Positive cervical flexion-rotation test
- Headache reproduced with provocation of the involved upper cervical segments
- Limited cervical ROM
- Restricted upper cervical segmental mobility
- Strength, endurance, and coordination deficits of the neck muscles

Neck Pain With Radiating Pain (Radicular)

Common symptoms
- Neck pain with radiating (narrow band of lancinating) pain in the involved extremity
- Upper extremity dermatomal paresthesia or numbness, and myotomal muscle weakness

Expected exam findings
- Neck and neck-related radiating pain reproduced or relieved with radiculopathy testing: positive test cluster includes upper-limb nerve mobility, Spurling's test, cervical distraction, cervical ROM
- May have upper extremity sensory, strength, or reflex deficits associated with the involved nerve roots

Figure continues on page A23.

FIGURE. Proposed model for examination, diagnosis, and treatment planning for patients with neck pain. *Clinicians are encouraged to refer to the International Classification of Headache Disorders[83] for a more inclusive list of headache types/classifications (https://www.ichd-3.org/how-to-use-the-classification/), and to The National Institute for Health and Care Excellence[149] for signs, symptoms, and conditions that should be considered in patients who present with a headache in addition to neck pain.

Evaluation/Intervention Component 3: determination of condition stage (acute/subacute/chronic)

Acute, subacute, and chronic stages are time-based stages helpful in classifying patient conditions. Time-based stages are helpful in making treatment decisions only in the sense that in the acute phase, the condition is usually highly irritable (pain experienced at rest or with initial to mid-range spinal movements: before tissue resistance); in the subacute phase, the condition often exhibits moderate irritability (pain experienced with mid-range motions that worsen with end-range spinal movements: with tissue resistance); and chronic conditions often have a low degree of irritability (pain that worsens with sustained end-range spinal movements or positions: overpressure into tissue resistance). There are cases where the alignment of irritability and the duration of symptoms does not match accordingly, requiring clinicians to make judgments when applying time-based research results on a patient-by-patient basis

Evaluation/Intervention Component 4: intervention strategies for patients with neck pain

Neck Pain With Mobility Deficits

Acute
- Thoracic manipulation
- Cervical mobilization or manipulation
- Cervical ROM, stretching, and isometric strengthening exercise
- Advice to stay active plus home cervical ROM and isometric exercise
- Supervised exercise, including cervicoscapulothoracic and upper extremity stretching, strengthening, and endurance training
- General fitness training (stay active)

Subacute
- Cervical mobilization or manipulation
- Thoracic manipulation
- Cervicoscapulothoracic endurance exercise

Chronic
- Thoracic manipulation
- Cervical mobilization
- Combined cervicoscapulothoracic exercise plus mobilization or manipulation
- Mixed exercise for cervicoscapulothoracic regions—neuromuscular exercise: coordination, proprioception, and postural training; stretching; strengthening; endurance training; aerobic conditioning; and cognitive affective elements
- Supervised individualized exercises
- "Stay active" lifestyle approaches
- Dry needling, low-level laser, pulsed or high-power ultrasound, intermittent mechanical traction, repetitive brain stimulation, TENS, electrical muscle stimulation

Neck Pain With Movement Coordination Impairments (WAD)

Acute if prognosis is for a quick and early recovery
- Education: advice to remain active, act as usual
- Home exercise: pain-free cervical ROM and postural element
- Monitor for acceptable progress
- Minimize collar use

Subacute if prognosis is for a prolonged recovery trajectory
- Education: activation and counseling
- Combined exercise: active cervical ROM and isometric low-load strengthening plus manual therapy (cervical mobilization or manipulation) plus physical agents: ice, heat, TENS
- Supervised exercise: active cervical ROM or stretching, strengthening, endurance, neuromuscular exercise including postural, coordination, and stabilization elements

Chronic
- Education: prognosis, encouragement, reassurance, pain management
- Cervical mobilization plus individualized progressive exercise: low-load cervicoscapulothoracic strengthening, endurance, flexibility, functional training using cognitive behavioral therapy principles, vestibular rehabilitation, eye-head-neck coordination, and neuromuscular coordination elements
- TENS

Neck Pain With Headache (Cervicogenic)

Acute
- Exercise: C1-2 self-SNAG

Subacute
- Cervical manipulation and mobilization
- Exercise: C1-2 self-SNAG

Chronic
- Cervical manipulation
- Cervical and thoracic manipulation
- Exercise for cervical and scapulothoracic region: strengthening and endurance exercise with neuromuscular training, including motor control and biofeedback elements
- Combined manual therapy (mobilization or manipulation) plus exercise (stretching, strengthening, and endurance training elements)

Neck Pain With Radiating Pain (Radicular)

Acute
- Exercise: mobilizing and stabilizing elements
- Low-level laser
- Possible short-term collar use

Chronic
- Combined exercise: stretching and strengthening elements plus manual therapy for cervical and thoracic region: mobilization or manipulation
- Education counseling to encourage participation in occupational and exercise activity
- Intermittent traction

FIGURE. Proposed model for examination, diagnosis, and treatment planning for patients with neck pain. *Clinicians are encouraged to refer to the International Classification of Headache Disorders[83] for a more inclusive list of headache types/classifications (https://www.ichd-3.org/how-to-use-the-classification/), and to The National Institute for Health and Care Excellence[149] for signs, symptoms, and conditions that should be considered in patients who present with a headache in addition to neck pain.

addition to these conditions, clinicians should screen for the presence of psychosocial issues that may affect prognostication and treatment decision making for rehabilitation. For example, elevated scores on the Impact of Events Scale have been associated with other severe symptoms and a longer recovery in individuals with neck pain after whiplash injury.[195] Accordingly, identifying cognitive behavioral tendencies during the patient's evaluation can direct the therapist to employ specific patient education strategies to optimize patient outcomes to physical therapy interventions and potentially provide indications for referring the patient for consultation with another medical or mental health practitioner.[8]

Component 2[111]

Differential evaluation of musculoskeletal clinical findings is used to determine the most relevant physical impairments associated with the patient's reported activity limitations and medical diagnosis. Clusters of these clinical findings, which commonly coexist in patients, are described as impairment patterns in the physical therapy literature[4] and for neck pain are classified according to the key impairment(s) of body function, along with the characteristic and distribution of pain associated with that classification. The ICD-10 and primary and secondary ICF codes associated with neck pain are provided in the 2008 ICF-based neck pain CPG.[29] These classifications are useful in determining interventions focused on normalizing the key impairments of body function, which in turn strive to improve the movement and function of the patient and lessen or alleviate pain and/or activity limitations. Key clinical findings to differentiate the classifications are shown in the **FIGURE**. In addition, when it comes to neck-related headaches, clinicians are encouraged to refer to the International Classification of Headache Disorders[83] for a more inclusive list of headache types/classifications (https://www.ichd-3.org/how-to-use-the-classification/), and to The National Institute for Health and Care Excellence[149] for additional signs, symptoms, and conditions that should be considered in patients who present with a headache in addition to neck pain. Overall, classification is critical for matching the intervention strategy that is most likely to provide the optimal outcome for a patient's condition. However, it is important for clinicians to understand that patients with neck pain often exhibit signs and symptoms that fit more than 1 classification, and that the most relevant impairments of body function and the associated intervention strategies often change during the patient's episode of care. Thus, continual re-evaluation of the patient's response to treatment and the patient's emerging clinical findings is important for providing the optimal interventions throughout the patient's episode of care.

Component 3[111]

For research purposes, acute, subacute, and chronic stages are time-based stages helpful in classifying patient conditions and in making treatment decisions. In part, they define the stage of healing: in the acute phase, the condition is usually more irritable; in the subacute phase, the condition often exhibits moderate irritability; chronic conditions often have a lower degree of irritability. There are cases where the alignment of irritability and the duration of symptoms does not match, requiring clinicians to make judgments when applying time-based research results on a patient-by-patient basis. Irritability is a term used by rehabilitation practitioners to reflect the tissue's ability to handle physical stress,[142] and is presumably related to physical status and the extent of inflammatory activity that is present. Assessment of tissue irritability relies on clinical judgment, and is important for guiding the clinical decisions regarding treatment frequency, intensity, duration, and type, with the goal of matching the optimal dosage of treatment to the status of the tissue being treated. There are other biopsychosocial elements that may relate to staging of the condition, including, but not limited to, the level of disability reported by the patient, extent of interrupted sleep, medication dosage, and activity avoidance.[34]

Component 4

Interventions are listed by category of neck pain, and ordered by stage (acute/subacute/chronic). Because irritability level often reflects the tissue's ability to accept physical stress, clinicians should match the most appropriate intervention strategies to the irritability level of the patient's condition.[34,45,110,111] Additionally, clinicians should attend to influences from psychosocial[86] and altered pain processing elements[151] in patients with conditions in all stages of recovery.

CLINICAL GUIDELINES

Interventions

The literature concerning nonsurgical interventions for neck pain rarely describes subject populations with terms synonymous with the 4 categories of the 2008 neck pain CPG[29] and carried forward in this revision. As such, the results of the literature can rarely be applied exclusively and exhaustively to these separate categories. Additionally, the evidence is very weak regarding the differential effectiveness of many interventions for neck pain based on subpopulations (eg, age, sex, ethnicity). Reporting of intervention dosage in terms of intensity, duration, and frequency is variable and may not allow confident translation into practice. One method of arriving at possible intervention dosage is to combine original trial dosage descriptions with clinical judgment, including principles of exercise, movement, and pain science, and patient preferences.

This CPG attempts to differentiate the effects of interventions as they may be applied to the categories of neck pain. When available, information regarding stage (acute, less than 6 weeks; subacute, 6 to 12 weeks; or chronic, greater than 12 weeks), comparison group, and follow-up (immediate, within 1 day; short term, closest to 4 weeks; intermediate term, closest to 6 months; and long term, closest to 12 months) is provided. The concepts of immediate, short, intermediate, and long-term follow-up are research-based periods and do not represent duration of care, but do provide an estimate of the duration of the treatment effects. Similarly, the concepts of acute, subacute, and chronic stages represent unequal periods, and it is acknowledged that the duration of symptoms may be less relevant than the characteristics of the condition to a patient's progression from one stage to the next stage.

The 2008 intervention recommendations and literature syntheses were not specifically aligned to the ICF-based neck pain categories, but some guidance in this regard can be gained from **TABLE 4** of that document.[29] In this revision, the tables presenting the evidence update are organized first by intervention type (eg, manual therapy, exercise, multimodal, education, and physical agents), then by stage (eg, acute, subacute, and chronic), and finally by comparison group and effect (eg, benefit compared to control, benefit compared to an alternate treatment, no benefit compared to control, and no benefit compared to an alternate treatment). In general, the interventions described below have a low risk profile for causing adverse events. While major adverse events can and do occur on a patient-by-patient basis, as evidenced by case reports and medicolegal documents, reports of serious events in randomized controlled trials are ostensibly absent. Nonetheless, clinicians should apply a benefit to harm screening protocol, such as the IFOMPT framework for risk assessment,[177] prior to performing any intervention.

NECK PAIN WITH MOBILITY DEFICITS

2008 Recommendations

The intervention literature analyses were not specifically aligned to the neck pain categories, but the recommendations were made for cervical mobilization/manipulation, thoracic mobilization/manipulation, stretching exercises, and coordination, strengthening, and endurance exercises.

Evidence Update

Identified were 43 systematic reviews investigating physical therapy interventions on patients who could be classified as having neck pain with mobility deficits. Levels of evidence assigned to systematic reviews in this section were assessed according to **TABLE 1**. Primary sources were generally of high or moderate methodological quality with low risk of bias, but had numbers of participants that were considered small. This resulted in downgrading the strength of the evidence by 1 or 2 levels due to imprecision and limited directness (**TABLE 1**).[63] **TABLE 7** details the levels of evidence of included studies with underpinning evidence statements. Consideration of the trade-offs between desirable and undesirable consequences (important adverse events) was made. Adverse events or side effects were rarely reported in the studies, and when reported were minor, transient, and of short duration. For manual therapy or exercise, the only consistently reported problem was a mild transient exacerbation of symptoms.[36,93] For manipulation, rare but serious adverse events such as stroke or serious neurological deficits were not reported in any of the trials. Serious but rare adverse events for manipulation are known to occur.[23] Graham et al[68] reported mild adverse events equal in treatment and placebo groups, including tiredness, nausea, headache, and increased pain following laser treatment.

V The following are expert opinions of the CPG development group:

• Clinicians should integrate the recommendations below with consideration of the results of the patient evaluation (eg, physical impairments most related to the patient's reported activity limitation or concerns, severity and irritability of the condition, patient values and motivating factors).

TABLE 7 Intervention Evidence for Neck Pain With Mobility Deficits by Intervention Type, Stage, Level of Evidence, Evidence of Benefit or No Benefit, and Comparison

		Manual Therapy
Stage/Level	**Study**	**Evidence Statement**
Acute		
III	Brown et al[21] Cross et al[41] Furlan et al[64] Gross et al[72] Huisman et al[92] Hurwitz et al[93] Scholten-Peeters et al[182]	For patients with acute neck pain with mobility deficits, there was a **benefit** compared to control for using multiple sessions of thoracic manipulation for reducing pain over the immediate and short term.[21,41,64,72,92,93,182] This finding was consistent over the intermediate term but the magnitude of effect was small for pain, function, and quality of life.[72]
IV	Coronado et al[36] Gross et al[73] Gross et al[72]	For patients with acute neck pain with mobility deficits, there was a **benefit** compared to control for using 1 to 4 sessions of a single cervical manipulation for reducing pain over the immediate term but not short term.[36,72,73]
IV	Gross et al[72]	For patients with acute and chronic neck pain with mobility deficits, there is **conflicting evidence** supporting the use of multiple sessions of cervical manipulation as a stand-alone therapy.[72]
II	Clar et al[30] Furlan et al[64] Gross et al[72] Hurwitz et al[93] Vincent et al[229]	For patients with acute and chronic neck pain with mobility deficits, there was **no benefit** compared to cervical mobilization, in using multiple sessions of cervical manipulation for reducing pain and improving function, quality of life, global perceived effect, and patient satisfaction over the immediate, short, and intermediate term.[30,64,72,93,229]
III	Leaver et al[119]	For patients with acute to subacute neck pain with mobility deficits, there was a **benefit** compared to only using cervical manipulation or only using cervical mobilization, in using combinations of manual therapies for providing analgesic benefits over the short term.[119]
III	Gross et al[72] Vincent et al[229]	For patients with acute to subacute neck pain with mobility deficits, there was a **benefit** compared to varied oral medication combinations (oral analgesic, opioid analgesic, NSAID, muscle relaxant), in using multiple sessions of cervical manipulation for reducing pain and improving function over the long term.[72,229]
IV	Furlan et al[64] Vernon et al[226]	For patients with acute to subacute neck pain with mobility deficits, there was a **benefit** when compared to control, in using cervical mobilization and ipsilateral, but not contralateral, cervical manipulation for reducing pain over the immediate term. [64,226]
Subacute		
IV	Furlan et al[64] Huisman et al[92] Young et al[244]	For patients with subacute neck pain with mobility deficits, there was a **benefit** when compared to control, in using: • A single session of thoracic manipulation for reducing pain and improving ROM over the short term[92,244] • A single session of thoracic manipulation for reducing disability over the immediate term[64]
III	Cross et al[41]	For patients with subacute to chronic neck pain with mobility deficits, there was **no benefit**, when compared to a control, in using a single session of thoracic manipulation for reducing pain over the immediate term.[41]
IV	Coronado et al[36]	For patients with subacute to chronic neck pain with mobility deficits, there was **no benefit**, when compared to a control, in using a single session of cervical manipulation for reducing pain over the immediate term.[36]
III	Leaver et al[119]	For patients with subacute to chronic neck pain with mobility deficits, there was **no benefit** in using 2 weeks of cervical manipulation compared to 2 weeks of cervical mobilization (low velocity, oscillating passive movements) on improving function or reducing pain, disability, or days to perceived recovery.[119]
III	Hurwitz et al[93]	For patients with subacute to chronic neck pain with mobility deficits, there was **no benefit** in using cervical manipulation alone or with advice and home exercises, compared to cervical mobilization and strengthening exercises, or instrumented manipulation, for reducing pain and disability over the short or long term.[93]
IV	Furlan et al[64]	For patients with subacute to chronic neck pain with mobility deficits, there was **no benefit** in using cervical mobilization, when compared to usual care, for reducing pain over the intermediate term.[64]

Table continues on page A27.

TABLE 7 Intervention Evidence for Neck Pain With Mobility Deficits by Intervention Type, Stage, Level of Evidence, Evidence of Benefit or No Benefit, and Comparison (continued)

		Manual Therapy
Stage/Level	**Study**	**Evidence Statement**
Chronic		
III	Furlan et al[64] Gross et al[73] Hurwitz et al[93]	For patients with chronic neck pain with mobility deficits, there was a **benefit**, when compared to a control, in using a single session of thoracic manipulation on pain over the immediate term.[64,73,93]
IV	Cross et al[41] Damgaard et al [44] Furlan et al[64] Gross et al[73] Huisman et al[92] Hurwitz et al[93] Leaver et al[119] Scholten-Peeters et al[182] Vincent et al[229] Walser et al[231]	For patients with chronic neck pain with mobility deficits, there was a **benefit**, when compared to a control in using • A single session of supine thoracic manipulation on pain over the immediate term[41,64,73,92,93,119,182,231] • 8 sessions of thoracic manipulation, for reducing pain and disability over the immediate and intermediate term[44,92,229]
IV	Gross et al[72] Young et al[244]	For patients with chronic neck pain with mobility deficits, there was a **benefit** in using the following techniques: • Upper thoracic manipulation, when compared to cervical manipulation, for reducing pain over the immediate term[244] • 12 sessions over 4 wk of anterior-posterior unilateral accessory movement procedures, when compared to a rotational or transverse accessory movement procedures, for reducing pain over the immediate term[72]
III	Furlan et al[64] Gross et al[72]	For patients with chronic neck pain with mobility deficits, there was **no benefit** in using cervical manipulation, when compared to medication (NSAIDs, Celebrex, Paracetamol) for reducing pain or improving function over the short term.[64,72]
IV	Gross et al[72]	For patients with chronic neck pain with mobility deficits, there was **no benefit** in using cervical mobilization, when compared to exercise, laser, pulsed ultrasound, acupuncture, and massage for reducing pain, improving function, and improving quality of life over the immediate to intermediate term.[72]
IV	Gross et al[72]	For patients with chronic neck pain with mobility deficits, there was **no benefit** in using the following mobilization techniques: • Mobilization at the most symptomatic segment when compared to mobilization at a randomly chosen segment • Central PA passive accessory movement mobilization technique when compared to random PAs at the same segment • Ipsilateral PAs when compared to a randomly selected PAs at the same segment • Mobilization perpendicular to the facet plane at most symptomatic segment when compared to the same mobilization 3 levels above, for reducing pain over the immediate term[72]
		Exercise
Stage/Level	**Study**	**Evidence Statement**
Acute		
III	Bertozzi et al[10] Gross et al[71] Kay et al[109]	For patients with acute to chronic neck pain with mobility deficits, there was a **benefit**, when compared to a control, in using scapulothoracic and upper extremity strengthening for reducing pain over the short term.[10,71,109]
III	Gross et al[71] Kay et al[109] O'Riordan et al[157] Southerst et al[190] Zronek et al[247]	For patients with acute to chronic neck pain with mobility deficits, there was a **benefit**, when compared to a control, in using the following: • Scapulothoracic and upper extremity endurance training for reducing pain over the immediate term[71,109,157,247] • Stretching exercises plus education for reducing pain and disability and improving quality of life over the short term[190]

Table continues on page A28.

TABLE 7 Intervention Evidence for Neck Pain With Mobility Deficits by Intervention Type, Stage, Level of Evidence, Evidence of Benefit or No Benefit, and Comparison (continued)

		Exercise
Stage/Level	**Study**	**Evidence Statement**
IV	Bertozzi et al[10] Kay et al[109] Gross et al[71]	For patients with acute to chronic neck pain with mobility deficits, there was a **benefit**, when compared to a control, in using: • General fitness training for reducing pain over the immediate and short term.[10,71,109] • Deep neck flexor recruitment combined with upper extremity strengthening/endurance exercises for reducing pain over the immediate term.[71]
III	Southerst et al[190] Zronek et al[247]	For patients with acute to subacute neck pain with mobility deficits, there was a **benefit** in using a home exercise program of daily cervical ROM exercises, education, and advice, when compared to medication, for reducing pain and disability for the intermediate term.[190,247]
III	Schroeder et al[184]	For patients with acute neck pain with mobility deficits, there was a **benefit** in using stretching, strengthening, ROM /flexibility, and relaxation exercise, when compared to soft tissue and cervical joint mobilization plus coordination, stabilization, and postural exercise.[184]
IV	Schroeder et al[184] Southerst et al[190] Zronek et al[247]	For patients with acute to subacute neck pain with mobility deficits, there was **no benefit** in using a home exercise program of daily cervical ROM exercises, education, and advice, when compared to cervical and thoracic manipulation, for reducing pain or improving function over the immediate and long term.[184,190,247]
Subacute		
III	Hurwitz et al[93]	For patients with subacute to chronic neck pain with mobility deficits, there was **no benefit** in using neck and shoulder endurance exercises, when compared to neck and shoulder strengthening exercises, for reducing pain or improving function or global perceived effect over the short and long term.[93]
Chronic		
III	Bertozzi et al[10] Gross et al[71] Kay et al[109] Leaver et al[119] Monticone et al[141] Nunes and Moita[152] Southerst et al[190] Verhagen et al[221]	For patients with chronic neck pain with mobility deficits, there was a **benefit**, when compared to a control, in using the following: • Neuromuscular exercise (eg, proprioception, eye-head-neck coordination) for reducing pain and improving function over the short term, but not intermediate or long term, and for improving global perceived effect over the intermediate term[109,119,141] • Cervical stretching and strengthening for reducing pain and improving function over the immediate and intermediate term[109,190] • Combined cervical and scapulothoracic stretching and strengthening for reducing pain and improving function over the intermediate and long term.[71,109] However, there is conflicting evidence when these exercises are combined with other elements of exercise[152,221] • Deep neck flexor isometric strengthening for reducing pain and disability over the immediate and short term[10]
IV	Gross et al[71] Kay et al[109] Lee et al[120] O'Riordan et al[157] Southerst et al[190]	For patients with chronic neck pain with mobility deficits, there was a **benefit**, when compared to a control, in using the following: • A combination of stretching, strengthening, endurance training, and balance/coordination exercises and aerobic conditioning, with a cognitive/affective component (Qigong) exercise for reducing pain and improving function over the immediate, short, and intermediate terms.[71,109,120,190] Conflicting results reported by Lee et al[120] are due to a combination of different primary sources • Postural and isometric exercise added to the use of a cervical pillow for reducing pain and improving function over the immediate and short term[71,109] • Isometric neck flexion exercise, plus upper extremity strengthening and stretching for reducing pain and improving function over the immediate term[157] • Whole body group exercise of cardiovascular training with coordination and extensibility exercise for reducing pain over the immediate term[109]
III	Hurwitz et al[93]	For patients with chronic neck pain with mobility deficits, there was a **benefit** in using strengthening exercises alone or in combination with manipulation, when compared to manipulation alone, for reducing pain and disability over the long term[93]

Table continues on page A29.

TABLE 7 Intervention Evidence for Neck Pain With Mobility Deficits by Intervention Type, Stage, Level of Evidence, Evidence of Benefit or No Benefit, and Comparison (continued)

		Exercise
Stage/Level	**Study**	**Evidence Statement**
IV	Damgaard et al[44] Haines et al[79] Kay et al[108] Macaulay et al[125] Monticone et al[141] Nunes and Moita[152] O'Riordan et al[157] Schroeder et al[184] Southerst et al[190] Verhagen et al[221] Vincent et al[229] Zronek et al[247]	For patients with chronic neck pain with mobility deficits, there was a **benefit** in using the following: • Stretching combined with upper body and neck strengthening on pain, when compared to a program of manipulation, massage, and sham micro-current, over the long term[125,184,229] • Cervical stretching and strengthening, when compared to Qigong exercise, for improving function over the intermediate term[190] • A 1-year home exercise program of 3 times per week neck flexion endurance exercise, plus upper extremity strengthening and stretching, when compared to aerobic exercise, for reducing pain and improving function and health related quality of life over the immediate term[44,157,247] • Cervical stretching or strengthening or endurance, when compared to a stress management program, for reducing pain over the immediate, but not long term[152] • Supervised exercise programs of neck and upper body strengthening and stretching, when compared to an individualized home exercise program of neck and shoulder mobilization, advice, and education, for reducing pain and improving global perceived effect over the short and long term[44,157,190] • Methods to increase physical activity at work and leisure (eg, bike to work, take stairs, general strengthening and conditioning exercise, and advice), when compared to specific exercise (eg, postural exercise, strengthening exercise for neck and shoulder, body awareness training), for reducing pain over the short term.[221] There was no difference for function, or on pain and function over the long term[221] • Deep neck flexor recruitment and strengthening, when compared to infrared radiation and advice, for reducing pain over the immediate term. There was no effect on function over the immediate term, or on pain or function over the intermediate term[157] • Individualized home exercise programs of stabilization, relaxation, and postural control, compared to written advice to stay active, for reducing pain and improving function over the intermediate term, but not over the long term[79,108,141,157] • Supervised group yoga, when compared to unsupervised home exercise program of postural exercise and neck and shoulder stretching and strengthening, for reducing pain and disability over the short term[190]
III	Bertozzi et al[10] Gross et al[71] Leaver et al[119] O'Riordan et al[157]	For patients with chronic neck pain with mobility deficits, there was **no benefit**, when compared to a control, in using upper extremity and trunk strengthening exercise,[10,71,157] and upper extremity stretching and endurance training,[71] and aerobic conditioning,[119] for reducing pain and improving function over the immediate, short, and long term.
IV	Bertozzi et al[10] Gross et al[71] Kay et al[109] Leaver et al[119] O'Riordan et al[157]	For patients with chronic neck pain with mobility deficits, there was **no benefit**, when compared to a control, in using the following: • A strengthening component added to a home based stretching program for reducing pain and disability, over the long term[157] • Breathing exercises for reducing pain and improving function and quality of life, over the immediate term[71] • McKenzie stretch/ROM plus dynamic stabilization exercises for reducing pain and disability over the immediate through long term[71,109,119] • Stretching exercise either before or after a manipulation for reducing pain and improving function over the immediate term[71,109] • General endurance, flexibility, coordination, and postural awareness training (Feldenkrais) for reducing pain over the short and long term[10,109] • Combination of strengthening, stretching, endurance, postural, and coordination exercise not specific to the neck, for reducing pain over the short term[10,109] • General strengthening for reducing pain and improving function or quality of life over the long term[157]

Table continues on page A30.

TABLE 7 Intervention Evidence for Neck Pain With Mobility Deficits by Intervention Type, Stage, Level of Evidence, Evidence of Benefit or No Benefit, and Comparison (continued)

Stage/Level	Study	Evidence Statement
		Exercise
IV	Gross et al[71] McCaskey et al[134] O'Riordan et al[157] Southerst et al[190]	For patients with chronic neck pain with mobility deficits, there was **no benefit** in using: • Active ROM, stabilization, and postural exercises specific to the neck, when compared to generalized exercises to the body, for reducing disability over the short term[190] • Neck and upper extremity endurance training plus stretching, when compared to aerobic conditioning plus stretching, for reducing pain and improving function over the immediate term, and for improving global perceived effect over the long term[157] • General endurance, flexibility, coordination, and postural awareness training (Feldenkrais), when compared to physiotherapy intervention (lumbopelvic stabilization, whole body strengthening, coordination, endurance and flexibility exercise, advice and home exercise program), for reducing pain over the long term[71] • Proprioceptive training, compared to stretching and strengthening exercise on pain and function over the short term[134] • Deep neck flexor training with pressure biofeedback, when compared to strength training of the neck flexor muscles with weights, for reducing pain and disability over the immediate term[157]
		Multimodal: Exercise and Manual Therapy
Acute		No update evidence identified
Subacute		No update evidence identified
Chronic		
III	Gross et al[75]	For patients with chronic neck pain with mobility deficits, with or without radiating pain, and with or without headache there was a **benefit**, compared to control, in using mobilization or manipulation combined with stretching and strengthening for reducing pain over the short and long term, and function over the long term.[75]
III	Miller et al[140]	For patients with chronic neck pain with mobility deficits, there was a **benefit** in using a combination of exercise plus manipulation or mobilization, compared to manipulation or mobilization alone, for reducing pain and improving quality of life over the long term.[140]
III	McCaskey et al[134]	For patients with chronic neck pain with mobility deficits, there was a **benefit** in using a multimodal intervention including proprioceptive elements, compared to no intervention, on reducing pain over the immediate term.[134]
		Education
Acute		No update evidence identified
Subacute		
IV	Monticone et al[141]	For patients with subacute neck pain with mobility deficits, there was a **benefit** in cognitive behavioral therapy in reducing pain and improving disability, compared to manipulation and mobilization plus exercise plus advice over the long term, but the difference was not clinically meaningful.[141]
Chronic		No update evidence identified
		Physical Agents
Acute		No update evidence identified
Subacute		No update evidence identified

Table continues on page A31.

TABLE 7 Intervention Evidence for Neck Pain With Mobility Deficits by Intervention Type, Stage, Level of Evidence, Evidence of Benefit or No Benefit, and Comparison (continued)

		Physical Agents
Stage/Level	**Study**	**Evidence Statement**
Chronic		
III	Cagnie et al[22] Damgaard et al[44] Graham et al[68] Gross et al[74] Kadhim-Saleh et al[104] Kietrys et al[113] Liu et al[124]	For patients with chronic neck pain with mobility deficits, there was a **benefit**, when compared to a control, in using the following: • Dry needling for reducing pain over the immediate[113,124] and short[22,124] term • 830-nm laser for reducing pain and improving function, global perceived effect, and quality of life over the immediate, short, and intermediate terms[44,68,74,104] • Pulsed ultrasound for reducing pain, but was inferior to mobilization over the immediate term[68] • Mechanical traction of the intermittent type, but not the continuous type, for reducing pain over the short term[68] • A variety of noninjection inserted needle treatment approaches for reducing pain over the immediate or short term[68]
III	Graham et al[68] Gross et al[74] Nunes and Moita[152]	For patients with chronic neck pain with mobility deficits, there was a **benefit**, when compared to a control, in using the following: • Laser for reducing pain over the immediate[74] and short term,[74,152], but not over the intermediate term.[152] Gross et al[74] reported that the super-pulse type of laser drive technology may improve outcomes in patients with chronic myofascial pain syndrome • TENS and repetitive magnetic stimulation for reducing pain over the immediate and short term.[68] • TENS combined with infrared, hot pack/exercise, and collar/exercise/analgesic interventions for reducing pain and disability, and improving function over the immediate and short term[68] • Electric muscle stimulation for reducing pain over the intermediate term[68]
IV	Cagnie et al[22]	For patients with chronic neck pain with mobility deficits, there was a **benefit**, in using dry needling when compared to another treatment, over the short term: • Non–trigger point dry needling on reducing pain and improving function[22] • Standard acupuncture on reducing pain and improving function[22]
III	Liu et al[124]	For patients with chronic neck pain with mobility deficits, there was **no benefit**, in using dry needling when compared to wet needling for reducing pain over the immediate or intermediate term. However, wet needling showed a benefit over dry needling in the short term.[124]
IV	Graham et al[68] Kroeling et al[118]	For patients with chronic neck pain with mobility deficits, there was **no benefit**, when compared to a control, in using a static magnetic necklace for reducing pain over the immediate term[68,118]
IV	Cagnie et al[22]	For patients with chronic neck pain with mobility deficits, there was **no benefit**, in using dry needling when compared to another treatment, over the short term: • Miniscalpel needling on reducing pain[22] • Lidocaine injection on reducing pain[22] • Lidocaine on reducing pain, but equal in terms of improving quality of life[22] • Nonsteroidal anti-inflammatory drugs (NSAID) for quality of life[22]
IV	Liu et al[124]	For patients with chronic neck pain with mobility deficits, there was **no benefit**, in using dry needling when compared to wet needling for reducing pain over the intermediate term[124]
IV	Graham et al[68]	For patients with chronic neck pain with mobility deficits associated with osteoarthritis, there was **conflicting evidence** of benefit, when compared to a control, for using pulsed electromagnetic field for reducing pain over the immediate term.[68]
III	Ong and Claydon[156]	For patients with chronic neck pain with mobility deficits, there was **no benefit** in using dry needling on myofascial trigger points when compared to lidocaine injections, for reducing pain over the immediate through intermediate terms, and for improving function over the immediate term.[156]

Table continues on page A32.

TABLE 7 Intervention Evidence for Neck Pain With Mobility Deficits by Intervention Type, Stage, Level of Evidence, Evidence of Benefit or No Benefit, and Comparison (continued)

		Physical Agents
Stage/Level	**Study**	**Evidence Statement**
III	Graham et al[68] Kietrys et al[113]	For patients with chronic neck pain with mobility deficits, there was **no benefit** in using the following: • Dry needling (as long as it elicited a localized twitch response), when compared to lidocaine injection for reducing pain in the immediate term. However, lidocaine injections were more effective than dry needling for reducing pain over the short term[113] • A hot pack, when compared to mobilization, manipulation, or electric muscle stimulation, for reducing pain and improving function over the intermediate term[68] • Infrared light, when compared to sham TENS, for reducing pain and improving function over the short term[68]
IV	Graham et al[68] Parreira et al[161]	For patients with chronic neck pain with mobility deficits, there was **no benefit** in using the following: • Electric muscle stimulation, when compared to manual therapy, TENS, or heat for reducing pain over the intermediate term[68] • Evaporative cooling spray and stretch, when compared to active control, placebo, or active treatment (heat, education, or exercise), for pain over the immediate term[68] • TENS, when compared to manual therapy or ultrasound, for reducing pain over the immediate and short term[68] • Kinesio Tape when compared to cervical manipulation on pain over the immediate term[161]

Abbreviations: NSAID, nonsteroidal anti-inflammatory drug; PA, posterior to anterior; ROM, range of motion; TENS, transcutaneous electrical nerve stimulation.

- Clinicians should utilize a multimodal approach in managing patients with neck pain with mobility deficits.
- In the subacute to chronic stage, the benefit of manual therapy appears to decrease. Manipulation may not offer any benefit over mobilization, and may be associated with transient discomfort.
- Exercise targeting cervical and scapulothoracic regions is a necessary component of managing patients with subacute and chronic neck pain with mobility deficits.
- Available adherence strategies (eg, McLean et al[136]) for adoption and maintenance of home exercise should be integrated to maximize clinical benefit over the long term.

2017 Recommendations

Acute

B For patients with acute neck pain with mobility deficits, clinicians should provide thoracic manipulation, a program of neck ROM exercises, and scapulothoracic and upper extremity stretching and strengthening exercises to enhance program adherence.

C For patients with acute neck pain with mobility deficits, clinicians may provide cervical manipulation and/or mobilization.

Subacute

B For patients with subacute neck pain with mobility deficits, clinicians should provide neck and shoulder girdle endurance exercises.

C For patients with subacute neck pain with mobility deficits, clinicians may provide thoracic manipulation and cervical manipulation and/or mobilization.

Chronic

B For patients with chronic neck pain with mobility deficits, clinicians should provide a multimodal approach of:

- Thoracic manipulation and cervical manipulation or mobilization
- Mixed exercise for cervical/scapulothoracic regions: neuromuscular exercise (eg, coordination, proprioception, and postural training), stretching, strengthening, endurance training, aerobic conditioning, and cognitive affective elements
- Dry needling, laser, or intermittent traction

C For patients with chronic neck pain with mobility deficits, clinicians may provide neck, shoulder girdle, and trunk endurance exercise approaches and patient education and counseling strategies that promote an active lifestyle and address cognitive and affective factors.

NECK PAIN WITH MOVEMENT COORDINATION IMPAIRMENTS

2008 Recommendation

The 2008 neck pain CPG intervention literature analyses were not specifically aligned to the neck pain categories or

staging, but the recommendations were made for coordination, strengthening, and endurance exercises, stretching exercises, and patient education and counseling that (1) promotes early return to normal, nonprovocative preinjury activities, and (2) provides reassurance to the patient that good prognosis and full recovery commonly occur.

Evidence Update

Identified were 27 systematic reviews investigating physical therapy interventions on patients who could be classified as having neck pain with movement coordination impairments. All of the studies in this section were on WAD. Levels of evidence assigned to systematic reviews in this section were assessed according to **TABLE 1.** Primary sources were generally of high or moderate methodological quality with low risk of bias, but had numbers of participants that were considered small. This resulted in downgrading the strength of the evidence by 1 or 2 levels due to imprecision and limited directness (**TABLE 1**).[63] **TABLE 8** details the levels of evidence of included studies with underpinning evidence statements. Consideration was made for the trade-offs between desirable and undesirable consequences (important adverse events). Adverse events or side effects were rarely reported in the studies, and when reported were minor, transient, and of short duration.

III In a 2015 systematic review of CPGs, Wong et al[240] found all guidelines to recommend education and exercise in the management of acute WAD, with most guidelines recommending education and exercise for the subacute and chronic stages as well. The components of education were: emphasis on remaining active, advice on management and coping, reassurance about the prognosis, and functional improvement goals. Further, this review found recommendations for mobilization or manipulation, a multimodal approach, and recommendations against the use of a cervical collar.[240]

V The following are expert opinions of the CPG development group:

- Clinicians should integrate the recommendations below with consideration of the results of the patient evaluation (eg, physical impairments most related to the patient's reported activity limitation or concerns, severity and irritability of the condition, patient values, and motivating factors).
- Existing evidence indicates that recovery from neck pain with movement coordination impairments is most likely to follow 1 of 3 trajectories: quick and early recovery, moderate to slow recovery with lingering impairments, and poor recovery with severe disability.[172] A patient's course of recovery within and between trajectories may not be fixed, as there are many factors that can influence the course of recovery. Appropriate evaluation of the acutely injured patient should focus on identifying risk factors for chronicity and predicting the most likely course of recovery for that patient. This prognostic subgrouping is conspicuously absent from many RCTs evaluated for these guidelines, but makes clinical sense. While early intervention may impede recovery in the quick and early recovery group, it is likely more appropriate for the severe and nonrecovered group. The available evidence provides little guidance for treatment recommendations based on anticipated trajectories. In light of this gap in knowledge, we endorse early, informed risk-based assessment and prognosis from which treatment recommendations should flow naturally. An aggressive search for the pain-generating "tissue at fault" is currently unlikely to be productive in the acute stage of injury.

Low Risk for Chronicity/Quick and Early Recovery Expected

As mentioned in the Clinical Course section in these guidelines, a significant portion of clients with acute neck pain with movement coordination impairments should expect to recover significantly within the first 2 to 3 months. For those clients whose condition is perceived to be at low risk of progressing into chronicity, clinicians should provide early advice, education, and counseling that includes reassurance of the expected course of recovery, encouragement to remain active at a level similar to prior to the current episode, and training in home exercises to maintain/improve movement of the neck within a comfortable range. Helpful information can be found at an Australian government-sponsored website.[193]

A supervised exercise program (minimum 1 session, and 1 follow-up session) is preferable over an unsupervised program (verbal instruction or pamphlet). Intensive exercise or work-hardening programs are not recommended in the early acute or subacute phases.

Unclear Risk for Chronicity/Moderate to Slow Recovery, With Lingering Impairments Expected

Repeated or ongoing examination may be required to make an informed assessment, which should be utilized to guide management decisions. Impairment-based treatment should flow naturally from evaluation findings. This group is more suitable for responding to a more intensive nonsurgical program combined with low-level pharmaceuticals. Clients should be monitored closely. The timing and achievement of defined favorable outcomes are often undetermined and unpredictable.

High Risk for Chronicity/Poor Recovery, With Severe Disability Expected

In consideration of the factors discussed in "Risk, Prognosis, and Clinical Course" and in "Imaging," some patients may be perceived to be at a higher risk of developing chronic problems and poor functional recovery. For those patients, a more

TABLE 8

Intervention Evidence for Neck Pain With Movement Coordination Impairments by Intervention Type, Stage, Level of Evidence, Evidence of Benefit or No Benefit, and Comparison

Stage/Level	Study	Evidence Statement
Manual Therapy		
Acute		No update evidence identified
Subacute		No update evidence identified
Chronic		No update evidence identified
Exercise		
Acute		
III	Drescher et al[49]	For patients with acute neck pain with movement coordination impairments, there was a **benefit** in using neck postural/stabilization exercise, when compared to use of a cervical collar, for reducing pain over the short through long term.[49]
IV	Teasell et al[204] Verhagen et al[223]	For patients with acute neck pain with movement coordination impairments, there was a **benefit** in using supervised exercise (endurance, stretch, stabilization, coordination), when compared to unsupervised exercise, for reducing pain and disability, and improving self-efficacy over the short but not intermediate term.[204,223]
IV	Conlin et al[33] Drescher et al[49]	For patients with acute neck pain with movement coordination impairments, there was **no benefit** in using neck kinesthetic and coordination exercise, when compared to advice to stay active, for reducing pain over the short and intermediate term.[33,49]
Subacute		
IV	Teasell et al[204] Verhagen et al[223]	For patients with subacute neck pain with movement coordination impairments, there was **no benefit** in using strengthening of the cervical and shoulder muscles, or balance and postural exercises, when compared to a control, for reducing pain or improving the ability to perform work activities, over the short and long term.[204,223]
Chronic		
IV	Damgaard et al[44] Gross et al[71] Kabisch[103] Kay et al[109] O'Riordan et al[157] Southerst et al[190] Teasell et al[205]	For patients with chronic neck pain with movement coordination impairments, when compared to a control, there was a **benefit** in using the following: • An individualized, progressive submaximal exercise program and pain education including strengthening, endurance, flexibility, coordination, aerobic, and functional exercise using cognitive behavioral therapy principles, for reducing pain and improving function over the immediate, but not long term[44,71,103,109,157,190,205] • Vestibular rehabilitation for improving Dizziness Handicap Inventory scores, but not for reducing pain, over the short term[71,205] • Eye-head-neck coordination exercise for improving head repositioning accuracy over the short term. An improvement in pain was realized, but the magnitude of the effect is questionable given the group differences in initial pain scores[71,205]
IV	Teasell et al[205]	For patients with chronic neck pain with movement coordination impairments, there was **no benefit** in using cervical rotation strength training, when compared to endurance training, for reducing pain, improving muscle strength, and improving SF-36 physical function scores, over the short term.[205]
Multimodal: Exercise and Manual Therapy		
Acute		
IV	Kay et al[108]	For patients with acute neck pain with movement coordination impairments, there was a **benefit** in using a home program consisting of cervical ROM exercise, advice, physical agents, and limited collar use, when compared to a control, for reducing pain over the short term.[108]

Table continues on page A35.

TABLE 8 Intervention Evidence for Neck Pain With Movement Coordination Impairments by Intervention Type, Stage, Level of Evidence, Evidence of Benefit or No Benefit, and Comparison (continued)

		Multimodal: Exercise and Manual Therapy
Stage/Level	**Study**	**Evidence Statement**
III	Conlin et al[33] Drescher et al[49] Hurwitz et al[93] Kay et al[109] Miller et al[140] Shaw et al[186] Sutton et al[200] Teasell et al[203] Verhagen et al[223] Yu et al[245]	For patients with acute neck pain with movement coordination impairments, there was a **benefit** in using the following: • Intensive physical therapy program (including, manual therapy, cervical ROM and isometric strengthening exercise, advice, and physical agents), when compared to 1 session of physical therapy consisting of home exercise instruction and advice, for reducing pain and work days lost, and improving self-perceived benefit, over the intermediate term. These differences were statistically significant but of small magnitude, and thus, possibly not clinically relevant[200,245] • Cervical mobilization or manipulation combined with active cervical ROM exercise when compared to rest, use of a collar and/or analgesic medications and/or advice, for reducing pain,[140] but there was no difference in function, over the short term[33,49,93,109,140,186,203,223]
IV	Kabisch[103] Teasell et al[203]	For patients with acute neck pain with movement coordination impairments, there was a **benefit** in using the following: • Massage, active and resisted exercise of the neck and shoulder, and heat, when compared to collar use, for reducing pain and disability over the intermediate term[203] • Cervical mobilization plus low intensity active kinesthetic, postural and ROM exercise, when compared to a self-managed exercise and education program, for reducing pain and disability, over the immediate term[103,205]
IV	Haines et al[79] Hurwitz et al[93] Teasell et al[203]	For patients with acute neck pain with movement coordination impairments, there was **no benefit** in using massage plus mobilization plus active ROM exercises, when compared to collar use or advice to stay active, for affecting pain disability, work capacity, and quality of life, over the long term.[79,93,203]
IV	Kay et al[108] Verhagen et al[223]	For patients with acute neck pain with movement coordination impairments who received intensive multimodal physical therapy, a higher percentage reported symptoms after 2 years, as compared with those who received a single session of physical therapy consisting of home active cervical ROM exercise and advice.[108,223]
Subacute		No update evidence identified
Chronic		
IV	Kabisch[103]	For patients with chronic neck pain with movement coordination impairments, there was a **benefit** in using cervical mobilization combined with low load cervical and scapular muscle activation and kinesthetic training, when compared to a booklet on education and exercise, for reducing pain and improving function over the immediate term.[103]

		Education
Stage/Level	**Study**	**Evidence Statement**
Acute		
III	Gross et al[76] Gross et al[70]	For patients with acute neck pain with movement coordination impairments, there was a **benefit** in using an educational video, when compared to the following: • No treatment, for reducing pain over the short, intermediate, and long term[76] • Control, for improving muscular activation over the intermediate term but not the long term[70]
III	Meeus et al[138] Teasell et al[203]	For patients with acute neck pain with movement coordination impairments, there was a **benefit** in using the following: • Instructions to decrease the use of a cervical collar, improve posture, and perform mobilizing exercises, when compared to only receiving rest and analgesics, to increase ROM and decrease pain, over the intermediate term[138] • Advice to act as usual, when compared to use of a soft collar, for reducing pain over the intermediate and long term[203]

Table continues on page A36.

TABLE 8 Intervention Evidence for Neck Pain With Movement Coordination Impairments by Intervention Type, Stage, Level of Evidence, Evidence of Benefit or No Benefit, and Comparison (continued)

Stage/Level	Study	Evidence Statement
		Education
IV	Meeus et al[138] Gross et al[76]	For patients with acute neck pain with movement coordination impairments, there was **no benefit** in using the following: • Verbal education on the mechanism of injury to reduce fear and uncertainty, and advice to remain active, when compared to the use of a semi-rigid collar or active mobilization, for reducing neck pain, headache disability, and improving work ability over the long term[138] • Instructions to decrease the use of a cervical collar, improve posture and perform mobilizing exercise, when compared to active physiotherapy, for improving cervical ROM and reducing pain intensity over the intermediate term[138] • Advice to act as usual, when compared to use of a Philadelphia collar plus manual therapy plus exercise, on improving pain, function, or quality of life over the long term[76] • Whiplash pamphlet focusing on activity, when compared to a generic information sheet, on reducing pain or improving function over the short term[76]
IV	Gross et al[70]	For patients with acute neck pain with movement coordination impairments, there was **no benefit** in using a pamphlet focusing on activity, when compared to generic information provided in the emergency department, for reducing pain or improving function over the short term.[70]
Subacute		No update evidence identified
Chronic		
IV	Meeus et al[138]	For patients with chronic neck pain with movement coordination impairments, there was a **benefit** in using verbal education focusing on prognosis, encouragement, assurance, and activity integrated with exercise, when compared to a control, for reducing pain and disability over the short term.[138]
IV	Gross et al[76]	For patients with chronic neck pain with movement coordination impairments, there was **no benefit** in adding cognitive behavioral training to a physical therapy program, on reducing pain or improving disability over the short term.[76]
		Physical Agents
Stage/Level	**Study**	**Evidence Statement**
Acute		
IV	Gross et al[76] Parreira et al[161] Vanti et al[216]	For patients with acute neck pain with movement coordination impairments, there was a **benefit** in using Kinesiotape when compared to sham Kinesio Tape on reducing pain over the immediate term. The difference was small and possibly not clinically meaningful.[76,161,216]
IV	Graham et al[68]	For patients with acute neck pain with movement coordination impairments, there was **no benefit**, when compared to a control, in using the following: • Laser for reducing pain over the immediate or intermediate term[68] • Pulsed ultrasound on function or global perceived effect over the immediate term[68] • Iontophoresis for reducing pain over the immediate term[68]
IV	Graham et al[68]	For patients with acute neck pain with movement coordination impairments, there was **no benefit** in using iontophoresis, when compared to interferential current, and was inferior to a multimodal treatment of traction, exercise, and massage, for reducing pain over the immediate term.[68]
Subacute		No update evidence identified
Chronic		
IV	Graham et al[68]	For patients with an unspecified duration of neck pain with movement coordination impairments, there was a **benefit**, when compared to a control, in using transcutaneous electrical nerve stimulation for reducing pain over the immediate term.[68]

Abbreviations: ROM, range of motion; SF-36, Medical Outcomes Study 36-Item Short-Form Health Survey.

concerted multimodal treatment program that could include medical and psychological consultation would be indicated.

- Available adherence strategies (eg, McLean et al[136]) for adoption and maintenance of home exercise should be integrated to maximize clinical benefit over the long term

2017 Recommendation

Acute

For patients with **acute** neck pain with movement coordination impairments (including WAD):

B Clinicians should provide the following:

1. Education of the patient to
   - Return to normal, nonprovocative preaccident activities as soon as possible
   - Minimize use of a cervical collar
   - Perform postural and mobility exercises to decrease pain and increase ROM
2. Reassurance to the patient that recovery is expected to occur within the first 2 to 3 months.

B Clinicians should use a multimodal intervention approach including manual mobilization techniques plus exercise (eg, strengthening, endurance, flexibility, postural, coordination, aerobic, and functional exercises) for those patients expected to experience a moderate to slow recovery with persistent impairments.

C Clinicians may provide to patients whose condition is perceived to be at low risk of progressing toward chronicity:

- A single session consisting of early advice, exercise instruction, and education
- A comprehensive exercise program (including strength and/or endurance with/without coordination exercises)
- TENS

F Clinicians should monitor recovery status in an attempt to identify those patients experiencing delayed recovery and who may need more intensive rehabilitation and an early pain education program.

Chronic

For patients with **chronic** neck pain with movement coordination impairments (including WAD):

C Clinicians may provide the following:

- Patient education and advice focusing on reassurance, encouragement, prognosis, and pain management
- Mobilization combined with an individualized, progressive submaximal exercise program including cervicothoracic strengthening, endurance, flexibility, and coordination, using principles of cognitive behavioral therapy
- TENS

NECK PAIN WITH HEADACHE

2008 Recommendation

The intervention literature analyses were not specifically aligned to the neck pain categories or staging, but recommendations were made for coordination, strengthening, and endurance exercises to reduce neck pain and headache.

Evidence Update

Identified were 17 systematic reviews investigating physical therapy interventions for neck pain with cervicogenic headache. Levels of evidence assigned to systematic reviews in this section were assessed according to **TABLE 1.** Primary sources were generally of high or moderate methodological quality, that is, with low risk of bias, but had numbers of participants that were considered small. This resulted in downgrading the strength of the evidence by 1 or 2 levels due to imprecision and limited directness (**TABLE 1**).[63] **TABLE 9** details the levels of evidence of included studies with underpinning evidence statements. Considerations were made of the trade-offs between desirable and undesirable consequences (important adverse events). Adverse events or side effects were poorly reported in the studies, and when reported were minor, transient, and of short duration. For manual therapy or exercise, the only consistently reported problem was local discomfort or dizziness. For manipulation, rare but serious adverse events such as stroke or serious neurological deficits were not reported in any of the trials. Serious but rare adverse events for manipulation are known to occur.[23]

V The following are expert opinions of the CPG development group:

- Clinicians should integrate the recommendations below with consideration of the results of the patient evaluation (eg, physical impairments most related to the patient's reported activity limitation or concerns, severity and irritability of the condition, patient values, and motivating factors).
- With patients in this category, clinicians should follow the screening and assessment procedures outlined in the IFOMPT framework before implementing interventions.
- Treatments for subgroups of patients having neck pain with headache need further research, including patients post-concussion and patients experiencing symptoms related to the temporomandibular joint.
- Craniocervical strength training may be of particular benefit.
- Available adherence strategies (eg, McLean et al[136]) for adoption and maintenance of home exercise should be integrated to maximize clinical benefit over the long term.

TABLE 9

Intervention Evidence for Neck Pain With Headache by Intervention Type, Stage, Levels of Evidence, Evidence of Benefit or No Benefit, and Comparison

		Manual Therapy
Stage/Level	**Study**	**Evidence Statement**
Acute		No update evidence identified
Subacute		
III	Chaibi and Russell[28] Fernández-de-las-Peñas et al[59] Hurwitz et al[93] Racicki et al[163]	For patients with subacute to chronic neck pain with headache, there was a **benefit**, when compared to a control, in using cervical manipulation and mobilization for reducing neck pain, headache intensity, and headache frequency over the immediate through long term.[28,59,93,163]
Chronic		
III	Brønfort et al[20] Chaibi and Russell[28] Fernández-de-las-Peñas et al[59] Gross et al[72] Racicki et al[163]	For patients with chronic neck pain with headache, there was a **benefit** in using the following: • Cervical manipulation done 3 or 4 times per week for 12 to 18 sessions, when compared to cervical manipulations done 1 time per week for 3 to 8 sessions, for reducing headache pain and frequency over the short term.[21,57] This benefit was not maintained over the intermediate term[28,72] • Multiple sessions of cervical or cervicothoracic manipulation, when compared to multiple sessions of massage or placebo treatments, for reducing pain and improving function over the short and intermediate term[28,59,163] • Cervical manipulation, when compared to cervical mobilization, for reducing pain, over the immediate, but not the short term[20]
III	Brønfort et al[20] Chaibi and Russell[28] Gross et al[72] Hurwitz et al[93] Macaulay et al[125] Racicki et al[163] Varatharajan et al[220]	For patients with chronic neck pain with headache, there was **no benefit** in using the following: • Cervical manipulation and mobilization, when compared to exercise alone or manipulation plus exercise, affecting neck pain and headache intensity, frequency, and duration, over the long term.[20,93,220] However 2 other reviews reported a small advantage in using manual therapy and exercise, when compared to manipulation alone, for reducing pain and improving function, with a 69% advantage in global perceived effect, over the long term[71,125] • Cervical manipulation alone, when compared to laser and massage, for reducing headache intensity or duration, over the immediate term[28,163]
		Exercise
Stage/Level	**Study**	**Evidence Statement**
Acute		
III	Gross et al[76]	For patients with acute whiplash with neck pain with headache, there was a **benefit** for active mobility exercise (physical therapist provided instruction, then home exercise), when compared to collar use, in reducing pain and disability over the short term, and pain over the intermediate term.[76]
IV	Gross et al[71] Kay et al[109] Racicki et al[163] Zronek et al[247]	For patients with acute to subacute neck pain with headache, there was a **benefit**, when compared to a control, in C1-2 self-SNAG for reducing pain and headache intensity[163] over the short and long term.[71,109,163,247]
Subacute		No update evidence identified
Chronic		
III	Gross et al[75] Gross et al[71] Kay et al[109] Racicki et al[163] Varatharajan et al[220]	For patients with chronic neck pain with headache, there was a **benefit**, when compared to a control, in using cervicoscapular strengthening and endurance exercise including craniocervical flexion training with pressure biofeedback for reducing pain and function, and improving global perceived effect, over the long term.[71,75,109,163,220]
III	Bronfort et al[19] Gross et al[71] Kay et al[109]	For patients with chronic neck pain with headache, there was **no benefit** in using endurance, isometric, and stretching exercise, when compared to manipulation, for reducing pain, headache frequency, or headache duration, over the short and long term.[19,71,109]

Table continues on page A39.

TABLE 9 Intervention Evidence for Neck Pain With Headache by Intervention Type, Stage, Levels of Evidence, Evidence of Benefit or No Benefit, and Comparison (continued)

	Multimodal: Exercise and Manual Therapy	
Stage/Level	**Study**	**Evidence Statement**
Acute		No update evidence identified
Subacute		No update evidence identified
Chronic		
III	Brønfort et al[20] Chaibi and Russell[28] Fernández-de-las-Peñas et al[59] Gross et al[75] Hurwitz et al[93] Miller et al[140] Racicki et al[163] Reid and Rivett[167]	For patients with chronic neck pain with headache, there was a **benefit**, when compared to a control, in using mobilization, manipulation, and exercise (stretching, strengthening, and endurance), for reducing pain, headache frequency, headache intensity, and improving function and global perceived effect, over the short and long term.[20,28,59,75,93,140,163,167]
III	Gross et al[75]	For patients with mechanical neck pain, with or without radiating pain, and with or without headache there was a **benefit**, compared to control, in using mobilization or manipulation combined with stretching and strengthening to reduce pain over the short and long term, sand improve function over the long term.[75]
IV	Chaibi and Russell[28]	For patients with chronic neck pain with headache who also report at least 1 sign of temporomandibular dysfunction (eg, pain in the area of the jaw [or face, or ear], a click or pop heard when opening or closing the mouth, restrictions or deviations of jaw motion, or pain in the muscles of mastication), there was a **benefit**, when compared to manual therapy and exercise focused on the craniocervical region, in using manual therapy and exercise interventions focused on the temporomandibular joint, for reducing pain and improving function over the short and intermediate term.[28]

Abbreviations: SNAG, sustained natural apophyseal glide.

2017 Recommendation

Acute

B For patients with acute neck pain with headache, clinicians should provide supervised instruction in active mobility exercise.

C Clinicians may utilize C1-2 self-sustained natural apophyseal glide (self-SNAG) exercise.

Subacute

B For patients with subacute neck pain with headache, clinicians should provide cervical manipulation and mobilization.

C Clinicians may provide C1-2 self-SNAG exercise.

Chronic

B For patients with chronic neck pain with headache, clinicians should provide cervical or cervicothoracic manipulation or mobilizations combined with shoulder girdle and neck stretching, strengthening, and endurance exercise.

NECK PAIN WITH RADIATING PAIN

2008 Recommendation

B Clinicians should consider the use of upper-quarter and nerve mobilization procedures to reduce pain and disability in patients with neck and arm pain.

C Specific repeated movements or procedures to promote centralization are not more beneficial in reducing disability when compared to other forms of interventions.

B Clinicians should consider the use of mechanical intermittent cervical traction, combined with other interventions such as manual therapy and strengthening exercises, for reducing pain and disability in patients with neck and neck-related arm pain.

TABLE 10

Intervention Evidence for Neck Pain With Radiating Pain by Intervention Type, Stage, Level of Evidence, Evidence of Benefit or No Benefit, and Comparison

		Manual Therapy
Stage/Level	**Study**	**Evidence Statement**
Acute		
IV	Boyles et al[17]	For patients with acute to chronic neck pain with radiating pain, there was **no benefit** from using the following: combined cervical lateral glides, thoracic mobilizations, and nerve mobilization procedures for the median nerve, when compared to general strengthening, for reducing pain and disability, over the immediate term[17]
Subacute		No update evidence identified
Chronic		
IV	Zhu et al[246]	For patients with chronic neck pain with radiating pain, there was a **benefit** in using cervical manipulation on pain, compared to mechanical traction over the immediate term.[246]
		Exercise
Stage/Level	**Study**	**Evidence Statement**
Acute		
IV	Southerst et al[190] Kay et al[109] Salt et al[178] Gross et al[71] Zronek et al[247]	For patients with acute neck pain with radiating pain, there was a **benefit**, when compared to a control, in using cervical mobilizing and stabilizing exercises for reducing pain but not for improving function over the immediate term. The benefit for relief of pain was not sustained over the short[190] or intermediate term.[71,109,178,247]
IV	Southerst et al[190] Salt et al[178]	For patients with acute to subacute neck pain with radiating pain, there was **no benefit** in using cervical stretching and strengthening exercises, when compared to wearing a semi-hard cervical collar, for reducing pain and improving function, over the immediate, short, and intermediate term.[178,190]
Subacute		No update evidence identified
Chronic		No update evidence identified
		Multimodal: Exercise and Manual Therapy
Stage/Level	**Study**	**Evidence Statement**
Acute		No update evidence identified
Subacute		No update evidence identified
Chronic		
III	Gross et al[75]	For patients with mechanical neck pain, with or without radiating pain, and with or without headache, there was a **benefit**, when compared to a control, in using mobilization or manipulation combined with stretching and strengthening exercises for reducing pain over the short and long term, and for improving function over the long term.[75]
III	Salt et al[178]	For patients with chronic neck pain with radiating pain, there was **no benefit** in using manual therapy plus exercise, when compared to advice plus sham ultrasound, or when compared to manual therapy, or when compared to exercise alone, for reducing pain or improving function, over the short and long term.[178]
IV	Salt et al[178] Boyles et al[17]	For patients with chronic neck pain with radiating pain, there was **no benefit** in using manual therapy plus exercise, when compared to rigid or soft collar, or when compared to surgery, for reducing pain or improving function, over the immediate and long term.[17,178]
		Education
Stage/Level	**Study**	**Evidence Statement**
Acute		No update evidence identified
Subacute		No update evidence identified
Chronic		
III	Salt et al[178]	For patients with chronic neck pain with radiating pain, there was a **benefit**, when compared to a control, for using patient education and counseling that encourage exercise and moderate to heavy physical activities related to work, for reducing pain, but not for improving function or reducing disability over the long term.[178]

Table continues on page A41.

TABLE 10 Intervention Evidence for Neck Pain With Radiating Pain by Intervention Type, Stage, Level of Evidence, Evidence of Benefit or No Benefit, and Comparison (continued)

	Education	
Stage/Level	**Study**	**Evidence Statement**
IV	Varatharajan et al[219]	For patients with chronic neck pain with radiating pain, there was **no benefit**, when compared to a control, for adding job stress education to ergonomic interventions for reducing pain, ergonomic risk, or work stress, or for improving function, over the intermediate and long term.[219]
	Physical Agents	
Stage/Level	**Study**	**Evidence Statement**
Acute		
IV	Graham et al[68] Gross et al[76] Kadhim-Saleh et al[104] Thoomes et al[208]	For patients with acute neck pain with radiating pain, there was a **benefit**, when compared to a control, in using the following: • 905-nm laser for reducing pain, improving function, global perceived effect, and quality of life over the immediate and intermediate term.[68,76,104] Graham et al[68] reported mild adverse events equal in treatment and placebo groups, including tiredness, nausea, headache, and increased pain following laser treatment • A cervical collar for reducing arm pain over the short but not intermediate term[76,208]
IV	Rhee et al[169]	For neck pain with radiating pain and a diagnosis of mild cervical myelopathy, there was a **benefit**, compared to surgery, in using multimodal nonsurgical management (intermittent use of collar or bed rest, medications, and activity modification) for improving gait speed over the long term, but no difference in neurological status or performance of daily living activities as compared to surgical management.[169] Rhee et al[169] also strongly recommended that traction, as part of nonsurgical management, should not be routinely prescribed for patients with moderate to severe cervical myelopathy.
IV	Gross et al[76]	For patients with acute neck pain with radiating pain, there was **no benefit**, when compared to a control, in using a semi-rigid collar for improving function over the short, intermediate, or long term.[76]
III	Graham et al[68] Thoomes et al[208]	For patients with acute and chronic neck pain with radiating pain, there was **no benefit**, when compared to a control, in using continuous traction for reducing pain or disability over the immediate, short, and intermediate term.[68,208]
IV	Thoomes et al[208]	For patients with acute and chronic neck pain with radiating pain, there was **no benefit** in using a collar, when compared to multimodal physical therapy, for reducing pain over the short term.[208]
Subacute		No update evidence identified
Chronic		
III	Graham et al[68]	For patients with chronic neck pain with radiating pain, there was a **benefit**, when compared to a control, in using intermittent traction for reducing pain in the short term.[68]
IV	Graham et al[68]	For patients with chronic neck pain with radiating pain, there was **no benefit**, when compared to a control, in using electric muscular stimulation, or modified galvanic current for reducing pain over the immediate term.[68]

Evidence Update

Identified were 15 systematic reviews investigating physical therapy interventions for neck pain with radiating pain. Levels of evidence assigned to systematic reviews in this section were assessed according to **TABLE 1**. Primary sources were generally of high or moderate methodological quality, that is, with low risk of bias, but had numbers of participants that were considered small. This resulted in downgrading the strength of the evidence by 1 or 2 levels due to imprecision and limited directness (**TABLE 1**).[63] **TABLE 10** details the levels of evidence of included studies with underpinning evidence statements. Consideration of the trade-offs between desirable and undesirable consequences (important adverse events) was made. Adverse events or side effects were poorly reported in the studies, and when reported were minor, transient, and of short duration.

V The following are expert opinions of the CPG development group:

- Clinicians should integrate the recommendations below with consideration of the results of the patient evaluation (eg, related impairments, severity, and irritability of the condition, and values). Clinicians have a responsibility to make appropriate referrals if signs and symptoms are not resolving or are worsening.
- Since the 2008 neck pain CPG, there has been little advancement in our knowledge of how to nonsurgically

treat neck pain with radiating pain. While 1 meta-analysis showed benefit from manual therapy and exercise in a population that included a mixture of neck pain categories, other studies that were selective to neck pain with radiating pain were not able to show similar benefits from this approach.

- Clinicians should monitor symptom irritability, and adjust treatment accordingly, when applying manual therapy and exercise approaches applied to patients with radicular pain.
- Because of the detrimental effects of prolonged use, collars should be restricted to a limited time in the acute phase only, and only in individuals who do not obtain relief from other treatments.
- Available adherence strategies (eg, McLean et al[136]) for adoption and maintenance of home exercise should be integrated to maximize clinical benefit over the long term.

2017 Recommendation

Acute

C For patients with acute neck pain with radiating pain, clinicians may utilize mobilizing and stabilizing exercises, laser, and short-term use of a cervical collar.

Chronic

B For patients with chronic neck pain with radiating pain, clinicians should provide mechanical intermittent cervical traction, combined with other interventions such as stretching and strengthening exercise plus cervical and thoracic mobilization/manipulation.

B Clinicians should provide education and counseling to encourage participation in occupational and exercise activities.

Limitations to This CPG

1. The estimates of the prevalence of neck pain vary so widely, with respect to definitions and associated estimates, that reporting the actual prevalence is likely impossible.

2. Reviews of musculoskeletal clinical research frequently draw somewhat vague conclusions that are only partially helpful to clinical practice. This makes the development of absolute or firm recommendations or guidelines difficult at this point in time.

3. Health care research does not account well for the dynamic or individualized nature of the less well-defined diagnoses, such as those afflicting patients with neck pain, the solutions to those problems, or the ongoing doubt associated with whether a solution to any given problem has been reached after the implementation of treatment.

4. The comparable sign, a highly adaptable patient response to a specific clinical test, appears to not be present in the scientific literature. This may complicate attempts to incorporate scientific findings into clinical practice.

5. Health care research attempts to classify and quantify the scientific aspects of patient care but cannot sufficiently capture the intuitive, responsive process so frequently associated with both the evaluation and management processes. This, to a certain extent, will of course limit the applicability of CPGs in certain scenarios.

6. Comparison across scientific papers is problematic when discrepencies exist in experience and mastery of the diagnostic process and intervention delivery. In addition, intervention specifics (eg, position, dosage) are frequently poorly described, further complicating comparison between and among studies. The clinician may have to return to the original articles in an attempt to determine evidence-based dosage.

7. The guideline recommends interventions predominantly for their effect on pain, and thus the reader may be under the impression that the authors have ignored other common symptoms associated with neck disorders, such as light-headedness and poor balance/dizziness (which are common symptoms in persons with whiplash and even cervicogenic headache).

8. The guideline discusses the major problem of the recurrent nature of neck pain and the transition to chronicity. Recommendations are based on higher-level evidence that considered relief of an episode of pain.

9. The guideline does not review a large body of research on neuromuscular and sensorimotor impairments in neck pain disorders. In many cases, the available evidence did not meet our threshold for inclusion.

10. The guideline positions itself within the ICF but does not consider the biopsychosocial context informing assessment, prognostic, and theranostic strategies on a patient-by-patient basis. In time and with more research, it is anticipated that this information will combine, if not refine, using strict inclusion criteria.

Competing Interests, Disclosures, and Author Contributions

The guideline development group members declared relationships and developed a conflict management plan that included submitting a Conflict of Interest form to the Orthopaedic Section, APTA, Inc. Articles that were authored by a group member were assigned to an alternate member for assessment. Partial funding was provided to the CPG development team for travel and expenses for CPG training and development; the content of this guideline was not influenced by this funding. The CPG development team maintained editorial independence.

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APPENDIX A

SEARCH STRATEGIES

Below is an example EMBASE search strategy for articles related to the Physical Agents section of Interventions.

Modalities =#1

'combined modality therapy'/de OR 'electrostimulation therapy'/exp OR 'electrostimulation'/de OR 'traction therapy'/exp OR 'phototherapy'/exp OR 'physiotherapy'/exp OR 'rehabilitation'/exp OR 'ultrasound therapy'/exp OR 'laser'/de OR 'cryotherapy'/exp OR 'cryoanesthesia'/de OR 'ice'/de OR 'acupuncture'/exp OR Modalit* OR 'electric stimulation' OR 'electrical stimulation' OR electrotherapy OR tens OR 'transcutaneous electric nerve stimulation' OR electroacupuncture OR acupuncture OR needling OR heat OR cold OR traction OR laser OR lasers OR rehabilitation OR 'physical therapy' OR ultrasound OR ultrasonic OR cryotherapy OR hyperthermia OR 'vapocoolant spray' OR cryoanesthesia OR ice OR faradic OR traction OR iontophoresis OR phonophoresis OR phototherapy OR hydrotherapy OR 'light therapy' OR diathermy OR ultraviolet OR infrared OR ((trigger* OR dry) and needl*)

neck anatomy =#2

'neck'/exp OR 'cervical plexus'/de OR 'cervical spine'/de OR 'atlantoaxial joint'/de OR 'atlantooccipital joint'/de OR 'spinal root'/de OR 'brachial plexus'/de OR 'atlas'/de OR 'axis'/de OR 'thoracic spine'/de OR (brachial NEAR/3 plexus) OR neck OR (thoracic NEAR/3 spine) OR (thoracic NEAR/3 outlet) OR (thoracic NEAR/3 vertebra*) OR trapezius OR odontoid* OR occip* OR atlant* OR ((cervical OR cervico*) NOT ('gynecologic disease'/exp OR 'uterus'/exp OR uterus OR cervix))

pain =#3

'pain'/exp OR pain* OR ache* OR sore* OR stiff* OR discomfort OR injur* OR neuropath* OR neuralgia* OR neurodynia*

neck pain =#4

'atlantoaxial dislocation'/de OR 'neck pain'/de OR 'brachial plexus neuropathy'/de OR 'neck injury'/exp OR 'thorax outlet syndrome'/de OR 'torticollis'/de OR 'cervical pain' OR neckache* OR neck ache* OR whiplash OR cervicodynia* OR cervicalgia* OR brachialgia* OR 'brachial neuritis' OR brachial neuralgia* OR 'cervicobrachial neuritis' OR cervicobrachial neuralgia* OR neck pain* OR neck injur* OR brachial plexus neuropath* OR 'brachial plexus neuritis' OR monoradicul* OR monoradicl* OR torticollis OR 'thoracic outlet syndrome' OR 'cervical dystonia' OR (headache* AND cervic*)

disc problems =#5

'vertebra dislocation'/exp OR 'intervertebral disk disease'/exp OR (('intervertebral disk'/exp OR disks OR disk OR discs OR disc) AND (herniat* OR slipped OR prolapse* OR displace* OR degenerat* OR bulge OR bulged OR bulging))

diseases =#6

'radiculopathy'/exp OR 'temporomandibular joint disorder'/de OR 'myofascial pain'/de OR 'musculoskeletal disease'/exp OR 'neuritis'/exp OR radiculopath* OR radiculitis OR temporomandibular OR (myofascial NEAR/3 pain*) OR (thoracic outlet syndrome*) OR 'spinal osteophytosis' OR neuritis OR spondylosis OR splondylitis OR spondylolisthesis OR spondylolysis OR arthritis OR osteoarthritis OR spondylarthritis OR fibromyalgia OR sprain* OR strain*

disease rehab =#7

'radiculopathy'/exp/dm_rh OR 'temporomandibular joint disorder'/dm_rh OR 'myofascial pain'/dm_rh OR 'musculoskeletal disease'/exp/dm_rh OR 'neuritis'/exp/dm_rh

neck pain rehab =#8

'atlantoaxial dislocation'/dm_rh OR 'neck pain'/dm_rh OR 'brachial plexus neuropathy'/dm_rh OR 'neck injury'/exp/dm_rh OR 'thorax outlet syndrome'/dm_rh OR 'torticollis'/dm_rh

Systematic Review Filter =#9

'meta analysis'/de OR 'meta analysis (topic)'/de OR 'systematic review'/de OR 'systematic review (topic)'/de OR Meta analy* OR metaanaly* OR meta analy* OR Systematic review* OR systematic overview* OR Cochrane OR embase OR psyclit OR psychlit OR psycinfo OR psychinfo OR cinahl OR cinhal OR science citation index OR bids OR cancerlit OR 'web of science' OR Reference list* OR bibliograph* OR hand search* OR 'relevant journals' OR manual search* OR (('selection criteria' OR data NEAR/3 extract*) AND (review OR reviews))

APPENDIX A

Embase Session Results

Number	Query	Results, n
1	'combined modality therapy'/de OR 'electrostimulation therapy'/exp OR 'electrostimulation'/de OR 'traction therapy'/exp OR 'phototherapy'/exp OR 'physiotherapy'/exp OR 'rehabilitation'/exp OR 'ultrasound therapy'/exp OR 'laser'/de OR 'cryotherapy'/exp OR 'cryoanesthesia'/de OR 'ice'/de OR 'acupuncture'/exp OR modalit* OR 'electric stimulation' OR 'electrical stimulation' OR electrotherapy OR tens OR 'transcutaneous electric nerve stimulation' OR electroacupuncture OR acupuncture OR needling OR heat OR cold OR laser OR lasers OR rehabilitation OR 'physical therapy' OR ultrasound OR ultrasonic OR cryotherapy OR hyperthermia OR 'vapocoolant spray' OR cryoanesthesia OR ice OR faradic OR traction OR iontophoresis OR phonophoresis OR phototherapy OR hydrotherapy OR 'light therapy' OR diathermy OR ultraviolet OR infrared OR (trigger* OR dry AND needl*) AND [english]/lim AND ([embase]/lim OR [embase classic]/lim)	1647419
2	'neck'/exp OR 'cervical plexus'/de OR 'cervical spine'/de OR 'atlantoaxial joint'/de OR 'atlantooccipital joint'/de OR 'spinal root'/de OR 'brachial plexus'/de OR 'atlas'/de OR 'axis'/de OR 'thoracic spine'/de OR brachial NEAR/3 plexus OR neck OR thoracic NEAR/3 spine OR thoracic NEAR/3 outlet OR thoracic NEAR/3 vertebra* OR trapezius OR odontoid* OR occip* OR atlant* OR (cervical OR cervico* NOT ('gynecologic disease'/exp OR 'uterus'/exp OR uterus OR cervix))	1467424
3	'pain'/exp OR pain* OR ache* OR sore* OR stiff* OR discomfort OR injur* OR neuropath* OR neuralgia* OR neurodynia*	3295582
4	'atlantoaxial dislocation'/de OR 'neck pain'/de OR 'brachial plexus neuropathy'/de OR 'neck injury'/exp OR 'thorax outlet syndrome'/de OR 'torticollis'/de OR 'cervical pain' OR neckache* OR neck AND ache* OR whiplash OR cervicodynia* OR cervicalgia* OR brachialgia* OR 'brachial neuritis' OR brachial AND neuralgia* OR 'cervicobrachial neuritis' OR cervicobrachial AND neuralgia* OR neck AND pain* OR neck AND injur* OR brachial AND plexus AND neuropath* OR 'brachial plexus neuritis' OR monoradicul* OR monoradicl* OR torticollis OR 'thoracic outlet syndrome' OR 'cervical dystonia' OR (headache* AND cervic*)	22970
5	'vertebra dislocation'/exp OR 'intervertebral disk disease'/exp OR ('intervertebral disk'/exp OR disks OR disk OR discs OR disc AND (herniat* OR slipped OR prolapse* OR displace* OR degenerat* OR bulge OR bulged OR bulging))	46463
6	'radiculopathy'/exp OR 'temporomandibular joint disorder'/de OR 'myofascial pain'/de OR 'musculoskeletal disease'/exp OR 'neuritis'/exp OR radiculopath* OR radiculitis OR temporomandibular OR myofascial NEAR/3 pain* OR (thoracic AND outlet AND syndrome*) OR 'spinal osteophytosis' OR neuritis OR spondylosis OR splondylitis OR spondylolisthesis OR spondylolysis OR arthritis OR osteoarthritis OR spondylarthritis OR fibromyalgia OR sprain* OR strain*	2801790
7	'radiculopathy'/exp/dm_rh OR 'temporomandibular joint disorder'/dm_rh OR 'myofascial pain'/dm_rh OR 'musculoskeletal disease'/exp/dm_rh OR 'neuritis'/exp/dm_rh	20066
8	'atlantoaxial dislocation'/dm_rh OR 'neck pain'/dm_rh OR 'brachial plexus neuropathy'/dm_rh OR 'neck injury'/exp/dm_rh OR 'thorax outlet syndrome'/dm_rh OR 'torticollis'/dm_rh	644
9	'meta analysis'/de OR 'meta analysis (topic)'/de OR 'systematic review'/de OR 'systematic review (topic)'/de OR meta AND analy* OR metaanaly* OR meta AND analy* OR systematic AND review* OR systematic AND overview* OR cochrane OR embase OR psyclit OR psychlit OR psycinfo OR psychinfo OR cinahl OR cinhal OR science AND citation AND index OR bids OR cancerlit OR 'web of science' OR reference AND list* OR bibliograph* OR hand AND search* OR 'relevant journals' OR manual AND search* OR ('selection criteria' OR data NEAR/3 extract* AND (review OR reviews))	75731
10	#1 AND #2 AND #3	71583
11	#1 AND #4	4332
12	#1 AND #2 AND #5	1956
13	#1 AND #2 AND #6	31349
14	#2 AND #7	2689
15	#8 OR #10 OR #11 OR #12 OR #13 OR #14	83564
16	#9 AND #15	979
17	#16 AND [english]/lim AND ([embase]/lim OR [embase classic]/lim)	957
18	#17 AND (2010:py OR 2011:py OR 2012:py OR 2013:py OR 2014:py)	500

APPENDIX A

Below is an example Medline-OVID search for articles related to Interventions. We only used articles published between January 2007 and August 2016.

1. Neck Pain/
2. exp Brachial Plexus Neuropathies/
3. exp neck injuries/ or exp whiplash injuries/
4. cervical pain.mp.
5. neckache.mp.
6. whiplash.mp.
7. cervicodynia.mp.
8. cervicalgia.mp.
9. brachialgia.mp.
10. brachial neuritis.mp.
11. brachial neuralgia.mp.
12. neck pain.mp.
13. neck injur*.mp.
14. brachial plexus neuropath*.mp.
15. brachial plexus neuritis.mp.
16. thoracic outlet syndrome/ or cervical rib syndrome/
17. Torticollis/
18. exp brachial plexus neuropathies/ or exp brachial plexus neuritis/
19. cervico brachial neuralgia.ti,ab.
20. cervicobrachial neuralgia.ti,ab.
21. (monoradicul* or monoradicl*).tw.
22. or/1-21
23. exp headache/ and cervic*.tw.
24. exp genital diseases, female/
25. genital disease*.mp.
26. or/24-25
27. 23 not 26
28. 22 or 27
29. neck/
30. neck muscles/
31. exp cervical plexus/
32. exp cervical vertebrae/
33. atlanto-axial joint/
34. atlanto-occipital joint/
35. Cervical Atlas/
36. spinal nerve roots/
37. exp brachial plexus/
38. (odontoid* or cervical or occip* or atlant*).tw.
39. axis/ or odontoid process/
40. Thoracic Vertebrae/
41. cervical vertebrae.mp.
42. cervical plexus.mp.
43. cervical spine.mp.
44. (neck adj3 muscles).mp.
45. (brachial adj3 plexus).mp.
46. (thoracic adj3 vertebrae).mp.
47. neck.mp.
48. (thoracic adj3 spine).mp.
49. (thoracic adj3 outlet).mp.
50. trapezius.mp.
51. cervical.mp.
52. cervico*.mp.
53. 51 or 52
54. exp genital diseases, female/
55. genital disease*.mp.
56. exp *Uterus/
57. 54 or 55 or 56
58. 53 not 57
59. 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 58
60. exp pain/
61. exp injuries/
62. pain.mp.
63. ache.mp.
64. sore.mp.
65. stiff.mp.
66. discomfort.mp.
67. injur*.mp.
68. neuropath*.mp.
69. or/60-68
70. 59 and 69
71. Radiculopathy/
72. exp temporomandibular joint disorders/ or exp temporomandibular joint dysfunction syndrome/
73. myofascial pain syndromes/
74. exp "Sprains and Strains"/
75. exp Spinal Osteophytosis/
76. exp Neuritis/
77. Polyradiculopathy/
78. exp Arthritis/
79. Fibromyalgia/
80. spondylitis/ or discitis/
81. spondylosis/ or spondylolysis/ or spondylolisthesis/
82. radiculopathy.mp.
83. radiculitis.mp.
84. temporomandibular.mp.
85. myofascial pain syndrome*.mp.
86. thoracic outlet syndrome*.mp.
87. spinal osteophytosis.mp.
88. neuritis.mp.
89. spondylosis.mp.
90. spondylitis.mp.
91. spondylolisthesis.mp.
92. or/71-91

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93. 59 and 92
94. exp neck/
95. exp cervical vertebrae/
96. Thoracic Vertebrae/
97. neck.mp.
98. (thoracic adj3 vertebrae).mp.
99. cervical.mp.
100. cervico*.mp.
101. 99 or 100
102. exp genital diseases, female/
103. genital disease*.mp.
104. exp *Uterus/
105. or/102-104
106. 101 not 105
107. (thoracic adj3 spine).mp.
108. cervical spine.mp.
109. 94 or 95 or 96 or 97 or 98 or 106 or 107 or 108
110. Intervertebral Disk/
111. (disc or discs).mp.
112. (disk or disks).mp.
113. 110 or 111 or 112
114. 109 and 113
115. herniat*.mp.
116. slipped.mp.
117. prolapse*.mp.
118. displace*.mp.
119. degenerat*.mp.
120. (bulge or bulged or bulging).mp.
121. 115 or 116 or 117 or 118 or 119 or 120
122. 114 and 121
123. intervertebral disk degeneration/ or intervertebral disk displacement/
124. intervertebral disk displacement.mp.
125. intervertebral disc displacement.mp.
126. intervertebral disk degeneration.mp.
127. intervertebral disc degeneration.mp.
128. 123 or 124 or 125 or 126 or 127
129. 109 and 128
130. 28 or 70 or 93 or 122 or 129
131. animals/ not (animals/ and humans/)
132. 130 not 131
133. exp *neoplasms/
134. exp *wounds, penetrating/
135. 133 or 134
136. 132 not 135
137. Neck Pain/rh [Rehabilitation]
138. exp Brachial Plexus Neuropathies/rh
139. exp neck injuries/rh or exp whiplash injuries/rh
140. thoracic outlet syndrome/rh or cervical rib syndrome/rh
141. Torticollis/rh
142. exp brachial plexus neuropathies/rh or exp brachial plexus neuritis/rh
143. 137 or 138 or 139 or 140 or 141 or 142
144. Radiculopathy/rh
145. exp temporomandibular joint disorders/rh or exp temporomandibular joint dysfunction syndrome/rh
146. myofascial pain syndromes/rh
147. exp "Sprains and Strains"/rh
148. exp Spinal Osteophytosis/rh
149. exp Neuritis/rh
150. Polyradiculopathy/rh
151. exp Arthritis/rh
152. Fibromyalgia/rh
153. spondylitis/rh or discitis/rh
154. spondylosis/rh or spondylolysis/rh or spondylolisthesis/rh
155. or/144-154
156. 59 and 155
157. exp Combined Modality Therapy/
158. Exercise/
159. Physical Exertion/
160. exp Exercise Therapy/
161. exp Electric Stimulation Therapy/
162. Transcutaneous Electric Nerve Stimulation/
163. pulsed electro magnetic field.mp.
164. pulsed electromagnetic field.tw.
165. Electromagnetic Fields/
166. Magnetic Field Therapy/
167. Electric Stimulation/
168. exp Orthotic Devices/
169. kinesiotaping.tw.
170. taping.tw.
171. oral splints.tw.
172. Occlusal Splints/
173. pillow?.tw.
174. collar?.tw.
175. Traction/
176. traction.tw.
177. exp Laser Therapy/
178. laser therapy.tw.
179. exp Rehabilitation/
180. Ultrasonic Therapy/
181. exp Phototherapy/
182. Lasers/
183. exp Physical Therapy Modalities/
184. repetitive magnetic stimulation.tw.
185. exp Cryotherapy/
186. Hydrotherapy/
187. exp Hyperthermia, Induced/

APPENDIX A

188. vapocoolant spray.mp.
189. Cryoanesthesia/
190. Ice/
191. postur* correction.mp.
192. Feldenkrais.mp.
193. (alexander adj (technique or method)).tw.
194. Relaxation Therapy/
195. Biofeedback, Psychology/
196. faradic stimulation.mp.
197. or/157-196
198. 136 and 197
199. 143 or 156 or 198
200. animals/ not (animals/ and humans/)
201. 199 not 200
202. guidelines as topic/
203. practice guidelines as topic/
204. guideline.pt.
205. practice guideline.pt.
206. (guideline? or guidance or recommendations).ti.
207. consensus.ti.
208. or/202-207
209. 201 and 208
210. 136 and 208
211. 209 or 210
212. limit 211 to yr="2006 -Current"
213. limit 211 to yr="1902 - 2005"
214. meta-analysis/
215. exp meta-analysis as topic/
216. (meta analy* or metaanaly* or met analy* or metanaly*).tw.
217. review literature as topic/
218. (collaborative research or collaborative review* or collaborative overview*).tw.
219. (integrative research or integrative review* or intergrative overview*).tw.
220. (quantitative adj3 (research or review* or overview*)).tw.
221. (research integration or research overview*).tw.
222. (systematic* adj3 (review* or overview*)).tw.
223. (methodologic* adj3 (review* or overview*)).tw.
224. exp technology assessment biomedical/
225. (hta or thas or technology assessment*).tw.
226. ((hand adj2 search*) or (manual* adj search*)).tw.
227. ((electronic adj database*) or (bibliographic* adj database*)).tw.
228. ((data adj2 abstract*) or (data adj2 extract*)).tw.
229. (analys* adj3 (pool or pooled or pooling)).tw.
230. mantel haenszel.tw.
231. (cohrane or pubmed or pub med or medline or embase or psycinfo or psyclit or psychinfo or psychlit or cinahl or science citation indes).ab.
232. or/214-231
233. 201 and 232
234. limit 233 to yr="2006 -Current"
235. limit 233 to yr="1902 - 2005"

Below is an example MEDLINE-OVID search for articles related to Manual Therapy. We only used articles published between January 2007 and August 2016. Last update: April 21, 2012.

1. Neck Pain/
2. exp Brachial Plexus Neuropathies/
3. exp neck injuries/ or exp whiplash injuries/
4. cervical pain.mp.
5. neckache.mp.
6. whiplash.mp.
7. cervicodynia.mp.
8. cervicalgia.mp.
9. brachialgia.mp.
10. brachial neuritis.mp.
11. brachial neuralgia.mp.
12. neck pain.mp.
13. neck injur*.mp.
14. brachial plexus neuropath*.mp.
15. brachial plexus neuritis.mp.
16. thoracic outlet syndrome/ or cervical rib syndrome/
17. Torticollis/
18. exp brachial plexus neuropathies/ or exp brachial plexus neuritis/
19. cervico brachial neuralgia.ti,ab.
20. cervicobrachial neuralgia.ti,ab.
21. (monoradicul* or monoradicl*).tw.
22. or/1-21
23. exp headache/ and cervic*.tw.
24. exp genital diseases, female/
25. genital disease*.mp.
26. or/24-25
27. 23 not 26
28. 22 or 27
29. neck/
30. neck muscles/
31. exp cervical plexus/
32. exp cervical vertebrae/
33. atlanto-axial joint/
34. atlanto-occipital joint/

APPENDIX A

35. Cervical Atlas/
36. spinal nerve roots/
37. exp brachial plexus/
38. (odontoid* or cervical or occip* or atlant*).tw.
39. axis/ or odontoid process/
40. Thoracic Vertebrae/
41. cervical vertebrae.mp.
42. cervical plexus.mp.
43. cervical spine.mp.
44. (neck adj3 muscles).mp.
45. (brachial adj3 plexus).mp.
46. (thoracic adj3 vertebrae).mp.
47. neck.mp.
48. (thoracic adj3 spine).mp.
49. (thoracic adj3 outlet).mp.
50. trapezius.mp.
51. cervical.mp.
52. cervico*.mp.
53. 51 or 52
54. exp genital diseases, female/
55. genital disease*.mp.
56. exp *Uterus/
57. 54 or 55 or 56
58. 53 not 57
59. 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 58
60. exp pain/
61. exp injuries/
62. pain.mp.
63. ache.mp.
64. sore.mp.
65. stiff.mp.
66. discomfort.mp.
67. injur*.mp.
68. neuropath*.mp.
69. or/60-68
70. 59 and 69
71. Radiculopathy/
72. exp temporomandibular joint disorders/ or exp temporomandibular joint dysfunction syndrome/
73. myofascial pain syndromes/
74. exp "Sprains and Strains"/
75. exp Spinal Osteophytosis/
76. exp Neuritis/
77. Polyradiculopathy/
78. exp Arthritis/
79. Fibromyalgia/
80. spondylitis/ or discitis/
81. spondylosis/ or spondylolysis/ or spondylolisthesis/
82. radiculopathy.mp.
83. radiculitis.mp.
84. temporomandibular.mp.
85. myofascial pain syndrome*.mp.
86. thoracic outlet syndrome*.mp.
87. spinal osteophytosis.mp.
88. neuritis.mp.
89. spondylosis.mp.
90. spondylitis.mp.
91. spondylolisthesis.mp.
92. or/71-91
93. 59 and 92
94. exp neck/
95. exp cervical vertebrae/
96. Thoracic Vertebrae/
97. neck.mp.
98. (thoracic adj3 vertebrae).mp.
99. cervical.mp.
100. cervico*.mp.
101. 99 or 100
102. exp genital diseases, female/
103. genital disease*.mp.
104. exp *Uterus/
105. or/102-104
106. 101 not 105
107. (thoracic adj3 spine).mp.
108. cervical spine.mp.
109. 94 or 95 or 96 or 97 or 98 or 106 or 107 or 108
110. Intervertebral Disk/
111. (disc or discs).mp.
112. (disk or disks).mp.
113. 110 or 111 or 112
114. 109 and 113
115. herniat*.mp.
116. slipped.mp.
117. prolapse*.mp.
118. displace*.mp.
119. degenerat*.mp.
120. (bulge or bulged or bulging).mp.
121. 115 or 116 or 117 or 118 or 119 or 120
122. 114 and 121
123. intervertebral disk degeneration/ or intervertebral disk displacement/
124. intervertebral disk displacement.mp.
125. intervertebral disc displacement.mp.
126. intervertebral disk degeneration.mp.
127. intervertebral disc degeneration.mp.
128. 123 or 124 or 125 or 126 or 127
129. 109 and 128
130. 28 or 70 or 93 or 122 or 129

APPENDIX A

131. animals/ not (animals/ and humans/)
132. 130 not 131
133. exp *neoplasms/
134. exp *wounds, penetrating/
135. 133 or 134
136. 132 not 135
137. Neck Pain/rh, th [Rehabilitation, Therapy]
138. exp Brachial Plexus Neuropathies/rh, th
139. exp neck injuries/rh, th or exp whiplash injuries/rh, th
140. thoracic outlet syndrome/rh, th or cervical rib syndrome/rh, th
141. Torticollis/rh, th
142. exp brachial plexus neuropathies/rh, th or exp brachial plexus neuritis/rh, th
143. or/137-142
144. Radiculopathy/rh, th
145. exp temporomandibular joint disorders/rh, th or exp temporomandibular joint dysfunction syndrome/rh, th
146. myofascial pain syndromes/rh, th
147. exp "Sprains and Strains"/rh, th
148. exp Spinal Osteophytosis/rh, th
149. exp Neuritis/rh, th
150. Polyradiculopathy/rh, th
151. exp Arthritis/rh, th
152. Fibromyalgia/rh, th
153. spondylitis/rh, th or discitis/rh, th
154. spondylosis/rh, th or spondylolysis/rh, th or spondylolisthesis/rh, th
155. or/144-154
156. 59 and 155
157. acupuncture/ or chiropractic/
158. exp Musculoskeletal Manipulations/
159. massage.tw.
160. mobili?ation.tw.
161. Acupuncture Therapy/
162. (acupuncture or acu-puncture or needling or acupressure or mox?bustion).tw.
163. ((neck or spine or spinal or cervical or chiropractic* or musculoskeletal* or musculo-skeletal*) adj3 (adjust* or manipulat* or mobiliz* or mobilis*)).tw.
164. (manual adj therap*).tw.
165. (manipulati* adj (therap* or medicine)).tw.
166. (massag* or reflexolog* or rolfing or zone therap*).tw.
167. Nimmo.mp.
168. exp Vibration/tu [Therapeutic Use]
169. (vibration adj5 (therap* or treatment*)).tw.
170. (Chih Ya or Shiatsu or Shiatzu or Zhi Ya).tw.
171. (flexion adj2 distraction*).tw.
172. (myofascial adj3 (release or therap*)).tw.
173. muscle energy technique*.tw.
174. trigger point.tw.
175. proprioceptive Neuromuscular Facilitation*.tw.
176. cyriax friction.tw.
177. (lomilomi or lomi-lomi or trager).tw.
178. aston patterning.tw.
179. (strain adj counterstrain).tw.
180. (craniosacral therap* or cranio-sacral therap*).tw.
181. (amma or ammo or effleuurage or petrissage or hacking or tapotment).tw.
182. Complementary Therapies/
183. ((complement* or alternat* or osteopthic*) adj (therap* or medicine)).tw.
184. (Tui Na or Tuina).tw.
185. or/157-184
186. 136 and 185
187. 143 or 156 or 186
188. animals/ not (animals/ and humans/)
189. 187 not 188
190. exp randomized controlled trials as topic/
191. randomized controlled trial.pt.
192. controlled clinical trial.pt.
193. (random* or sham or placebo*).tw.
194. placebos/
195. random allocation/
196. single blind method/
197. double blind method/
198. ((singl* or doubl* or trebl* or tripl*) adj25 (blind* or dumm* or mask*)).ti,ab.
199. (rct or rcts).tw.
200. (control* adj2 (study or studies or trial*)).tw.
201. or/190-200
202. 189 and 201
203. limit 202 to yr="2006 -Current"
204. limit 202 to yr="1902 -Current"
205. limit 202 to yr="1902 -2005"
206. guidelines as topic/
207. practice guidelines as topic/
208. guideline.pt.
209. practice guideline.pt.
210. (guideline? or guidance or recommendations).ti.
211. consensus.ti.
212. or/206-211
213. 189 and 212
214. limit 213 to yr="2006 -Current"
215. limit 213 to yr="1902 -2005"
216. meta-analysis/
217. exp meta-analysis as topic/
218. (meta analy* or metaanaly* or met analy* or metanaly*).tw.

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219. review literature as topic/
220. (collaborative research or collaborative review* or collaborative overview*).tw.
221. (integrative research or integrative review* or intergrative overview*).tw.
222. (quantitative adj3 (research or review* or overview*)).tw.
223. (research integration or research overview*).tw.
224. (systematic* adj3 (review* or overview*)).tw.
225. (methodologic* adj3 (review* or overview*)).tw.
226. exp technology assessment biomedical/
227. (hta or thas or technology assessment*).tw.
228. ((hand adj2 search*) or (manual* adj search*)).tw.
229. ((electronic adj database*) or (bibliographic* adj database*)).tw.
230. ((data adj2 abstract*) or (data adj2 extract*)).tw.
231. (analys* adj3 (pool or pooled or pooling)).tw.
232. mantel haenszel.tw.
233. (cohrane or pubmed or pub med or medline or embase or psycinfo or psyclit or psychinfo or psychlit or cinahl or science citation indes).ab.
234. or/216-233
235. 189 and 234
236. limit 235 to yr="2006 -Current"
237. limit 235 to yr="1902 -2005"
238. (ae or to or po or co).fs.
239. (safe or safety or unsafe).tw.
240. (side effect* or side event*).tw.
241. ((adverse or undesirable or harm* or injurious or serious or toxic) adj3 (effect* or event* or reaction* or incident* or outcome*)).tw.
242. (abnormalit* or toxicit* or complication* or consequence* or noxious or tolerabilit*).tw.
243. or/238-242
244. 189 and 243
245. limit 244 to yr="2006 -Current"
246. limit 244 to yr="1902 -2005"
247. limit 202 to ed=20100701-20120321
248. limit 213 to ed=20100701-20120321
249. limit 235 to ed=20100701-20120321
250. limit 245 to ed=20100701-20120321

APPENDIX B

SEARCH DATES AND RESULTS

August 25, 2016

Database	Platform	Years Covered	Date Conducted	Results, n
MEDLINE	OVID	2014-August 2016	8-25-16	835
CINAHL	EBSCO	2014-August 2016	8-25-16	40
Web of Science	Web of Knowledge	2014-August 2016	8-25-16	...
Cochrane	Wiley	2014-August 2016	8-25-16	27
Embase		2014-August 2016	8-25-16	161
Total				1063
With duplicates removed				177

April 25, 2014: Neck Pain Modalities

Database	Platform	Years Covered	Date Conducted	Results, n
MEDLINE	OVID	2010-2014	4-21-14	153
CINAHL	EBSCO	2010-2014	4-21-14	92
Web of Science	Web of Knowledge	2010-2014	4-21-14	235
Cochrane	Wiley	2010-2014	4-21-14	57
Embase		2010-2014	4-25-14	500
Total				1037
With duplicates removed				793

May 29, 2015: Update Through November 2014

Database	Platform	Years Covered	Date Conducted	Results, n
MEDLINE	OVID	2014	5-29-15	31
CINAHL	EBSCO	2014	5-29-15	11
Web of Science	Web of Knowledge	2014	5-29-15	52
Cochrane	Wiley	2014	5-29-15	13
Embase		2014	5-29-15	47
Total				154
With duplicates removed				114

September 29, 2014: Education*

Database	Platform	Years Covered	Date Conducted	Results, n
MEDLINE	OVID	2010-current	9-29-14	34
CINAHL	EBSCO	2010-current	9-29-14	15
Web of Science	Web of Knowledge	2010-current	9-29-14	33
Cochrane	Wiley	2010-current	9-29-14	10
Embase		2010-current	9-29-14	26
Total				118
With duplicates removed				88

**Some Overlap With ICON, Whose Search Went From 2000 to 2010.*

APPENDIX B

September 29, 2014: Cervical Orthoses*

Database	Platform	Years Covered	Date Conducted	Results, n
MEDLINE	OVID	2010-current	9-29-14	43
CINAHL	EBSCO	2010-current	9-29-14	17
Web of Science	Web of Knowledge	2010-current	9-29-14	46
Cochrane	Wiley	2010-current	9-29-14	10
Embase		2010-current	9-29-14	32
Total				148
With duplicates removed				91

**Some Overlap With ICON, Whose Search Went From 2000 to 2010.*

APPENDIX C

CRITERIA FOR INCLUSION AND EXCLUSION OF STUDIES OF INTERVENTIONS

Systematic reviews and meta-analyses published in peer-reviewed journals were reviewed.

Exclusions: experimental and quasi-experimental trials, cohort, case series, and cross-sectional studies, meeting abstracts, press releases, theses, nonsystematic review articles, case reports, and articles that could not be retrieved in English.

Inclusion Criteria

- screening / differential diagnosis

OR

- diagnosis / classification

OR

- patient reported outcome measures related to neck pain.

OR

- measurement properties of physical impairments, or of activity limitation/participation restriction using data from a sample of patients with neck pain

AND

- adults (≥18 years old)

AND

- interventions within the scope of physical therapist practice for neck pain, including:
  - manual therapy
  - exercise
  - multimodal physical therapy treatments
  - patient education
  - physical agents
    - heat and cold
    - electrotherapeutic modalities
    - laser
    - inserted needle techniques (reviews clearly identified as dry needling)
    - traction
    - ultrasound
    - orthoses (neck braces)

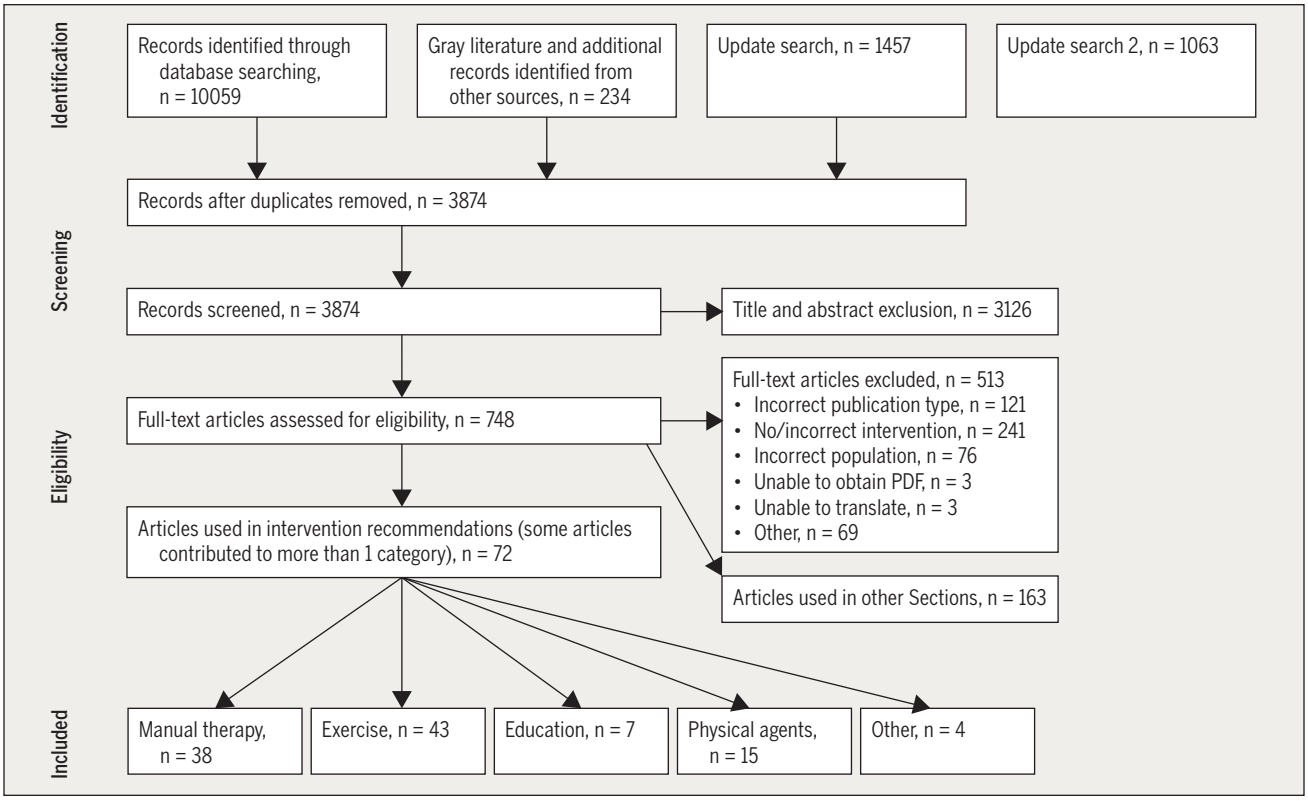
Exclusion Criteria

Articles reporting on the following were excluded:

- primarily infants, children, or adolescents (<18 years old)
- postsurgical neck pain
- cervical vertebral fracture
- nonmusculoskeletal neck pain:
  - visceral or vascular referral
  - integumentary
    - topics outside the scope of physical therapist practice (eg, surgery)
    - pharmacological interventions

APPENDIX D

FLOW DIAGRAM OF ARTICLES LEADING TO INTERVENTION RECOMMENDATIONS



APPENDIX E

ARTICLES INCLUDED IN RECOMMENDATIONS BY TOPIC

IMPAIRMENT/FUNCTION-BASED DIAGNOSIS

Prevalence

Andersson HI. The epidemiology of chronic pain in a Swedish rural area. *Qual Life Res*. 1994;3 suppl 1:S19-S26. https://doi.org/10.1007/BF00433371

Borghouts JA, Koes BW, Bouter LM. The clinical course and prognostic factors of non-specific neck pain: a systematic review. *Pain*. 1998;77:1-13. https://doi.org/10.1016/S0304-3959(98)00058-X

Borghouts JA, Koes BW, Vondeling H, Bouter LM. Cost-of-illness of neck pain in The Netherlands in 1996. *Pain*. 1999;80:629-636. https://doi.org/10.1016/S0304-3959(98)00268-1

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Bovim G, Schrader H, Sand T. Neck pain in the general population. *Spine (Phila Pa 1976)*. 1994;19:1307-1309.

Brattberg G, Thorslund M, Wikman A. The prevalence of pain in a general population. The results of a postal survey in a county of Sweden. *Pain*. 1989;37:215-222. https://doi.org/10.1016/0304-3959(89)90133-4

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Côté P, Cassidy JD, Carroll L. The Saskatchewan Health and Back Pain Survey. The prevalence of neck pain and related disability in Saskatchewan adults. *Spine (Phila Pa 1976)*. 1998;23:1689-1698.

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Goode AP, Freburger J, Carey T. Prevalence, practice patterns, and evidence for chronic neck pain. *Arthritis Care Res (Hoboken)*. 2010;62:1594-1601. https://doi.org/10.1002/acr.20270

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Holmstrom EB, Lindell J, Moritz U. Low back and neck/shoulder pain in construction workers: occupational workload and psychosocial risk factors. Part 2: Relationship to neck and shoulder pain. *Spine (Phila Pa 1976)*. 1992;17:672-677.

Hoving JL, Gross AR, Gasner D, et al. A critical appraisal of review articles on the effectiveness of conservative treatment for neck pain. *Spine (Phila Pa 1976)*. 2001;26:196-205.

Hoy DG, Protani M, De R, Buchbinder R. The epidemiology of neck pain. *Best Pract Res Clin Rheumatol*. 2010;24:783-792. https://doi.org/10.1016/j.berh.2011.01.019

Jacobsson L, Lindgarde F, Manthorpe R. The commonest rheumatic complaints of over six weeks' duration in a twelve-month period in a defined Swedish population. Prevalences and relationships. *Scand J Rheumatol*. 1989;18:353-360.

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Murray CJ, Barber RM, Foreman KJ, et al. Global, regional, and national disability-adjusted life years (DALYs) for 306 diseases and injuries and healthy life expectancy (HALE) for 188 countries, 1990-2013: quantifying the epidemiological transition. *Lancet*. 2015;386:2145-2191. https://doi.org/10.1016/S0140-6736(15)61340-X

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APPENDIX F

PROCEDURES FOR ASSIGNING LEVELS OF EVIDENCE

- Levels of evidence were assigned based on the study design, the quality of the study, and the quality of the primary sources (if the study is a systematic review or meta-analysis), using the Levels of Evidence table (**TABLE 1**).
- Quality of systematic reviews (or review of reviews) was assessed using a critical appraisal tool (AMSTAR, or the closely related SIGN II), and the review was assigned 1 of 4 overall quality ratings based on the critical appraisal results:
  - High, AMSTAR or SIGN score of 8 or better
  - Acceptable, AMSTAR or SIGN score of 6 or 7
  - Low, AMSTAR or SIGN score of 4 or 5
  - Very low, AMSTAR or SIGN score of less than 4 (Reviews scored very low were not used in this revision)
- Quality of primary sources was calibrated to a 4-level scale. If the quality of the primary sources were not available in the systematic review, or if the quality appraisal tool was unique or not familiar to the guideline authors, or if the quality ratings differed between reviews, the primary source was graded by the guideline authors using the GRADE system and methods described in the text. Sources receiving a rating of very low were not used in this guideline.
  - GRADE system[77]
- Study starts with a "high" rating
- Downgrade at least 1 level for violations of
  - Risk of bias
  - Precision
  - Directness
  - publication bias
- Results in 4 levels of quality of evidence
  - High
  - moderate
  - Low
  - very low
  - PEDro system (http://abiebr.com/set/1-introduction-and-methodology/determining-levels-evidence)
    - High, score of 9 or better
    - moderate, score of 6 to 8
    - Low, score of 4 or 5
    - Very low, score of 3 or lower

APPENDIX G

AMSTAR SCORES*

Study	1	2	3	4	5	6	7	8	9	10	11	Quality†
Included articles												
Bertozzi et al[10]	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	High
Boyles et al[17]	Y	Y	Y	N	Y	Y	Y	Y	NA	N	N	Acceptable
Brønfort et al[20]	Y	Y	Y	Y	Y	Y	Y	Y	NA	N	N	High
Bronfort et al[19]	Y	N	Y	N	N	N	Y	Y	NA	N	N	Low
Brown et al[21]	Y	Y	Y	Y	N	Y	Y	Y	NA	N	Y	High
Cagnie et al[22]	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y	High
Chaibi and Russell[28]	Y	N	N	N	N	Y	Y	Y	NA	NA	N	Low
Clar et al[30]	Y	Y	Y	N	N	Y	Y	Y	NA	N	N	Acceptable
Conlin et al[33]	Y	N	Y	N	N	Y	Y	Y	Y	N	N	Acceptable
Coronado et al[36]	Y	N	N	N	N	Y	Y	Y	NA	N	N	Low
Cross et al[41]	Y	Y	Y	N	N	Y	Y	Y	NA	N	N	Acceptable
Damgaard et al[44]	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	High
Drescher et al[49]	Y	Y	Y	Y	N	Y	Y	Y	NA	N	N	Acceptable
Fernández-de-las-Peñas et al[59]	Y	N	Y	N	N	Y	Y	Y	NA	N	N	Low
Ferreira et al[60]	Y	Y	Y	Y	N	N	N	NA	NA	N	N	Low
Furlan et al[64]	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	High
Graham et al[68]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Gross et al[75]	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	High
Gross et al[73]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	High
Gross et al[70]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Gross et al[74]	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	High
Gross et al[76]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Gross et al[71]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	High
Gross et al[72]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	High
Haines et al[79]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	High
Holly et al[87]	Y	N	Y	N	N	Y	Y	Y	NA	N	N	Low
Horn et al[89]	Y	Y	Y	Y	N	Y	Y	Y	NA	N	N	Acceptable
Huisman et al[92]	Y	N	Y	N	Y	Y	Y	Y	NA	N	N	Acceptable
Hurwitz et al[93]	Y	N	N	Y	N	Y	Y	Y	NA	N	N	Low
Kabisch[103]	Y	N	Y	N	N	Y	Y	Y	Y	N	N	Acceptable
Kadhim-Saleh et al[104]	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	High
Kay et al[108]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	High
Kay et al[109]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	High
Kelly et al[112]	Y	Y	Y	Y	N	Y	Y	Y	NA	N	N	Acceptable
Kietrys et al[113]	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	High
Kroeling et al[118]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	High
Leaver et al[119]	Y	Y	Y	N	N	Y	Y	Y	Y	N	N	Acceptable
Lee et al[120]	Y	Y	Y	Y	Y	Y	Y	Y	NA	N	N	High
Liu et al[124]	Y	Y	Y	Y	N	Y	y	Y	Y	Y	N	High
Macaulay et al[125]	Y	N	Y	N	N	Y	Y	Y	NA	N	N	Low

Table continues on page A79.

APPENDIX G

AMSTAR SCORES* (CONTINUED)

Study	1	2	3	4	5	6	7	8	9	10	11	Quality†
MacDermid et al[127]	Y	Y	Y	N	N	Y	Y	Y	NA	N	N	Acceptable
McCaskey et al[134]	Y	N	Y	Y	N	Y	Y	Y	NA	Y	Y	High
McLean et al[136]	Y	Y	Y	Y	N	Y	Y	Y	NA	N	N	Acceptable
Meeus et al[138]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	High
Miller et al[140]	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	High
Monticone et al[141]	Y	Y	Y	Y	N	N	Y	Y	Y	N	N	Acceptable
Nunes and Moita[152]	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	High
Ong and Claydon[156]	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	High
O'Riordan et al[157]	Y	N	Y	N	N	Y	Y	N	NA	N	N	Low
Parreira et al[161]	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	High
Racicki et al[163]	Y	N	Y	N	Y	Y	Y	N	NA	N	N	Low
Reid and Rivett[167]	Y	N	Y	N	N	Y	Y	Y	NA	N	N	Low
Rhee et al[169]	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	High
Rubio-Ochoa et al[176]	Y	Y	Y	Y	N	Y	Y	Y	NA	N	N	Acceptable
Salt et al[178]	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	High
Schellingerhout et al[180]	Y	Y	Y	N	N	Y	Y	Y	NA	N	N	Acceptable
Schellingerhout et al[181]	Y	Y	Y	N	N	Y	Y	Y	NA	N	N	Moderate
Scholten-Peeters et al[182]	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	High
Shaw et al[186]	Y	Y	Y	N	N	Y	Y	Y	NA	N	N	Acceptable
Snodgrass et al[189]	Y	Y	Y	Y	N	Y	Y	Y	NA	Y	Y	High
Southerst et al[190]	Y	Y	Y	N	N	Y	Y	N	NA	N	N	Low
Stanton et al[192]	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	High
Sutton et al[200]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Takasaki and May[202]	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	High
Teasell et al[203]	Y	N	Y	N	N	Y	Y	Y	NA	N	N	Low
Teasell et al[204]	Y	N	Y	N	N	Y	Y	Y	NA	N	N	Low
Teasell et al[205]	Y	N	Y	N	N	Y	Y	Y	NA	N	N	Low
Thoomes et al[208]	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	High
Vanti et al[216]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	High
van Trijffel et al[217]	Y	Y	N	Y	N	Y	Y	Y	NA	N	N	Acceptable
Varatharajan et al[219]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Varatharajan et al[220]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	High
Verhagen et al[223]	Y	Y	Y	N	Y	Y	Y	Y	Y	N	N	High
Verhagen et al[221]	Y	Y	Y	N	Y	Y	Y	Y	Y	N	N	High
Vernon et al[226]	Y	N	Y	N	N	Y	Y	Y	NA	N	N	Low
Vincent et al[229]	Y	N	Nr	N	N	Y	Y	Y	NA	N	N	Low
Walser et al[231]	Y	N	Y	Y	N	Y	Y	Y	Y	N	N	Acceptable
Williams et al[238]	Y	N	Y	N	N	N	Y	Y	NA	N	Y	Low
Wong et al[240]	Y	Y	Y	Y	Y	Y	Y	Y	NA	N	N	High
Young et al[244]	Y	N	Y	Y	N	Y	Y	Y	NA	N	N	Acceptable
Yu et al[245]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Zhu et al[246]	Y	N	Y	Y	N	Y	Y	Y	Y	N	Y	High

Table continues on page A80.

APPENDIX G

AMSTAR SCORES* (CONTINUED)

Study	1	2	3	4	5	6	7	8	9	10	11	Quality†
Zronek et al[247]	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	High
Excluded articles												
Ainpradub et al	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	High
Ambrosio et al	Y	N	Y	Y	N	Y	Y	Y	Y	Y	N	High
Bervoets et al	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	High
Clay et al	Y	Y	Y	Y	N	y	Y	Y	Y	Y	Y	High
Ernst et al	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Acceptable
Ernst et al	Y	N	Y	N	N	Y	N	N	N	N	N	Very low
Fernández-de-las-Peñas et al	Y	N	Y	N	N	Y	Y	N	NA	N	N	Low
France et al	Y	Y	Y	Y	N	Y	Y	Y	NA	Y	Y	High
Franke et al	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	High
Furlan et al	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	High
Garcia et al	Y	N	Y	Y	N	Y	N	N	NA	N	Y	Low
Hug et al	Y	N	Y	Y	Y	Y	N	N	N	N	N	Low
Jang et al	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	High
Kim et al	Y	Y	Y	Y	N	Y	Y	N	NA	N	Y	Acceptable
Kroeling et al	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	High
Lee et al	N	N	N	Y	N	N	Y	Y	N	N	N	Very low
Lu et al	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	High
MacPherson et al	Y	N	Y	N	N	Y	N	N	Y	N	N	Low
Mao et al	N	N	N	N	N	N	N	N	N	N	N	Very low
Misailidou et al	Y	N	Y	N	N	N	N	N	NA	N	N	Very low
Moon et al	Y	Y	Y	Y	N	Y	Y	Y	NA	Y	Y	High
Murphy et al	Y	Y	Y	N	N	N	N	N	NA	N	N	Very low
Rodine et al	Y	N	N	N	N	Y	N	NA	NA	N	N	Very low
Ruston et al	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	High
Schroeder et al	N	N	N	N	N	Y	N	N	N	N	Y	Very low
Sihawong et al	Y	Y	N	N	Y	Y	Y	Y	NA	N	N	Acceptable
Trinh et al	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Vernon et al	Y	N	N	N	N	Y	N	N	NA	N	N	Very low
Wanderley et al	Y	Y	Y	Y	N	Y	Y	Y	NA	N	N	Acceptable
Yuan et al	Y	N	Y	N	N	Y	Y	Y	Y	Y	N	Acceptable
Wei et al	Y	Y	Y	Y	N	Y	Y	Y	NA	N	Y	High
Wiangkham et al	Y	Y	Y	Y	N	y	y	Y	Y	N	N	High
Zarghooni et al	Y	N	N	N	N	N	N	N	NA	N	N	Very low

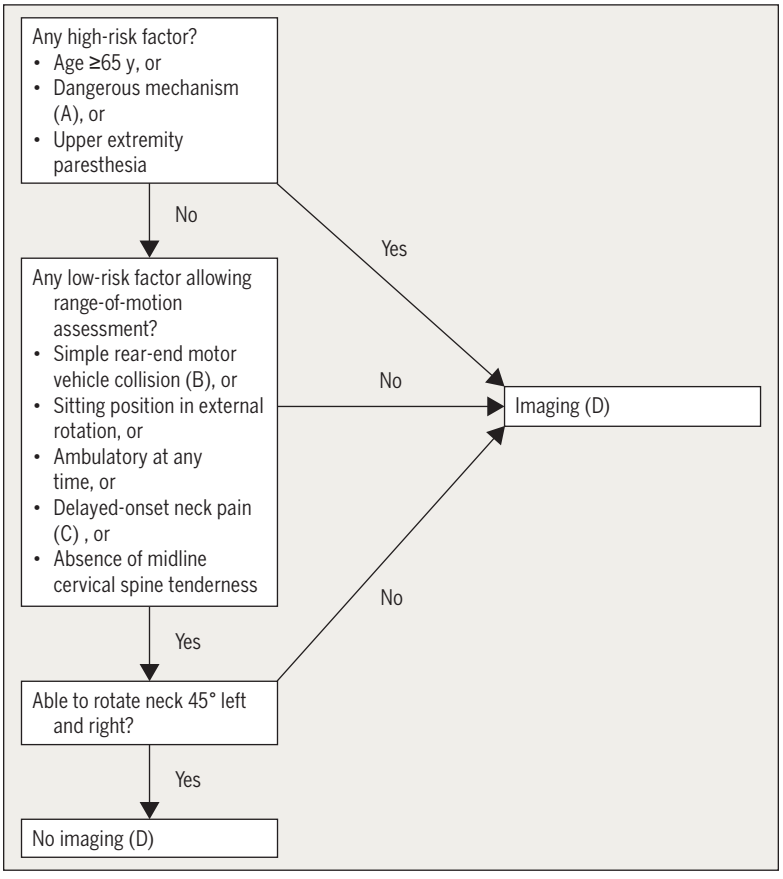
Abbreviations: N, no; NA, not applicable; Y, yes.

**Yes/no. Items: 1, the study addresses a clearly defined research question; 2, at least two people should select studies and extract data; 3, a comprehensive literature search is carried out; 4, the authors clearly state if or how they limited their review by publication type; 5, the included and excluded studies are listed; 6, the characteristics of the included studies are provided; 7, the scientific quality of the included studies is assessed and documented; 8, yhe scientific quality of the included studies was assessed appropriately; 9, appropriate methods are used to combine the individual study findings; 10, the likelihood of publication bias is assessed; 11, conflicts of interest are declared.*

†Quality rating: 8 or higher, high; 6 or 7, acceptable; 5 or 4, low; 3 or below, very low.

APPENDIX H

IMAGING CONDITIONS FOR SUSPECTED SPINE TRAUMA FROM THE AMERICAN COLLEGE OF RADIOLOGY APPROPRIATENESS CRITERIA



(A) Dangerous Mechanism = Fall from ≥3 ft/5 stairs, axial load, MVC at >60 mph or rollover or ejection, motorized recreational vehicle accident, bicycle collision.
(B) Simple Rear-End MVC excludes pushed into on-coming traffic, hit by bus or large truck, rollover, hit by high speed vehicle
(C) Delayed onset neck pain = No immediate onset after trauma
(D) At time of derivation, radiograph was chosen imaging. Now, American College of Radiology recommends computed tomography, if positive on criteria.

Reproduced from Elliott JM, Dayanidhi S, Hazle C, et al. Advancements in imaging technology: do they (or will they) equate to advancements in our knowledge of recovery in whiplash? *J Orthop Sports Phys Ther*. 2016;46:862-873. https://doi.org/10.2519/jospt.2016.6735

Sensitivity, Specificity, and Negative Predictive Values of the Canadian Cervical Spine Rules and the NEXUS Low-Risk Criteria for 162 Cases of "Clinically Important" Injury in 7438 Patients[32,85,160,196,197]

APPENDIX H

	Canadian Cervical Spine Rule		NEXUS Low-Risk Criteria	
Decision Rule	Yes	No	Yes	No
Positive	161	3995	147	4599
Negative	1	3281	15	2677
Sensitivity, %*	99.4 (96, 100)		90.7 (85, 94)	
Specificity, %*	45.1 (44, 46)		36.8 (36, 88)	
Negative predictive value, %	100.0		99.4	

Abbreivation: NEXUS, National Emergency X-Radiography Utilization Study.
**Values in parentheses are 95% confidence interval.*

Interests that were disclosed include financial interests and secondary interests (eg, personal, academic, political).

Author	Competing Interests	Disclosures
Peter Blanpied	None known	None known
Anita Gross	ICON - International Collaboration on Neck - I am a lead and reviewer within this body of work. COG - Cervical Overview Group contributing to a series of systematic reviews for Neck Pain in Cochrane Collaboration - I am the coordinator and reviewer on primary systematic reviews on this topic.	None known
James Elliott	JOSPT - Board of Directors - Advisory Member JOSPT - International Editorial Board Spine - Advisory Board Member Musculoskeletal Science and Practice (formerly Manual Therapy) - International Advisory Board NIHR01HD079076 - NICHD/NCMRR	Partial ownership/investment interest in Pain ID, LLC (a medical-consulting start-up).
Laurie Devaney	None known	None known
Derek Clewley	None known	None known
David Walton	ICON - International Consensus on Neck Pain, Prognosis section lead reviewer Journal of Musculoskeletal Science and Practice (formerly Manual Therapy) - Associate Editor JOSPT - International Editor International Association for the Study of Pain - Education Special Interest Group Secretary	Owner/Operator - David Walton Rehabilitation Education, Consulting and Research
Cheryl Sparks	None known	None known
Eric Robertson	None known	None known

Peter Blanpied coordinated the Neck Pain CPG Revision, secured limited funding, coordinated and collated searches and search results, organized retrieval of papers, screened and appraised papers, extracted data from papers, analyzed and interpreted data, provided a methodological, clinical, and end-user perspective, and wrote the revision.

Anita Gross coordinated and collated searches and search results, organized retrieval of papers, screened and appraised papers, extracted data from papers, analyzed and interpreted data, provided a methodological, clinical, and end-user perspective, and wrote the revision.

James Elliott screened and appraised papers, extracted data from papers, analyzed and interpreted data, provided a methodological, clinical, and end-user perspective, and wrote the revision.

APPENDIX H

Laurie Devaney screened and appraised papers, extracted data from papers, analyzed and interpreted data, provided a methodological, clinical, and end-user perspective, and wrote the revision.

Derek Clewley screened and appraised papers, extracted data from papers, analyzed and interpreted data, provided a methodological, clinical, and end-user perspective, and wrote the revision.

David Walton screened and appraised papers, extracted data from papers, analyzed and interpreted data, provided a methodological, clinical, and end-user perspective, and wrote the revision.

Cheryl Sparks screened and appraised papers, extracted data from papers, analyzed and interpreted data, provided a methodological, clinical, and end-user perspective, and wrote the revision.

Eric Robertson screened and appraised papers, extracted data from papers, analyzed and interpreted data, provided a methodological, clinical, and end-user perspective, and wrote the revision.

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Neck Pain:

Clinical Practice Guidelines Linked to the International Classification of Functioning, Disability, and Health From the Orthopaedic Section of the American Physical Therapy Association

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Recommendations*

PATHOANATOMICAL FEATURES: Although the cause of neck pain may be associated with degenerative processes or pathology identified during diagnostic imaging, the tissue that is causing a patient's neck pain is most often unknown. Thus, clinicians should assess for impaired function of muscle, connective, and nerve tissues associated with the identified pathological tissues when a patient presents with neck pain. (Recommendation based on theoretical/foundational evidence.)

RISK FACTORS: Clinicians should consider age greater than 40, coexisting low back pain, a long history of neck pain, cycling as a regular activity, loss of strength in the hands, worrisome attitude, poor quality of life, and less vitality as predisposing factors for the development of chronic neck pain. (Recommendation based on moderate evidence.)

DIAGNOSIS/CLASSIFICATION: Neck pain, without symptoms or signs of serious medical or psychological conditions, associated with (1) motion limitations in the cervical and upper thoracic regions, (2) headaches, and (3) referred or radiating pain into an upper extremity are useful clinical findings for classifying a patient with neck pain into one of the following International Statistical Classification of Diseases and Related Health Problems (ICD) categories: cervicalgia, pain in thoracic spine, headaches, cervicocranial syndrome, sprain and strain of cervical spine, spondylosis with radiculopathy, and cervical disc disorder with radiculopathy; and the associated International Classification of Functioning, Disability, and Health (ICF) impairment-based category of neck pain with the following impairments of body function:

- Neck pain with mobility deficits (b7101 Mobility of several joints)
- Neck pain with headaches (28010 Pain in head and neck)
- Neck pain with movement coordination impairments (b7601 Control of complex voluntary movements)
- Neck pain with radiating pain (b2804 Radiating pain in a segment or region)

The following physical examination measures may be useful in classifying a patient in the ICF impairment-based category of neck pain with mobility deficits and the associated ICD categories of cervicalgia or pain in thoracic spine. (Recommendation based on moderate evidence.)

- Cervical active range of motion
- Cervical and thoracic segmental mobility

The following physical examination measures may be useful in classifying a patient in the ICF impairment-based category of neck pain with headaches and the associated ICD categories of headaches or cervicocranial syndrome. (Recommendation based on moderate evidence.)

- Cervical active range of motion
- Cervical segmental mobility
- Cranial cervical flexion test

The following physical examination measures may be useful in classifying a patient in the ICF impairment-based category of neck pain with movement coordination impairments and the associated ICD category of sprain and strain of cervical spine. (Recommendation based on moderate evidence.)

- Cranial cervical flexion test
- Deep neck flexor endurance test

The following physical examination measures may be useful in classifying a patient in the ICF impairment-based category of neck pain with radiating pain and the associated ICD categories of spondylosis with radiculopathy or cervical disc disorder with radiculopathy. (Recommendation based on moderate evidence.)

- Upper limb tension test
- Spurling's test
- Distraction test

DIFFERENTIAL DIAGNOSIS: Clinicians should consider diagnostic classifications associated with serious pathological conditions or psychosocial factors when the patient's reported activity limitations or impairments of body function and structure are not consistent with those presented in the diagnosis/classification section of this guideline, or, when the patient's symptoms are not resolving with interventions aimed at normalization of the patient's impairments of body function. (Recommendation based on moderate evidence.)

EXAMINATION – OUTCOME MEASURES: Clinicians should use validated self-report questionnaires, such as the Neck Disability Index and the Patient-Specific Functional Scale for patients with neck pain. These tools are useful for identifying a patient's baseline status relative to pain, function, and disability and for monitoring a change in a patient's status throughout the course of treatment. (Recommendation based on strong evidence.)

EXAMINATION – ACTIVITY LIMITATION AND PARTICIPATION RESTRICTION MEASURES: Clinicians should utilize easily reproducible activity limitation and participation restriction measures associated with their patient's neck pain to assess the changes in the patient's level of function over the episode of care. (Recommendation based on expert opinion.)

INTERVENTIONS – CERVICAL MOBILIZATION/MANIPULATION: Clinicians should consider utilizing cervical manipulation and mobilization procedures, thrust and non-thrust, to reduce neck pain and headache. Combining cervical manipulation and mobilization with exercise is more effective for reducing neck pain, headache, and disability than manipulation and mobilization alone. (Recommendation based on strong evidence.)

INTERVENTIONS – THORACIC MOBILIZATION/MANIPULATION: Thoracic spine thrust manipulation can be used for patients with primary complaints of neck pain. Thoracic spine thrust manipulation can also be used for reducing pain and disability in patients with neck and neck-related arm pain. (Recommendation based on weak evidence.)

Recommendations* *(continued)*

INTERVENTIONS – STRETCHING EXERCISES: Flexibility exercises can be used for patients with neck symptoms. Examination and targeted flexibility exercises for the following muscles are suggested: anterior/medial/posterior scalenes, upper trapezius, levator scapulae, pectoralis minor, and pectoralis major. (Recommendation based on weak evidence.)

INTERVENTIONS – COORDINATION, STRENGTHENING, AND ENDURANCE EXERCISES: Clinicians should consider the use of coordination, strengthening, and endurance exercises to reduce neck pain and headache. (Recommendation based on strong evidence.)

INTERVENTIONS – CENTRALIZATION PROCEDURES AND EXERCISES: Specific repeated movements or procedures to promote centralization are not more beneficial in reducing disability when compared to other forms of interventions. (Recommendation based on weak evidence.)

INTERVENTIONS – UPPER QUARTER AND NERVE MOBILIZATION PROCEDURES: Clinicians should consider the use of upper quarter and nerve mobilization procedures to reduce pain and disability in patients with neck and arm pain. (Recommendation based on moderate evidence.)

INTERVENTIONS – TRACTION: Clinicians should consider the use of mechanical intermittent cervical traction, combined with other interventions such as manual therapy and strengthening exercises, for reducing pain and disability in patients with neck and neck-related arm pain. (Recommendation based on moderate evidence.)

INTERVENTIONS – PATIENT EDUCATION AND COUNSELING: To improve recovery in patients with whiplash-associated disorder, clinicians should (1) educate the patient that early return to normal, non-provocative pre-accident activities is important, and (2) provide reassurance to the patient that good prognosis and full recovery commonly occurs. (Recommendation based on strong evidence.)

*These recommendations and clinical practice guidelines are based on the scientific literature published prior to June 2007.

Introduction

AIM OF THE GUIDELINE

The Orthopaedic Section of the American Physical Therapy Association (APTA) has an ongoing effort to create evidence-based practice guidelines for orthopaedic physical therapy management of patients with musculoskeletal impairments described in the World Health Organization's International Classification of Functioning, Disability, and Health (ICF).[86]

The purposes of these clinical guidelines are to:

Describe evidence-based physical therapy practice including diagnosis, prognosis, intervention, and assessment of outcome for musculoskeletal disorders commonly managed by orthopaedic physical therapists

- Classify and define common musculoskeletal conditions using the World Health Organization's terminology related to impairments of body function and body structure, activity limitations, and participation restrictions
- Identify interventions supported by current best evidence to address impairments of body function and structure, activity limitations, and participation restrictions associated with common musculoskeletal conditions
- Identify appropriate outcome measures to assess changes resulting from physical therapy interventions in body function and structure as well as in activity and participation of the individual
- Provide a description to policy makers, using internationally accepted terminology, of the practice of orthopaedic physical therapists
- Provide information for payers and claims reviewers regarding the practice of orthopaedic physical therapy for common musculoskeletal conditions
- Create a reference publication for orthopaedic physical therapy clinicians, academic instructors, clinical instructors, students, interns, residents, and fellows regarding the best current practice of orthopaedic physical therapy

STATEMENT OF INTENT

This guideline is not intended to be construed or to serve as a standard of medical care. Standards of care are determined on the basis of all clinical data available for an individual patient and are subject to change as scientific knowledge and technology advance and patterns of care evolve. These parameters of practice should be considered guidelines only. Adherence to them will not ensure a successful outcome in every patient, nor should they be construed as including all proper methods of care or excluding other acceptable methods of care aimed at the same results. The ultimate judgment regarding a particular clinical procedure or treatment plan must be made in light of the clinical data presented by the patient, the diagnostic and treatment options available, and the patient's values, expectations, and preferences. However, we suggest that significant departures from accepted guidelines should be documented in the patient's medical records at the time the relevant clinical decision is made.

Methods

Content experts were appointed by the Orthopaedic Section, APTA as developers and authors of clinical practice guidelines for musculoskeletal conditions of the cervical region that are commonly treated by physical therapists. These content experts were given the task to identify impairments of body function and structure, activity limitations, and participation restrictions, described using ICF terminology, that could (1) categorize patients into mutually exclusive impairment patterns upon which to base intervention strategies, and (2) serve as measures of changes in function over the course of an episode of care. The second task given to the content experts was to describe interventions and supporting evidence for specific subsets of patients based upon the previously chosen patient categories. It was also acknowledged by the Orthopaedic Section, APTA content experts that a systematic search and review of the evidence solely related to diagnostic categories based on International Statistical Classification of Diseases and Health Related Problems (ICD)[87] terminology would not be useful for these ICF-based clinical practice guidelines as most of the evidence associated with changes in levels of impairment or function in homogeneous populations is not readily searchable using the ICD terminology. Thus, the authors of this clinical practice guideline systematically searched MEDLINE, CINAHL, and the Cochrane Database of Systematic Reviews (1966 through June 2007) for any relevant articles related to classification, outcome measures, and intervention strategies for musculoskeletal conditions of the neck region commonly treated by physical therapists. Each content expert was assigned a specific subcategory (classification, outcome measures, and intervention strategies for musculoskeletal conditions of the neck region) to search by the lead author (JDC) based upon their specific area of expertise. Two content experts were assigned to each subcategory and both individuals performed a separate search, including but not limited to the 3 databases listed above, to identify articles to assure that no studies of relevance were omitted. Additionally, when relevant articles were identified, their reference lists were hand-searched in an attempt to identify other articles that might have contributed to the outcome of these clinical practice guidelines.

This guideline was issued in 2008 based upon publications in the scientific literature prior to June 2007. This guideline will be considered for review in 2012, or sooner if substantive new evidence becomes available. Any updates to the guideline in the interim period will be noted on the Orthopaedic Section of the APTA website: www.orthopt.org

LEVELS OF EVIDENCE

Once the content experts of each subcategory had identified all relevant articles, they independently graded each article according to criteria described by the Center for Evidence-Based Medicine, Oxford, United Kingdom (Table 1 below). If the 2 content experts did not agree on a grade of evidence for a particular article, a third content expert was used to resolve the issue.

I	Evidence obtained from high-quality randomized controlled trials, prospective studies, or diagnostic studies
II	Evidence obtained from lesser-quality randomized controlled trials, prospective studies, or diagnostic studies (eg, improper randomization, no blinding, < 80% follow-up)
III	Case controlled studies or retrospective studies
IV	Case series
V	Expert opinion

GRADES OF EVIDENCE

The overall strength of the evidence supporting recommendations made in this guideline will be graded according to guidelines described by Guyatt et al,[71] as modified by MacDermid and adopted by the coordinator and reviewers of this project. In this modified system, the typical A, B, C, and D grades of evidence have been modified to include the role of consensus expert opinion and basic science research to demonstrate biological or biomechanical plausibility (Table 2 below).

GRADES OF RECOMMENDATION		STRENGTH OF EVIDENCE
A	Strong evidence	A preponderance of level I and/or level II studies support the recommendation. This must include at least 1 level I study
B	Moderate evidence	A single high-quality randomized controlled trial or a preponderance of level II studies support the recommendation
C	Weak evidence	A single level II study or a preponderance of level III and IV studies including statements of consensus by content experts support the recommendation
D	Conflicting evidence	Higher-quality studies conducted on this topic disagree with respect to their conclusions. The recommendation is based on these conflicting studies
E	Theoretical/ foundational evidence	A preponderance of evidence from animal or cadaver studies, from conceptual models/principles, or from basic sciences/bench research support this conclusion
F	Expert opinion	Best practice based on the clinical experience of the guidelines development team

Methods *(continued)*

REVIEW PROCESS

The Orthopaedic Section, APTA also selected consultants from the following areas to serve as reviewers of the early drafts of this clinical practice guideline:

- Claims review
- Coding
- Epidemiology
- Medical practice guidelines
- Orthopaedic physical therapy residency education
- Physical therapy academic education
- Sports physical therapy residency education

Comments from these reviewers were utilized by the authors to edit this clinical practice guideline prior to submitting it for publication to the Journal of Orthopaedic & Sports Physical Therapy

In addition, several physical therapists practicing in orthopaedic and sports physical therapy settings were sent initial drafts of this clinical practice guideline along with feedback forms to determine its usefulness, validity, and impact. All returned feedback forms from these practicing clinicians described this clinical practice guideline as:

- "Moderately useful" or "extremely useful"
- An "accurate representation of the peer-reviewed literature"
- A guideline that will have a "substantial positive impact on orthopaedic physical therapy patient care"

However, several reviewers noted that preliminary drafts of this clinical guideline did not clearly link data gathered during the patient's subjective and physical examinations to diagnostic classification and intervention. To assist in clarifying these links, it was recommended that the authors add a table to these clinical guidelines that provides a summary of symptoms, impairment findings, and matched interventions for each diagnostic category. This recommendation led the authors to add Table 4 to these clinical guidelines.

CLASSIFICATION

The primary ICD-10 codes and conditions associated with neck pain are: M54.2 Cervicalgia, M54.6 Pain in thoracic spine, R51 Headache, M53.0 Cervicocranial syndrome, S13.4 Sprain and strain of cervical spine, M47.2 Spondylosis with radiculopathy, and M50.1 Cervical disc disorder with radiculopathy.[87] The corresponding ICD-9 CM codes and conditions, which are used in the USA, are 723.1 Cervicalgia, 724.1 Pain in thoracic spine, 784.0 Headache, 723.2 Cervicocranial syndrome, 847.0 Sprains and strains of the neck, and 723.4 Brachial neuritis or radiculitis, not otherwise specified (Cervical radiculitis/Radicular syndrome of upper limbs).

The primary ICF body function codes associated with the above noted ICD-10 conditions are the sensory functions related to pain and the movement functions related to joint motion and control of voluntary movements. These body function codes are **b7101 Mobility of several joints, b28010 Pain in head and neck, b7601 Control of complex voluntary movements, and b2803 Radiating pain in a dermatome.**

The primary ICF body structure codes associated with neck pain are **s7103 Joints of head and neck region, s7104 Muscles of head and neck region, s7105 Ligaments and fasciae of head and neck region, s76000 Cervical vertebral column, and s1201 Spinal nerves.**

The primary ICF activities and participation codes associated with neck pain are **d4108 Changing a basic body position, d4158 Maintaining a body position, and d4452 Reaching.**

The ICD-10 and primary and secondary ICF codes associated with neck pain are provided in Table 3 (below).

ICD-10 and ICF Codes Associated With Neck Pain

INTERNATIONAL STATISTICAL CLASSIFICATION OF DISEASES AND RELATED HEALTH PROBLEMS		
Neck Pain With Mobility Deficits		
Primary ICD-10	M54.2 M54.6	Cervicalgia Pain in thoracic spine
Neck Pain With Headaches		
Primary ICD-10	R51 M53.0	Headache Cervicocranial syndrome
Neck Pain With Movement Coordination Impairments		
Primary ICD-10	S13.4	Sprain and strain of cervical spine
Neck Pain With Radiating Pain		
Primary ICD-10	M47.2 M50.1	Spondylosis with radiculopathy Cervical disc disorder with radiculopathy

INTERNATIONAL CLASSIFICATION OF FUNCTIONING, DISABILITY, AND HEALTH

PRIMARY ICF CODES

Neck Pain With Mobility Deficits		
Body functions	b7101	Mobility of several joints
Body structure	s76000	Cervical vertebral column
Activities and participation	d4108	Changing a basic body position, specified as moving the head and neck while looking to the left or to the right
Neck Pain With Headaches		
Body functions	b28010	Pain in head and neck
Body structure	s7103 s7104	Joints of head and neck region Muscles of head and neck region
Activities and participation	d4158	Maintaining a body position, specified as maintaining the head in a flexed position, such as when reading a book; or, maintaining the head in an extended position, such as when looking up at a video monitor
Neck Pain With Movement Coordination Impairments		
Body functions	b7601	Control of complex voluntary movements
Body structure	s7105	Ligaments and fasciae of head and neck region
Activities and participation	d4158	Maintaining a body position, specified as maintaining alignment of the head, neck, and thorax such that the cervical vertebral segments function in a neutral, or mid-range, position
Neck Pain With Radiating Pain		
Body functions	b2804	Radiating pain in a segment or region
Body structure	s1201	Spinal nerves
Activities and participation	d4452	Reaching

SECONDARY ICF CODES

Neck Pain With Mobility Deficits		
Body functions	b28010 b28013 b28014 b7101 b7151 b7305 b7350 b7400 b7601	Pain in head and neck Pain in back Pain in upper limb Mobility of several joints Stability of several joints Power of muscles of the trunk Tone of isolated muscles and muscle groups Endurance of isolated muscles Control of complex voluntary movements
Body structure	s12001 s130 s7103 s7104 s7105 s76000 s76001 s7601 s7602	Thoracic spinal cord Structure of meninges Joints of head and neck region Muscles of head and neck region Ligaments and fasciae of head and neck region Cervical vertebral column Thoracic vertebral column Muscles of trunk Ligaments and fasciae of trunk

INTERNATIONAL CLASSIFICATION OF FUNCTIONING, DISABILITY, AND HEALTH *(CONTINUED)*		
Activities and participation	d2302	Completing the daily routine
	d2400	Handling responsibilities
	d4100	Lying down
	d4105	Bending
	d4150	Maintaining a lying position
	d4750	Driving human-powered transportation
	d4751	Driving motorized vehicles
	d4752	Driving animal-powered transportation
	d4554	Swimming
	d6409	Doing housework, unspecified
	d9109	Community life, unspecified
	d9209	Recreation and leisure, unspecified
Neck Pain With Headaches		
Body functions	b2803	Radiating pain in a dermatome
	b2804	Radiating pain in a segment or region
	b7101	Mobility of several joints
	b7151	Stability of several joints
	b7305	Power of muscles of the trunk
	b7350	Tone of isolated muscles and muscle groups
	b7400	Endurance of isolated muscles
	b7601	Control of complex voluntary movements
	b2359	Vestibular functions, unspecified
	b2409	Sensations associated with hearing and vestibular function, unspecified
Body structure	s12000	Cervical spinal cord
	s12001	Thoracic spinal cord
	s1201	Spinal nerves
	s130	Structure of meninges
	s7105	Ligaments and fasciae of head and neck region
	s76001	Thoracic vertebral column
	s76000	Cervical vertebral column
	s7601	Muscles of trunk
Activities and participation	d163	Thinking
	d166	Reading
	d2302	Completing the daily routine
	d2400	Handling responsibilities
	d4150	Maintaining a lying position
	d4153	Maintaining a sitting position
	d4154	Maintaining a standing position
	d4750	Driving human-powered transportation
	d4751	Driving motorized vehicles
	d4752	Driving animal-powered transportation
	d6409	Doing housework, unspecified
	d9109	Community life, unspecified
	d9209	Recreation and leisure, unspecified
Neck Pain With Movement Coordination Impairments		
Body functions	b28010	Pain in head and neck
	b28013	Pain in back
	b28014	Pain in upper limb
	b7151	Stability of several joints
	b7305	Power of muscles of the trunk
	b7400	Endurance of isolated muscles
	b7602	Coordination of voluntary movements

INTERNATIONAL CLASSIFICATION OF FUNCTIONING, DISABILITY, AND HEALTH *(CONTINUED)*		
Body structure	s7103	Joints of head and neck region
	s7104	Muscles of head and neck region
	s76000	Cervical vertebral column
	s76001	Thoracic vertebral column
	s7601	Muscles of trunk
	s7602	Ligaments and fasciae of trunk
Activities and participation	d2302	Completing the daily routine
	d2400	Handling responsibilities
	d4105	Bending
	d4153	Maintaining a sitting position
	d4154	Maintaining a standing position
	d4750	Driving human-powered transportation
	d4751	Driving motorized vehicles
	d4752	Driving animal-powered transportation
	d6409	Doing housework, unspecified
	d9109	Community life, unspecified
	d9209	Recreation and leisure, unspecified
Neck Pain With Radiating Pain		
Body functions	b28013	Pain in back
	b28014	Pain in upper limb
	b2803	Radiating pain in a dermatome
	b7101	Mobility of several joints
	b7151	Stability of several joints
	b7305	Power of muscles of the trunk
	b7350	Tone of isolated muscles and muscle groups
	b7400	Endurance of isolated muscles
	b7601	Control of complex voluntary movements
Body structure	s12000	Cervical spinal cord
	s12001	Thoracic spinal cord
	s1201	Spinal nerves
	s130	Structure of meninges
	s7105	Ligaments and fasciae of head and neck region
	s76000	Cervical vertebral column
	s76001	Thoracic vertebral column
	s7601	Muscles of trunk
	s7602	Ligaments and fasciae of trunk
Activities and participation	d2302	Completing the daily routine
	d2400	Handling responsibilities
	d4150	Maintaining a lying position
	d4153	Maintaining a sitting position
	d4154	Maintaining a standing position
	d4300	Lifting
	d4301	Carrying in the hands
	d4302	Carrying in the arms
	d4303	Carrying on shoulders, hip, and back
	d4304	Carrying on the head
	d4305	Putting down objects
	d4750	Driving human-powered transportation
	d4751	Driving motorized vehicles
	d4752	Driving animal-powered transportation
	d6409	Doing housework, unspecified
	d9109	Community life, unspecified
	d9209	Recreation and leisure, unspecified

CLINICAL GUIDELINES

Impairment/Function-based Diagnosis

PREVALENCE

Pain and impairment of the neck is common. It is estimated that 22% to 70% of the population will have neck pain some time in their lives.[19,20,42,43,55,115,129] In addition, it has been suggested that the incidence of neck pain is increasing.[126,181] At any given time, 10% to 20% of the population reports neck problems,[19,44,78,167] with 54% of individuals having experienced neck pain within the last 6 months.[42] Prevalence of neck pain increases with age and is most common in women around the fifth decade of life.[4,19,46,116,163]

Although the natural history of neck pain appears to be favorable,[51,92] rates of recurrence and chronicity are high.[15,81] One study reported that 30% of patients with neck pain will develop chronic symptoms, with neck pain of greater than 6 months duration affecting 14% of all individuals who experience an episode of neck pain.[19] Additionally, a recent survey demonstrated that 37% of individuals who experience neck pain will report persistent problems for at least 12 months.[44] Five percent of the adult population with neck pain will be disabled by the pain, representing a serious health concern.[19,88] In a survey of workers with injuries to the neck and upper extremity, Pransky et al[135] reported that 42% missed more than 1 week of work and 26% experienced recurrence within 1 year. The economic burden due to disorders of the neck is high, and includes costs of treatment, lost wages, and compensation expenditures.[16,138] Neck pain is second only to low back pain in annual workers' compensation costs in the United States.[181] In Sweden, neck and shoulder problems account for 18% of all disability payments.[126] Jette et al[91] reported that patients with neck pain make up approximately 25% of patients receiving outpatient physical therapy. Additionally, patients with neck pain frequently are treated without surgery by primary care and physical therapy providers.[17,51,92]

PATHOANATOMICAL FEATURES

A variety of causes of neck pain have been described and include osteoarthritis, discogenic disorders, trauma, tumors, infection, myofascial pain syndrome, torticollis, and whiplash.[121] Unfortunately, clearly defined diagnostic criteria have not been established for many of these entities. Similar to low back pain, a pathoanatomical cause is not identifiable in the majority of patients who present with complaints of neck pain and neck related symptoms of the upper quarter.[15] Therefore, once serious medical pathology (such as cervical fracture or myelopathy) has been ruled out, patients with neck pain are often classified as having either a nerve root compromise or a "mechanical neck disorder."

II In some conditions, particularly those that are degenerative in nature or involve abnormalities of the vertebral motion segment, abnormal findings are not always associated with symptoms. Fourteen to 18% of people without neck pain demonstrate a wide range of abnormalities with imaging studies, including disc protrusion or extrusion and impingement of the thecal sac on the nerve root and spinal cord.[12] However, degenerative changes are still suggested to be a possible cause of mechanical neck pain in some cases,[109,130,131] despite the fact that these changes are present in asymptomatic individuals, are non-specific, and are highly prevalent in the elderly.[168] Disorders such as cervical radiculopathy and cervical compressive myelopathy are reported to be caused by space-occupying lesions (osteophytosis or herniated cervical disc). These may be secondary to degenerative processes and can give rise to neck and/or upper quarter pain as well as neurologic signs and symptoms.[136] While cervical disc herniation and spondylosis are most commonly linked to cervical radiculopathy and myelopathy,[10,136] the bony and ligamentous tissues affected by these conditions are themselves pain generators and are capable of giving rise to some of the referred symptoms observed in patients with these disorders.[13,40]

II Because most patients with neck pain usually lack an identifiable pathoanatomic cause for their problem, the majority are classified as having mechanical neck disorders.[82]

E Although the cause of neck pain may be associated with degenerative processes or pathology identified during diagnostic imaging, the tissue that is causing a patient's neck pain is most often unknown. Thus, clinicians should assess for impaired function of muscle, connective, and nerve tissues associated with the identified pathological tissues when a patient presents with neck pain.

RISK FACTORS

II Bot and colleagues[18] investigated the clinical course and predictors of recovery for patients with neck and shoulder pain. Four hundred forty three patients who consulted their primary care physician with neck or shoulder symptoms were followed for 12 months. At 12 months, 32% of patients reported that they had recovered. Predictors of poor pain-related outcome at 12 months included less intense pain at baseline, a history of neck and shoulder symptoms, more worrying, worse perceived health, and a moderate or bad quality of life. The predictors for a poor disability-related response at 12 months included older age, less disability at baseline, longer duration of symptoms, loss of strength in hands, having multiple symptoms, more worrying, moderate or bad quality of life, and less vitality.

II Hill and colleagues[76] investigated the course of neck pain in an adult population over a 12 month period. Significant baseline characteristics, which predicted persistent neck pain were age (45-59 years), being off work at the time of the baseline survey (odds ratio [OR] = 1.6), comorbid low back pain (OR = 1.6), and bicycling as a regular activity (OR = 2.4).

II In a prospective cohort study, Hoving et al[80] examined the predictors of outcome in a patient population with neck pain. A total of 183 patients participated in the study of which 63% had improved at a 12-month follow-up. In the short term, older age (≥40), concomitant low back pain, and headache were associated with poor outcome. In the long-term, in addition to age and concomitant low back pain, previous trauma, a long duration of neck pain, stable neck pain during the 2 weeks prior to baseline measurement, and previous neck pain predicted poor prognosis.

B Clinicians should consider age greater than 40, coexisting low back pain, a long history of neck pain, bicycling as a regular activity, loss of strength in the hands, worrisome attitude, poor quality of life, and less vitality as predisposing factors for the development of chronic neck pain.

CLINICAL COURSE

Approximately 44% of patients experiencing neck pain will go on to develop chronic symptoms,[15] and many will continue to exhibit moderate disability at long-term follow-up.[66] A recent systematic review examined the outcomes of non-treatment control groups in clinical trials for the conservative management of chronic mechanical neck pain - not due to whiplash.[171] The outcomes of patients receiving a control or placebo intervention were analyzed and effect sizes were calculated. The changes in pain scores over the varying trial periods in these untreated subjects with chronic mechanical neck pain were consistently small and not significant.[171]

Conversely, there is substantial evidence that favorable outcomes are attained following treatment of patients with cervical radiculopathy.[79,136] For example, Radhakrishnan and colleagues[136] reported that nearly 90% of patients with cervical radiculopathy presented with only mild symptoms at a median follow-up of 4.9 years. Honet and Puri[79] found that 70% of patients with cervical radiculopathy exhibited good or excellent outcomes after a 2-year follow-up. Outcomes for the patients in the aforementioned studies[79,136] appeared favorable and suggest that 70-90% of this population can experience improvement without surgical intervention. In contrast, the clinical prognosis of patients with whiplash-associated disorder is less favorable. A survey of 108 patients with a history of whiplash requiring care at an emergency department found that 55% had residual pain/disability referable to the original accident at a mean follow-up of 17 years later. Neck pain, radiating pain, and headache were the most common symptoms. Thirty-three percent of the respondents with residual symptoms suffered from work disability, compared to 6% in the group of patients without residual disorders.[25]

DIAGNOSIS/CLASSIFICATION

III Strategies for the classification of patients with neck pain have been recently proposed by Wang et al,[177] Childs et al,[27] and Fritz and Brennan.[62] The underlying premise is that classifying patients into groups based on clinical characteristics and matching these patient subgroups to management strategies likely to benefit them will improve the outcome of physical therapy interventions.[27] The classification system described by Wang et al[177] categorized patients into 1 of 4 subgroups based on the area of symptoms and the presumed source of the symptoms. The labels of these 4 categories were neck pain only, headaches, referred arm pain and neck pain, and radicular arm pain and neck pain. Distinct treatment approaches were linked to each of the 4 categories. Wang et al[177] reported the results of 30 patients treated using this classification strategy as well as 27 patients who were not treated. Statistically and clinically significant reductions in pain and disability were reported for the classification group only.[177] It is difficult to draw conclusions regarding the potential usefulness of the Wang et al[177] classification system because patients in the control group were not treated, which is not reflective of physical therapy practice. The classification system described by Childs et al[27] and Fritz and Brennan[62] uses information from the history and physical examination to place patients into 1 of 5 separate treatment subgroups. The labels of these 5 subgroups, which are mobility, centralization, exercise and

conditioning, pain control, and headache, intend to capture the primary focus or goal of treatment. Fritz and Brennan,[62] utilizing a prospective, observational study of 274 patients, reported that patients who received interventions matched with their treatment subgroup had better outcomes than patients who received interventions that were not matched with their subgroup. The classification system described in this practice guideline linked to the ICF, parallels the Childs et al[27] and Fritz and Brennan[62] classification with 2 noteworthy differences. The first difference is that the labels in this clinical practice guideline incorporate the following ICF impairments of body functions terminology: Neck pain with mobility deficits, neck pain with headaches, neck pain with movement coordination impairments, and neck pain with radiating pain. The second difference is that Fritz and Brennan's[62] "pain control" category, which was linked to mobilization and range of motion exercises following an acute cervical sprain, was divided into the "neck pain with movement coordination impairments," and "neck pain with mobility deficits" categories, where the patient would receive interventions linked to the most relevant impairment(s) exhibited at a given period during the patient's episode of care.

I The ICD diagnosis of cervicalgia, or pain in thoracic spine and the associated ICF diagnosis of neck pain with mobility deficits is made with a reasonable level of certainty when the patient presents with the following clinical findings[33,62,82,166]:

- Younger individual (age <50 years)
- Acute neck pain (duration <12 weeks)
- Symptoms isolated to the neck
- Restricted cervical range of motion

II The ICD diagnosis of headaches, or cervicocranial syndrome and the associated ICF diagnosis of neck pain with headaches is made with a reasonable level of certainty when the patient presents with the following clinical findings[6,62,99,185]:

- Unilateral headache associated with neck/suboccipital area symptoms that are aggravated by neck movements or positions
- Headache produced or aggravated with provocation of the ipsilateral posterior cervical myofascia and joints
- Restricted cervical range of motion
- Restricted cervical segmental mobility
- Abnormal/substandard performance on the cranial cervical flexion test

I The ICD diagnosis of sprain and strain of cervical spine and the associated ICF diagnosis of neck pain with movement coordination impairments is made with a reasonable level of certainty when the patient presents with the following clinical findings[22,29,145,162,182,184]:

- Longstanding neck pain (duration >12 weeks)
- Abnormal/substandard performance on the cranial cervical flexion test
- Abnormal/substandard performance on the deep flexor endurance test
- Coordination, strength, and endurance deficits of neck and upper quarter muscles (longus colli, middle trapezius, lower trapezius, serratus anterior)
- Flexibility deficits of upper quarter muscles (anterior/middle/posterior scalenes, upper trapezius, levator scapulae, pectoralis minor, pectoralis major)
- Ergonomic inefficiencies with performing repetitive activities

II The ICD diagnosis of spondylosis with radiculopathy or cervical disc disorder with radiculopathy and the associated ICF diagnosis of neck pain with radiating pain is made with a reasonable level of certainty when the patient presents with the following clinical findings[175]:

- Upper extremity symptoms, usually radicular or referred pain, that are produced or aggravated with Spurling's maneuver and upper limb tension tests, and reduced with the neck distraction test
- Decreased cervical rotation (<60°) toward the involved side
- Signs of nerve root compression
- Success with reducing upper extremity symptoms with initial examination and intervention procedures

B Neck pain, without symptoms or signs of serious medical or psychological conditions, associated with (1) motion limitations in the cervical and upper thoracic regions, (2) headaches, and (3) referred or radiating pain into an upper extremity are useful clinical findings for classifying a patient with neck pain into the following International Statistical Classification of Diseases and Related Health Problems (ICD) categories: cervicalgia, pain in thoracic spine, headaches, cervicocranial syndrome, sprain and strain of cervical spine, spondylosis with radiculopathy, and cervical disc disorder with radiculopathy; and the associated International Classification of Functioning, Disability, and Health (ICF) impairment-based category of neck pain with the following impairments of body function:

- Neck pain with mobility deficits (b7101 Mobility of several joints)
- Neck pain with headaches (28010 Pain in head and neck)
- Neck pain with movement coordination impairments (b7601 Control of complex voluntary movements)
- Neck pain with radiating pain (b2804 Radiating pain in a segment or region)

The following physical examination measures may be useful in classifying a patient in the ICF impairment-based category

of neck pain with mobility deficits and the associated ICD categories of cervicalgia or pain in thoracic spine:
- Cervical active range of motion
- Cervical and thoracic segmental mobility

The following physical examination measures may be useful in classifying a patient in the ICF impairment-based category of neck pain with headaches and the associated ICD categories of headaches or cervicocranial syndrome:
- Cervical active range of motion
- Cervical segmental mobility
- Cranial cervical flexion test

The following physical examination measures may be useful in classifying a patient in the ICF impairment-based category of neck pain with movement coordination impairments and the associated ICD category of sprain and strain of cervical spine:
- Cranial cervical flexion test
- Deep neck flexor endurance

The following physical examination measures may be useful in classifying a patient in the ICF impairment-based category of neck pain with radiating pain and the associated ICD categories of spondylosis with radiculopathy or cervical disc disorder with radiculopathy:
- Upper limb tension test
- Spurling's test
- Distraction test

DIFFERENTIAL DIAGNOSIS

III A primary goal of diagnosis is to match the patient's clinical presentation with the most efficacious treatment approach. A component of this decision is determining whether the patient is, in fact, appropriate for physical therapy management. In the vast majority of patients with neck pain, symptoms can be attributed to mechanical factors. However, in a much smaller percentage of patients, the cause of neck pain may be something more serious, such as cervical myelopathy, cervical instability,[49] fracture,[77] neoplastic conditions,[90,140,152,154] vascular compromise,[151] or systemic disease.[8,24] Clinicians must be aware of the key signs and symptoms associated with serious pathological neck conditions, continually screen for the presence of these conditions, and initiate referral to the appropriate medical practitioner when a potentially serious medical condition is suspected.

I When a patient with neck pain reports a history of trauma, the therapist needs to be particularly alert for the presence of cervical instability, spinal fracture, and the presence of or potential for spinal cord or brain stem injury. A clinical prediction rule has been developed to assist clinicians in determining when to order radiographs in individuals who have experienced trauma.[159]

II In addition to medical conditions, clinicians should be aware of psychosocial factors that may be contributing to a patient's persistent pain and disability, or that may contribute to the transition of an acute condition to a chronic, disabling condition. Researchers have recently shown that psychosocial factors are an important prognostic indicator of prolonged disability.[63,64,114,150] When relevant psychosocial factors are identified, the rehabilitation approach may need to be modified to emphasize active rehabilitation, graded exercise programs, positive reinforcement of functional accomplishments, and/or graduated exposure to specific activities that a patient fears as potentially painful or difficult to perform.[65]

B Clinicians should consider diagnostic classifications associated with serious pathological conditions or psychosocial factors when the patient's reported activity limitations or impairments of body function and structure are not consistent with those presented in the diagnosis/classification section of this guideline, or, when the patient's symptoms are not resolving with interventions aimed at normalization of the patient's impairments of body function.

IMAGING STUDIES

Adults with cervical pain precipitated by trauma should be classified as low risk or high risk based on the Canadian Cervical Spine Rule (CCR) for radiography in alert and stable trauma patients[159] and the 2001 American College of Radiology (ACR) suspected Spine Trauma Appropriateness Criteria.[3] According to the CCR, patients who (1) are able to sit in the emergency department; or (2) have had a simple rear-end motor vehicle collision; or (3) are ambulatory at any time; or (4) have had a delayed onset of neck pain; or (5) do not have midline cervical spine tenderness; and (6) are able to actively rotate their head 45° in each direction, are classified as low risk. Those who are classified as low risk do not require imaging for acute conditions. Patients who are (1) greater than 65 years of age; or (2) have had a dangerous mechanism of injury; or (3) have paresthesias in the extremities, are classified as high risk.[159] Those classified as high risk should undergo cervical radiography.[9,47]

There is a paucity of available literature regarding the pediatric population to help guide decision making on the need for imaging. Adult risk classification features should be applied in children greater than age 14. Due to the added radiation exposure of computed tomography the ACR recommends plain radiography (3 views) in those under 16 years of age regardless of mental status.[3]

There is no consensus for routine investigation of patients with chronic neck pain with imaging beyond plain radiographs.[3,48] Routine use of ultrasonography, CT, and magnetic resonance imaging (MRI) in patients without neurologic insult or other disease has not been justified in view of the infrequency of abnormalities detected, the lack of prognostic value, inaccessibility, and the high cost of the procedures.[14,73,119,133,141,146,174] A major limitation is the lack of specific findings in patients with neck disorder and no definite correlation between the patient's subjective symptoms and abnormal findings seen on imaging studies. As a result, debate continues as to whether persistent pain is attributable to structural pathology or to other underlying causes.

Recently, Kristjansson[111] compared sagittal plane, rotational, and translational cervical segmental motion in women with (1) persistent whiplash-associated disorder (WAD) (grades I and II), (2) persistent non-traumatic, insidious onset of neck pain, and (3) normal values of rotational and translational motion. Lateral radiographic analysis revealed significantly increased rotational motion at C3-4 and C4-5 for individuals in the WAD and insidious groups, significantly excessive translational motion at C3-4 for individuals in the WAD and insidious groups, and significantly excessive translational motion at C5-6 for individuals in the WAD group when compared to normal subjects.

Ultrasonography has been used to accurately measure the size of the cervical multifidus muscle at the C4 level in asymptomatic female subjects. For those with chronic WAD, ultrasonography did not accurately measure the cervical multifidus because the fascial borders of the multifidus were largely indistinguishable, indicating possible pathological conditions.[110]

High resolution proton density-weighted MRI has recently demonstrated abnormal signal intensity (indicative of tissue damage) in both the alar and transverse ligaments in some subjects with chronic WAD.[108] Later follow-up studies indicated a strong relationship between alar ligament damage, head position (turned) at time of impact, and disability levels (as measured with the Neck Disability Index).[101,102,107]

Elliott et al[53] have demonstrated that female patients (18-45 years old) with persistent WAD (grade II) show MRI changes in the fat content of the cervical extensor musculature that were not present in subjects with chronic insidious onset neck pain or healthy controls. It is currently unclear whether the patterns of fatty infiltration are the result of local structural trauma causing a general inflammatory response, a specific nerve injury or insult, or a generalized disuse phenomenon. Further, as the muscular changes were observed in the chronic state, it is not yet known whether they occur uniformly in all people who have sustained whiplash injury irrespective of recovery or are unique to only those who develop chronic symptoms.

In addition to fatty infiltration, Elliott et al[54] have identified changes in the relative cross-sectional area (rCSA) of the cervical paraspinal musculature in patients with chronic WAD relative to control subjects with no history of neck pain. Specifically, the WAD group demonstrated a consistent pattern of larger rCSA in the multifidii muscles at each segment (C3-C7). Inference can be drawn that the larger rCSAs recorded in the multifidii muscles of those with chronic WAD are the result of larger amounts of fatty infiltrate.

In summary, imaging studies often fail to identify any structural pathology related to symptoms in patients with neck disorder and in particular, whiplash injury. However, emerging evidence into upper cervical ligamentous disruption, altered segmental motion, and muscular degeneration has been demonstrated with radiographs, ultrasonography, and MRI studies. It remains unknown if (1) these findings are unique to chronic WAD; (2) whether they relate to patients' physical signs and symptoms, and (3) whether specific physical therapy intervention can alter such degeneration. Such knowledge may offer prognostic information and provide the foundation for interventional based studies.

CLINICAL GUIDELINES

Examination

OUTCOME MEASURES

I The Neck Disability Index (NDI) is a commonly utilized outcome measure to capture perceived disability in patients with neck pain.[134] The NDI contains 10 items, 7 related to activities of daily living, 2 related to pain, and 1 related to concentration.[172] Each item is scored from 0-5 and the total score is expressed as a percentage, with higher scores corresponding to greater disability. Riddle and Stratford[139] identified a significant association between the NDI and both the physical and mental health components of the SF-36. The authors also identified that the NDI possesses adequate sensitivity as compared to the magnitude of change that occurred for patients reaching their functional goals, work status, and if the patient was currently in litigation.[139] Jette and Jette[92] further substantiated the sensitivity to change by calculating the effect sizes for change scores of both the NDI and SF-36.

Two studies[161,179] with small sample sizes have identified the minimal detectable change, or the amount of change that must be observed before the change can be considered to exceed the measurement error, for the NDI. Westaway[179] identified the minimal detectable change as 5 (10 percentage points) in a group of 31 patients with neck pain. Stratford and colleagues[161] identified the minimal detectable change also to be 5 (10 percentage points) in a group of 48 patients with neck pain. However, the minimum clinically important difference, the smallest difference which patients perceive as beneficial, may be more useful to clinicians.[89] Stratford and colleagues[161] identified the minimal clinically important difference as 5 points (10 percentage points). More recently, Cleland and colleagues,[35] described the minimum clinically important difference for the NDI to be 9.5 (19 percentage points) for patients with mechanical neck disorders.

The NDI has demonstrated moderate test re-test reliability and has been shown to be a valid health outcome measure in a patient population with cervical radiculopathy.[37] In this group, the intraclass correlation coefficient (ICC) for test re-test reliability was 0.68 for the NDI and the minimum clinically important difference was 7 (14 percentage points).[37]

I The Patient-Specific Functional Scale (PSFS) is a practical alternative or supplement to generic and condition-specific measures.[179] The PSFS asks patients to list 3 activities that are difficult as a result of their symptoms, injury, or disorder. The patient rates each activity on a 0-10 scale, with 0 representing the inability to perform the activity, and 10 representing the ability to perform the activity as well as they could prior to the onset of symptoms.[160] The final PSFS score is the average of the 3 activity scores. The PSFS was developed by Stratford et al[160] in an attempt to present a standardized measure for recording a patient's perceived level of disability across a variety of conditions. The PSFS has been evaluated for reliability and validity in patients with neck pain.[179] The ICC value for test retest reliability in patients with cervical radiculopathy was 0.82.[37] The minimal detectable change in that population was identified to be 2.1 points with a minimum clinically important difference of 2.0.[37]

A Clinicians should use validated self-report questionnaires, such as the Neck Disability Index and the Patient-Specific Functional Scale for patients with neck pain. These tools are useful for identifying a patient's baseline status relative to pain, function, and disability and for monitoring a change in patient's status throughout the course of treatment.

ACTIVITY LIMITATION AND PARTICIPATION RESTRICTION MEASURES

V There are no activity limitation and participation restriction measures specifically reported in the literature associated with neck pain - other than those that are part of the self-report questionnaire noted in this guideline's section on Outcome Measures. However, the following measures are options that a clinician may use to assess changes in a patient's level of function over an episode of care.

- Pain level at end ranges of looking over shoulder
- Pain level at end ranges of looking down
- Pain level at end ranges of looking up
- Pain level after sitting for 2 hours
- Number of times per night that pain disrupts sleep
- Deskwork tolerance (in number of minutes or hours)
- Percent of time experiencing neck pain over the previous 24 hours
- Percent of time experiencing headache(s) over the previous month

In addition, the Patient-Specific Functional Scale is a questionnaire that can be used to quantify changes in activity limitations and participation restrictions for patients with neck pain.[160] This scale enables the clinician to collect measures related to function that may be different then the measures that are components of the region-specific outcome measures section such as the Neck Disability Index.[179]

F Clinicians should utilize easily reproducible activity limitation and participation restriction measures associated with their patient's neck pain to assess the changes in the patient's level of function over the episode of care.

PHYSICAL IMPAIRMENT MEASURES

CERVICAL ACTIVE RANGE OF MOTION

ICF category	Measurement of impairment of body function – mobility of several joints
Description	The amount of active neck flexion, extension, rotation, and sidebending motion measured using an inclinometer
Measurement method	All cervical range of motion (ROM) measures are performed in the upright sitting position. Care should be taken to ensure the patient maintains an upright sitting position throughout the examination and during subsequent follow-up examinations. The following procedures are used to measure the ROM for the cervical spine. **Neck Flexion/Extension:** For neck flexion, the inclinometer is placed on the top of the patient's head aligned with the external auditory meatus and then zeroed. The patient is asked to flex the head forward as far as possible, bringing the chin to the chest. The amount of neck flexion is recorded from the inclinometer. For extension ROM, the inclinometer is positioned in the same manner, and the patient is asked to extend the neck backwards as far as possible. The amount of neck extension is recorded with the inclinometer. **Neck Sidebending:** The inclinometer is positioned in the frontal plane on the top of the patient's head in alignment with the external auditory meatus. To measure right sidebending, the patient is asked to move the right ear to the right shoulder. The amount of sidebending is recorded with the inclinometer. The opposite is performed to measure left sidebending. Care should be taken to avoid concomitant rotation or flexion with the sidebending movement. **Neck Rotation:** Rotation can be measured with a universal/standard goniometer. The patient is seated, looking directly forward with the neck in neutral position. The fulcrum of the goniometer is placed over the top of the head with the stationary arm aligned with the acromion process of the shoulder, and the moveable arm bisecting the patient's nose. The patient is asked to rotate in each direction as far as possible.
Nature of variable	Continuous
Units of measurement	Degrees
Measurement properties	Cervical ROM measurements for flexion, extension, and sidebending using a bubble inclinometer have exhibited reliability coefficients ranging from 0.66 to 0.84 ($ICC_{2,1}$).[32,175]
Instrument variations	In addition to using an inclinometer,[5,83,128,180] cervical ROM can also be measured for clinical purposes using a cervical range of motion (CROM) device[113,165] or a tape measure. All methods are moderately correlated with more definitive radiographic and 3D kinematic measurement.[4,5]

CERVICAL AND THORACIC SEGMENTAL MOBILITY

ICF category	Measurement of impairment of body function – mobility of single joints
Description	With the patient prone, cervical and thoracic spine segmental movement and pain response are assessed
Measurement method	The patient is prone. The examiner contacts each cervical spinous process with the thumbs. The lateral neck musculature is gently pulled slightly posterior with the fingers. The examiner should be directly over the contact area keeping elbows extended, then he/she uses the upper trunk to impart a posterior to anterior force in a progressive oscillatory fashion over the spinous process. This is repeated for each cervical segment. The examiner then changes his/her contact position and places the hypothenar eminence (just distal to the pisiform) of one hand over the spinous process of each thoracic spinous process and repeats the same posterior to anterior forces in a progressive oscillatory fashion. The test result is considered to be positive if the patient reports reproduction of pain. The mobility of the segment is judged to be normal, hypermobile, or hypomobile. Interpretation of mobility is based on the examiner's perception of the mobility at each spinal segment relative to those above and below the tested segment, and based on the examiner's experience and perception of normal mobility.
Nature of variable	Nominal (pain response) and ordinal (mobility judgment)

CERVICAL AND THORACIC SEGMENTAL MOBILITY (CONTINUED)

Units of measurement	None
Diagnostic accuracy and measurement properties	Diagnostic Accuracy[144]: Pain during segmental testing associated with reports of neck pain. Sensitivity = 0.82; negative likelihood ratio (-LR) = 0.23 Specificity = 0.79; positive likelihood ratio (+LR) = 3.9 Reliability for cervical spine assessment: Kappa = 0.14 to 0.37 (pain)[169] ICC = 0.42 to 0.79 (pain)[11] ICC = 0.78 to 1.0 (presence of joint dysfunction in upper 3 cervical spine segments)[100] Weighted kappa: -0.26 to 0.74 (mobility), -0.52 to 0.90 (pain)[32] Reliability for thoracic spine assessment: Weighted kappa: 0.13 to 0.82 (mobility), -0.11 to 0.90 (pain)[32]

CRANIAL CERVICAL FLEXION TEST

ICF category	Measurement of impairment of body function – control of simple voluntary movements and endurance of isolated muscles
Description	In supine, the ability to initiate and maintain isolated cranial and cervical flexion
Measurement method	Patient is positioned supine in hook lying and the head and neck in mid-range neutral (imaginary line between forehead and chin and imaginary line between the tragus of the ear and the neck longitudinally should be parallel to each other and the surface of the treatment table). Towels may be needed under the occiput to achieve this neutral position. A pneumatic pressure device, such as a pressure biofeedback unit, is inflated to 20 mmHg to fill the space between the cervical lordotic curve and the surface of the table (behind the suboccipital region, not below the lower cervical area). While keeping the posterior head/occiput stationary (do not lift, do not push down), the patient performs cranial cervical flexion (CCF) in a graded fashion in 5 increments (22, 24, 26, 28, and 30 mmHg) and aims to hold each position for 10 seconds. Ten seconds rest is provided between stages. To perform CCF, the patient is instructed to gently nod the head as though they were saying "yes" with the upper neck. This motion will flatten the cervical lordosis, thus changing the pressure in the pneumatic pressure device. While the patient is performing the test movement, the therapist palpates the neck to monitor for unwanted activation of the superficial cervical muscles, such as the sternocleidomastoid. The patient can place his/her tongue on the roof of the mouth, with lips together but the teeth slightly separated, to help decrease platysma and/or hyoid activation. The test is graded according to the pressure level the patient can achieve with concentric contractions and accurately sustain isometrically. The test is terminated when the pressure is decreased by more than 20% or when the patient cannot perform the proper CCF movement without substitution strategies. A normal response is for the pressure to increase to between 26-30 mmHg and be maintained for 10 seconds without utilizing superficial cervical muscle substitution strategies. An abnormal response is where the patient: 1. Is unable to generate an increase in pressure of at least 6 mmHg, 2. Is unable to hold the generated pressure for 10 seconds, 3. Uses superficial neck muscles to accomplish the cervical flexion motion, or 4. Uses a sudden movement of the chin or pushing (extending) the neck forcefully against the pressure device Scoring: • Activation Score: Pressure achieved and held for 10 second • Performance Index: Increase in Pressure × number of repetitions
Nature of variable	Continuous
Units of measurement	mmHg for the activation score
Measurement properties	Reliability assessment for 50 asymptomatic subjects, tested twice (1 week apart): Activation score: ICC=0.81; Performance Index: ICC=.93[96]

NECK FLEXOR MUSCLE ENDURANCE TEST

ICF category	Measurement of impairment of body function – endurance of isolated muscles
Description	In supine, the ability to lift the head and neck against gravity for an extended period

NECK FLEXOR MUSCLE ENDURANCE TEST (CONTINUED)

Measurement method	The test is performed in a supine, hook-lying position. With the chin maximally retracted and maintained isometrically, the patient lifts the head and neck until the head is approximately 2.5 cm (1 in) above the plinth while keeping the chin retracted to the chest. The clinician focuses on the skin folds along the patient's neck and places a hand on the table just below the occipital bone of the patient's head. Verbal commands (ie, "Tuck your chin" or "Hold your head up") are given when either the skin fold(s) begins to separate or the patient's occiput touches the clinician's hand. The test is terminated if the skin fold(s) is separated due to loss of chin tuck or the patient's head touches the clinician's hand for more than 1 second.[75]
Nature of variable	Continuous
Units of measurement	Seconds
Measurement properties	In a study by Harris et al,[75] 41 subjects with and without neck pain performed this test. Two raters tested all subjects at baseline, and subjects without neck pain were tested again 1 week later. Reliability: Subjects without neck pain: ICC (3,1) = 0.82 to 0.91, SEM 8.0 - 11.0 seconds ICC (2,1) = 0.67 to 0.78, SEM 12.6 - 15.3 seconds Subjects with neck pain: ICC (2,1) = 0.67, SEM 11.5 seconds Test results: Subjects without neck pain: Mean 38.95 seconds (SD=26.4) Subjects with neck pain: Mean 24.1 seconds (SD=12.8)

UPPER LIMB TENSION TEST

ICF category	Measurement of impairment of structure of the nervous system, other specified
Description	In non-weight bearing, the amount of mobility of the neural elements of the upper limb are assessed while determining whether the patient's upper quarter symptoms are elicited during performance of the test
Measurement method	Upper limb tension tests are performed with the patient supine. During performance of the upper limb tension test that places a bias toward testing the patient's response to tension placed on the median nerve, the examiner sequentially introduces the following movements to the symptomatic upper extremity: • Scapular depression • Shoulder abduction to about 90° with the elbow flexed • Forearm supination, wrist and finger extension • Shoulder lateral rotation • Elbow extension • Contralateral then ipsilateral cervical side-bending A positive test occurs when any of the following findings are present: 1. reproduction of all or part of the patient's symptoms 2. side-to-side differences of greater than 10° of elbow extension or wrist extension 3. on the symptomatic side, contralateral cervical side-bending increases the patient's symptoms, or ipsilateral side-bending decreases the patient's symptoms
Nature of variable	Nominal
Units of measurement	None

Diagnostic accuracy indices for the upper limb tension test, based on the study by Wainner et al[175]

		95% Confidence Interval
Kappa	0.76	0.51-1.0
Sensitivity	0.97	0.90-1.0
Specificity	0.22	0.12-0.33
Positive likelihood ratio	1.30	1.10-1.5
Negative likelihood ratio	0.12	0.01-1.9

SPURLING'S TEST

ICF category	Measurement of impairment of structure of the nervous system, other specified

Spurling's Test (continued)

Description	Combination of sidebending to the symptomatic side coupled with compression to reduce the diameter of the neural foramen and elicit the patient's symptoms		
Measurement method	The patient is seated and is asked to sidebend and slightly rotate the head to the painful side. The examiner places a compression force of approximately 7 kg through the top of the head in an effort to further narrow the intervertebral foramen. The test is considered positive when it reproduces the patient's symptoms. The test is not indicated if the patient has no upper extremity or scapular region symptoms.		
Nature of variable	Nominal/dichotomous		
Units of measurement	None		
Diagnostic accuracy indices for Spurling's test, based on the study by Wainner et al[175]			95% Confidence Interval
	Kappa	0.60	0.32 - 0.87
	Sensitivity	0.50	0.27 - 0.73
	Specificity	0.86	0.77 - 0.94
	Positive likelihood ratio	3.50	1.60 - 7.50
	Negative likelihood ratio	0.58	0.36 - 0.94

Distraction Test

ICF category	Measurement of impairment of structure of the nervous system, other specified		
Description	Distraction of the cervical spine to maximize the diameter of the neural foramen and reduce or eliminate the patient's symptoms		
Measurement method	The distraction test is used to identify cervical radiculopathy and is performed with the patient supine. The examiner grasps under the chin and occiput, flexes the patient's neck to a position of comfort, and gradually applies a distraction force of up to approximately 14 kg. A positive test occurs with the reduction or elimination of the patient's upper extremity or scapular symptoms. This test is not indicated if the patient has no upper extremity or scapular region symptoms.		
Nature of variable	Nominal		
Units of measurement	None		
Diagnostic accuracy indices for the upper limb tension test, based on the study by Wainner et al[175]			95% Confidence Interval
	Kappa	0.88	0.64 - 1.0
	Sensitivity	0.44	0.21 - 0.67
	Specificity	0.90	0.82 - 0.98
	Positive likelihood ratio	4.40	1.80 - 11.1
	Negative likelihood ratio	0.62	0.40 - 0.90

Valsalva Test

ICF category	Measurement of impairment of structure of the nervous system, other specified		
Description	Maneuver in which the patient bears down without exhaling to increase intrathecal pressure and elicit upper quarter symptoms		
Measurement method	The patient is seated and instructed to take a deep breath and hold it while attempting to exhale for 2-3 seconds. A positive response occurs with reproduction of symptoms.		
Nature of variable	Nominal/dichotomous		
Units of measurement	None		
Diagnostic accuracy indices for the valsalva test, based on the study by Wainner et al[175]			95% Confidence Interval
	Kappa	0.69	0.36 - 1.0
	Sensitivity	0.22	0.03 - 0.41
	Specificity	0.94	0.88 - 1.0
	Positive likelihood ratio	3.50	0.97 - 12.6
	Negative likelihood ratio	0.83	0.64 - 1.1

CLINICAL GUIDELINES

Interventions

A variety of interventions have been described for the treatment of neck pain and there is good evidence from high-quality randomized, controlled trials and systematic reviews to support the benefits of physical therapy intervention in these patients.

CERVICAL MOBILIZATION/MANIPULATION

I The most recent Cochrane Collaboration Review[69] of mobilization and manipulation for mechanical neck disorders included 33 randomized controlled trials of which 42% were considered high quality. They concluded that the most beneficial manipulative interventions for patients with mechanical neck pain with or without headaches should be combined with exercise to reduce pain and improve patient satisfaction. Manipulation (thrust) and mobilization (non-thrust manipulation) intervention alone were determined to be less effective than when combined with exercise (combined intervention).[69] A recently published clinical practice guideline concluded that the evidence for combined intervention was relatively strong, while the evidence for the effectiveness of thrust or non-thrust manipulation in isolation was weaker.[68]

The recommendations of the Cochrane Review[69] and the recently published clinical practice guideline[68] were based on key findings that warrant further discussion. Studies cited included patients with both acute[82]and chronic neck pain[22] and interventions consisted of soft-tissue mobilization and manual stretching procedures, as well as thrust,[17,83] and non-thrust manipulative procedures[82] directed at spinal motion segments. Number of visits ranged from 6 over a 3 week period[82] to 20 over an 11 week period[22] and the duration of sessions ranged from 30 minutes[99] to 60 minutes.[22] Combined intervention was compared with various competing interventions that included manipulation alone,[22,99] various non-manual physical therapy interventions,[82] high-tech and low-tech exercises,[22,82,99] general practitioner care (medication, advice, education),[82] and no treatment.[99] The majority of studies report either clinically or statistically important differences in pain in favor of combined intervention when compared to competing single interventions.[69] Differences in muscle performance[22,99] as well as patient satisfaction have also been reported for both short-term[22,82,99] as well as long-term outcomes 1[22] and 2 years later.[58] When compared to care rendered by a general practitioner and non-manual physical therapy interventions, the combination of manipulation and exercise resulted in significant cost-savings of up to 68%.[106]

II Although many patients experience a significant benefit when treated with thrust manipulation, it is still unclear which patients benefit most. Tseng et al[166] reported 6 predictors for patients who experienced an immediate improvement in either pain, satisfaction, or perception of condition following manipulation of the cervical spine. These predictors included[166]:

- Initial scores on Neck Disability Index less than 11.5
- Having bilateral involvement pattern
- Not performing sedentary work more than 5 hours per day
- Feeling better while moving the neck
- Did not feel worse while extending the neck
- The diagnosis of spondylosis without radiculopathy

The presence of 4 or more of these predictors increased the probability of success with manipulation from 60% to 89%.[166] Predictors of which patients respond best to combined intervention have not been reported.

I Nilsson et al[125] conducted a randomized, clinical trial (n=53) in individuals with cervicogenic headache. Subjects were randomized to receive high velocity low amplitude spinal manipulation or low level laser and deep friction massage. The use of analgesics were reduced by 36% in the manipulation group but were unchanged in the laser/massage group. The number of headache hours per day decreased by 69% for the individuals in the manipulation group and 37% in the laser/massage group. Headache intensity per episode decreased by 36% for those in the manipulation group and 17% in the laser/massage group.

II A systematic review by Vernon et al,[171] which included studies published through 2005, concluded that there is moderate- to high-quality evidence that subjects with chronic neck pain and headaches show clinically important improvements from a course of spinal mobilization or manipulation at 6, 12, and up to 104 weeks post-treatment.

Despite good evidence to support the benefits of cervical mobilization/manipulation, it is important that physical

therapists be aware of the potential risks in using these techniques.[68,69] However, it is impossible to determine the precise risk because (1) it is extremely difficult to quantify the number of cervical spine mobilization/manipulative interventions performed each year, and (2) not all adverse events occurring after mobilization/manipulation interventions are published in the peer-reviewed literature, and there is no accepted standard for reporting these injuries. Reported risk factors include hypertension, migraines, oral contraceptive use, and smoking.[72] However, the prevalence of these factors in the study by Haldeman et al[72] is largely the same or lower than that which occurs in the general population.

Although the true risk for complications remains unknown, the risk for serious complications is estimated to be 6 in 10 million (0.00006%) manipulations, with the risk of death being 3 in 10 million (0.000003%). Importantly, these rates are adjusted assuming that only 1 in 10 complications is actually reported in the literature.[84] Gross et al[70] recently reported, in a clinical practice guideline on the use of mobilization/manipulation in patients with mechanical neck pain, that estimates for serious complication for manipulation ranged from 1 in 20,000 (0.01%) to 5 in 10 million (0.0005%).[70]

The risk estimate for patients experiencing non-serious side effects such as increased symptoms, ranges from 1% to 2%.[149] The most common side effects included local discomfort (53%), local headache (12%), fatigue (11%), or radiating discomfort (10%). Patients characterized 85% of these complaints as mild or moderate, with 64% of side effects appearing within 4 hours after manipulation. Within 24 hours after manipulation, 74% of the complaints had resolved. Less than 5% of side effects were characterized as dizziness, nausea, hot skin, or other complaints. Side effects were rarely still noted on the day after manipulation, and very few patients reported the side effects as being severe.

Due the potential risk of serious adverse effects associated with cervical manipulation, such as vertebrobasilar artery stroke,[56] it has been recommended that non-thrust cervical mobilization/manipulation be utilized in favor of thrust manipulation.[50,85] However, information regarding the risk/benefit ratio of providing cervical thrust manipulation to patients with impairments of body function purported to benefit from cervical mobilization/manipulation, such as cervical segmental mobility deficits, has not been reported. In addition, the case reports in the literature describing serious adverse effects associated with cervical thrust manipulation do not provide information regarding either the presence of impairments of body functions, or the presence of red flags for vertebrobasilar insufficiency,[7] prior to the application of the manipulative procedure suspected to be linked with the reported harmful effects.

A Recommendation: Clinicians should consider utilizing cervical manipulation and mobilization procedures, thrust and non-thrust, to reduce neck pain and headache. Combining cervical manipulation and mobilization with exercise is more effective for reducing neck pain, headache, and disability than manipulation and mobilization alone.

THORACIC MOBILIZATION/MANIPULATION

A survey among clinicians that practice manual physical therapy reported that the thoracic spine is the region of the spine most often manipulated, despite the fact that more patients complain of neck pain.[1] While several randomized clinical trials have examined the effectiveness of thoracic spine thrust manipulation (TSM) for patients with neck pain, patients in these studies also received cervical manipulation.[2,22,57] The rationale to include thoracic spine mobilization/manipulation in the treatment of patients with neck pain stems from the theory that disturbances in joint mobility in the thoracic spine may be an underlying contributor to musculoskeletal disorders in the neck.[94,105]

I Cleland et al[34] compared the effectiveness of TSM in a trial in which patients were randomized to either a single session of TSM or sham manipulation. Patients who received TSM experienced a clinically meaningful and statistically significant reduction in pain on the visual analogue scale (VAS) compared to patients who received the sham intervention ($P<.001$).[34] A similar finding (reduction of pain) was also reported in a randomized trial that compared TSM intervention to an active exercise program.[147] A subsequent randomized trial by Cleland et al[38] which compared TSM to non-thrust manipulation (mobilization) found significant differences in favor of the TSM group in pain, disability, and patient perceived improvement upon re-evaluation 48 hours later.

II While preliminary reports indicate that patients with complaints of primary neck pain experience a significant benefit when treated with TSM, it is still unclear which patients benefit most. Cleland et al[33] reported a preliminary clinical prediction rule for patients with primary neck pain who experience short-term improvement (1-week) with TSM. Each subject received a total of 3 thoracic manipulations directed at the upper and middle thoracic spine for up to 2 sessions. Using a global rating of change score ≥ 5 as a reference criterion, 6 variables were reported as predictors of improvement and included[33]:

- Symptom duration of less than 30 days
- No symptoms distal to the shoulder
- Subject reports that looking up does not aggravate symptoms
- Fear-avoidance Beliefs Questionnaire-Physical Activity Scale score less than 12

- Diminished upper thoracic spine kyphosis (T3–T5)
- Cervical extension of less than 30°

Interestingly, the lack of symptom aggravation with looking up was also one of the predictors reported by Tseng et al[166] in the cervical manipulation clinical prediction rule. Validation of both the cervical and TSM clinical rules is required before they can be recommended for widespread clinical use.

I In a randomized clinical trial Fernández de las Peñas et al[59] demonstrated that patients with neck pain related to a whiplash-associated disorder receiving TSM experienced a significantly greater (P<.003) reduction in pain as measured by the visual analogue scale, than those who did not receive the thoracic manipulation. The mean change in pain levels in the group receiving TSM was 54.1 mm (SD 18.8 mm) compared to a mean change of 13.4 mm (SD 8.9 mm) in the group not receiving thoracic manipulation. The length of follow-up was not clearly defined.

IV Self-reported levels of pain and cervical active ROM were assessed before and immediately after TSM in 26 patients with a primary complaint of neck pain. The mean reduction in pain on an 11-point numeric pain rating scale was approximately 2 points (P<.01), which has been shown to indicate that a clinically meaningful improvement has occurred. Significant increases in cervical active ROM were also observed in all directions except extension (P<.001). This study did not include a control group and only consisted of an immediate follow-up, but the immediate improvements in pain and cervical active ROM suggest that TSM may have some merit in patients with neck pain.[61]

IV There have been 4 case series that have incorporated thoracic spine thrust manipulation in the multi-modal management of patients with cervical radiculopathy.[23,39,120,176] In the first case series,[39] 10 of the 11 patients (91%) demonstrated a clinically meaningful improvement in pain and function at the 6-month follow-up after a mean of 7.1 physical therapy visits. In the second case series[176] all patients except for 1 exhibited a significant reduction in disability. In the third case series,[120] full resolution of pain was reported in 8 of 15 (53%) patients, where all 6 of the patients receiving mobilization and manipulation achieved full resolution of pain. In addition, there has been 1 case series[23] that included thoracic spine thrust manipulation in the management of 7 patients with grade I cervical compressive myelopathy. All patients exhibited a reduction in pain and improvement in function at the time of discharge.

C Recommendation: Thoracic spine thrust manipulation can be used for patients with primary complaints of neck pain. Thoracic spine thrust manipulation can also be used for reducing pain and disability in patients with neck and neck-related arm pain.

STRETCHING EXERCISES

I In a randomized controlled trial, Ylinen et al[183] assessed the effectiveness of manual therapy procedures implemented twice a week compared with a stretching regimen performed 5 times a week in those with non-specific neck pain. At the 4 and 12 week follow-up both groups improved but there were no significant differences between the groups related to pain. Neck pain and disability outcome measures, shoulder pain and disability outcome measures, and neck stiffness were reduced significantly more in those receiving manual therapy, but the clinical difference was minimal. The authors concluded that the low-cost of stretching exercises should be included in the initial treatment plan for patients with neck pain.

V The authors of this clinical practice guideline have observed that patients with neck pain often present with impairments of flexibility of key muscles related to the lower cervical and upper thoracic spine, such as the anterior, medial, and posterior scalenes, upper trapezius, levator scapulae, pectoralis minor, and pectoralis major, that should be addressed with stretching exercises. One study reported that upper quarter muscle flexibility deficits were common in dental hygienists,[95] an occupation that requires frequent repetitive activities involving the shoulders, arms, and hands. Although research generally does not support the effectiveness of interventions that focus on stretching and flexibility, clinical experience suggests that addressing specific impairments of muscle length for an individual patient may be a beneficial addition to a comprehensive treatment program.

C Recommendation: Flexibility exercises can be used for patients with neck symptoms. Examination and targeted flexibility exercises for the following muscles are suggested: anterior/medial/posterior scalenes, upper trapezius, levator scapulae, pectoralis minor, and pectoralis major.

COORDINATION, STRENGTHENING, AND ENDURANCE EXERCISES

I Jull et al[99] conducted a multi-centered, randomized clinical trial (n=200) in participants who met the diagnostic criteria for cervicogenic headache. The inclusion criteria were unilateral or unilateral dominant side-consistent headache associated with neck pain and aggravated by neck postures or movement, joint tenderness in at least 1 of the upper 3 cervical joints as detected by

manual palpation, and a headache frequency of at least 1 per week over a period of 2 months to 10 years. Subjects were randomized into 4 groups: mobilization/manipulation group, exercise therapy group, combined mobilization/manipulation and exercise group, and a control group. The primary outcome was a change in headache frequency. At the 12-month follow-up, the mobilization/manipulation, combined mobilization/manipulation and exercise, and the specific exercise groups had significantly reduced headache frequency and intensity. Additionally 10% more patients experienced a complete reduction in headache frequency when treated with mobilization/manipulation and exercise than those treated with the alternative approaches.[99]

The exercise program in this clinical trial by Jull et al[99] used low load endurance exercises to train muscle control of the cervicoscapular region. The first stage consisted of specific craniocervical flexion exercises, performed in supine lying, aimed to target the deep neck flexor muscles, which are the longus capitis and longus colli. Subsequently, isometric exercises using a low level of rotatory resistance were used to train the co-contraction of the neck flexors and extensors. The exercise groups had significantly reduced headache frequency and intensity when compared to the controls.

I Chiu et al[28] assessed the benefits of an exercise program that focused both on motor control training of the deep neck flexors and dynamic strengthening. A total of 145 patients with chronic neck pain were randomized to either an exercise or a non-exercise control group. At week 6, the exercise group had significantly better improvements in disability scores, pain levels, and isometric neck muscle strength. However, significant differences between the 2 groups were found only in pain and patient satisfaction at the 6-month follow-up.

I In a randomized, clinical trial, Ylinen et al[184] demonstrated the effectiveness of both strengthening exercises and endurance training of the deep neck flexor muscles in reducing pain and disability at the 1-year follow-up in women (n = 180) with chronic, nonspecific neck pain. The endurance training group performed dynamic neck exercises, which included lifting the head up from the supine and prone positions. The strength training group performed high-intensity isometric neck strengthening and stabilization exercises with an elastic band. Both training groups performed dynamic exercises for the shoulders and upper extremities with dumbbells. Both groups were advised to also do aerobic and stretching exercises 3 times a week. In a 3-year follow-up study, Ylinen et al[182] found that women (n = 118) in both the strengthening exercise and endurance training groups achieved long-term benefits from the 12-month programs.

III O'Leary et al[127] compared the effect of 2 specific cervical flexor muscle exercise protocols on immediate pain relief in the cervical spine of people with chronic neck pain. They found that those performing the specific craniocervical flexion exercise demonstrated greater improvements in pressure pain thresholds, mechanical hyperalgesia, and perceived pain relief during active movement.

III In a cross-sectional comparative study, Chiu et al[29] compared the performance of the deep cervical flexor muscles on the craniocervical flexion test in individuals with (n = 20) and without (n = 20) chronic neck pain. Those with chronic neck pain had significantly poorer performance on the craniocervical flexion test (median pressure achieved, 24 mmHg when starting at 20 mmHg) when compared with those in the asymptomatic group (median pressure achieved, 28 mmHg when starting at 20 mmHg).

I Jull et al[97] compared the effects of conventional proprioceptive training and craniocervical flexion training on cervical joint position error in people with persistent neck pain. The aim was to evaluate whether proprioceptive training was superior in improving proprioceptive acuity compared to a form of exercise that has been shown to be effective in reducing neck pain. Sixty-four female subjects with persistent neck pain and deficits in cervical joint position error were randomized into 2 exercise groups: proprioceptive training or craniocervical flexion training. Exercise regimens were conducted over a 6-week period. The results demonstrated that both proprioceptive training and craniocervical flexion training have a demonstrable benefit on impaired cervical joint position error in people with neck pain, with marginally more benefit gained from proprioceptive training. The results suggest that improved proprioceptive acuity following intervention with either exercise protocol may occur through an improved quality of cervical afferent input or by addressing input through direct training of relocation sense.[97]

I In a randomized, clinical trial, Taimela et al[162] compared the efficacy of a multimodal treatment emphasizing proprioceptive training in patients with non-specific chronic neck pain (n = 76). The proprioceptive treatment, which consisted of exercises, relaxation, and behavioral support was more efficacious than comparison interventions that consisted of (1) attending a lecture on the neck and 2 sessions of practical training for a home exercise program, and (2) a lecture regarding care of the neck with a recommendation to exercise. Specifically, the proprioceptive treatment group had greater reductions in neck symptoms, improvements in general health, and improvements in the ability to work.

I In a randomized clinical trial, Viljanen et al[173] assessed the effectiveness of dynamic muscle training (n= 135), relaxation training (n = 128), or ordinary activity (n = 135) for female office workers with chronic neck pain. Dynamic muscle training and relaxation training did not lead to better improvements in neck pain compared with ordinary activity.

I In a randomized clinical trial, Bronfort et al[22] found that a combined program of strengthening and endurance exercises combined with manual therapy resulted in greater gains in strength, endurance, range of motion, and long-term patient pain ratings in those with chronic neck pain than programs that only incorporated manual therapy. Additionally, Evans et al[58] found that these results were maintained at a 2-year follow-up.

IV In a prospective case series, Nelson et al[124] followed patients with cervical and lumbar pain and found that an aggressive strengthening program was able to prevent surgery in 35 of the 60 patients (46 of the 60 completed the program, 38 were available for follow-up, and only 3 reported having surgery). Despite the methodological limitations of this study, some patients that were originally given the option of surgery were able to successfully avoid surgery in the short term following participation in an aggressive strengthening exercise program.

II In a systematic review of 9 randomized clinical trials and 7 comparative trials with moderate methodological quality for patients with mechanical neck disorders, Sarig-Bahat[145] reported relatively strong evidence supporting the effectiveness of proprioceptive exercises and dynamic resisted strengthening exercises of the neck-shoulder musculature for patients with chronic or frequent neck disorders. The evidence identified could not support the effectiveness of group exercise, neck schools, or single sessions of extension-retraction exercises.

I In a randomized clinical trial, Chiu et al[30] found in patients with chronic neck pain (n = 218), that a 6-week treatment of transcutaneous electrical nerve stimulation or exercise had a better and clinically relevant improvement in disability, isometric neck muscle strength, and pain compared to a control group. All the improvements in the intervention groups were maintained at the 6-month follow-up.

IV Hammill et al[74] used a combination of postural education, stretching, and strengthening exercises to reduce the frequency of headaches and improve disability in a series of 20 patients, with results being maintained at a 12-month follow-up.

I In a systematic review, Kay et al[103] concluded that specific exercises may be effective for the treatment of acute and chronic mechanical neck pain, with or without headache.

I A recent Cochrane review[69] concluded that mobilization and/or manipulation when used with exercise are beneficial for patients with persistent mechanical neck disorders with or without headache. However, manual therapy without exercise or exercise alone were not superior to one another.

V Although evidence is generally lacking, postural correction and body mechanics education and training may also be indicated if clinicians identify ergonomic inefficiencies during either the examination or treatment of patients with motor control, movement coordination, muscle power, or endurance impairments.

A Recommendation: Clinicians should consider the use of coordination, strengthening, and endurance exercises to reduce neck pain and headache.

CENTRALIZATION PROCEDURES AND EXERCISES

I Kjellman and colleagues[104] randomly assigned 77 patients with neck pain (29 of which presented with cervical radiculopathy) to general exercise, McKenzie method of examination and treatment, or a control group (low intensity ultrasound and education). The McKenzie method of treatment consists of patient positioning, specific repeated movements, manual procedures, and patient education in self management in case of recurrence.[104,118] The repeated specific movements with the McKenzie method intend to centralize (promote the migration of symptoms from an area more distal to location more proximal) or reduce pain.[118] At the 12 month follow-up all groups showed significant reductions in pain intensity and disability but no significant difference between groups existed. Seventy-nine percent of patients reported that they were better or completely restored after treatment, although 51% reported constant/daily pain. All 3 groups had similar recurrence rates.

III Murphy et al[122] incorporated McKenzie procedures to promote centralization in the management of a cohort of 31 patients with cervical radiculopathy. These patients also received cervical manipulation or muscle energy techniques and neural mobilization. Seventy-seven percent of patients at the short-term follow-up and 93% of patients at the long-term follow-up exhibited a clinically important improvement in disability. However, specific details regarding the number of patients receiving procedures to promote centralization was not reported.

There has not been a clinical trial that recruited patients with only cervical radiculopathy. Therefore, it is not possible to comment on the efficacy of the McKenzie method or the use of centralization procedures and exercises for this particular subgroup of patients.[31]

C Recommendation: Specific repeated movements or procedures to promote centralization are not more beneficial in reducing disability when compared to other forms of interventions.

UPPER QUARTER AND NERVE MOBILIZATION PROCEDURES

II Allison et al[2] examined the effectiveness of 2 different manual therapy techniques (neural mobilization and cervical/upper quadrant mobilization) in the management of cervico-brachial syndrome. All patients received treatment for 8 weeks in addition to a home exercise program. The results demonstrated that both manual therapy groups exhibited improvements in pain and function. At the final data collection there existed no difference between the manual therapy groups for function but a significant difference between groups for reduction in pain was identified in favor of the neural mobilization group.

II In a randomized clinical trial, Coppieters et al[41] assigned 20 patients with cervico-brachial pain to receive either cervical mobilization with the upper extremity in an upper limb neurodynamic position or therapeutic ultrasound. The group receiving the mobilizations exhibited significantly greater improvements in elbow range of motion during neurodynamic testing as well as greater reductions in pain compared to the ultrasound group.

III Murphy et al[122] incorporated neural mobilization in the management of a cohort of patients with cervical radiculopathy. Seventy seven percent of patients at the short-term follow-up and 93% of patients at the long term follow-up exhibited a clinically important decrease in disability. However, no specifics were provided relative to which patients received neural mobilization procedures.

IV Cleland et al[39] described the outcomes of a consecutive series of patients presenting to physical therapy who received cervical mobilization (cervical lateral glides) with the upper extremity in a neurodynamic position as well as thoracic spine manipulation, cervical traction, and strengthening exercises. Ten of the 11 patients (91%) demonstrated a clinically meaningful improvement in pain and function following a mean of 7.1 physical therapy visits.

B Recommendation: Clinicians should consider the use of upper quarter and nerve mobilization procedures to reduce pain and disability in patients with neck and arm pain.

TRACTION

I A systematic review by Graham and colleagues[67] reported that there is moderate evidence to support the use of mechanical intermittent cervical traction.

II Taghi Joghataei et al[93] randomly assigned 30 patients to receive a treatment program consisting of ultrasound and exercise with or without mechanical intermittent cervical traction for 10 sessions. The group receiving traction exhibited greater improvements in grip strength, the primary outcome measure, after 5 sessions. However, no statistically significant difference between groups existed at the time of discharge from physical therapy.[93]

III Saal et al[143] investigated the outcomes of 26 consecutive patients who fit the diagnostic criteria for herniated cervical disc with radiculopathy who received a rehabilitation program consisting of cervical traction and exercise. Twenty-four patients avoided surgical intervention and 20 exhibited good or excellent outcomes.

II In a prospective cohort design Cleland et al[36] identified predictor variables of short-term success for patients presenting to physical therapy with cervical radiculopathy. One of the predictor variables for patients who exhibited a short-term success included a multimodal physical therapy approach consisting of manual or mechanical traction, manual therapy (cervical or thoracic mobilization/manipulation), and deep neck flexor strengthening. The pretest probability for the likelihood of short-term success was 53%. The mean duration of mechanical traction used on patients in this study was 17.8 minutes with an average force of pull of 11 kg (24.3 pounds). The positive likelihood ratio for patients receiving the multimodal treatment approach (excluding other predictor variables) was 2.2, resulting in a post-test probability of success of 71%.[36]

II Raney et al[137] recently developed a clinical prediction rule to identify patients with neck pain likely to benefit from cervical mechanical traction. Sixty-eight patients (38 female) were included in data analysis of which 30 had a successful outcome. All patients received 6 sessions of mechanical intermittent cervical traction starting with a force of pull between 4.5-5.4 kg (10-12 pounds) for a duration of 15 minutes. The force of pull progressively

increased based on centralization of symptoms at each subsequent session. A clinical prediction rule with 5 variables was identified:

- Patient reported peripheralization with lower cervical spine (C4-7) mobility testing
- Positive shoulder abduction sign
- Age ⩾55 years
- Positive upper limb tension test (median nerve bias utilizing shoulder abduction to 90°)
- Relief of symptoms with manual distraction test

Having at least 3 out of 5 variables present resulted in a positive likelihood ratio equal to 4.81 (95% CI = 2.17-11.4), increasing the likelihood of success with cervical traction from 44% to 79.2%. If at least 4 out of 5 variables were present, the positive likelihood ratio was equal to 11.7 (95% CI = 2.09-69.58), increasing the post-test probability of having improvement with cervical traction to 90.2%.

IV Three separate case series[39,120,176] describe the management of patients with cervical radiculopathy, where the interventions included traction. In these case series, the patients were treated with a multimodal treatment approach and the vast majority of patients exhibited improved outcomes. In the first report, Cleland et al[39] described the outcomes of a consecutive series of 11 patients presenting to physical therapy with cervical radiculopathy and managed with the use of manual physical therapy, cervical traction, and strengthening exercises. At 6 month follow-up, 91% demonstrated a clinically meaningful improvement in pain and function following a mean of 7.1 physical therapy visits. Similarly, Waldrop[176] treated 6 patients with cervical radiculopathy with mechanical intermittent cervical traction, thoracic thrust joint manipulation, and range of motion and strengthening exercises for the cervical spine. Upon discharge (mean treatment 10 visits, range 5-18 visits; duration 33 days, range 19-56 days), there was a reduction in disability between 13% and 88%. In the third case series, Moeti and Marchetti[120] investigated the outcomes associated with cervical traction, neck retraction exercises, scapular muscle strengthening, and mobilization/manipulation techniques (used for some patients) for 15 patients with cervical radiculopathy. These authors reported full resolution of pain in 53% of patients at the time of discharge.

IV Browder and colleagues[23] investigated the effectiveness of a multimodal treatment approach in the management of 7 female patients with grade I cervical compressive myelopathy. Patients were treated with intermittent mechanical cervical traction and thoracic manipulation for a median of 9 sessions over a median of 56 days. The median decrease in pain scores was 5 from a baseline of 6 (using a 0-10 pain scale), and median improvement in Functional Rating Index scores was 26% from a baseline of 44%.

B Recommendation: Clinicians should consider the use of mechanical intermittent cervical traction, combined with other interventions such as manual therapy and strengthening exercises, for reducing pain and disability in patients with neck and neck-related arm pain.

PATIENT EDUCATION AND COUNSELING

I There is a paucity of high quality evidence surrounding efficacy of treatments for whiplash-associated disorder (WAD). However, existing research supports instructing patients in active interventions, such as exercises, and early return to regular activities as a means of pain control. Rosenfeld et al[142] compared the long-term efficacy of active intervention with that of standard intervention and the effect of early versus delayed initiation of intervention. Patients were randomized to an intervention using frequent active cervical rotation range of motion exercises complemented by assessment and treatment according to McKenzie's principles or to an intervention that promoted initial rest, soft collar utilization, and gradual self-mobilization. In patients with WAD, early active intervention was more effective in reducing pain intensity and sick leave, and in retaining/regaining total range of motion than intervention that promoted rest, collar usage, and gradual self-mobilization. Patient education promoting an active approach can be carried out as home exercises and progressive return to activities initiated and supported by appropriately trained health professionals.

I An often prescribed intervention for acute whiplash injury is the use of a soft cervical collar. Crawford et al[45] prospectively investigated 108 consecutive patients following a soft tissue injury of the neck that resulted from motor vehicle accidents. Each patient was randomized to a group instructed to engage in early mobilization using an exercise regime or to a group that was instructed to utilize a soft cervical collar for 3 weeks followed by the same exercise regime. Patients were assessed clinically at 3, 12, and 52 week intervals from injury. Intervention that utilized a soft collar was found to have no obvious benefit in terms of functional recovery after neck injury and was associated with a prolonged time period off work. Other investigations have reported similar results.[148,170] Interventions that instruct patients to perform exercises early in their recovery from whiplash type injuries have been reported to be more effective in reducing pain intensity and disability following whiplash injury than interventions that instruct patients to use cervical collars.[148,170]

I Existing research supports active interventions and early return to regular activities but it has largely been unknown as to which type of active intervention would yield the most benefit. Brison et al[21] assessed the efficacy of an educational video in the prevention of persistent WAD symptoms following rear-end motor vehicle collisions. The video provided reassurance, and education about posture, return to regular activities, specific exercises, and pain management. Patients were randomized to receive either an educational video plus usual care or usual care alone. The primary outcome was presence of persistent WAD symptoms at 24 weeks post injury, based on the frequency and severity of neck, shoulder, or upper back pain. The group receiving the instructional video demonstrated a trend toward less severe WAD symptoms suggesting that the 'act as usual' recommendation that is often prescribed as a management strategy for patients with WAD is not sufficient and, in fact, may exacerbate their symptoms if such activities are provocative of pain.[21]

III A reduction in pain alone is not sufficient to address the neuromuscular control deficits in patients with chronic symptoms,[157] as these deficits require specific rehabilitation techniques.[99] For example, persistent sensory and motor deficits may render the patient at risk for symptom persistence.[155,156] Support for specificity in rehabilitation can be indirectly found from a recent population-based, incidence cohort study evaluating a government policy of funding community and hospital-based fitness training and multidisciplinary rehabilitation for whiplash.[26] No supportive evidence was found for the effectiveness of this general rehabilitation approach. Therefore, only addressing the lack of fitness and conditioning in this patient population may not be the most efficacious approach to treatment.

I Ferrari et al[60] studied whether an educational intervention using a pamphlet provided to patients in the acute stage of whiplash injury might improve the recovery rate. One hundred twelve consecutive subjects were randomized to 1 of 2 treatment groups: educational intervention or usual care. The education intervention group received an educational pamphlet based on the current evidence, whereas the control group only received usual emergency department care and a standard non-directed discharge information sheet. Both groups underwent follow-up by telephone interview at 2 weeks and 3 months. The primary outcome measure of recovery was the patient's response to the question, "How well do you feel you are recovering from your injuries?" At 3 months post collision, 21.8% in the education intervention group reported complete recovery compared with 21.0% in the control group (absolute risk difference, 0.8%; 95% CI = -14.4% to 16.0%). At 3 months, there were no clinically or statistically significant differences between groups in severity of remaining symptoms, limitations in daily activities, therapy use, medications used, lost time from work, or litigation. This study concluded that an evidence-based educational pamphlet provided to patients at discharge from the emergency department is no more effective than usual care for patients with grade I or II WAD.[60]

I Jull et al[99] conducted a preliminary randomized controlled trial with 71 participants with persistent neck pain following a motor vehicle accident to explore whether a multimodal program of physical therapies was an appropriate management strategy compared to a self-management approach. Participants were randomly allocated to receive either a multimodal physical therapy program or a self-management program (advice and exercise). Furthermore, participants were stratified according to the presence or absence of widespread mechanical or cold hyperalgesia. The intervention period was 10 weeks and outcomes were assessed immediately following treatment. Even with the presence of sensory hypersensitivity in 72.5% of subjects, both groups reported some relief of neck pain and disability, measured using Neck Disability Index scores, and it was superior in the group receiving multimodal physical therapy (P=.04). However, the overall effects of both programs were mitigated in the group presenting with both widespread mechanical and cold hyperalgesia. Further research aimed at testing the validity of this sub-group observation is warranted.[98]

II A comprehensive review[117] of the available scientific evidence produced a set of unambiguous patient centered messages that challenge unhelpful beliefs about whiplash, promoting an active approach to recovery. The use of this rigorously developed educational booklet (The Whiplash Book) was capable of improving beliefs about whiplash and its management for patients with whiplash-associated disorders.[117]

IV In a small case series, Soderlund and Lindberg[153] reported that physical therapy integrated with cognitive behavioral components decreased pain intensity in problematic daily activities in 3 individuals with chronic WAD.

II Predictors of outcome following whiplash injury have been limited to socio-demographic and factors of symptom location and severity, which are not readily amenable to intervention. However, evidence exists to demonstrate that psychological factors are present soon following injury and play a role in recovery from whiplash injury.[98,155,158] These factors can be as diverse as the physical presentation and can include affective disturbances, anxiety, depression, and fear of movement.[123,132,178] Furthermore, post-traumatic stress disorder[112] has also been

observed in both the acute[52] and chronic conditions and has been shown to be prognostic.[171] Identifying these factors in patients may assist in the development of relevant subgroups and appropriately matched education and counseling strategies that practitioners should utilize in management of patients with WAD.

A Recommendation: To improve the recovery in patients with whiplash-associated disorder, clinicians should (1) educate the patient that early return to normal, non-provocative pre-accident activities is important, and (2) provide reassurance to the patient that good prognosis and full recovery commonly occurs.

TABLE 4 Neck Pain Impairment/Function-based Diagnosis, Examination and Intervention Recommended Classification Criteria*

Impairment-Based Category (With ICD-10 Associations)	Symptoms	Impairments of Body Function	Interventions
Neck pain with mobility deficit • Cervicalgia • Pain in thoracic spine	• Unilateral neck pain • Neck motion limitations • Onset of symptoms is often linked to a recent unguarded / awkward movement or position • Associated (referred) upper extremity pain may be present	• Limited cervical range of motion • Neck pain reproduced at end ranges of active and passive motions • Restricted cervical and thoracic segmental mobility • Neck and neck-related upper extremity pain reproduced with provocation of the involved cervical or upper thoracic segments	• Cervical mobilization / manipulation • Thoracic mobilization / manipulation • Stretching exercises • Coordination, strengthening, and endurance exercises
Neck Pain with Headache • Headache • Cervicocranial syndrome	• Noncontinuous, unilateral neck pain and associated (referred) headache • Headache is precipitated or aggravated by neck movements or sustained positions	• Headache reproduced with provocation of the involved upper cervical segments • Limited cervical range of motion • Restricted upper cervical segmental mobility • Strength and endurance deficits of the deep neck flexor muscles	• Cervical mobilization / manipulation • Stretching exercises • Coordination, strengthening, and endurance exercises
Neck Pain with Movement Coordination Impairments • Sprain and strain of cervical spine	• Neck pain and associated (referred) upper extremity pain • Symptoms are often linked to a precipitating trauma/whiplash and may be present for an extended period of time	• Strength, endurance, and coordination deficits of the deep neck flexor muscles • Neck pain with mid-range motion that worsens with end range movements or positions • Neck and neck-related upper extremity pain reproduced with provocation of the involved cervical segment(s) • Cervical instability may be present (note that muscle spasm adjacent to the involved cervical segment(s) may prohibit accurate testing)	• Coordination, strengthening, and endurance exercises • Patient education and counseling • Stretching exercises
Neck Pain with Radiating Pain • Spondylosis with radiculopathy • Cervical disc disorder with radiculopathy	• Neck pain with associated radiating (narrow band of lancinating) pain in the involved upper extremity • Upper extremity paresthesias, numbness, and weakness may be present	• Neck and neck-related radiating pain reproduced with: 1. Cervical extension, sidebending, and rotation toward the involved side (Spurling's test) 2. Upper limb tension testing • Neck and neck-related radiating pain relieved with cervical distraction • May have upper extremity sensory, strength, or reflex deficits associated with the involved nerve(s)	• Upper quarter and nerve mobilization procedures • Traction • Thoracic mobilization / manipulation

** Recommendation based on expert opinion.*

CLINICAL GUIDELINES

Summary of Recommendations

E PATHOANATOMICAL FEATURES

Although the cause of neck pain may be associated with degenerative processes or pathology identified during diagnostic imaging, the tissue that is causing a patient's neck pain is most often unknown. Thus, clinicians should assess for impaired function of muscle, connective, and nerve tissues associated with the identified pathological tissues when a patient presents with neck pain.

B RISK FACTORS

Clinicians should consider age greater than 40, coexisting low back pain, a long history of neck pain, cycling as a regular activity, loss of strength in the hands, worrisome attitude, poor quality of life, and less vitality as predisposing factors for the development of chronic neck pain.

B DIAGNOSIS/CLASSIFICATION

Neck pain, without symptoms or signs of serious medical or psychological conditions, associated with (1) motion limitations in the cervical and upper thoracic regions, (2) headaches, and (3) referred or radiating pain into an upper extremity are useful clinical findings for classifying a patient into one of the following International Statistical Classification of Diseases and Related Health Problems (ICD) categories: cervicalgia, pain in thoracic spine, headaches, cervicocranial syndrome, sprain and strain of cervical spine, spondylosis with radiculopathy, and cervical disc disorder with radiculopathy; and the associated International Classification of Functioning, Disability, and Health (ICF) impairment-based category neck pain with the following impairments of body function:

Neck pain with mobility impairments (b7101 Mobility of several joints)
Neck pain with headaches (28010 Pain in head and neck)
Neck pain with movement coordination impairments (b7601 Control of complex voluntary movements)
Neck pain with radiating pain (b2804 Radiating pain in a segment or region)

The following physical examination measures may be useful in classifying a patient in the ICF impairment-based category of neck pain with mobility impairments and the associated ICD categories of cervicalgia or pain in thoracic spine.

- Cervical active range of motion
- Cervical and thoracic segmental mobility

The following physical examination measures may be useful in classifying a patient in the ICF impairment-based category of neck pain with headaches and the associated ICD categories of headaches or cervicocranial syndrome.

- Cervical active range of motion
- Cervical segmental mobility
- Cranial cervical flexion test

The following physical examination measures may be useful in classifying a patient in the ICF impairment-based category of neck pain with movement coordination impairments and the associated ICD category of sprain and strain of cervical spine.

- Cranial cervical flexion test
- Deep neck flexor endurance

The following physical examination measures may be useful in classifying a patient in the ICF impairment-based category of neck pain with radiating pain and the associated ICD categories of spondylosis with radiculopathy or cervical disc disorder with radiculopathy.

- Upper limb tension test
- Spurling's test
- Distraction test

B DIFFERENTIAL DIAGNOSIS

Clinicians should consider diagnostic classifications associated with serious pathological conditions or psychosocial factors when the patient's reported activity limitations or impairments of body function and structure are not consistent with those presented in the diagnosis/classification section of this guideline, or, when the patient's symptoms are not resolving with interventions aimed at normalization of the patient's impairments of body function.

A EXAMINATION – OUTCOME MEASURES

Clinicians should use validated self-report questionnaires, such as the Neck Disability Index and the Patient-Specific Functional Scale for patients with neck pain. These tools are useful for identifying a patient's baseline status relative to pain, function, and disability and for monitoring a change in patient's status throughout the course of treatment.

F EXAMINATION – ACTIVITY LIMITATION MEASURES

Clinicians should utilize easily reproducible activity limitation and participation restriction measures associated with their patient's neck pain to assess the changes in the patient's level of function over the episode of care.

A INTERVENTIONS – CERVICAL MOBILIZATION/ MANIPULATION

Clinicians should consider utilizing cervical manipulation and mobilization procedures, thrust and non-thrust, to reduce neck pain and headache. Combining cervical manipulation and mobilization with exercise is more effective for reducing neck pain, headache, and disability than manipulation and mobilization alone.

C INTERVENTIONS – THORACIC MOBILIZATION/ MANIPULATION

Thoracic spine thrust manipulation can be used for patients with primary complaints of neck pain. Thoracic spine thrust manipulation can also be used for reducing pain and disability in patients with neck and neck-related arm pain.

Summary of Recommendations *(continued)*

C **INTERVENTIONS – STRETCHING EXERCISES**

Flexibility exercises can be used for patients with neck symptoms. Examination and targeted flexibility exercises for the following muscles are suggested by the authors: anterior/medial/posterior scalenes, upper trapezius, levator scapulae, pectoralis minor, and pectoralis major.

A **INTERVENTIONS – COORDINATION, STRENGTHENING, AND ENDURANCE EXERCISES**

Clinicians should consider the use of coordination, strengthening, and endurance exercises to reduce neck pain and headache.

C **INTERVENTIONS – CENTRALIZATION PROCEDURES AND EXERCISES**

Specific repeated movements or procedures to promote centralization are not more beneficial in reducing disability when compared to other forms of interventions.

B **INTERVENTIONS – UPPER QUARTER AND NERVE MOBILIZATION PROCEDURES**

Clinicians should consider the use of upper quarter and nerve mobilization procedures to reduce pain and disability in patients with neck and arm pain.

B **INTERVENTIONS – TRACTION**

Clinicians should consider the use of mechanical intermittent cervical traction, combined with other interventions such as manual therapy and strengthening exercises, for reducing pain and disability in patients with neck and neck-related arm pain.

A **INTERVENTIONS – PATIENT EDUCATION AND COUNSELING**

To improve the recovery in patients with whiplash-associated disorder, clinicians should (1) educate the patient that early return to normal, non-provocative pre-accident activities is important, and (2) provide reassurance to the patient that good prognosis and full recovery commonly occurs.

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CORRECTIONS

In the September 2008 issue of *Journal of Orthopaedic & Sports Physical Therapy*, we make the following corrections to the "Neck Pain: Clinical Practice Guidelines":

- Under "Primary ICF Codes" on page A6, the ICF code for "Pain in head and neck," printed as "28010," should be b28010.
- Under Secondary ICF Codes on pages A7 and A8, the ICF code for "Driving motorized vehicles," printed in 4 instances as "d4750," should be d4751.
- Under Secondary ICF Codes on pages A7 and A8, the ICF code for "Driving animal-powered transportation," printed in 4 instances as "d4750," should be d4752.
- Under Secondary ICF codes on pages A7 and A8, the ICF Code for "Maintaining a standing position," printed in 2 instances as "d4150," should be d4154.

Please accept our apology for these errors. Corrected reprints of the Guidelines are available for download on the *JOSPT* web site (www.jospt.org).

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Development of Active Hip Abduction as a Screening Test for Identifying Occupational Low Back Pain

• **STUDY DESIGN:** Analytic observational prospective study performed in a controlled laboratory setting.

• **OBJECTIVES:** To assess the ability of a new screening tool, the active hip abduction test, to predict low back pain development during prolonged standing in previously asymptomatic individuals.

• **BACKGROUND:** Most screening tools used for a patient with low back pain do not assess the patient's ability to maintain postural control in the frontal plane, when placed in an unstable position. Postural-control differences in pain developers, as compared to non-pain developers, during standing have been found previously. An attempt was made to predict pain development with a simple screening test.

• **METHODS:** Forty-three previously asymptomatic volunteers underwent a clinical assessment prior to a 2-hour standing protocol designed to induce low back pain. Participants rated low back pain with a visual analog scale and were classified into pain developers or non-pain developers.

• **RESULTS:** Forty percent of participants developed low back pain. The active hip abduction test was the only test that discriminated between pain-developer groups. When the examiner scored the test, the odds ratio was 3.85 (95% confidence interval [CI]: 1.05-19.07), and when the test was self-rated, the odds ratio was 6.55 (95% CI: 1.14-37.75) for pain development during standing.

• **CONCLUSION:** The active hip abduction test appears to show promise for predicting individuals who are at risk for low back pain development during prolonged standing. More work is required to validate the test in clinical populations, and to assess interrater and intrarater reliability.

• **LEVEL OF EVIDENCE:** Diagnosis, level 2b.

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• **KEY WORDS:** *clinical assessment, diagnostic tests, lumbar spine, stabilization*

Low back pain (LBP) is a major contributor to increasing healthcare costs in North America, with estimates that 70% to 85% of all adults will experience an acute episode of LBP at some point in their lives.[8] Epidemiological studies have shown that standing occupations have a strong association with LBP.[1,25] Checkout clerks and other individuals with occupations requiring long periods of standing are known to develop LBP as the length of time on their feet increases.[15] From an occupational safety and health perspective, it would be ideal to have a simple screening tool that could identify "at-risk" workers and guide an appropriate preventative exercise program.

While multiple researchers have identified differences in motor control patterns between patients with LBP and healthy controls,[4,5,7] there have been few prospective studies published to evaluate whether these differences are adaptive to the LBP disorder or are risk factors that might increase the likelihood of pain development. We have previously used a "functionally induced low back pain" model as a prospective design to study factors linked to LBP development during standing.[9,10,23] The main idea behind this protocol is that a percentage of individuals who have no prior history of LBP will develop considerable levels of LBP during a common, functional task. This allows for a standardized laboratory approach to evaluating individual movement patterns and the effect on pain development. Previous work has shown that anywhere from 40% to 65% of asymptomatic individuals will fall into this pain development category. Based on findings of increased bilateral gluteus medius and trunk flexor-extensor muscle coactivation in pain developers,[22,23] we hypothesized that these individuals

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could be considered a "subclinical" group, and would possibly demonstrate positive findings on a physical therapy clinical examination that included an assessment of trunk control during a challenge initiated by movement from the hip.

To our knowledge, in the literature there is a lack of good screening tools designed to identify individuals that are predisposed to developing LBP. A low-demand test that assesses trunk control while performing a simple movement might be sensitive to predicting pain development during a low-demand functional activity. Therefore, we developed the active hip abduction (AHAbd) test as a simple screening tool to provide a general assessment of an individual's ability to maintain trunk and pelvis alignment during lower extremity movement when placed in an inherently unstable position. To perform the test, individuals were placed in sidelying with both lower limbs extended and aligned with the trunk. The pelvis was aligned so that it was in the frontal plane, perpendicular to the support surface (**FIGURE 1**). We then asked individuals to perform a single active abduction of the hip, keeping the knee extended and the lower limb aligned with the trunk, while maintaining the frontal plane alignment of the pelvis. The specific instructions to the individual were, "Please keep your knee straight and raise your top thigh and leg towards the ceiling, keeping them in line with your body, and try not to let your pelvis tip forwards or backwards." The participant was asked to rate the difficulty of the task on an ordinal scale of 0 ("no difficulty") to 5 ("unable to perform"), and these scores were summed for both lower limbs, similar to the scoring for the active straight-leg raise (ASLR) test, as described by Mens et al.[19,20] In the AHAbd test, the examiner also rated the performance of the test on an ordinal scale of 0 ("no loss of frontal plane position"), 1 ("minimal loss of frontal plane") , 2 ("moderate loss of frontal plane"), and 3 ("severe loss of frontal plane"). For the examiner-rated test, the score from the worse of the 2 sides was used. **FIGURE 2** shows good frontal plane control of the pelvis during active hip abduction (score, 0), while **FIGURE 3** shows poor frontal plane control of the pelvis (score, 3) (**ONLINE VIDEO**). **TABLE 1** contains specific cues to differentiate between levels of performance and to assist the examiner in scoring the test.

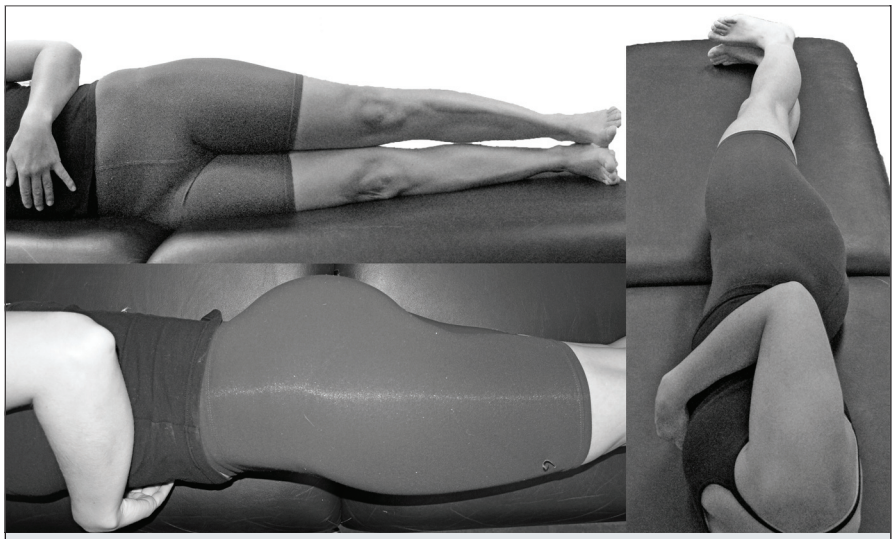

FIGURE 1. Participant is positioned with pelvis aligned in the frontal plane and lower extremities in line with the trunk. Top panel shows frontal plane view, bottom panel shows sagittal plane view from above, and side panel shows a sagittal/transverse plane view to allow a visualization of the axial rotation of the pelvis and trunk.

FIGURE 2. Participant demonstrates good control of the pelvis and trunk during active hip abduction, resulting in an examiner score of 0. Note the lower limbs, trunk, shoulders, and pelvis remain aligned in the frontal plane.

The purpose of this study was to determine whether performance on the AHAbd test was useful in discriminating between LBP developers and nondevelopers in a functionally induced LBP protocol. We hypothesized that individuals who had greater difficulty maintaining frontal plane alignment of the pelvis and trunk during the AHAbd test would be more likely to be pain developers during

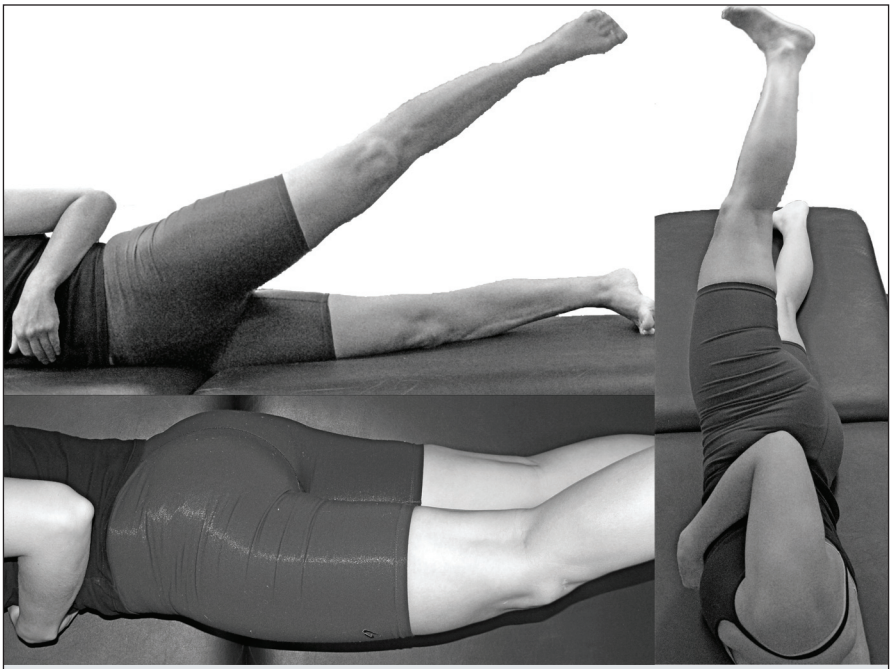

FIGURE 3. Participant demonstrates poor control of the pelvis and trunk during active hip abduction, resulting in an examiner score of 3. Note the pelvis tips forward out of the frontal plane during the hip abduction movement, trunk and shoulders are starting to rotate, and abducting hip is internally rotated.

TABLE 1 Cues to Differentiate Test Performance

Examiner Score	Cues for Examiner
Test score, 0 (no loss of pelvis frontal plane)	• Participant smoothly and easily performs the movement. • Lower extremities, pelvis, trunk and shoulders remain aligned in the frontal plane.
Test score, 1 (minimal loss of pelvis frontal plane)	• Participant may demonstrate a slight wobble at initiation of the movement, but quickly regains control. • Movement may be performed with noticeable effort or with a slight ratcheting of the moving limb.
Test score, 2 (moderate loss of pelvis frontal plane)	• Participant has a noticeable wobble, tipping of the pelvis, rotation of the shoulders or trunk, hip flexion, and/or internal rotation of the abducting limb. • Movement may be performed too rapidly, and participant may or may not be able to regain control of the movement once it has been lost.
Test score, 3 (severe loss of pelvis frontal plane)	• Participant demonstrates the same patterns as in a test score of 2, with greater severity. • Participant is unable to regain control of the movement and may have to use a hand or arm on the table to maintain balance.

standing than those who did not have difficulty performing the test.

METHODS

Ethics approval for research involving human subjects was obtained from the Office for Research Ethics at the University of Waterloo. Forty-three volunteers (22 male, 21 female) without any prior history of LBP were recruited from the university population and surrounding community. Exclusion criteria included the following: any lifetime event of LBP that was significant enough to cause the subject to seek care from a medical doctor, physical therapist, or chiropractor, or that resulted in greater than 3 days off work or school; current low back or hip pain; previous hip surgery; inability to stand for greater than 4 hours; inability to complete questionnaires; and employment in an occupation requiring static standing during the previous 12 months.

After informed consent was obtained, participants completed a baseline measure of current pain symptoms on a 100-mm visual analogue scale (VAS) for the low back, with end point anchors of "no pain" and "worst pain imaginable," and a 4-week activity scale. The VAS was chosen, as it has been found to have good construct validity[28] and reliability.[24] The Minnesota Leisure Time Physical Activity Questionnaire was chosen for the activity scale based on its high test-retest reliability.[6]

In addition to the AHAbd test, a standardized assessment, similar to that which would be performed in a clinical setting on a patient with LBP, was performed by a licensed physical therapist (E.N.W.). Clinical measures included active and passive hip and lumbar range of motion, ASLR test,[21] time to fatigue in side-support,[13,18] assessment of lumbar segmental mobility,[14] and prone instability testing.[13,14] The clinical assessment tools chosen for this study were based on the tools commonly used in physical therapy examination of patients with LBP. Observation of aberrant motions during active lumbar range of motion has been reported to have moderate interrater reliability (κ = 0.60; 95% confidence interval [CI]: 0.47-0.73)[14]; however, to our knowledge, validity studies have not been reported on these measures. The ASLR has shown strong test-retest reliability (Pearson r = 0.87),[19] and its validity has been established in a pregnancy-related posterior pelvic pain sample.[20] It has been suggested that the ASLR might be useful in LBP populations other than the patient group with pregnancy-related posterior pelvic pain.[13,19] Time to fatigue in side-support has been shown to have excellent test-retest reliability (intraclass correlation coefficient [ICC], >0.95)[18]; however, to our knowledge, no validity studies have been published on this test. Passive segmental mobility testing in the lumbar spine has been found to have

poor interrater reliability for assessment of mobility, with ICC values ranging from 0.03 to 0.37[2,17]; however, this assessment was included, as it is a standard part of physical therapy practice. The prone instability test has excellent interrater reliability (κ = 0.87; 95% CI: 0.80-0.94); however, validity studies have not been published to our knowledge.[13,14]

Following the clinical assessment, participants performed a prolonged standing task that has previously been used to functionally induce LBP symptoms in asymptomatic individuals.[10,23] A standing table was positioned in front of the participant and tasks that were meant to simulate light occupational activities were performed during the 2-hour standing period. These included a "sorting" task, a small-object "assembly" task, and a "boredom" task, where participants were asked to stand without activity or social interaction. Participants were instructed to stand "in their usual manner, as if they were standing for an extended period," with the only stipulations being that they could not rest their foot on the standing table frame and they could not lean on the table surface with their upper extremities to support their body weight. As this study was a part of a larger biomechanical study that involved extensive instrumentation, another baseline VAS for LBP was collected prior to the start of the 2-hour standing period to ensure that participants had not developed pain during the instrumentation period. Participants that reported a non-zero VAS score (average ± SD, 1.85 ± 0.71 mm) following instrumentation had this value subtracted as a bias from the remaining VAS scores collected. VAS was collected every 15 minutes during the 2-hour standing period, for a total of 9 VAS scores, including those of the baseline measure.

Participants were classified into pain developer (PD) and non-pain developer (NPD) groups, based on their reported LBP scores on the VAS. Because the goal of this study was to induce pain in previously pain-free individuals, a threshold VAS score was required to separate participants into PD or NPD categories. Studies investigating criteria for minimally clinically important difference (MCID) scores for VAS have been conducted across a wide range of diagnoses and populations and have resulted in a large range of MCID values. Typically, MCID scores are used to detect improvement in symptoms in response to treatment. Hagg and colleagues[11] investigated the MCID for both improvement and deterioration in VAS in patients with LBP. They found the MCID for patients to report improvement in their LBP was 15 mm, while the MCID for patients to feel their LBP symptoms had worsened was only 8 mm. While MCID is useful for investigating response to treatment, minimal detectable change (MDC) may also be useful for investigation of perceived pain increases in an induced-pain model. MDC for VAS score at the 95% CI was calculated using the equation $1.96 \times \sqrt{2 \times SEM}$), with an estimate of the SEM calculated as the square-root of the within-subject variance.[16] Using this method, the MDC for this sample was calculated to be 5.94 mm. It has also been suggested that individuals with less severe pain conditions might have lower MCID values than those with more severe pain conditions.[27] Based on the low calculated MDC value, the MCID for worsening LBP symptoms in a clinical population reported by Hagg et al[11] and the relatively low-level pain-inducing stimulus used in this study, the decision was made to use a change of 10 mm on VAS as the cut-point to categorize participants in this study as PD or NPD.

TABLE 2 Baseline Characteristics of Participants, Group Statistics

Characteristic/Group	n	Mean ± SD	SEM	*P* Value
Age (y)				.562
NPD	26	22.50 ± 3.11	0.611	
PD	17	23.12 ± 3.77	0.915	
BMI (kg/m^2)				.844
NPD	26	23.68 ± 3.25	0.637	
PD	17	23.88 ± 3.28	0.796	
MPAQ previous 4 wk				.315
NPD	26	14438.7 ± 7554.9	1481.6	
PD	17	17071.1 ± 9342.4	2265.9	

Abbreviations: BMI, body mass index; MPAQ, Modified Minnesota Leisure Time Physical Activity Questionnaire; NPD, non-pain developer; PD, pain developer.

SPSS, Version 17.0 (SPSS, Inc, Chicago, IL) was used for all statistical analyses. Independent *t* tests were conducted to ensure equality of groups on personal characteristics of age, body mass index (BMI), and activity level, as documented by the Minnesota Leisure Time Physical Activity Questionnaire score. Clinical assessment variables and VAS scores were entered into a 3-way general linear model, with between-factors of gender and pain developer group, and 9 repeated measures on the VAS. Nonparametric tests were conducted on the nominal clinical assessment variables where appropriate. The level for significance was set at $P<.05$ for all statistical tests.

The AHAbd test was also transformed into a categorical variable by considering different cutoff thresholds for "positive" and "negative" tests, and a receiver operating characteristic (ROC) analysis was performed to determine the optimal cutoff threshold for a positive score. An ROC curve was generated for the examiner-rated scores, using cutoff thresholds of 0, 1, 2, and 3, and plotting the sensitivity against 1 – specificity. Similarly, ROC curves were constructed for the self-rated scores, using cutoff thresholds on a point-

by-point basis. Area under the ROC curves (AUC) was calculated in SPSS.

RESULTS

Pain Development During Standing

Baseline characteristics of the participants within each group (PD and NPD) were statistically similar (**TABLE 2**). The standing protocol was successful in inducing LBP in 40% of the participants (**FIGURES 4** and **5**). As expected, there was a significant interaction of time and group ($F_{2.984,116.394} = 14.222$; $P<.001$). **FIGURE 4** shows the PD/NPD group averages for low back VAS at each point in time over the 2-hour standing period. **FIGURE 5** shows the group averages for the absolute maximum VAS scores reported over the 2-hour period. Because the PD individuals reported their maximum VAS scores at different times over the 2-hour period, there is some "washout effect," and the mean values in **FIGURE 4** appear to be lower than those in **FIGURE 5**. Although a higher percentage of females reported LBP (47.6%) than males (31.8%), there was a significant group-by-gender interaction ($F_{1,39} = 9.345$, $P<.01$), with male PD reporting higher average VAS scores than female PD. As all of the participants classified as PD exceeded the threshold criteria, this was not deemed to adversely affect the remaining analyses.

Clinical Assessment Findings

The self-rated and examiner-scored AHAbd test was the only clinical assessment test that showed differences between groups ($F_{1,41} = 4.943$ and $F_{1,41} = 7.418$; $P<.05$, respectively). A summary of the clinical assessment findings is presented as **TABLE 3**. There was no main effect of gender and no interaction of gender and group.

For the examiner-rated test, results from the ROC analysis indicated that there was no difference in optimal cutoff threshold for a positive test between scores of 1 or 2, with the perpendicular distances from the line of identity to the cutoff score being equivalent (**FIGURE 6**). AUC values for cutoff scores of 1 and 2 were

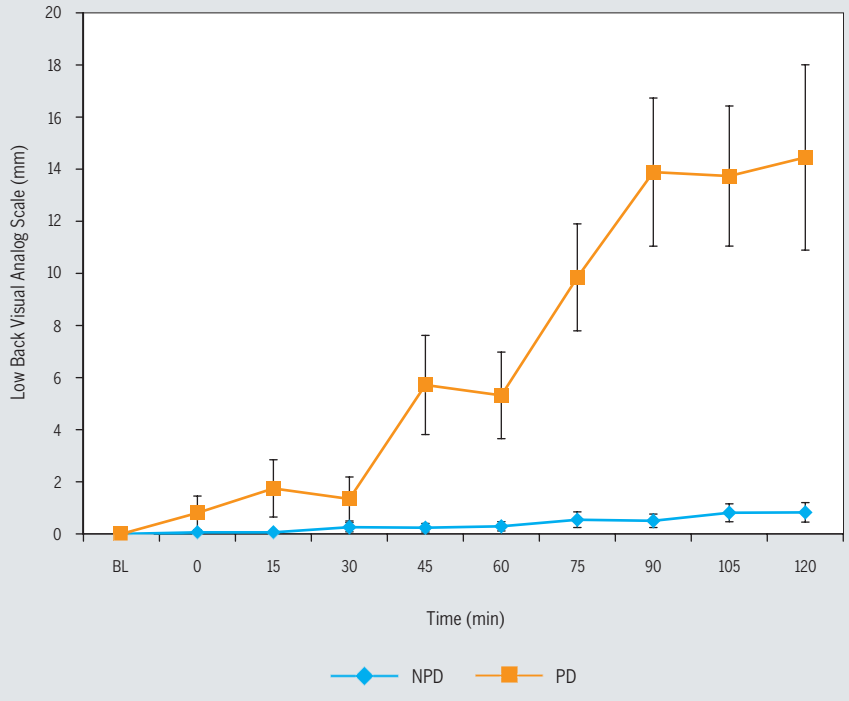

FIGURE 4. The 2-hour standing protocol was successful at inducing pain in 40% of the participants with a clear differentiation between pain developer (PD) and non-pain developer (NPD) groups (time-by-group interaction significant at $P<.001$). Plotted data are group means ± standard error of the mean (SEM). Pain scale: 0-100, with 0 as "no pain" and 100 as "worst pain imaginable." Abbreviation: BL, baseline.

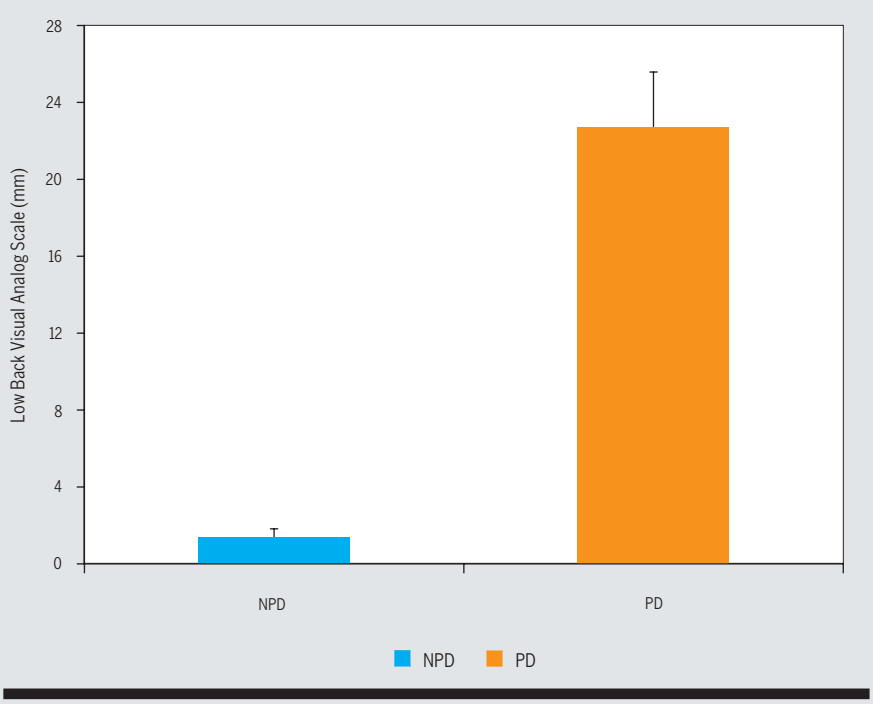

FIGURE 5. Pain developers (PD) averaged a maximum ± SEM visual analogue scale (VAS) score of 22.7 ± 2.91 mm, and non-pain developers (NPD) averaged a maximum VAS score of 1.37 ± 0.45 mm.

TABLE 3 Group Data (Mean ± SD) on Clinical Measures

Clinical Measures	NPD	PD	*P* Value
Lumbar flexion (°)	122.2 ± 14.3	124.8 ± 17.5	.60
Lumbar extension (°)	48.9 ± 11.9	52.1 ± 12.3	.40
Left lumbar lateral flexion (°)	53.0 ± 7.8	50.2 ± 9.9	.31
Right lumbar lateral flexion (°)	50.8 ± 7.8	48.8 ± 9.4	.45
Right hip flexion (°)	119.2 ± 9.8	122.7 ± 9.3	.25
Left hip flexion (°)	123.5 ± 9.2	122.8 ± 8.5	.82
Right hip extension, in prone (°)	17.2 ± 6.1	14.4 ± 5.8	.40
Left hip extension, in prone (°)	17.4 ± 4.9	16.8 ± 5.4	.72
Right hip internal rotation, prone (°)	37.9 ± 11.1	42.1 ± 7.8	.18
Left hip internal rotation, prone (°)	40.1 ± 11.7	44.8 ± 10.7	.19
Right hip external rotation, prone (°)	45.7 ± 11.7	44.4 ± 15.3	.75
Left hip external rotation, prone (°)	42.9 ± 10.4	42.0 ± 11.7	.81
Right straight-leg raise (°)	67.0 ± 14.3	70.2 ± 13.1	.47
Left straight-leg raise (°)	70.6 ± 12.7	73.6 ± 15.8	.49
ASLR test (>0, positive finding)	0.77 ± 1.3	1.59 ± 2.1	.12
Lumbar segmental mobility; L5 PA (0, hypo; 1, normal; 2, hyper)	0.69 ± 0.55	0.41 ± 0.51	.10
Side-support, time to failure (s)	91.5 ± 38.6	97.7 ± 41.8	.62
Beiring-Sorensen test, time to failure (s)	139.3 ± 43.6	154.4 ± 59.7	.35
Instability catch (0, absent; 1, present)	0.0 ± 0.0	0.0 ± 0.0	1.0
Gower's sign (0, absent; 1, present)	0.0 ± 0.0	0.0 ± 0.0	1.0
Lumbopelvic reversal (0, absent; 1, present)	0.23 ± 0.43	0.12 ± 0.33	.36
Prone instability test at L5 (0, negative; 1, positive)	0.04 ± 0.2	0.18 ± 0.39	.13
Self-rated AHAbd test (0, no difficulty; 5, unable)	1.19 ± 1.41	2.44 ± 2.28	.032
Examiner scored AHAbd test (0, no loss; 1, minimal loss; 2, moderate loss; 3, severe loss)	0.65 ± 0.75	1.35 ± 0.93	.009

Abbreviation: AHAbd, active hip abduction; ASLR, active straight-leg raise; NPD, non-pain developer; PD, pain developer.

also very similar: 0.662 (95% CI: 0.497-0.827) and 0.629 (95% CI: 0.452-0.826), respectively. However, the calculated odds ratio (OR) using a cutoff score of 1 had a 95% CI that included the null value of 1.0, indicating that the test result has a chance of being meaningless, with a cutoff score of 1. Using a cutoff score of 2, the positive likelihood ratio (LR+) was 2.68 (95% CI: 1.02-8.54) and the OR was 3.85 (95% CI: 1.05-19.07). This OR indicates that an individual who scores 2 or greater on the examiner-rated AHAbd test would be 3.85 times more likely to develop LBP during occupational standing. The 2-by-2 table for this scenario is presented in **TABLE 4**. For the self-rated test, the ROC analysis indicated that an appropriate cutoff score would range from 3 to 5 out of a possible 10. AUC values and 95% CIs for each of these cutoff scores were similar to those of the examiner-scored test. When OR was calculated using each of these cutoff scores, the cutoff score of 4 was found to be the best, with an LR+ of 4.59 (95% CI: 1.05-20.13) and an OR of 6.55 (95% CI: 1.14-37.75). The 2-by-2 table for this scenario is presented as **TABLE 5**.

DISCUSSION

The main purpose of this study was to evaluate the utility of a novel screening tool designed to assess trunk and pelvis control during active lower limb movement in predicting pain development during standing in a previously asymptomatic sample. Our hypothesis that individuals who developed LBP would display decreased trunk and pelvis control, as evidenced by difficulty maintaining the pelvis in a neutral position during active hip abduction in sidelying, was supported. Although the examiner-scored test had a statistically stronger difference between pain groups than the self-rated test, the self-rated test, with a cutoff score of 4, had higher OR and LR+ values than the examiner-scored test. Mens and colleagues[19] described a positive finding on the ASLR, a test on which the AHAbd test was loosely based, as being any nonzero rating. The ROC and OR analysis on the AHAbd test in this study indicated that an individual was required to perceive a higher level of difficulty in performing the movement for it to be predictive of LBP development during standing.

OR values for each method of scoring the test had 95% CIs, with the lower limits being only marginally greater than the null value of 1.0. This is likely due to the very small sample size in this study, and further research is needed in a larger sample before this test is incorporated into clinical practice. The lower limit of the LR+ 95% CIs for each scoring method was also just above the null value of 1.0. The sensitivity values were poor for both methods; however, the specificity values of 0.92 and 0.88 for self-rated and examiner scored tests, respectively, indicate that the test may be useful for ruling in pain development during standing. The ROC analyses for both scoring methods yielded poor AUC values, with all 95% CIs encompassing the null value of 0.5. This indicates that the test may not be useful in discriminating PD from NPD in standing; again, this is likely a function of the small sample size in this study.

The AHAbd test differs from the other clinical assessment tools used in this study in that trunk control in the frontal plane during a low-demand challenge is presented. The ASLR challenges trunk control during lower limb movement;

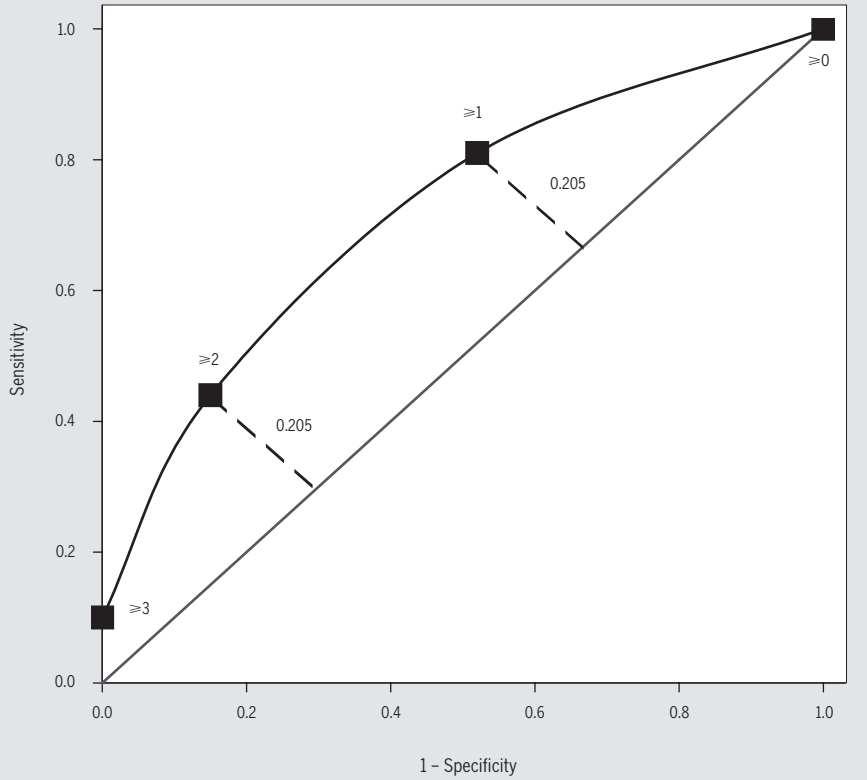

FIGURE 6. Receiver operator characteristic (ROC) plot for different cutoff thresholds. The equivalent perpendicular distance from the line of identity, 0.205, indicates no difference in optimum cutoff threshold between scores of 1 and 2. Area under the curve (AUC) is approximately 0.64, and indicates limited utility of the test.

TABLE 4 Two-by-Two Table for Examiner-Scored Test With Cutoff Score Greater Than or Equal to 2

Active Hip Abduction Test	PD	NPD
Positive test (predicts PD)	7	4
Negative test (predicts NPD)	10	22
Sensitivity	0.41 (0.23-0.67)	
Specificity	0.85 (0.68-0.94)	
LR+	2.68 (1.02-8.54)	
LR–	0.70 (0.42-1.05)	
OR	3.85 (1.05-19.07)	

Abbreviations: CI, confidence interval; LR+, positive likelihood ratio; LR–, negative likelihood ratio; NPD, non-pain developer; OR, odds ratio; PD, pain developer.
** Values in parentheses represent the 95% confidence interval.*

however, the patient is in a supine position, which is inherently stable, and also has the benefit of broad tactile input from the supporting surface. The side-support test is a measure of endurance, and while it does require trunk control in the frontal plane, trunk control is not assessed specifically. The side-support test is a high-demand, static task, that involves extensive cocontraction of the trunk musculature to accomplish.[18] The AHAbd test was designed to challenge the trunk musculature during active lower limb movement in a destabilized position of sidelying with extended lower extremities. The finding that PD had greater difficulty controlling this movement and maintaining the trunk in a neutral position during a relatively low-demand challenge supports the concept of decreased trunk control during an upright posture.

Although this sample did not include a clinical LBP population, the ability to predict future LBP development during a specific activity in previously asymptomatic individuals has powerful implications. This simple screening tool, if it can be further validated, has a potential application for workplace screening and early identification of individuals who may be at risk to develop LBP with prolonged standing exposures. This work was conducted as part of a larger study that is investigating muscle activation patterns and other biomechanical factors prior to and during acute LBP development, as well as evaluating effects of an exercise intervention aimed at trunk and hip control on pain development during prolonged standing.

Previous work using this "functionally induced LBP" protocol has shown differences in muscle activation patterns between pain development groups in the trunk and in the hip abductors.[22,23] Specifically, previously asymptomatic individuals who went on to develop LBP during standing demonstrated higher levels of bilateral gluteus medius muscle coactivation than NPD, even prior to subjectively reporting any pain symptoms. It has been suggested that this might be a compensatory muscle activation pattern at the hip in response to an inability to adequately activate the trunk musculature for postural control during a relatively static standing task. Preliminary findings examining changes in muscle coactivation pattern of PD in response to an exercise intervention aimed at trunk and hip control during dynamic limb movement have shown promise, with subjective decreases in pain during standing, as well as following exercise intervention.

There are several limitations to this study. Although electromyography was

TABLE 5 Two-by-Two Table for Self-Rated Test With Cutoff Score Greater Than or Equal to 4*

Active Hip Abduction Test	PD	NPD
Positive test (predicts PD)	6	2
Negative test (predicts NPD)	11	24
Sensitivity	0.35 (0.17-0.59)	
Specificity	0.92 (0.76-0.98)	
LR+	4.59 (1.05-20.13)	
LR–	0.70 (0.49-1.01)	
OR	6.55 (1.14-37.8)	

Abbreviations: LR+, positive likelihood ratio; LR–, negative likelihood ratio; OR, odds ratio; NPD, non-pain developer; PD, pain developer.
** Values in parentheses represent 95% confidence interval.*

collected during the standing task, the AHAbd test was performed without biomechanical instrumentation. Therefore, direct comparisons of muscle activation patterns and timing cannot be made between the screening test and the pain-inducing standing task. There have been no interrater or intrarater reliability analyses performed on this test, as it was done as part of a much larger study and this was not the primary aim. Repeatability of self-scoring within individuals has also not been assessed. Continued studies of the AHAbd test are being conducted currently to address these issues and answer questions concerning interrater and intrarater reliability and validity. All of the clinical assessments were performed by the same physical therapist, and it is unknown whether the subjective judgment of minimal, moderate, or severe loss of pelvis frontal plane would be similar between different examiners; however, cues to guide clinicians to achieve similar classification of performance during the AHAbd test are included (**TABLE 1**). The improved OR of the test, with an examiner-scored cutoff threshold of moderate or severe loss of frontal plane and a self-rated score of greater than 4, indicates that these thresholds should be used as a baseline for future testing and clinical assessments. The test has been used only in an asymptomatic sample without prior history of LBP, and it is unknown at this point how it might perform in a clinical population. The standing protocol used in this study, while it has been shown to be successful at inducing LBP in previously asymptomatic individuals, has not yet been validated as an indicator of future LBP occurrence. VAS scores for the PD group ranged from 11 to 56 mm, and it is unclear whether these pain levels would prevent individuals from performing their occupational duties in a real-world setting. Given the very high financial and social costs associated with LBP in the workplace, any increase in LBP in an occupational setting is cause for concern. Several studies have shown altered postural and trunk control in response to perturbations in individuals with LBP.[3,12,26] Therefore, it may be expected that a test designed to identify impairments in trunk and pelvis control during a self-initiated perturbation should be sensitive to differences in clinical populations, and may be of particular benefit in identifying patients with LBP who will respond to exercise intervention aimed at trunk and pelvis control during dynamic lower limb movement.

CONCLUSION

The AHAbd test performed moderately well in predicting the occurrence of LBP during exposure to an occupational-standing task in previously asymptomatic individuals. The test appears to have potential utility as a screening tool to determine which individuals might be at risk for LBP development during a prolonged-standing task. Future work is needed to determine the reliability, validity, and generalizability to clinical and occupational populations. ◉

KEY POINTS

FINDINGS: The AHAbd test is a novel clinical screening tool that assesses trunk and pelvis control during active lower limb movement from an unstable position. Preliminary findings show the test may be useful for predicting LBP development during prolonged standing tasks.
IMPLICATION: This test may be a useful screening tool for early identification of people at risk for LBP during standing.
CAUTION: Small sample sizes were used in this study, and the CIs for the LR+ and OR are close to 1.0. The test may not be valid in clinical populations, as it has only been studied within the context of an induced-pain model in asymptomatic individuals. No reliability studies have been conducted on the test to date.

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Low Back Pain

Clinical Practice Guidelines Linked to the International Classification of Functioning, Disability, and Health from the Orthopaedic Section of the American Physical Therapy Association

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Recommendations*

RISK FACTORS: Current literature does not support a definitive cause for initial episodes of low back pain. Risk factors are multifactorial, population specific, and only weakly associated with the development of low back pain. (Recommendation based on moderate evidence.)

CLINICAL COURSE: The clinical course of low back pain can be described as acute, subacute, recurrent, or chronic. Given the high prevalence of recurrent and chronic low back pain and the associated costs, clinicians should place high priority on interventions that prevent (1) recurrences and (2) the transition to chronic low back pain. (Recommendation based on theoretical/foundational evidence.)

DIAGNOSIS/CLASSIFICATION: Low back pain, without symptoms or signs of serious medical or psychological conditions, associated with clinical findings of (1) mobility impairment in the thoracic, lumbar, or sacroiliac regions, (2) referred or radiating pain into a lower extremity, and (3) generalized pain , is useful for classifying a patient with low back pain into the following International Statistical Classification of Diseases and Related Health Problems (ICD) categories: low back pain, lumbago, lumbosacral segmental/somatic dysfunction, low back strain, spinal instabilities, flatback syndrome, lumbago due to displacement of intervertebral disc, lumbago with sciatica, and the associated International Classification of Functioning, Disability, and Health (ICF) impairment-based category of low back pain (b28013 Pain in back, b28018 Pain in body part, specified as pain in buttock, groin, and thigh) and the following, corresponding impairments of body function:

- Acute or subacute low back pain with mobility deficits (b7101 Mobility of several joints)
- Acute, subacute, or chronic low back pain with movement coordination impairments (b7601 Control of complex voluntary movements)
- Acute low back pain with related (referred) lower extremity pain (b28015 Pain in lower limb)
- Acute, subacute, or chronic low back pain with radiating pain (b2804 Radiating pain in a segment or region)
- Acute or subacute low back pain with related cognitive or affective tendencies (b2703 Sensitivity to a noxious stimulus, b1522 Range of emotion, b1608 Thought functions, specified as the tendency to elaborate physical symptoms for cognitive/ideational reasons, b1528 Emotional functions, specified as the tendency to elaborate physical symptoms for emotional/affective reasons)
- Chronic low back pain with related generalized pain (b2800 Generalized pain, b1520 Appropriateness of emotion, b1602 Content of thought)

DIFFERENTIAL DIAGNOSIS: Clinicians should consider diagnostic classifications associated with serious medical conditions or psychosocial factors and initiate referral to the appropriate medical practitioner when (1) the patient's clinical findings are suggestive of serious medical or psychological pathology, (2) the reported activity limitations or impairments of body function and structure are not consistent with those presented in the diagnosis/classification section of these guidelines, or (3) the patient's symptoms are not resolving with interventions aimed at normalization of the patient's impairments of body function. (Recommendation based on strong evidence.)

EXAMINATION – OUTCOME MEASURES: Clinicians should use validated self-report questionnaires, such as the Oswestry Disability Index and the Roland-Morris Disability Questionnaire. These tools are useful for identifying a patient's baseline status relative to pain, function, and disability and for monitoring a change in a patient's status throughout the course of treatment. (Recommendation based on strong evidence.)

EXAMINATION – ACTIVITY LIMITATION AND PARTICIPATION RESTRICTION MEASURES: Clinicians should routinely assess activity limitation and participation restriction through validated performance-based measures. Changes in the patient's level of activity limitation and participation restriction should be monitored with these same measures over the course of treatment. (Recommendation based on expert opinion.)

INTERVENTIONS – MANUAL THERAPY: Clinicians should consider utilizing thrust manipulative procedures to reduce pain and disability in patients with mobility deficits and acute low back and back-related buttock or thigh pain. Thrust manipulative and nonthrust mobilization procedures can also be used to improve spine and hip mobility and reduce pain and disability in patients with subacute and chronic low back and back-related lower extremity pain. (Recommendation based on strong evidence.)

INTERVENTIONS – TRUNK COORDINATION, STRENGTHENING, AND ENDURANCE EXERCISES: Clinicians should consider utilizing trunk coordination, strengthening, and endurance exercises to reduce low back pain and disability in patients with sub-

Recommendations *(continued)**

acute and chronic low back pain with movement coordination impairments and in patients post lumbar microdiscectomy. (Recommendation based on strong evidence.)

INTERVENTIONS – CENTRALIZATION AND DIRECTIONAL PREFERENCE EXERCISES AND PROCEDURES: Clinicians should consider utilizing repeated movements, exercises, or procedures to promote centralization to reduce symptoms in patients with acute low back pain with related (referred) lower extremity pain. Clinicians should consider using repeated exercises in a specific direction determined by treatment response to improve mobility and reduce symptoms in patients with acute, subacute, or chronic low back pain with mobility deficits. (Recommendation based on strong evidence.)

INTERVENTIONS – FLEXION EXERCISES: Clinicians can consider flexion exercises, combined with other interventions such as manual therapy, strengthening exercises, nerve mobilization procedures, and progressive walking, for reducing pain and disability in older patients with chronic low back pain with radiating pain. (Recommendation based on weak evidence.)

INTERVENTIONS – LOWER-QUARTER NERVE MOBILIZATION PROCEDURES: Clinicians should consider utilizing lower-quarter nerve mobilization procedures to reduce pain and disability in patients with subacute and chronic low back pain and radiating pain. (Recommendation based on weak evidence.)

INTERVENTIONS – TRACTION: There is conflicting evidence for the efficacy of intermittent lumbar traction for patients with low back pain. There is preliminary evidence that a subgroup of patients with signs of nerve root compression along with peripheralization of symptoms or a positive crossed straight leg raise will benefit from intermittent lumbar traction in the prone position. There is moderate evidence that clinicians should not utilize intermittent or static lumbar traction for reducing symptoms in patients with acute or subacute, nonradicular low back pain or patients with chronic low back pain. (Recommendation based on conflicting evidence.)

INTERVENTIONS – PATIENT EDUCATION AND COUNSELING: Clinicians should not utilize patient education and counseling strategies that either directly or indirectly increase the perceived threat or fear associated with low back pain, such as education and counseling strategies that (1) promote extended bed-rest or (2) provide in-depth, pathoanatomical explanations for the specific cause of the patient's low back pain. Patient education and counseling strategies for patients with low back pain should emphasize (1) the promotion of the understanding of the anatomical/structural strength inherent in the human spine, (2) the neuroscience that explains pain perception, (3) the overall favorable prognosis of low back pain, (4) the use of active pain coping strategies that decrease fear and catastrophizing, (5) the early resumption of normal or vocational activities, even when still experiencing pain, and (6) the importance of improvement in activity levels, not just pain relief. (Recommendation based on moderate evidence.)

INTERVENTIONS – PROGRESSIVE ENDURANCE EXERCISE AND FITNESS ACTIVITIES: Clinicians should consider (1) moderate- to high-intensity exercise for patients with chronic low back pain without generalized pain, and (2) incorporating progressive, low-intensity, submaximal fitness and endurance activities into the pain management and health promotion strategies for patients with chronic low back pain with generalized pain. (Recommendation based on strong evidence.)

*These recommendations and clinical practice guidelines are based on the scientific literature accepted for publication prior to January 2011.

Introduction

AIM OF THE GUIDELINES

The Orthopaedic Section of the American Physical Therapy Association (APTA) has an ongoing effort to create evidence-based practice guidelines for orthopaedic physical therapy management of patients with musculoskeletal impairments described in the World Health Organization's International Classification of Functioning, Disability, and Health (ICF).[325]

The purposes of these clinical guidelines are to:

- Describe evidence-based physical therapy practice, including diagnosis, prognosis, intervention, and assessment of outcome, for musculoskeletal disorders commonly managed by orthopaedic physical therapists
- Classify and define common musculoskeletal conditions using the World Health Organization's terminology related to

Introduction *(continued)*

impairments of body function and body structure, activity limitations, and participation restrictions
- Identify interventions supported by current best evidence to address impairments of body function and structure, activity limitations, and participation restrictions associated with common musculoskeletal conditions
- Identify appropriate outcome measures to assess changes resulting from physical therapy interventions in body function and structure as well as in activity and participation of the individual
- Provide a description to policy makers, using internationally accepted terminology, of the practice of orthopaedic physical therapists
- Provide information for payers and claims reviewers regarding the practice of orthopaedic physical therapy for common musculoskeletal conditions
- Create a reference publication for orthopaedic physical therapy clinicians, academic instructors, clinical instructors, students, interns, residents, and fellows regarding the best current practice of orthopaedic physical therapy

The purpose of these low back pain clinical practice guidelines, in particular, is to describe the peer-reviewed literature and make recommendations related to (1) treatment matched to low back pain subgroup responder categories, (2) treatments that have evidence to prevent recurrence of low back pain, and (3) treatments that have evidence to influence the progression from acute to chronic low back pain and disability.

STATEMENT OF INTENT

These guidelines are not intended to be construed as or to serve as a standard of medical care. Standards of care are determined on the basis of all clinical data available for an individual patient and are subject to change as scientific knowledge and technology advance and patterns of care evolve. These parameters of practice should be considered guidelines only. Adherence to them will not ensure a successful outcome in every patient, nor should they be construed as including all proper methods of care or excluding other acceptable methods of care aimed at the same results. The ultimate judgment regarding a particular clinical procedure or treatment plan must be made in light of the clinical data presented by the patient, the diagnostic and treatment options available, and the patient's values, expectations, and preferences. However, we suggest that significant departures from accepted guidelines should be documented in the patient's medical records at the time the relevant clinical decision is made.

Methods

Content experts were appointed by the Orthopaedic Section, APTA as developers and authors of clinical practice guidelines for musculoskeletal conditions of the low back region. These content experts were given the task to identify impairments of body function and structure, activity limitations, and participation restrictions, described using ICF terminology, that could (1) categorize patients into mutually exclusive impairment patterns upon which to base intervention strategies, and (2) serve as measures of changes in function over the course of an episode of care. The second task given to the content experts was to describe the supporting evidence for the identified impairment pattern classification as well as interventions for patients with activity limitations and impairments of body function and structure consistent with the identified impairment pattern classification. It was also acknowledged by the Orthopaedic Section, APTA content experts that only performing a systematic search and review of the evidence related to diagnostic categories based on International Statistical Classification of Diseases and Related Health Problems (ICD) terminology would not be sufficient for these ICF-based clinical practice guidelines, as most of the evidence associated with changes in levels of impairment or function in homogeneous populations is not readily searchable using the ICD terminology. Thus, the authors of these guidelines independently performed a systematic search of the MEDLINE, CINAHL, and the Cochrane Database of Systematic Reviews (1966 through 2010) for any relevant articles related to classification, examination, and intervention for musculoskeletal conditions related to the low back region. The lead author (A.D.) assigned a specific subcategory (classification, measures, and intervention strategies for musculoskeletal conditions of the low back region) to search based upon their specific area of expertise. Two authors were assigned to each subcategory and both individuals performed a separate search, including but not limited to the 3 databases listed above, to identify articles to ensure that no studies of relevance were omitted. Additionally, when relevant articles

Methods *(continued)*

were identified, their reference lists were hand-searched in an attempt to identify other articles that might have contributed to the content of these clinical practice guidelines. Articles from the searches were compiled and reviewed for accuracy by the authors. Articles with the highest levels of evidence that were most relevant to classification, examination, and intervention for patients with musculoskeletal conditions related to the low back region were included in these guidelines.

These guidelines were issued in 2012 based upon articles accepted for publication in the scientific literature prior to January 2011. These guidelines will be considered for review in 2017, or sooner if new evidence becomes available. Any updates to the guidelines in the interim period will be noted on the Orthopaedic Section of the APTA website: www.orthopt.org.

LEVELS OF EVIDENCE

Individual clinical research articles were graded according to criteria described by the Centre for Evidence-Based Medicine, Oxford, United Kingdom (http://www.cebm.net/index.aspx?o=1025) for diagnostic, prospective, and therapeutic studies.[238] If the 2 content experts did not agree on a grade of evidence for a particular article, a third content expert was used to resolve the issue.

I	Evidence obtained from high-quality diagnostic studies, prospective studies, or randomized controlled trials
II	Evidence obtained from lesser-quality diagnostic studies, prospective studies, or randomized controlled trials (eg, weaker diagnostic criteria and reference standards, improper randomization, no blinding, <80% follow-up)
III	Case-controlled studies or retrospective studies
IV	Case series
V	Expert opinion

GRADES OF EVIDENCE

The overall strength of the evidence supporting recommendations made in these guidelines will be graded according to guidelines described by Guyatt et al,[132] as modified by MacDermid and adopted by the coordinator and reviewers of this project. In this modified system, the typical A, B, C, and D grades of evidence have been modified to include the role of consensus expert opinion and basic science research to demonstrate biological or biomechanical plausibility.

GRADES OF RECOMMENDATION BASED ON		STRENGTH OF EVIDENCE
A	Strong evidence	A preponderance of level I and/or level II studies support the recommendation. This must include at least 1 level I study
B	Moderate evidence	A single high-quality randomized controlled trial or a preponderance of level II studies support the recommendation
C	Weak evidence	A single level II study or a preponderance of level III and IV studies, including statements of consensus by content experts, support the recommendation
D	Conflicting evidence	Higher-quality studies conducted on this topic disagree with respect to their conclusions. The recommendation is based on these conflicting studies
E	Theoretical/foundational evidence	A preponderance of evidence from animal or cadaver studies, from conceptual models/principles, or from basic science/bench research supports this conclusion
F	Expert opinion	Best practice based on the clinical experience of the guideline development team

REVIEW PROCESS

The Orthopaedic Section, APTA also selected consultants from the following areas to serve as reviewers of the early drafts of these clinical practice guidelines:

- Claims review
- Coding
- Epidemiology
- Low back pain rehabilitation
- Manipulative therapy
- Medical practice guidelines
- Movement science
- Orthopaedic physical therapy residency education
- Outcomes research
- Pain sciences
- Physical therapy academic education
- Rheumatology

Methods *(continued)*

- Spinal biomechanics
- Sports physical therapy residency education
- Sports rehabilitation

Comments from these reviewers were utilized by the authors to edit these clinical practice guidelines prior to submitting them for publication to the *Journal of Orthopaedic & Sports Physical Therapy*. In addition, several physical therapists practicing in orthopaedic and sports physical therapy settings were sent initial drafts of this clinical practice guideline along with feedback forms to assess its usefulness, validity, and impact.

Several practicing clinicians and reviewers noted that the classification criteria summary of the ICF-based Neck Pain Clinical Practice Guidelines[49] was useful in linking data gathered during the patient's subjective and physical examinations to diagnostic classification and intervention. Thus, similar recommended classification criteria were included by the authors for these ICF-based Low Back Pain Clinical Practice Guidelines, which provide a summary of symptoms, impairment findings, and matched interventions for each diagnostic category. This summary is provided in the Recommended Low Back Pain Impairment/Function-based Classification Criteria with Recommended Interventions table.

CLASSIFICATION

The primary ICD-10 codes and conditions associated with low back pain are: **M99.0 Lumbosacral segmental/somatic dysfunction**, **M53.2 Spinal instabilities**, **M40.3 Flatback syndrome**, **M51.2 Lumbago due to displacement of intervertebral disc**, **M54.1 Lumbar radiculopathy**, **M54.4 Lumbago with sciatica**, **M54.5 Low back pain**, **G96.8 Disorder of central nervous system, specified as central nervous system sensitivity to pain**, and **F45.4 Persistent somatoform pain disorder**.[324] The corresponding ICD-9-CM codes and conditions, which are used in the United States, are **739.3 Nonallopathic lesion, lumbar region**, **846.0 Lumbosacral ligament sprain**, **724.3 Sciatica**, **724.4 Thoracic or lumbosacral neuritis or radiculitis, unspecified**, and **724.2 Lumbago**.

The primary ICF body-function codes associated with the above noted ICD-10 conditions are **b28013 Pain in back**, **b28018 Pain in body part, specified as pain in buttock, groin, and thigh**, **b28015 Pain in lower limb**, **b2803 Radiating pain in a dermatome**, **b2703 Sensitivity to a noxious stimulus**, **b2800 Generalized pain**, **b7101 Mobility of several joints**, **b7108 Mobility of joint functions, specified as mobility in a vertebral segment**, **b7601 Control of complex voluntary movements**, **b789 Movement functions, specified as mobility of the meninges, peripheral nerves and adjacent tissues**, **b1520 Appropriateness of emotion**, **b1522 Range of emotion**, **b1528 Emotional functions, specified as the tendency to elaborate physical symptoms for emotional/affective reasons**, **b1602 Content of thought**, and **b1608 Thought functions, specified as the tendency to elaborate physical symptoms for cognitive/ideational reasons**.

The primary ICF body-structure codes associated with low back pain are **s76001 Thoracic vertebral column**, **s76002 Lumbar vertebral column**, **s7602 Ligaments and fasciae of trunk**, **s130 Structure of meninges**, **s1201 Spinal nerves**, **s7601 Muscles of trunk**, **s7401 Joints of pelvic region**, **s7402 Muscles of pelvic region**, **s75001 Hip joint**, **s75002 Muscles of thigh**, **s1100 Structure of cortical lobes**, **s1101 Structure of midbrain**, **s1102 Structure of diencephalon**, **s1103 Basal ganglia and related structures**, **s1104 Structure of brainstem**, and **s1200 Structure of spinal cord**.

The primary ICF activities and participation codes associated with low back pain are **d4108 Bending**, **d4106 Shifting the body's centre of gravity**, **d4158 Maintaining a body position**, **d4153 Maintaining a sitting position**, **d2303 Completing the daily routine**, **d5701 Managing diet and fitness**, and **d129 Purposeful sensory experiences, specified as repetitive perception of noninjurious sensory stimuli**.

The ICD-10 and ICF codes associated with low back pain are provided in the following table.

ICD-10 and ICF Codes Associated With Low Back Pain

INTERNATIONAL STATISTICAL CLASSIFICATION OF DISEASES AND RELATED HEALTH PROBLEMS (ICD) CODES		
Acute and Subacute Low Back Pain with Mobility Deficits	M99.0	Lumbosacral segmental/somatic dysfunction
Acute, Subacute, and Chronic Low Back Pain with Movement Coordination Impairments	M53.2	Spinal instabilities
Acute Low Back Pain with Related (Referred) Lower Extremity Pain	M40.3	Flatback syndrome
	M51.2	Other specified intervertebral disc displacement (lumbago due to displacement of intervertebral disc)
Acute, Subacute, and Chronic Low Back Pain with Radiating Pain	M54.1	Lumbar radiculopathy (neuritis or radiculitis)
	M54.4	Lumbago with sciatica
Acute or Subacute Low Back Pain with Related Cognitive or Affective Tendencies	M54.5	Low back pain
	G96.8	Disorder of central nervous system, specified as central nervous system sensitivity to pain
Chronic Low Back Pain with Related Generalized Pain	M54.5	Low back pain
	G96.8	Disorder of central nervous system, specified as central nervous system sensitivity to pain
	F45.4	Persistent somatoform pain disorder

INTERNATIONAL CLASSIFICATION OF FUNCTIONING, DISABILITY, AND HEALTH (ICF) CODES		
ACUTE LOW BACK PAIN WITH MOBILITY DEFICITS		
Body functions	b28013	Pain in back
	b28018	Pain in body part, specified as pain in buttock, groin, and thigh
	b7101	Mobility of several joints
	b7108	Mobility of joint functions, specified as mobility in a vertebral segment
Body structure	s76001	Thoracic vertebral column
	s76002	Lumbar vertebral column
	s7401	Joints of pelvic region
Activities and participation	d4108	Bending
SUBACUTE LOW BACK PAIN WITH MOBILITY DEFICITS		
Body functions	b28013	Pain in back
	b28018	Pain in body part, specified as pain in buttock, groin, and thigh
	b7101	Mobility of several joints
	b7108	Mobility of joint functions, specified as mobility in a vertebral segment
Body structure	s76001	Thoracic vertebral column
	s76002	Lumbar vertebral column
	s7401	Joints of pelvic region
	s7402	Muscles of pelvic region
	s75001	Hip joint
	s75002	Muscles of thigh

Body structure (continued)	s75003	Ligaments and fascia of thigh
Activities and participation	d4108	Bending
ACUTE LOW BACK PAIN WITH MOVEMENT COORDINATION IMPAIRMENTS		
Body functions	b28013	Pain in back
	b28015	Pain in lower limb
	b7601	Control of complex voluntary movements
Body structure	s7601	Muscles of trunk
	s7602	Ligaments and fasciae of trunk
	s7402	Muscles of pelvic region
Activities and participation	d4106	Shifting the body's centre of gravity
	d4158	Maintaining a body position, specified as maintaining alignment of the trunk, pelvis and lower extremities such that the lumbar vertebral segments function in a neutral, or mid-range, position
SUBACUTE AND CHRONIC LOW BACK PAIN WITH MOVEMENT COORDINATION IMPAIRMENTS		
Body functions	b28013	Pain in back
	b28015	Pain in lower limb
	b7601	Control of complex voluntary movements
Body structure	s7601	Muscles of trunk
	s7602	Ligaments and fasciae of trunk
	s7402	Muscles of pelvic region
	s75001	Hip joint
	s75002	Muscles of thigh
	s75003	Ligaments and fascia of thigh
Activities and participation	d4106	Shifting the body's centre of gravity
	d4158	Maintaining a body position, specified as maintaining alignment of the trunk, pelvis and lower extremities such that the lumbar vertebral segments function in a neutral, or mid-range, position
	d4153	Maintaining a sitting position
	d4108	Bending
	d4302	Carrying in the arm
	d4303	Carrying on shoulders, hip and back
	d5701	Managing diet and fitness
	d2303	Completing the daily routine
	d6402	Cleaning living area
	d6601	Assisting others in movement
	d9202	Arts and culture
	e1151	Assistive products and technology for personal use in daily living
	e1351	Assistive products and technology for employment
	e1401	Assistive products and technology for culture, recreation, and sport
ACUTE LOW BACK PAIN WITH RELATED (REFERRED) LOWER EXTREMITY PAIN		
Body functions	b28013	Pain in back
	b28015	Pain in lower limb
	b7101	Mobility of several joints
Body structure	s76002	Lumbar vertebral column
Activities and participation	d4153	Maintaining a sitting position

Activities and participation (continued)	d4158	Maintaining a body position, specified as maintaining the lumbar spine in an extended, or neutral position, such as when getting in and out of a sitting or standing position, or when lifting, carrying, or putting down objects
ACUTE LOW BACK PAIN WITH RADIATING PAIN		
Body functions	b28013	Pain in back
	b2803	Radiating pain in a dermatome
	b789	Movement functions, specified as mobility of the meninges, peripheral nerves and adjacent tissues
Body structure	s1201	Spinal nerves
	s130	Structure of meninges
Activities and participation	d4108	Bending
	d4150	Maintaining a lying position
	d4154	Maintaining a standing position
SUBACUTE AND CHRONIC LOW BACK PAIN WITH RADIATING PAIN		
Body functions	b28013	Pain in back
	b2803	Radiating pain in a dermatome
	b789	Movement functions, specified as mobility of the meninges, peripheral nerves and adjacent tissues
Body structure	s1201	Spinal nerves
	s130	Structure of meninges
	s75002	Muscles of thigh
	s75003	Ligaments and fascia of thigh
Activities and participation	d4108	Bending
	d4150	Maintaining a lying position
	d4154	Maintaining a standing position
	d4158	Maintaining a body position, specified as maintaining a slump or long-sitting position
	d4751	Driving motorized vehicles
ACUTE OR SUBACUTE LOW BACK PAIN WITH RELATED COGNITIVE OR AFFECTIVE TENDENCIES		
Body functions	b2703	Sensitivity to a noxious stimulus (sensory function of sensing painful or uncomfortable sensations)
	b1522	Range of emotion (mental functions that produce the spectrum of experience of arousal of affect or feelings such as love, hate, anxiousness, sorrow, joy, fear and anger)
	b1608	Thought functions, specified as the tendency to elaborate physical symptoms for cognitive/ideational reasons
	b1528	Emotional functions, specified as the tendency to elaborate physical symptoms for emotional/affective reasons
Body structure	s1100	Structure of cortical lobes
	s1101	Structure of midbrain
	s1102	Structure of diencephalon
	s1103	Basal ganglia and related structures
	s1104	Structure of brainstem
	s1200	Structure of spinal cord
Activities and participation	d2303	Completing the daily routine
	d5701	Managing diet and fitness
	d129	Purposeful sensory experiences, specified as repetitive perception of noninjurious sensory stimuli

CHRONIC LOW BACK PAIN WITH RELATED GENERALIZED PAIN		
Body functions	b2800	Generalized pain (sensation of unpleasant feeling indicating potential or actual damage to some body structure felt all over, or throughout the body)
	b1520	Appropriateness of emotion (mental functions that produce congruence of feeling or affect with the situation, such as happiness at receiving good news)
	b1602	Content of thought (mental functions consisting of the ideas that are present in the thinking process and what is being conceptualized. Inclusions: impairments of delusions, overvalued ideas and somatization)
Body structure	s1100	Structure of cortical lobes
	s1101	Structure of midbrain
	s1102	Structure of diencephalon
	s1103	Basal ganglia and related structures
	s1104	Structure of brainstem
	s1200	Structure of spinal cord
Activities and participation	d2303	Completing the daily routine
	d5701	Managing diet and fitness
	d129	Purposeful sensory experiences, specified as repetitive perception of noninjurious sensory stimuli
	d7105	Physical contact in relationships (making and responding to bodily contact with others, in a contextually and socially appropriate manner)
	d7203	Interacting according to social rules (acting independently in social interactions and complying with social conventions governing one's role, position or other social status in interactions with others)

CLINICAL GUIDELINES

Impairment/Function-Based Diagnosis

PREVALENCE

Expert opinion has likened the frequency of low back pain experienced by modern society to an "epidemic," and reports in the literature consistently support this view. A recent systematic review estimated the 1-year incidence of a first-ever episode of low back pain to range between 6.3% and 15.3%, while estimates of the 1-year incidence of any episode of low back pain range between 1.5% and 36%.[166] Low back pain is the leading cause of activity, limitation and work absence throughout much of the world and is associated with an enormous economic burden.[180,282,291] Also, individuals who have experienced activity-limiting low back pain often experience reoccurring episodes with estimates ranging between 24% and 33%.[280,309] Chronic low back pain has specifically demonstrated rapid increases. Freburger et al[101] demonstrated an increase in chronic low back pain from 3.9% (95% CI: 3.4, 4.4) in 1992 to 10.2% (95% CI: 9.3, 11.0) in 2006 in a telephone survey of North Carolina households.

While it is clear that individuals in all strata of society commonly experience low back pain, its prevalence does appear to vary based on factors such as sex, age, education, and occupation. Women tend to have a higher prevalence of low back pain than men, although the differences reported vary in magnitude.[21,239,240,262] An increase in age is also associated with higher prevalence of low back pain. The more severe forms of low back pain continue to increase with age[86] and the overall prevalence increases until ages 60 to 65.[193,201] Lower educational status is associated with increased prevalence of low back pain[86,88,166,254] as well as a longer episode duration and worse outcome.[88]

Occupational differences in low back pain prevalence have also been reported[166] with an association between higher physical demand and low back pain prevalence.[210] Material workers were reported to have a low back pain prevalence of 39%, whereas workers whose job responsibilities were classified as sedentary were reported to have a prevalence of 18.3%.[210] Although differences exist between different occupational groups, similar low back pain prevalence rates have been reported between working and nonworking groups.[240]

RISK FACTORS

Studies of risk factors are important because they seek to provide information about variables important in the etiology of mechanical low back pain as well as the potential for resistance to recovery from low back pain. A number of factors have been examined for their value in predicting the first onset of low back pain. The 2 major categories of suspected risk factors for low back pain are individual and activity-related (work and leisure) factors. Individual factors include but are not limited to demographic, anthropometric, physical, and psychosocial factors.

II The individual factors for which there is the most research include genetics, gender, age, body build, strength, and flexibility. Genetic factors have been linked to specific disorders of the spine such as disc degeneration.[17] The link of heredity to development of nonspecific low back pain, however, remains questionable. A study by Battie et al[18] demonstrated that there appears to be some relation between genetics, body build, and early environmental influences in determining the degenerative changes of the spine frequently associated with aging. Degenerative changes on magnetic resonance imaging (MRI), myelography, and computer-assisted tomography (CAT), however, are not strongly related to low back pain symptoms.[31,161,319] There is some evidence that supports back pain associated with operating heavy equipment.[310] Cardiovascular hypertension and lifestyle (smoking, overweight, obesity) risk factors are associated with sciatica.[271] There is inconclusive evidence for a relationship between trunk muscle strength or mobility of the lumbar spine and the risk of low back pain.[139]

II Psychosocial factors appear to play a larger prognostic role than physical factors in low back pain. There are some reviews that question if changes in behavioral variables and reductions of disability that facilitate an improvement in function may be more important than physical performance factors for successful treatment of chronic low back pain.[315] There is some evidence to suggest that fear may play a role when pain has become persistent.[125,126] There is a growing consensus that distress/depression plays an important role at early stages, and clinicians should focus on these factors.[243] Physical distress, depression, and fear avoidance are well-defined psychosocial entities that are best assessed with specific screening tools. There is no high-quality evidence to support pain-drawing

use as a psychological assessment tool; therefore, pain drawings are not recommended for this purpose.[42]

II Though some individual and lifestyle variables have been associated with prevalence of low back pain, the same factors may not have an influence on the recovery of patients who already have back pain. For example, a previous history of low back pain, job satisfaction, educational level, marital status, number of dependents, smoking, working more than 8-hour shifts, occupation, and size of industry or company does not influence duration of sick leave due to low back pain.[282] In addition, the clinical course for patients with comorbidities, who may seem more complicated at the start of treatment, is just as favorable as for those without such comorbidities.[213] Consistent evidence was found for one's own expectations of recovery as a predictor for the decision to return to work. Patients with higher expectations had less sickness absence at the moment of follow-up measurement.[188] Consistent evidence was found for the predictive value of pain intensity (more pain associated with worse outcome), several work-related parameters (eg, high satisfaction associated with better outcome), and coping style (active coping associated with better outcome).[297]

II In adolescents, the overall risk of low back pain is similar to adults, with prevalence rates as high as 70% to 80% by 20 years of age.[170] Similar to adults, girls appear to have a higher prevalence, with 1 study demonstrating that females have almost 3 times the risk of back pain as their male counterparts.[300] Anthropometrics (eg, height, weight, body mass index) do not appear to be strongly associated with low back pain in adolescents, nor does lumbar mobility[189] or trunk muscle weakness.[15] In adolescents, lifestyle factors that have been studied with respect to risk for low back pain include physical activity, sedentary activity, and mechanical load. With regard to physical activity, there appear to be mixed findings, with certain activities related to specific sports (eg, weightlifting, body building, rowing) associated with low back pain.[90,145,214] In cross-sectional studies, activity and prevalence of back pain take on a U-shaped function, with back pain increased at the sedentary and higher-activity ends.[290,311] However, in longitudinal studies, the relationship between modifying physical activity and back pain prevalence has not been well established.[172,261] As is the case in adults, psychological and psychosocial factors are commonly increased in children with low back pain and there is some evidence that such factors can predict future onset of low back pain.[171-173,311]

B Current literature does not support a definitive cause for initial episodes of low back pain. Risk factors are multifactorial, population specific, and only weakly associated with the development of low back pain.

PATHOANATOMICAL FEATURES

Any innervated structure in the lumbar spine can cause symptoms of low back and referred pain into the extremity or extremities. This long list of potential structures includes the muscles, ligaments, dura mater and nerve roots, zygapophyseal joints, annulus fibrosis, thoracolumbar fascia, and vertebrae.[177,178,192] One might expect that improvement in the resolution of imaging technology has increased the likelihood of detecting a link between pathology and pain in the lumbar spine. However, the determination of a pathoanatomic origin of low back pain is made difficult by the rate of false-positive findings on imaging studies, that is, individuals without low back pain showing abnormal findings. For example, evidence of herniated disc material is shown on computerized tomography (CT) scans,[319] MRI,[31] and myelography[161] in 20% to 76% of persons with no sciatica. Furthermore, Savage et al[264] reported that 32% of their asymptomatic subjects had "abnormal" lumbar spines (evidence of disc degeneration, disc bulging or protrusion, facet hypertrophy, or nerve root compression) and only 47% of their subjects who were experiencing low back pain had an abnormality identified.

In longitudinal studies, low back pain can develop in the absence of any associated change in radiographic appearance of the spine.[264] Boos et al[33] followed asymptomatic patients with a herniated disc for 5 years and determined that physical job characteristics and psychological aspects of work were more powerful than MRI-identified disc abnormalities in predicting the need for low back pain–related medical consultation. Thus, the association between clinical complaints and concurrent pathological examination with radiological findings must be considered cautiously. Further, even when abnormalities are present, establishing a direct cause and effect between the pathological finding and the patient condition has proven to be elusive and most often does not assist greatly in patient management.

CLINICAL COURSE

Classically, the course of low back pain has been described to consist of acute, subacute, and chronic phases, with temporal definitions typically associated with each phase. While different operational definitions have been reported in the literature, commonly accepted definitions for the acute, subacute, and chronic phases are, respectively, less than 1 month, between 2 and 3 months, and greater than 3 months since the onset of the episode of low back pain.

II Because low back pain is often recurrent in nature, exclusive use of temporal definitions to describe its course has been challenged in the literature.[302,304] The primary argument is that when low back pain is recurrent, the time to improvement from a single episode does not

accurately describe outcomes. This is not purely an academic issue, as the prognosis of low back pain changes when the influence of recurrence is considered. Of patients with acute low back pain who were followed for 1 year, 65% reported 1 or more additional episodes.[23] In that same study, 2 months was the median time to another episode of low back pain and 60 days was the median total duration of low back pain in the year. Other studies have reported lower, but still substantial, recurrence rates ranging from 20% to 35% over a period of 6 to 22 months[41] and 45% over 3 years.[8]

II When these other factors are considered, the prognosis for low back pain becomes less favorable and more variable. At the 1-year follow-up of patients with low back pain followed by primary care practitioners, 69% of patients with recent onset (within the past 6 months) of low back pain reported having pain in the last month.[303] Only 21% of these patients were pain free at 1 year, with 55% reporting low disability and low pain intensity, 10% reporting low disability and high pain intensity, and 14% reporting high disability with varying amounts of pain intensity.[303] Similar trends were noted for the 82% of patients with persistent (onset longer than the past 6 months) low back pain who reported having pain in the last month.[303] At 1-year follow-up, only 12% were pain free, with 52% reporting low disability and low pain intensity, 16% reporting low disability and high pain intensity, and 20% reporting high disability with varying amounts of pain intensity.[303]

Clinicians should also consider screening for and addressing factors that increase the probability of developing recurrent or chronic low back pain. Prognostic factors for development of recurrent pain include (1) history of previous episodes,[280,304] (2) excessive spine mobility,[139,191] and (3) excessive mobility in other joints.[218,224] Prognostic factors for development of chronic pain include (1) presence of symptoms below the knee,[48,175] (2) psychological distress or depression,[48,243,249] (3) fear of pain, movement, and reinjury or low expectations of recovery,[123,125,126,175,188,282] (4) pain of high intensity,[175] and (5) a passive coping style.[170,249,297]

E The clinical course of low back pain can be described as acute, subacute, recurrent, or chronic. Given the high prevalence of recurrent and chronic low back pain and the associated costs, clinicians should place high priority on interventions that prevent (1) recurrences and (2) the transition to chronic low back pain.

DIAGNOSIS/CLASSIFICATION

I Attempts to identify effective interventions for individuals with low back pain have been largely unsuccessful, with most interventions being found to be ineffective or having only marginal effect sizes. Most intervention studies have taken an approach whereby low back pain is treated as a homogeneous entity once medical red flags and nerve root compression are excluded. Most clinicians, however, perceive that recognizable subgroups exist, and researchers agree that clinical care may be improved with effective subgrouping methods. The utility of subgrouping based on pathoanatomy is limited by an inability to identify a pathological mechanism for most patients. Emphasis in the development of subgrouping methods for conservative care has therefore been placed on patterns of signs and symptoms from the clinical examination.[276] The development of classification systems has been identified as a priority among researchers in the primary care management of patients with low back pain.[34] This challenge has been taken on largely by researchers who have focused on nonsurgical interventions with the goal of identifying subgroups of patients in whom tailored interventions can be administered with the goal of more rapid recovery.[35,51,78,79,107,108,141,152,202,293]

I The best available evidence supports a classification approach that de-emphasizes the importance of identifying specific anatomical lesions after red flag screening is completed. While many interventions have been dismissed as either ineffective or accompanied with small effect sizes when studied in people with heterogeneous, nonspecific low back pain,[83] recent reports in the literature suggest that interventions based on subgroup classification have the potential to enhance effect sizes over studies where the identical interventions were administered in a one-size-fits-all approach.[35,51,108,124,204]

There are a variety of low back pain classification systems described in the literature.[27,256] The underlying premise is that classifying patients into groups based on clinical characteristics and matching these patient subgroups to management strategies likely to benefit them will improve the outcome of physical therapy interventions. Therefore, the authors of these guidelines provide a synthesis of these classification approaches by highlighting particular subgroups of patients with low back pain that have high levels of evidence supporting their identification and management.

I The treatment-based classification system[107,110] uses information from the history and physical examination to place patients into 1 of 4 separate treatment subgroups. The labels of these 4 subgroups, which are mobilization, specific exercise, immobilization, and traction, intend to capture the primary focus of the physical therapy intervention. Fritz et al,[108] utilizing a randomized clinical trial of 78 patients with acute, work-related low back pain, reported that patients who received interventions matched with their examination findings had better outcomes than

patients who received interventions that were not matched with their examination findings.

The classification system described in these practice guidelines, linked to the ICF, parallels the treatment-based classification system[107] with 3 noteworthy differences. The first difference is that the categories in these clinical practice guidelines incorporate the following ICF impairments of body functions terminology: low back pain with mobility deficits, low back pain with movement coordination impairments, low back pain with related lower extremity pain, low back pain with radiating pain, and low back pain with related generalized pain. The second difference is the addition of the low back pain with "related cognitive or affective tendencies" and "generalized pain" categories to provide a classification for patients with pain who, in addition to movement-related impairments of body function, have impairments of mental functioning (appropriateness of emotion, content of thought) and impairments of sensory function (generalized pain). The third difference is the addition of the patient's level of acuity to this ICF-based classification system, with the level of acuity defined in terms of (1) time since onset of symptoms and (2) movement/pain relations.

These ICF-based clinical practice guidelines will expand on the work of others[260,283] and incorporate the ICF model into low back pain management. Specifically, these clinical guidelines will describe the diagnostic classification categories using ICF impairment of body functions terminology and link those categories to the associated ICD condition. These clinical guidelines will also incorporate the patient's level of acuity in the description of the impairment of body functions category, describing the impairment category/pattern as acute, subacute, or chronic. In addition to the temporal definitions typically associated with the acute, subacute, and chronic phases of a patient's low back pain episodes, the level of acuity in these clinical guidelines will also incorporate the relation of the patient's reported pain to active movements that the patient performs, such as bending, or to passive movements that the clinician utilizes during the physical examination of the patient, such as segmental motion testing or straight leg raising. The authors of these guidelines propose that the recurring nature of low back pain requires clinicians to expand beyond the time frames traditionally used for acute (less than 1 month), subacute (between 2 and 3 months), and chronic (greater than 3 months) low back pain categorization. For example, clinicians frequently are required to assist patients with managing acute exacerbations of "chronic" low back pain conditions. For patients who have had low back pain for more than 3 months and/or for patients who have recurring low back pain, these clinical guidelines promote categorizing acute, subacute, and chronic low back pain based on movement/pain relations rather than solely using time since the patient's initial onset of low back pain. Movement/pain relations are commonly used in physical therapy for classifying patients into treatment categories that respond best to matched intervention strategies,[35,89,103,105,107,108] as well as to guide dosing of manual therapy, therapeutic exercise, and patient education interventions.[176] The dosing of interventions based upon movement/pain relations is consistent with the concept of tissue irritability and is important for guiding clinical decisions regarding treatment frequency, intensity, duration, and type with the goal of matching the optimal dosage of treatment to the status of the tissue being treated. Irritability is a term used by rehabilitation practitioners to reflect the tissue's ability to handle physical stress[222] and is presumably related to its physical status and the extent of inflammatory activity present, which is relevant for the mobility deficit, movement coordination impairments, and radiating pain diagnostic classifications used in these clinical guidelines.

ICF Impairment of Body Functions Terminology and Characteristics

For **acute low back pain with mobility deficits**, the distinguishing movement/pain characteristic is that the patient demonstrates restricted spinal range of motion and segmental mobility, and that the patient's low back and low back–related lower extremity symptoms are reproduced with provocation of the involved segments, with intervention strategies focused on reducing pain and improving mobility of the involved spinal segments.

For **acute low back pain with movement coordination impairments** and **acute low back pain with radiating pain**, the distinguishing movement/pain characteristic is pain that occurs with initial to mid-ranges of active or passive motions, with intervention strategies focused on movements that limit pain or increase the pain-free movement in the mid-ranges.

For **subacute low back pain with mobility deficits**, **subacute low back pain with movement coordination impairments**, and **subacute low back pain with radiating pain**, the distinguishing movement/pain characteristic is pain that occurs with mid- to end-ranges of active or passive motions, with intervention strategies focused on movements that increase movement tolerances in the mid- to end-ranges of motions.

For **chronic low back pain with movement coordination impairments** and **chronic low back pain with radiating pain**, the distinguishing movement/pain characteristic is pain that occurs with sustained end-range movements or positions, with intervention strategies focused on move-

ments that increase movement tolerances in the end ranges of motion.

Another acute pain category, **acute low back pain with related (referred) lower extremity pain**, is a condition with high irritability but, in contrast to the above mentioned acute low back pain categories, the intervention strategy is focused on centralizing or abolishing the patient's symptoms.

For the **acute and subacute low back pain with related cognitive and affective tendencies** and **chronic low back pain with generalized pain** categories, the low back pain does not follow the initial, mid-range, or end-range movement/pain relations reflective of tissue stress, inflammation, and irritability. Hence, the intervention strategies for these pain categories are not focused on normalizing movement/pain relations but rather on addressing the relevant cognitive and affective tendencies and pain behaviors with patient education and counseling.

I In the randomized clinical trials suggesting that interventions based on impairment-based classifications are an effective strategy for management of low back pain,[35,79,108] the subjects in the impairment-based classification groups were re-evaluated continually during the patient's episode of care, and, if the patient's examination finding changed, resulting in a new classification, the treatment was altered to match the new classification. Thus, it is important for clinicians to reassess and adjust the treatment program on the basis of changes in physical examination findings and to consider that the most relevant impairments of body function, primary intervention strategy, and the associated ICF-based classification will often change during the patient's episode of care. In addition, when using impairment-based classification approaches, patients with low back pain often fit more than 1 ICF-based classification, or do not definitively fit a single classification category,[279] and thus the expectation is to classify the majority of patients, not all of them. In addition, overlap may exist between the ICF-based classification system used in these clinical guidelines and other published classification systems.[102,312]

Impairment/Function-Based Classification Criteria

I The ICD diagnosis of *lumbosacral segmental/somatic dysfunction* and the associated ICF diagnosis of **acute low back pain with mobility deficits** are made with a reasonable level of certainty when the patient presents with the following clinical findings[35,51,108,116]:

- Acute low back, buttock, or thigh pain (duration of 1 month or less)
- Restricted lumbar range of motion and segmental mobility
- Low back and low back–related lower extremity symptoms reproduced with provocation of the involved lower thoracic, lumbar, or sacroiliac segments

I The ICD diagnosis of *lumbosacral segmental/somatic dysfunction* and the associated ICF diagnosis of **subacute low back pain with mobility deficits** are made with a reasonable level of certainty when the patient presents with the following clinical findings[35,116]:

- Subacute, unilateral, low back, buttock, or thigh pain
- Symptoms reproduced with *end-range* spinal motions and provocation of the involved lower thoracic, lumbar, or sacroiliac segments
- Presence of thoracic, lumbar, pelvic girdle, or hip active, segmental, or accessory mobility deficits

II The ICD diagnosis of *spinal instabilities* and the associated ICF diagnosis of **acute low back pain with movement coordination impairments** are made with a reasonable level of certainty when the patient presents with the following clinical findings[35,108]:

- Acute exacerbation of recurring low back pain that is commonly associated with referred lower extremity pain
- Symptoms produced with initial to mid-range spinal movements and provocation of the involved lumbar segment(s)
- Movement coordination impairments of the lumbopelvic region with low back flexion and extension movements

II The ICD diagnosis of *spinal instabilities* and the associated ICF diagnosis of **subacute low back pain with movement coordination impairments** are made with a reasonable level of certainty when the patient presents with the following clinical findings[116,152]:

- Subacute exacerbation of recurring low back pain that is commonly associated with referred lower extremity pain
- Symptoms produced with *mid-range* motions that *worsen with end-range* movements or positions and provocation of the involved lumbar segment(s)
- Lumbar segmental hypermobility may be present
- Mobility deficits of the thorax and pelvic/hip regions may be present
- Diminished trunk or pelvic region muscle strength and endurance
- Movement coordination impairments while performing self-care/home management activities

II The ICD diagnosis of *spinal instabilities* and the associated ICF diagnosis of **chronic low back pain with movement coordination impairments** are made with a reasonable level of certainty when the patient

presents with the following clinical findings[78,141,293]:

- Chronic, recurring low back pain that is commonly associated with referred lower extremity pain
- Presence of 1 or more of the following:
  - Low back and/or low back–related lower extremity pain that *worsens with sustained end-range* movements or positions
  - Lumbar hypermobility with segmental motion assessment
  - Mobility deficits of the thorax and lumbopelvic/hip regions
  - Diminished trunk or pelvic region muscle strength and endurance
  - Movement coordination impairments while performing community/work-related recreational or occupational activities

I The ICD diagnosis of *flatback syndrome*, or *lumbago due to displacement of intervertebral disc*, and the associated ICF diagnosis of **acute low back pain with related (referred) lower extremity pain** are made with a reasonable level of certainty when the patient presents with the following clinical findings[35,89,94,108,204]:

- Low back pain, commonly associated with referred buttock, thigh, or leg pain, that worsens with flexion activities and sitting
- Low back and lower extremity pain that can be centralized and diminished with positioning, manual procedures, and/or repeated movements
- Lateral trunk shift, reduced lumbar lordosis, limited lumbar extension mobility, and clinical findings associated with the subacute or chronic low back pain with movement coordination impairments category are commonly present

II The ICD diagnosis of *lumbago with sciatica* and the associated ICF diagnosis of **acute low back pain with radiating pain** are made with a reasonable level of certainty when the patient presents with the following clinical findings[114]:

- Acute low back pain with associated radiating pain in the involved lower extremity
- Lower extremity paresthesias, numbness, and weakness may be reported
- Symptoms are reproduced or aggravated with *initial to mid-range* spinal mobility, lower limb tension/straight leg raising, and/or slump tests
- Signs of nerve root involvement (sensory, strength, or reflex deficits) may be present

It is common for the symptoms and impairments of body function in patients who have **acute low back pain with radiating pain** to also be present in patients who have **acute low back pain with related (referred) lower extremity pain**.

II The ICD diagnosis of *lumbago with sciatica* and the associated ICF diagnosis of **subacute low back pain with radiating pain** are made with a reasonable level of certainty when the patient presents with the following clinical findings[35,65,120]:

- Subacute, recurring, mid-back and/or low back pain with associated radiating pain and potential sensory, strength, or reflex deficits in the involved lower extremity
- Symptoms are reproduced or aggravated with *mid-range* and *worsen with end-range* lower-limb nerve tension/straight leg raising and/or slump tests

III The ICD diagnosis of *lumbago with sciatica* and the associated ICF diagnosis of **chronic low back pain with radiating pain** are made with a reasonable level of certainty when the patient presents with the following clinical findings[65,121]:

- Chronic, recurring, mid-back and/or low back pain with associated radiating pain and potential sensory, strength, or reflex deficits in the involved lower extremity
- Symptoms are reproduced or aggravated with *sustained end-range* lower-limb nerve tension/straight leg raise and/or slump tests

I The ICD diagnosis of *low back pain/low back strain/lumbago* and the associated ICF diagnosis of **acute or subacute low back pain with related cognitive or affective tendencies** are made with a reasonable level of certainty when the patient presents with the following clinical findings[112,124,136,183,318]:

- Acute or subacute low back and/or low back–related lower extremity pain
- Presence of 1 or more of the following:
  - Two positive responses to Primary Care Evaluation of Mental Disorders for depressive symptoms
  - High scores on the Fear-Avoidance Beliefs Questionnaire and behavior consistent with an individual who has excessive anxiety or fear
  - High scores on the Pain Catastrophizing Scale and cognitive processes consistent with individuals with high helplessness, rumination, or pessimism about low back pain

I The ICD diagnosis of *low back pain/low back strain/lumbago* and the associated ICF diagnosis of **chronic low back pain with related generalized**

pain are made with a reasonable level of certainty when the patient presents with the following clinical findings[12,75,136,183]:

- Low back and/or low back–related lower extremity pain with symptom duration of more than 3 months
- Generalized pain not consistent with other impairment-based classification criteria presented in these clinical guidelines
- Presence of depression, fear-avoidance beliefs, and/or pain catastrophizing

B Low back pain, without symptoms or signs of serious medical or psychological conditions, associated with clinical findings of (1) mobility impairment in the thoracic, lumbar, or sacroiliac regions, (2) referred or radiating pain into a lower extremity, and (3) generalized pain, is useful for classifying a patient with low back pain into the following International Statistical Classification of Diseases and Related Health Problems (ICD) categories: low back pain, lumbago, lumbosacral segmental/somatic dysfunction, low back strain, spinal instabilities, flatback syndrome, lumbago due to displacement of intervertebral disc, lumbago with sciatica, and the associated ICF impairment-based category of low back pain (b28013 Pain in back, b28018 Pain in body part, specified as pain in buttock, groin, and thigh) and the following, corresponding impairments of body function:

- Acute or subacute low back pain with mobility deficits (b7101 Mobility of several joints)
- Acute, subacute, or chronic low back pain with movement coordination impairments (b7601 Control of complex voluntary movements)
- Acute low back pain with related (referred) lower extremity pain (b28015 Pain in lower limb)
- Acute, subacute, or chronic low back pain with radiating pain (b2804 Radiating pain in a segment or region)
- Acute or subacute low back pain with related cognitive or affective tendencies (b2703 Sensitivity to a noxious stimulus, b1522 Range of emotion, b1608 Thought functions, specified as the tendency to elaborate physical symptoms for cognitive/ideational reasons, b1528 Emotional functions, specified as the tendency to elaborate physical symptoms for emotional/affective reasons)
- Chronic low back pain with related generalized pain (b2800 Generalized pain, b1520 Appropriateness of emotion, b1602 Content of thought)

DIFFERENTIAL DIAGNOSIS

III A primary goal of diagnosis is to match the patient's clinical presentation with the most efficacious treatment approach. A component of this decision is determining whether the patient is, in fact, appropriate for physical therapy management. In the vast majority of patients with low back pain, symptoms can be attributed to nonspecific mechanical factors. However, in a much smaller percentage of patients, the cause of back pain may be something more serious, such as cancer,[82,84,148] cauda equina syndrome,[74,84] spinal infection,[307] spinal compression fractures,[149] spinal stress fractures,[150] ankylosing spondylitis,[130] or aneurysm.[97] Clinical findings that increase the level of suspicion that there is a serious medical condition presenting as common, nonserious, musculoskeletal conditions, are commonly described as red flags. The table below lists serious medical conditions that can cause low back pain and their associated red flags, including tumors, cauda equina syndrome, infection, compression fracture, and abdominal aortic aneurysm.

V Clinicians must be aware of the key signs and symptoms associated with serious medical conditions that cause low back pain and develop a system to continually screen for the presence of these conditions. Such screening may include administering medical screening questionnaires that query patients regarding the nature, onset, and progression of their symptoms, specific movements or positions that make the symptoms better or worse, and any 24-hour pattern of symptom behavior. In addition, a neurological status examination should be included for patients with low back pain. For example, patients presenting with leg paresthesias (eg, tingling), sensory changes (eg, numbness), complaints of weakness (eg, foot drop), or signs of central nervous system disorders (eg, excessive muscle tone/clonus) should receive a thorough neurological examination including assessment of sensation, reflexes, muscle power, motor control, and movement coordination. When a potentially serious medical condition is suspected, clinicians should initiate referral to the appropriate medical practitioner.

III Failure to improve with conservative care can also be a sign of a serious medical condition[26] or misdiagnosis. As a general guideline, failure of a patient to demonstrate improvement in a period of time no longer than 30 days can be interpreted as a red flag.[84]

I Recent research is available investigating low back pain and 1 serious medical condition: spinal fractures. Henschke et al,[149] in a systematic review of 12 studies, reported that the 5 factors most helpful in identifying spinal fractures were age greater than 50 years (positive likelihood ratio [+LR] = 2.2, negative likelihood ratio [−LR] = 0.34), female gender (+LR = 2.3, −LR = 0.67), history of major trauma (+LR = 12.8, −LR = 0.37), pain and tenderness (+LR = 6.7, −LR = 0.44), and a co-occurring, distracting/painful injury (+LR = 1.7, −LR = 0.78). In a follow-up study involving an inception cohort of patients seeking primary

care treatment for low back pain, the rate of serious pathology was quite low (0.9%), with most of the identified red flag cases, 8 of 11, being spinal fractures.[150] Because most patients had at least 1 red flag, Henschke et al[150] have cautioned against use of isolated red flags because of poor diagnostic accuracy. To improve diagnostic accuracy, a diagnostic prediction rule for identifying spinal fracture, which included being female, older than 70 years, significant trauma, and prolonged use of corticosteroids, was developed.[149]

I In addition to medical conditions, clinicians should be aware of psychological and social factors that may be contributing to a patient's persistent pain and disability, or that may contribute to the transition from an acute condition to a chronic, disabling condition. Researchers have shown that psychosocial factors are an important prognostic indicator of prolonged disability.[315]

V The term "yellow flags" is commonly used in the literature to differentiate psychosocial risk factors for persistent pain from medical red flags. Identification of psychological factors is assisted with the use of standard questionnaires described in the Measures section of these clinical guidelines. When relevant psychological factors are identified, the rehabilitation approach should be modified to emphasize active rehabilitation, graded exercise programs, positive reinforcement of functional accomplishments, and/or graduated exposure to specific activities that a patient fears as potentially painful or difficult to perform. These approaches will be described in the Interventions section of these clinical guidelines. In addition, there should be standard processes so that clinicians screening for severe psychiatric disturbances (eg, clinical depression) have a clear indication of when referral for appropriate care is expected in a given clinical setting. An example of such a process can be made with the Primary Care Evaluation of Mental Disorders tool that has been described for depressive symptom screening in physical therapy settings.[136] A patient with a positive screening result for major or severe depressive symptoms should receive a focused clinical interview and should complete a full-length depressive symptom questionnaire (eg, Patient Health Questionnaire or Beck Depression Inventory). A referral to a mental healthcare provider is indicated to confirm a depression diagnosis if the results of the interview and questionnaire provide further indication that major or severe depressive symptoms are present and the patient is unaware of this. An immediate assessment by a medical and/or mental health professional is indicated for safety reasons if the patient had a plan to harm himself/herself or others. A similar process could be used for clinicians who screen for other psychopathology (eg, anxiety). The authors of these clinical guidelines acknowledge that this is a general description for a rather important process. However, there are no absolute guidelines for the levels of psychological symptoms that indicate referral. Therefore, clinicians will have to work within their own clinical environments, using available resources, to ensure this screening is handled appropriately.

A Clinicians should consider diagnostic classifications associated with serious medical conditions or psychosocial factors and initiate referral to the appropriate medical practitioner when (1) the patient's clinical findings are suggestive of serious medical or psychological pathology, (2) the reported activity limitations or impairments of body function and structure are not consistent with those presented in the diagnosis/classification section of these guidelines, or (3) the patient's symptoms are not resolving with interventions aimed at normalization of the patient's impairments of body function.

RED FLAGS FOR THE LOW BACK REGION

Condition	History and Physical Examination Data	Sensitivity	Specificity	+LR (95% CI)	−LR (95% CI)	Odds Ratio (95% CI)
Back-related tumor[82,84,148]	Constant pain not affected by position or activity; worse with weight bearing, worse at night	...	...	...	...	...
	Age over 50	0.84	0.69	2.2 (1.8, 2.7)	0.34 (0.17, 0.68)	...
	History of cancer	0.55	0.98	23.7 (11.3, 49.4)	0.25 (0.01, 9.19)	...
	Failure of conservative intervention (failure to improve within 30 days)	0.29	0.90	3.0 (1.4, 6.3)	0.79 (−0.58, 1.07)	...
	Unexplained weight loss	0.15	0.94	3.0 (1.0, 9.3)	0.87 (0.68, 1.12)	...
	No relief with bed-rest	1.00	0.46	1.7 (1.2, 2.2)	0.22 (0.02, 3.02)	...

(continued)

Condition	History and Physical Examination Data	Sensitivity	Specificity	+LR (95% CI)	–LR (95% CI)	Odds Ratio (95% CI)
Cauda equina syndrome [74,84]	Urine retention	0.90	0.95	18.0	0.11	...
	Fecal incontinence	...	...	...	...	...
	Saddle anesthesia	0.75	...	...	...	...
	Sensory or motor deficits in the feet (L4, L5, S1 areas)	0.80	...	...	...	...
Back-related infection [84 307]	Recent infection (eg, urinary tract or skin), intravenous drug user/abuser	0.40	...	...	...	...
	Concurrent immunosuppressive disorder	...	...	...	...	...
	Deep constant pain, increases with weight bearing	...	...	...	...	...
	Fever, malaise, and swelling	...	...	...	...	...
	Spine rigidity; accessory mobility may be limited	...	...	...	...	...
	Fever: tuberculosis osteomyelitis	0.27	0.98	13.5	0.75	...
	Fever: pyogenic osteomyelitis	0.50	0.98	25.0	0.51	...
	Fever: spinal epidural abscess	0.83	0.98	41.5	0.17	...
Spinal compression fracture [149]	History of major trauma, such as vehicular accident, fall from a height, or direct blow to the spine	0.30	0.85	12.8 (8.3, 18.7)	0.37 (0.20, 0.57)	...
	Age over 50	0.79	0.64	2.2 (1.4, 2.8)	0.34 (0.12, 0.75)	...
	Age over 75	0.59	0.84	3.7 (2.9, 4.5)	0.49 (0.37, 0.62)	...
	Prolonged use of corticosteroids	...	...	...	...	...
	Point tenderness over site of fracture	...	...	...	...	...
	Increased pain with weight bearing	...	...	...	...	...
Abdominal aneurysm (≥4 cm) [97]	Back, abdominal, or groin pain	...	...	...	...	...
	Presence of peripheral vascular disease or coronary artery disease and associated risk factors (age over 50, smoker, hypertension, diabetes mellitus)	...	...	...	...	...
	Smoking history	...	...	...	...	5.07 (4.13, 6.21)
	Family history	...	...	...	...	1.94 (1.63, 2.32)
	Age over 70	...	...	...	...	1.71 (1.61, 1.82)
	Non-Caucasian	...	...	...	...	1.02 (0.77, 1.35)
	Female	...	...	...	...	0.18 (0.07, 0.48)
	Symptoms not related to movement stresses associated with somatic low back pain	...	...	...	...	...
	Abdominal girth <100 cm	0.91	0.64	2.5	0.14	...
	Presence of a bruit in the central epigastric area upon auscultation	...	...	...	...	...
	Palpation of abnormal aortic pulse	0.88	0.56	2.0	0.22	...
	Aortic pulse 4 cm or greater	0.72	...	...	...	...
	Aortic pulse 5 cm or greater	0.82	...	...	...	...

IMAGING STUDIES

Imaging modalities have frequent false positive and negative results, limiting their utility in identification of active anatomic pain generators. Therefore, the primary utility of imaging lies in interventional and/or surgical planning or in determining the presence of serious medical conditions. For these purposes, lumbar MRI represents the most useful tool. However, routine ordering of imaging for low back pain should be discouraged. In particular, imaging in acute low back pain has not been shown to yield significant new findings[43] or alter outcomes.[54] In chronic low back pain, the role of routine diagnostic imaging is even less established. Current recommendations from the American College of Physicians are that (1) imaging is only indicated for severe progressive neurological deficits or when red flags are suspected, and (2) routine imaging does not result in clinical benefit and may lead to harm.[55]

Low Back Pain With Mobility Deficits

As this is described as acute symptoms, lasting 1 month or less, in the absence of red flag signs, no imaging is indicated.[56]

Low Back Pain With Movement Coordination Impairments

Poor trunk muscle function has been associated with back pain,[194] though it is not clear if this is a cause or a consequence of back pain. Nevertheless, this represents the basis for treatment efforts designed to improve the firing pattern of the muscles involved with optimal trunk control/stabilization of the lumbar spine. On imaging, multiple techniques have been used to assess the lumbar muscles. In examining the cross-sectional area of the multifidus muscle in patients with acute low back pain, muscle atrophy has been identified.[157] In addition, functional activity of lumbar muscles assessed by MRI demonstrated differences in usage and signal intensity in patients with low back pain.[98] Similarly, cross-sectional area changes in the multifidus with different postures demonstrate altered patterns in patients with low back pain.[196] In addition to changes in cross-sectional area, muscle composition has also been examined. Severe fat infiltration has been shown to be strongly associated with a history of low back pain (odds ratio [OR], 9.2) and low back pain within the last year (OR, 4.1).[182] Similarly, an association has been established between trunk attenuation on CT scanning (as an assessment of fat infiltration) and functional capacity among older adults with low back pain.[155] The potential exists for imaging modalities to detect muscular control impairments and ultimately guide treatment decisions; however, this has not been extensively explored in common clinical practice.

Low Back Pain With Related (Referred) Lower Extremity Pain

Similar to low back pain with mobility impairments, in the absence of red flags, routine imaging is not indicated. In addition, among adults 65 years of age or older in whom imaging changes are ubiquitous, severity of disc and facet disease was not associated with pain severity.[154]

Low Back Pain With Radiating Pain

In patients with severe or progressive neurologic deficits, prompt workup with MRI or CT is recommended because delayed treatment in patients with progressive neurologic involvement is associated with poorer outcomes.[85,292] In addition, if the patients are potential candidates for surgery or epidural steroid injections, MRI (or CT if unable to undergo MRI) may be indicated.[56] In the absence of these findings, there is no evidence that routine imaging affects treatment decisions or outcomes in these patients.[217]

Low Back Pain With Related Generalized Pain

Evidence exists that in addition to having no additional prognostic utility, knowledge of changes on routine imaging in patients with low back pain is associated with a lesser sense of well-being.[217] This is particularly relevant in patients with generalized pain disorders, suggesting that nonindicated imaging should be strongly discouraged.

While not currently being used clinically, functional MRI has been used in patients with low back pain to demonstrate relationships between high sustained back pain and altered activity of brain regions involved in negative emotions.[16] Currently being used in research studies, this may represent a useful assessment tool in the future to appreciate the brain-related changes contributing to patients' pain experience.

CLINICAL GUIDELINES

Examination

These clinical guidelines will describe a core set of examination tests and measures, with the best available evidence, that enable a clinician to determine (1) the presence of clinical findings associated with an impairment/function-based diagnostic category, and (2) changes in impairments of body function, activity limitations, and participation restrictions over the course of a patient's episode of care. Clinicians are expected to choose the most relevant outcome, activity limitation, and/or impairment measures to utilize based upon the patient's presentation, needs, or goals. This is especially true within the section for Mental Impairment Measures. For example, clinicians should decide which instruments are appropriate to utilize for a given patient based upon that patient's presentation in regard to depression, anxiety, or fear.

OUTCOME MEASURES

Patient-reported outcomes have become well-established in the low back pain area. Consensus documents have agreed on a "core" set of domains that should be captured in outcome assessment of low back pain, including pain, back-specific function, work disability, generic health status, and patient satisfaction.[32,81] The most often used generic health status index is the Medical Outcomes Survey Short-Form-36 (SF-36), in particular, the physical functioning domain.[80] The SF-36 has the distinct advantage of being more comprehensive in capturing these domains and has been reasonably responsive in trials of comparative and cost-effectiveness studies. However, generic measures also have the disadvantage of lacking region specificity and sensitivity to change in specific patient populations.

To optimize responsiveness and ease of administration, region-specific measures are commonly used in low back pain treatment and research. The Oswestry Disability Index is a commonly utilized outcome measure to capture perceived disability in patients with low back pain.[113,118] Originally described by Fairbank et al,[96] there are also modified versions widely reported in the literature.[113,118] This index contains 10 items: 8 related to activities of daily living and 2 related to pain. Each item is scored from 0 to 5 and the total score is expressed as a percentage, with higher scores corresponding to greater disability. The Oswestry Disability Index has long-standing recognition as an acceptable standard, with numerous studies that establish its reliability, validity, and responsiveness. Multiple studies have been undertaken to determine the error associated with the measure and the minimally important change, with the most recent international consensus conference determining that the minimally important change was 10 points (out of 100) or 30% from the baseline score.[233]

The Roland-Morris Disability Questionnaire is a practical alternative to the Oswestry Disability Index. Originally described by Roland and Morris,[257] the questionnaire was derived from the generic Sickness Impact Profile by choosing 24 items that appeared to have face validity in describing patients with low back pain. The Roland-Morris Disability Questionnaire asks patients to gauge whether each of the 24 items is possible to accomplish. The activities are led by the stem, "Because of my back pain," thus allowing it to be region specific. Like the Oswestry Disability Index, the Roland-Morris Disability Questionnaire has excellent psychometrics, is easy to administer, and has been shown to be responsive in clinical trials. Ostelo et al[233] reported from a consensus conference a minimally important change of 5 points (out of 24) or 30% from the baseline score.

Other self-report measures have been reported, including the Quebec Back Pain Disability Scale,[113,184] but they have failed to gather widespread adoption. In addition, the visual analog scale and numeric pain rating scale are commonly used both in the literature and clinically. These scales have the advantage of ease of administration but fail to adequately capture the majority of the "core" areas of outcome in low back pain assessment. They do assess pain very specifically, though, and the minimally important change for the visual analog scale is 15 (using a 100-mm scale) and it is 2 (using a 0-10 self-report scale) for the numeric pain rating scale.[52,135]

The process of collecting patient-reported functional outcomes data has progressed substantially over the past 2 decades through the application of item response theory (IRT) and computer adaptive testing (CAT), with several proprietary options available (eg, PROMIS, FOTO, AM-PAC).[142,144,169,258] When compared to traditional self-report functional outcome assessment measures (eg, Oswestry Disability Index), IRT/CAT functional status outcome tools allow for the administration of fewer test items to individual patients to obtain equally accurate, precise, and reliable scores.[142,144,169,258] Consequently, one of the major advantages of IRT/CAT measures is efficiency with enhanced psychometric qualities. In addition, well-constructed IRT/

CAT approaches to functional assessment theoretically allow for a test to more precisely depict functioning at the extremes of ability using the same outcome metric, though this assumes the IRT/CAT instrument has been subjected to rigorous testing, such as vetted item pool selection, accurate item calibration, and validated item-selection algorithms and scoring procedures. Future research is required to demonstrate further the advantages of IRT/CAT functional status outcomes measures versus more traditional self-report assessments.

Whether using traditional assessments or IRT/CAT instruments, regular and accurate outcome assessment becomes of paramount importance in determining cost-effectiveness of care. When integrated with electronic health records software, capturing process of care and outcomes becomes a powerful tool in determining the value of care delivery. Combining process of care and outcomes that are important to the patient (eg, patient-centered care) the foundation for comparative effectiveness studies designed to assess which treatments are associated with better outcomes for each patient.

A Clinicians should use validated self-report questionnaires, such as the Oswestry Disability Index or the Roland-Morris Disability Questionnaire. These tools are useful for identifying a patient's baseline status relative to pain, function, and disability and for monitoring a change in a patient's status throughout the course of treatment.

ACTIVITY LIMITATION AND PARTICIPATION RESTRICTION MEASURES

III There are instances where clinicians have to rely on more than self-reported instruments in determining a person's overall functional abilities as described in the ICF. This is especially true in decisions regarding activity limitations and participation restrictions (eg, return to work). There are a variety of tools used to assess functional capacity in a work setting. A systematic review was conducted by Gouttebarge and colleagues[129] on 4 commercially available Functional Capacity Evaluations: the Blankenship system, the ERGOS work simulator, the Ergo-Kit, and the Isernhagen work system, which identified 12 papers for inclusion. The interrater reliability and predictive validity of the Isernhagen work system were evaluated as good. However, the systematic review concluded that more rigorous studies were needed to demonstrate the reliability and the validity of Functional Capacity Evaluation methods.

III Schult and Ekholm[268] compared the ICF core data sets for chronic widespread pain and low back pain[58,59] with a work capacity assessment. They found that the work capacity assessment generally agreed with the comprehensive ICF core set representing body functions, body structures, activities and participation, and environmental factors. However, the authors concluded that both the work capacity assessment and ICF core data sets lacked the clinical analysis that could be obtained through an on-the-job site evaluation.[268]

It would appear that in some instances when activity limitation and participation restriction are an expectation (eg, chronic low back pain), outcome assessment would need to be expanded from self-reported region-specific tools to include clinician-measured tools such as Functional Capacity Evaluations.

F Clinicians should routinely assess activity limitation and participation restriction through validated performance-based measures. Changes in the patient's level of activity limitation and participation restriction should be monitored with these same measures over the course of treatment.

PHYSICAL IMPAIRMENT MEASURES

Lumbar Active Range of Motion

ICF category	Measurement of impairment of body function – mobility of several joints
Description	The amount of active lumbar flexion, extension, and side-bending motion measured using an inclinometer.
Measurement method	Inclinometers placed at the thoracolumbar junction and on the sacrum are zeroed with the patient in neutral. The patient is asked to bend forward maximally and motion is recorded at the thoracolumbar junction (total flexion measure) and at the sacrum, which is presumed to be motion in the sacroiliac and hip joints. The difference in motion represents the lumbar flexion measure. The patient is then asked to bend backward and the difference in motion is the lumbar extension measure. A similar process is used for side bending with the inclinometer aligned in the frontal plane, and the patient is asked to bend to each side.
Nature of variable	Continuous

(continued)

Lumbar Active Range of Motion (continued)

Units of measurement	Degrees
Measurement properties	In a study by Saur et al,[263] this method approximated lumbar motion obtained with radiographic measures (r = 0.93 overall; r = 0.95 with flexion and r = 0.85 with extension). Interrater (physician and physiotherapist) reliability was r = 0.88 for flexion (standard error of measurement [SEM], 4.6°) and r = 0.42 for extension (SEM, 2.3°).
Instrument variations	Two methods utilizing inclinometers have been described. In 1 method, the placement of the inclinometer is identical to Saur et al's[263] method but the subject bends forward twice, first with the inclinometer at the thoracolumbar junction and next with the inclinometer on the sacrum. The procedure is repeated with inclinometer placement but with the patient moving into extension. Lumbar flexion and extension are calculated as with the Saur et al[263] method. A second method has been described in which total flexion and extension are recorded. The inclinometer is placed and zeroed at the thoracolumbar junction and the subject bends forward once and the total flexion is recorded. The subject bends backward and the total extension is recorded.

Segmental Mobility Assessment

ICF category	Measurement of impairment of body function – mobility of joint functions, specified as mobility in a vertebral segment
Description	With the patient prone, lower thoracic and lumbar spine segmental movement and pain response are assessed.
Measurement method	The patient is positioned in prone. The examiner contacts each lower thoracic and lumbar spinous process with the thumbs (or alternately with the hypothenar eminence just distal to the pisiform). The examiner should be directly over the contact area, keeping elbows extended, utilizing the upper trunk to impart a posterior-to-anterior force in a progressive oscillatory fashion over the spinous process. This is repeated for each lower thoracic and lumbar segment. The pressures can also be directed lateral to the spinous process, in the region of the zygapophyseal joints, multifidi muscles, or transverse processes. The mobility of the segment is judged to be normal, hypermobile, or hypomobile. Interpretation of mobility is based on the examiner's perception of the mobility at each spinal segment relative to those above and below the tested segment, and on the examiner's experience and perception of normal mobility.
Nature of variable	Categorical with various grades depending on the study
Units of measurement	Ordered or categorical
Measurement properties	Measures for determining mobility reported low reliability for ordered scales, with intraclass correlation coefficients (ICCs) of 0.25 in patient studies[28] and kappa coefficients showing poor to minimal agreement (κ = –0.2-0.26).[153] Reliability for presence of any hypomobility or hypermobility during intervertebral motion testing demonstrated moderate to good agreement (κ = 0.38-0.48).[115] Validity has been established with correlation of radiographic lumbar segmental instability[2] and with response to treatment.[116]
Instrument variations	Segmental motion can also be tested with the subject in sidelying, facing the clinician, with hips and knees flexed and the clinician grasping the knee and flexing and extending, rotating, and laterally flexing the hip, pelvis, and lumbar spine while palpating intersegmental motion.[1]

Pain Provocation With Segmental Mobility Testing

ICF category	Measurement of impairment of body function – pain in back; pain in body part, specified as pain in buttock, groin, and thigh; and mobility of joint functions, specified as mobility in a vertebral segment.
Description	Pain provocation during mobility testing.
Measurement method	The patient is positioned in prone. The examiner contacts each lower thoracic and lumbar spinous process with the thumbs (or alternately with the hypothenar eminence just distal to the pisiform). The examiner should be directly over the contact area keeping elbows extended, utilizing the upper trunk to impart a posterior-to-anterior force in a progressive oscillatory fashion over the spinous process. This is repeated for each lower thoracic and lumbar segment. The pressures can also be directed lateral to the spinous process, in the region of the zygapophyseal joints, multifidi muscles, or transverse processes. After assessing baseline pain levels, the examiner inquires about pain provocation during the posterior-to-anterior pressure at each spinal level, and pain provocation is judged as present or absent.
Nature of variable	Categorical
Units of measurement	Present/absent
Measurement properties	Kappa values are reported to be moderate to good for pain provocation during spring testing of the lumbar vertebrae (κ = 0.25-0.55)[117,153]
Instrument variations	None

Judgments of Centralization During Movement Testing

ICF category	Measurement of impairment of body function – pain in back; pain in lower limb; and mobility of several joints
Description	Clinician judges the behavior of symptoms in response to movement testing to assess whether centralization or peripheralization occurs. Judgments of centralization require that an accurate assessment of the patient's baseline location of symptoms is made, followed by the precise application of active or passive movements and the associated assessments of any changes in the patient's baseline location of symptoms in response to the movements. Centralization occurs when the location of the patient's symptoms, such as pain or paresthesias, is perceived by the patient to be in a more proximal location in response to single and repeated movements or sustained positions. Peripheralization occurs when the location of the patient's symptoms is perceived in a more distal location, such as the calf or foot, in response to single and repeated movements or sustained positions.
Measurement method	Patient is asked to flex and extend in the sagittal plane, or laterally shift the pelvis and trunk in the frontal plane, in standing, supine, and prone with single and repeated movements in a systematic fashion. When appropriate, the clinician can manually guide the movements of the patient and apply passive overpressures to the movements. Judgments are made with regard to which movement, if any, produces centralization of the patient's symptoms.
Nature of variable	Categorical
Units of measurement	Present/absent
Measurement properties	Kappa coefficients are reported to be 0.70 to 0.90 for novice and experienced physical therapists.[109,181]
Instrument variations	Techniques to improve the precision of these judgments have been described, including strategies to discriminate between centralization and directional preference responses.[314] However, the practicality of using these strategies has not been demonstrated.

Prone Instability Test

ICF category	Measurement of impairment of body function – pain in back; pain in lower limb; mobility of joint functions, specified as mobility in a vertebral segment, control of complex voluntary movements
Description	The patient lies prone with the body on the examining table, legs over the edge and feet resting on the floor. While the patient rests in this position, the examiner applies posterior-to-anterior pressure to spinous processes of the lower portion of the lumbar spine. Any provocation of pain is noted. Then the patient lifts the legs off the floor (the patient may hold table to maintain position) and posterior-to-anterior pressure is again applied to the lumbar spine.
Measurement method	If pain is present in the resting position but subsides substantially (either reduces in severity/intensity or resolves) in the second position, the test is positive. Mild improvement in symptoms does not constitute a positive test. If pain is present in the resting position but does not subside substantially in the second position, the test is negative. Further, if the patient did not have any pain provocation with posterior-to-anterior pressures applied to the lumbar spine, then the test is judged "negative."
Nature of variable	Categorical
Units of measurement	Positive or negative
Diagnostic accuracy and measurement properties	Good to excellent agreement reported ($\kappa = 0.87$)[153] for 3 pairs of physical therapy raters evaluating 63 consecutive subjects currently experiencing low back pain and with a previous history of low back pain. As an independent test the Prone Instability Test has limited diagnostic use (+LR = 1.7 [95% CI: 1.1, 2.8]; –LR = 0.48 [95% CI: 0.22, 1.1])[152]; however, it may be most useful as a component of a cluster of tests to predict response to motor control exercises.[152]

Judgments of the Presence of Aberrant Movement

ICF category	Measurement of impairment of body function – pain in back; pain in lower limb; mobility of several joints; and control of complex voluntary movements.
Description	"Aberrant movement" includes the presence of any of the following: painful arc with flexion or return from flexion, instability catch, Gower sign, and reversal of lumbopelvic rhythm.
Measurement method	Painful arc with flexion or return from flexion is positive if the patient reports pain during movement but not at the end ranges of the motion. Instability "catch" is positive when patient deviates from straight plane sagittal movement during flexion and extension. Gower sign is positive if the patient needs to utilize "thigh climbing" on return from flexion, specifically, the hands push against the anterior thighs in a sequential distal to proximal manner to diminish the load on the low back when returning to the upright position from a forward bent position. Reversal of lumbopelvic rhythm is positive if the patient, upon return from a forward bent position, suddenly bends his/her knees to extend the hips, shifting pelvis anteriorly, as he/she returns to the standing position.

(continued)

Judgments of the Presence of Aberrant Movement (continued)

Nature of variable	Categorical
Units of measurement	Present/absent
Measurement properties	Observation of aberrant movements has demonstrated moderate to good reliability (κ = 0.60) for aberrant movement and variable reliability for individual tests (κ = 0-0.69), with painful arcs being most reliable (κ = 0.61-0.69)[153] in 3 pairs of physical therapy raters evaluating 63 consecutive subjects currently experiencing low back pain and with a previous history of low back pain.

Straight Leg Raise

ICF category	Measurement of impairment of body function – radiating pain in a dermatome; and movement functions, specified as mobility of the meninges, peripheral nerves, and adjacent tissues.
Description	A dural and lower-limb nerve mobility sign.
Measurement method	The patient is supine and the therapist passively raises the lower extremity, flexing the hip with an extended knee. A positive test is obtained with reproduction of lower extremity radiating/radicular pain.
Nature of variable	Categorical
Units of measurement	Positive/negative
Measurement properties	In a population of patients with a new episode of pain radiating below the gluteal fold, the straight leg raise test has demonstrated good reliability (κ = 0.68) for identifying pain in a dermatomal distribution and moderate reliability for identifying patients with symptoms for angles below 45° (κ = 0.43).[305]
Instrument variations	None

Slump Test

ICF category	Measurement of impairment of body function – pain in back; pain in lower limb; radiating pain in a dermatome; mobility of several joints; and movement functions, specified as mobility of the meninges, peripheral nerves, and adjacent tissues
Description	Clinician judges whether symptom reproduction occurs in response to different positions of the cervical spine, thoracic spine, lumbar spine, and lower extremities.
Measurement method	The patient is asked to sit in a slumped position with knees flexed over table. Cervical flexion, knee extension, and ankle dorsiflexion are sequentially added up to the onset of patient lower extremity symptoms. Judgments are made with regard to a reproduction of symptoms in this position, and relief of symptoms when the cervical spine component is extended or nerve tension is relieved from 1 or more of the lower-limb components, such as ankle plantar flexion or knee flexion.
Nature of variable	Categorical
Units of measurement	Positive/negative
Measurement properties	Reported kappa was from 0.83 to 0.89 for 6 pairs of physical therapists of varying experience testing 93 patients receiving treatment for low back and/or leg pain.[237]

Trunk Muscle Power and Endurance

ICF category	Measurement of impairment of body function – pain in back; pain in lower limb; control of complex voluntary movements
Description	Clinician assesses the performance of trunk flexors, trunk extensors, lateral abdominals, transversus abdominis, hip abductors, and hip extensors.
Measurement method	Trunk Flexors The patient is positioned in supine; the examiner elevates both of the patient's fully extended legs to the point at which the sacrum begins to rise off the table. The patient is instructed to maintain contact of the low back with the table while slowly lowering extended legs to the table without assistance. The examiner observes and measures when the lower back loses contact with the tabletop due to anterior pelvic tilt. *(continued)*

Trunk Muscle Power and Endurance (continued)

Measurement method (continued)	Trunk Extensors The patient is positioned in prone, with hands behind the back or by the sides. The patient is instructed to extend at the lumbar spine and raise the chest off the table to approximately 30° and hold the position. The test is timed until the patient can no longer hold the position. Lateral Abdominals The patient is positioned in sidelying with hips in neutral, knees flexed to 90°, and resting the upper body on the elbow. The patient is asked to lift the pelvis off the table and to straighten the curve of the spine without rolling forward or backward. The position is held and timed until the patient can no longer maintain the position. Transversus Abdominis The patient is positioned in prone over a pressure biofeedback unit that is inflated to 70 mmHg. The patient is instructed to draw in the abdominal wall for 10 seconds without inducing pelvic motion while breathing normally. The maximal decrease in pressure is recorded. Hip Abductors The patient is positioned in sidelying with both legs fully extended, in neutral rotation and a relaxed arm position, with the top upper extremity resting on the ribcage and hand on abdomen.[226] The patient is instructed to keep the leg extended and raise the top thigh and leg toward the ceiling, keeping the limb in line with the body. Patients are graded on quality of movement. Hip Extensors The patient is positioned in supine with knees flexed to 90° and the soles of the feet on the table. The patient is instructed to raise the pelvis off the table to a point where the shoulders, hips, and knees are in a straight line. The position is held and timed until the position can no longer be maintained.
Nature of variable	Continuous, ordinal
Units of measurement	Seconds to hold position, muscle performance assessment, change in mmHg using a pressure biofeedback device
Measurement properties	The double-leg lowering assessment for trunk flexor strength has demonstrated discriminative properties in identifying patients with chronic low back pain.[128,187] If patients demonstrate anterior pelvic tilt with hip flexion greater than 50° in males and 60° in females, they are more likely to have chronic low back pain.[327] The assessment of trunk extensor strength has been highly correlated with the development and persistence of low back pain.[9,167,219] Males who are unable to maintain an isometric hold of 31 seconds (33 seconds for females) are significantly more likely to experience low back pain (+LR = 4.05-6.5; −LR = 0.24-0.02) with good reliability (ICC = 0.89-0.90).[9] Lateral abdominal strength has been measured in healthy controls and found reliable (ICC = 0.97).[95,212] Performance of the transversus abdominis has been evaluated in prone and found to be reliable (ICC = 0.58; 95% CI: 0.28, 0.78).[69,164,284] A 4-mmHg decrease in pressure is established as normal, whereas the inability to decrease the pressure biofeedback device measure by 2 mmHg is associated with incidence of low back pain.[164,174,255] The hip abduction test has demonstrated discriminative ability to predict patients who will develop pain with standing (+LR = 2.68-4.59).[226,227] Endurance assessment of the bridge position to assess gluteus maximus strength has demonstrated good reliability (ICC = 0.84).[266] Mean duration of hold for patients with low back pain is 76.7 seconds compared to 172.9 seconds in persons without low back pain.[266]
Instrument variations	There are numerous alternate test positions for all described muscle groups. For trunk flexion, test variations include bent double-leg lowering and sit-up tasks. For trunk extension, numerous variations have been described, including the Sorensen test and prone double straight leg raise.[9,167,219] The Sorensen test and modified versions of this test have been the subject of extensive research, and strong diagnostic utility values for the test make it a viable alternative to the previously described back extensor test.[219] Transversus abdominis performance has been described by a palpatory method.[69] Hip abduction and hip extension strength can both be assessed with manual muscle testing.[179] Clinician's selection of test may be dependent on patient's level of conditioning and symptom behavior.

Passive Hip Internal Rotation, External Rotation, Flexion, and Extension

ICF category	Measurement of impairment of body function – mobility of a single joint
Description	The amount of passive hip rotation, flexion, and extension
Measurement method	Hip External and Internal Rotation The patient is positioned prone with feet over the edge of the treatment table. The hip measured is placed in 0° of abduction, and the contralateral hip is placed in about 30° of abduction. The reference knee is flexed to 90°, and the leg is passively moved to produce hip rotation. Manual stabilization is applied to the pelvis to prevent pelvic movement and also at the tibiofemoral joint to prevent motion (rotation or abduction/adduction), which could be construed as hip rotation. The motion is stopped when the extremity achieves its end of passive joint range of motion or when pelvic movement is necessary for additional movement of the leg. The inclinometer is aligned along the shaft of the tibia, just proximal to the medial malleolus, for both medial and lateral rotation range-of-motion measurements. Hip Flexion With the patient supine, the examiner passively flexes the hip to 90° and zeroes an inclinometer at the apex of the knee. The hip is then flexed until the opposite thigh begins to rise off the table. *(continued)*

Passive Hip Internal Rotation, External Rotation, Flexion, and Extension (continued)

Measurement method (continued)	Hip Extension With the patient supine at the edge of a plinth with the lower legs hanging free off the end of the plinth, the examiner flexes both hips and knees so that the patient's lumbar region is flat against the tabletop. One limb is held in this position, maintaining the knee and hip in flexion, the pelvis in approximately 10° of posterior tilt, and the lumbar region flush against the tabletop, while the ipsilateral thigh and leg are lowered toward the table in a manner to keep the hip in 0° of hip abduction and adduction. The patient is instructed to relax and allow gravity to lower the leg and thigh toward the floor. The angle of the femur of this lowered leg to the line of the trunk (and tabletop) is measured. The amount of knee flexion is also monitored to assess the relative flexibility of the rectus femoris muscle.
Nature of variable	Continuous
Units of measurement	Degrees
Measurement properties	Intrarater reliability for passive hip internal and external rotation range-of-motion measures is reported to be excellent (ICCs from 0.96 to 0.99).[92] The intrarater reliability for hip flexion measurements is also excellent (ICC = 0.94).[67] The intrarater reliability for hip extension measurements using the modified Thomas test position is reported to be moderate to excellent, with ICCs between 0.70 and 0.89,[298] between 0.71 and 0.95,[128] between 0.91 and 0.93,[60] and 0.98.[321] Pua et al[245] reported good intratester reliability with hip flexion and extension range of motion (ICC = 0.97 and 0.86, respectively), with SEMs of 3.5° and 4.7°, respectively, in patients with hip osteoarthritis.
Instrument variations	Alternate positions for the testing of hip internal rotation, external rotation, flexion, and extension have been described in both short sitting and supine, with the hip and knee in 90° of flexion for the rotation measures.[7,25,29,57,211,251] Hip extension range-of-motion assessment has also been described as being assessed in prone.[76,211,251]

MENTAL IMPAIRMENT MEASURES

The identification of affective or cognitive factors that coexist with the patient's presentation of low back pain allows the practitioner to determine the potential psychosocial or psychological influence on the clinical presentation. A variety of methods to screen for psychological disorders have been reported in the literature, with the focus being self-report questionnaires. This clinical guideline's assessment of psychological influence on low back pain will include screening for depressive symptoms, measurement of fear-avoidance beliefs and pain catastrophizing, and screening for psychological distress with composite measures.

Depression is a commonly experienced illness or mood state, with a wide variety of symptoms ranging from loss of appetite to suicidal thoughts.[242] Depression is commonly experienced in the general population, but it appears to be more commonly experienced in conjunction with chronic low back pain.[12,75,136] Depressive symptoms are associated with increased pain intensity, disability, medication use, and unemployment for patients with low back pain.[286] Based on this epidemiological information, routine screening for depression should be part of the clinical examination of low back pain.

Effective screening for depression involves more than just generating a clinical impression that the patient is depressed. Separate studies involving spine surgeons[131] and physical therapists[136] have demonstrated that clinical impressions are not sensitive enough to detect depression in patients with low back pain. Available evidence suggests that 2 specific questions from the Primary Care Evaluation of Mental Disorders patient questionnaire can be used to screen for depressive symptoms in physical therapy settings.[136,318] The questions suggested for use are (1) "During the past month, have you often been bothered by feeling down, depressed, or hopeless?" and (2) "During the past month, have you often been bothered by little interest or pleasure in doing things?" The patient responds to the questions with "yes" or "no" and the number of yes items are totaled, giving a potential range of 0 to 2. If a patient responds "no" to both questions, depression is highly unlikely, with a –LR of 0.07. Answering "yes" to 1 or both questions should raise suspicion of depressive symptoms.[318]

Fear-avoidance beliefs are a composite measure of the patient's fear related to low back pain and how these beliefs may affect physical activity and work.[197,301,306] Prospective studies suggest fear-avoidance beliefs are predictive of the development of chronic low back pain.[111,112,183,272] As a result, identification of elevated fear-avoidance beliefs has been suggested to be an important component in the assessment of low back pain. The Fear-Avoidance Beliefs Questionnaire (FABQ) is commonly used to assess fear-avoidance beliefs in patients with low back pain and has physical activity (FABQ-PA) and work (FABQ-W) scales.[306] Several studies indicate that the FABQ is a reliable and valid measure,[126,165,236,306] suggesting it is appropriate for use in clinical settings.

Pain catastrophizing is a negative belief that the experienced pain will inevitably result in the worst possible outcome.[287] Pain catastrophizing is believed to be a multidimensional construct comprising rumination, helplessness, and pessimism.[287] Pain catastrophizing has also been linked to the development and maintenance of chronic pain syndromes.

Frequent pain catastrophizing during acute low back pain was predictive of self-reported disability 6 months[241] and 1 year later,[39] even after considering select historical and clinical predictors. Pain catastrophizing is measured by the Pain Catastrophizing Scale (PCS), which is a 13-item scale that assesses the extent of catastrophic cognitions a patient experiences while in pain.[285]

In addition to assessing psychological constructs, clinicians also have the option to screen for psychosocial distress. One example is the Örebro Musculoskeletal Pain Questionnaire (OMPQ). A systematic review found that the OMPQ had moderate ability to predict long-term pain and disability, and was recommended for clinical use.[163] Another example of a questionnaire to screen for psychosocial distress is the Subgroups for Targeted Treatment (STarT) Back Screening Tool. The STarT Back Screening Tool was originally developed for use in primary care settings, where it has demonstrated sound measurement properties,[159] and recently the STarT Back Screening Tool demonstrated potential for its use in physical therapy settings.[104] Finally, there is a 5-item clinical prediction tool developed in primary care to identify patients with low back pain who are at risk for long-term functional limitations. Patients responding positively to the following items: feeling everything is an effort, trouble getting breath, hot/cold spells, numbness/tingling in parts of body, and pain in heart/chest were at elevated risk for poorer 2-year outcomes.[87]

Fear-Avoidance Beliefs Questionnaire

ICF category	Measurement of impairment of body function – content of thought (mental functions consisting of the ideas that are present in the thinking process and what is being conceptualized); and thought functions, specified as the tendency to elaborate physical symptoms for cognitive/ideational reasons
Description	The Fear-Avoidance Beliefs Questionnaire (FABQ) assesses fear-avoidance beliefs associated with low back pain and consists of a 4-item FABQ physical activity scale (FABQ-PA), potentially ranging from 0 to 24 when only summing responses to items 2 through 5, and a 7-item FABQ work scale (FABQ-W), potentially ranging from 0 to 42 when only summing responses to items 6, 7, 9, 10, 11, 12, and 15, with higher scores indicating higher levels of fear-avoidance beliefs for both FABQ scales.[306] Patients rate their agreement with statements related to either physical activity or work on a 7-point Likert scale (0 is "completely disagree," 6 is "completely agree").[306]
Measurement method	Self-report
Nature of variable	Continuous
Units of measurement	Individual items: 7-point Likert scale (0 is "completely disagree," 6 is "completely agree")
Measurement properties	The FABQ scales have been found to have acceptable reliability.[168,236,278,306] Test-retest reliability has been reported for the FABQ-PA (Pearson r = 0.84-0.88) and FABQ-W (Pearson r = 0.88-0.91).[278,306] Cronbach alpha estimates for the FABQ-PA (ranging from .70 to .83) and FABQ-W (ranging from .71 to .88) scores suggest both scales demonstrate internal consistency.[186,278,288,289,306] The FABQ-W has demonstrated predictive validity for disability and work loss in patients with low back pain.[111,112,278] A suggested FABQ-W cutoff score of greater than 29 has been suggested as an indicator of poor return to work status in patients receiving physical therapy for acute occupational low back pain[111] and a cutoff score of greater than 22 has been suggested in nonworking populations.[125] An FABQ-PA cutoff score of greater than 14, based on a median-split of the FABQ, has been suggested as an indicator of poor treatment outcomes in patients with low back pain seeking care from primary care or osteopathic physicians.[124] Data from 2 separate physical therapy intervention clinical trials indicated that the FABQ-W cutoff score (greater than 29) was a better predictor of self-reported disability at 6 months in comparison to the FABQ-PA cutoff score (greater than 14).[125] Another psychometric analysis indicated that single items of the FABQ-PA and FABQ-W were able to accurately identify those with elevated (above median) or not elevated (below median) total FABQ-PA and FABQ-W scores.[143]

Pain Catastrophizing Scale

ICF category	Measurement of impairment of body function – content of thought (mental functions consisting of the ideas that are present in the thinking process and what is being conceptualized); and thought functions, specified as the tendency to elaborate physical symptoms for cognitive/ideational reasons
Description	The Pain Catastrophizing Scale (PCS) assesses the extent of catastrophic cognitions due to low back pain.[285] Pain catastrophizing has been broadly defined as an exaggerated negative orientation toward actual or anticipated pain experiences.[285] The PCS is a 13-item questionnaire with a potential range of 0 to 52, with higher scores indicating higher levels of pain catastrophizing. The PCS assesses 3 independent dimensions of pain catastrophizing: rumination (items 8-11: ruminating thoughts, worrying, inability to inhibit pain-related thoughts), magnification (items 6, 7, 13: magnification of the unpleasantness of pain situations and expectancies for negative outcomes), and helplessness (items 1-5, 12: inability to deal with painful situations).[285,296] Patients rate their agreement with statements related to thoughts and feelings when experiencing pain on a 5-point Likert scale (0 is "not at all," 4 is "all the time").[285]

(continued)

Pain Catastrophizing Scale (continued)

Measurement method	Self-report
Nature of variable	Continuous
Units of measurement	Individual items: 5-point Likert scale (0 is "not at all," 4 is "all the time")
Measurement properties	Test-retest reliability at 6 (r = 0.75) and 10 weeks (r = 0.70) has been reported for the PCS.[285] Cronbach alpha estimates ranging from .85 to .92 suggest the PCS is internally consistent,[72,73,232] and similar findings have been found for items related to rumination (.85), magnification (.75), and helplessness (.86).[232] The PCS has been found to demonstrate several different types of validity.[72,73,232,285]

Örebro Musculoskeletal Pain Screening Questionnaire

ICF category	Measurement of limitation in activities and participation – completing the daily routine; purposeful sensory experiences, specified as repetitive perception of noninjurious sensory stimuli; and interacting according to social rules Measurement of impairment of body function – pain in back; pain in lower limb; content of thought; and thought functions, specified as the tendency to elaborate physical symptoms for cognitive/ideational reasons
Description	The Örebro Musculoskeletal Pain Screening Questionnaire (OMPSQ) (also referred to as the Acute Low Back Pain Screening Questionnaire) was originally developed to assist primary care practitioners in identifying psychosocial "yellow flags" and patients at risk for future work disability due to pain. The OMPSQ is a 25-item screening questionnaire (of which 21 are scored) that consists of items involving pain location (item 4), work absence due to pain (item 5), pain duration (item 6), pain intensity (items 8 and 9), control over pain (item 11), frequency of pain episodes (item 10), functional ability (items 20 through 24), mood (items 12 and 13), perceptions of work (items 7 and 16), patients' estimate of prognosis (items 14 and 15), and fear-avoidance (items 17 through 19).[199] The scored items are summed to provide a total score potentially ranging from 0 to 210, with higher scores indicating a higher risk of poor outcome.
Measurement method	Self-report
Nature of variable	Continuous
Units of measurement	Individual items rated on a 0-to-10 scale
Measurement properties	The ability of the OMPSQ to predict long-term pain, disability, and sick leave has been supported in previous studies,[207] including a systematic review of 7 publications (5 discrete data sets).[163]

Subgroups for Targeted Treatment Back Screening Tool

ICF category	Measurement of limitation in activities and participation – completing the daily routine; purposeful sensory experiences, specified as repetitive perception of noninjurious sensory stimuli; and interacting according to social rules Measurement of impairment of body function – pain in back; pain in lower limb; content of thought; and thought functions, specified as the tendency to elaborate physical symptoms for cognitive/ideational reasons; appropriateness of emotion (mental functions that produce congruence of feeling or affect with the situation, such as happiness at receiving good news); range of emotion (mental functions that produce the spectrum of experience of arousal of affect or feelings such as love, hate, anxiousness, sorrow, joy, fear, and anger); and emotional functions, specified as the tendency to elaborate physical symptoms for emotional/affective reasons
Description	The Subgroups for Targeted Treatment (STarT) Back Screening Tool is a 9-item screening measure used to identify subgroups of patients with low back pain in primary care settings based on the presence of potentially modifiable prognostic factors that may be useful in matching patients with targeted interventions.[159] The STarT contains items related to physical (items 2, 3, 5, 6) and psychosocial (items 1, 4, 7, 8, 9) factors that have been identified as strong independent predictors of persistent disabling low back pain.
Measurement method	Potential responses for the STarT are dichotomized ("agree" or "disagree"), with the exception of an item related to "bothersomeness" which uses a 5-point Likert scale. Overall STarT scores (ranging from 0 to 9) are determined by summing all positive responses. Psychosocial subscale scores (ranging from 0 to 5) are determined by summing items related to bothersomeness, fear, catastrophizing, anxiety, and depression (ie, items 1, 4, 7, 8, 9). Based on overall and psychosocial subscale scoring, the STarT categorizes patients as "*high-risk*" (psychosocial subscale scores $\geq$4), in which high levels of psychosocial prognostic factors are present with or without physical factors present, "*medium-risk*" (overall score >3; psychosocial subscale score <4), in which physical and psychosocial factors are present but not a high level of psychosocial factors, or "*low-risk*" (overall score 0-3), in which few prognostic factors are present.[146]
Nature of variable	Continuous subscale scores for function and psychosocial items and categorical subgroups
Units of measurement	Individual items: Bothersomeness item: 5-point Likert scale Remaining items: dichotomous scale

(continued)

Subgroups for Targeted Treatment Back Screening Tool (continued)

Units of measurement (continued)	Subgroup scoring: High risk (psychosocial subscale scores ⩾4) Medium risk (overall score >3; psychosocial subscale score <4) Low risk (overall score ⩽3)
Measurement properties	The STarT overall (0.79; 95% CI: 0.73, 0.95) and psychosocial subscale (0.76; 95% CI: 0.52, 0.89) scores have been found to have acceptable test-retest reliability (weighted kappa values) in patients with stable symptoms.[159] Cronbach alpha estimates for overall (.79) and psychosocial subscale (.74) scores suggest the STarT demonstrates internal consistency.[159] The predictive validity of the STarT has been reported in which subgrouping cutoff scores were predictive of poor 6-month disability outcomes in low (16.7%), medium (53.2%), and high-risk (78.4%) subgroups.[159] The discriminant validity of the STarT scores (area under the curve [AUC] range: 0.73 - 0.92) has been reported and suggests that overall scores best discriminate physical reference standards (eg, disability and referred leg pain), while psychosocial subscale scores best discriminate psychosocial reference standards (eg, catastrophizing, fear, and depression).[159] The STarT has demonstrated concurrent validity in comparison to the Örebro Musculoskeletal Pain Screening Questionnaire, in which both instruments displayed similar subgroup characteristics and the ability to discriminate for disability, catastrophizing, fear, comorbid pain, and time off work reference standards.[160] Subgroup status corresponded to initial pain intensity and disability scores in an ordinal manner for patients seeking care in outpatient physical therapy settings, and longitudinal analyses indicated different patterns of change for clinical outcomes.[104]

CLINICAL GUIDELINES

Interventions

A variety of interventions have been described for the treatment of low back pain, and it is not the intention of these clinical practice guidelines to exhaustively review all interventions. Instead, these guidelines focus on randomized, controlled trials and/or systematic reviews that have tested these interventions in environments that would match physical therapy application. In keeping with the overall theme of these guidelines, we are focusing on the peer-reviewed literature and making recommendations related to (1) treatment matched to subgroup responder categories, (2) treatments that have evidence to prevent recurrence, and (3) treatments that have evidence to influence the progression from acute to chronic low back pain and disability.

It is believed that early physical therapy intervention can help reduce the risk of conversion of patients with acute low back pain to patients with chronic symptoms. A study by Linton et al[200] demonstrated that early active physical therapy intervention for patients with the first episode of acute musculoskeletal pain significantly decreased the incidence of chronic pain. This study represented a cohort study comparing patients who received early versus delayed or no physical therapy intervention for occupational-related injury. At 12-month follow-up, the group that received early active physical therapy had significant reductions in amount of work time lost. Only 2% of patients who received early intervention went on to develop chronic symptoms, compared to 15% of the delayed treatment group.[200] These findings have been supported numerous times.[119,133,230,244,308] Recently, Gellhorn et al[120] demonstrated that those with early referral to physical therapy (less than 4 weeks), as compared to those referred after 3 months, were significantly less likely to receive lumbosacral injection (OR = 0.46; 95% CI: 0.44, 0.49) and frequent physician visits (OR = 0.47; 95% CI: 0.44, 0.50) in Medicare patients.

The order of the interventions presented in this section is based upon categories and intervention strategies presented in the Recommended Low Back Pain Impairment/Function-based Classification Criteria with Recommended Interventions table.

MANUAL THERAPY

I Thrust and nonthrust mobilization/manipulation is a common intervention utilized for acute, subacute, and chronic low back pain. Despite its popularity, recent systematic reviews have demonstrated marginal treatment effects across heterogeneous groups of patients with low back pain.[10,11] Also, most trials have assessed the efficacy of mobilization/manipulation in isolation rather than in combination with active therapies. Recent research has demonstrated that spinal manipulative therapy is effective for subgroups of patients and as a component of a comprehensive treatment plan, rather than in isolation.

II Research has determined a subgroup of patients likely to have dramatic changes with application of thrust manipulation to the lumbar spine, advice to remain active, and mobility exercise. Flynn et al[99] conducted an initial derivation study of patients most likely to benefit from a general lumbopelvic thrust manipulation. Five variables were determined to be predictors of rapid treatment success, defined as a 50% or greater reduction in Oswestry Disability Index scores within 2 visits. These predictors included:

- Duration of symptoms of less than 16 days
- No symptoms distal to the knee
- Lumbar hypomobility
- At least 1 hip with greater than 35° of internal rotation
- FABQ-W score less than 19

The presence of 4 or more predictors increased the probability of success with thrust manipulation from 45% to 95%.

I This test-item cluster was validated by Childs et al,[51] who demonstrated similar results with patients meeting 4 of the 5 predictors who received thrust manipulation (+LR = 13.2; 95% CI: 3.4, 52.1). Patients were randomized to receive either spinal manipulation or trunk strengthening exercises. Patients meeting the rule who received manipulation had greater reductions in disability than all other subjects. These results remained significant at 6-month follow-up. A pragmatic rule has also been published to predict dramatic improvement based on only 2 factors:

- Duration less than 16 days
- Not having symptoms distal to the knee

If these 2 factors were present, patients had a moderate-to-large shift in probability of a successful outcome following application of thrust manipulation (+LR = 7.2; 95% CI: 3.2, 16.1).[106]

Patients in the study by Childs et al[51] who received manipulation and exercise demonstrated less risk of worsening disability than those who received only exercise.[50] Patients who received only exercise were 8 (95% CI: 1.1, 63.5) times more likely to experience a worsening of disability. The number needed to treat (NNT) with manipulation to prevent 1 additional patient from experiencing a worsening in disability was 9.9 (95% CI: 4.9, 65.3).[50]

I This rule has been further examined by Cleland et al[66] with similar results for patients fitting the clinical prediction rule treated with 2 different thrust techniques, the previously utilized general lumbopelvic technique and a sidelying rotational technique. The 2 groups receiving thrust manipulation fared significantly better than a group receiving nonthrust mobilization at 1 week, 4 weeks, and 6 months.

I The Cleland et al[66] trial demonstrated that patient outcomes are dependent on utilization of a thrust manipulation, as those who received nonthrust techniques did not have dramatic improvement. This had previously been established by Hancock et al[140] in a secondary analysis of patients who fit the clinical prediction rule and were treated primarily with nonthrust mobilization, where no differences were found in a control group that received placebo intervention. The findings of the Cleland et al[66] and Hancock et al[140] papers demonstrate that rapid improvements associated with patients fitting the clinical prediction rule are specific to patients receiving thrust manipulation.

I A secondary analysis by Fritz et al[116] examined the relationship between judgments of passive accessory mobility assessments and clinical outcomes after 2 different interventions, stabilization exercise alone or thrust manipulation followed by stabilization exercise. The mean duration of symptoms for patients included in the analysis was 27 days (range, 1-594). Patients who were assessed to have lumbar hypomobility on physical examination demonstrated more significant improvements with the thrust manipulation and exercise intervention than with stabilization alone. Seventy-four percent of patients with hypomobility who received manipulation were deemed successful as compared to 26% of patients with hypermobility who were treated with manipulation. These findings may suggest that assessment of hypomobility, in the absence of contraindications, is sufficient to consider use of thrust manipulation as a component of comprehensive treatment.

I Beyond the success associated with the use of thrust manipulation in patients with acute low back pain who fit the clinical prediction rule, there is evidence for the use of thrust manipulation in other patients experiencing low back pain. Aure and colleagues[13] demonstrated superior reductions in pain and disability in patients with chronic low back pain who received thrust manipulations when compared to an exercise intervention. More recently, Cecchi et al[45] conducted a randomized controlled trial (n = 210) in patients with subacute and chronic low back pain. Subjects were randomized to receive thrust manipulation, back school intervention, or individualized physiotherapy intervention. Reductions in disability were significantly higher for the manipulation group at discharge and 12 months. Long-term pain relief, reoccurrences of low back pain, and drug usage also favored the manipulation group.

I Whitman et al[316,317] demonstrated that, for patients with clinical and imaging findings consistent with lumbar central spinal stenosis, a comprehensive treatment plan including thrust and nonthrust mobilization/manipulation directed at the lumbopelvic region is effective at improving patient recovery. In the randomized control trial, 58 patients were randomized to receive a comprehensive manual therapy approach, abdominal retraining, and body weight–supported treadmill training compared to lumbar flexion exercises and traditional treadmill training.[316] Seventy-eight percent of patients receiving manual treatments met the threshold for success compared to 41% of the flexion-based exercise group at 6 weeks. At long-term follow-up, all outcomes favored the experimental group, although these differences were not statistically significant. Manual therapy was delivered in a pragmatic impairment-based approach; specifically, 100% of patients received nonthrust mobilization to the lumbar spine, 50% of patients received thrust manipulation to the lumbar spine, and 31% of patients received lumbopelvic manipulation.[14] Patients also received manual therapy interventions to other regions of the lower quarter and thoracic spine as deemed important by the treating therapists.[14] This study supports the use of a comprehensive treatment program that includes manual therapy interventions in the management of patients with lumbar spinal stenosis.

III Murphy et al[223] published a prospective cohort study of 57 consecutive patients with central, lateral, or combined central and lateral lumbar spinal stenosis. Patients were treated with lumbar thrust manipulation, nerve mobilization procedures, and exercise. The mean improvement in disability, as measured by the Roland-Morris Disability Questionnaire, was 5.1 points from baseline to discharge, and 5.2 points from baseline to long-term follow-up, satisfying the criteria for minimally clinical important difference. Pain at worst was also reduced by a mean of 3.1 points. Reiman et al,[252] in a recent systematic review, recommended manual therapy techniques including thrust and nonthrust mobilization/manipulation to the lumbopelvic region for patients with lumbar spinal stenosis.

IV The hip has long been identified as a potential source of and contributor to low back dysfunction, and impairments in hip mobility have been found to be associated with the presence of low back pain.[22,92,253,270,323] It has been suggested that altered movements of the hip and spine may contribute to the development of low back pain, as they may alter the loads placed on the lumbar facets and posterior spinal ligaments.[3,195] Several authors have described restricted hip mobility in patients with low back pain as an indicator of positive response to interventions targeting the hip.[38,100,215,231,252] Some early evidence demonstrates successful incorporation of interventions targeting the hip into a more comprehensive treatment program for patients with lumbar spinal stenosis.[316,317] Though research in this area is developing, clinicians may consider including examination of the hip and interventions targeting identified hip impairments for patients with low back pain.

A Clinicians should consider utilizing thrust manipulative procedures to reduce pain and disability in patients with mobility deficits and acute low back and back-related buttock or thigh pain. Thrust manipulative and nonthrust mobilization procedures can also be used to improve spine and hip mobility and reduce pain and disability in patients with subacute and chronic low back and back-related lower extremity pain.

TRUNK COORDINATION, STRENGTHENING, AND ENDURANCE EXERCISES

Lumbar coordination, strengthening, and endurance exercises are another commonly utilized treatment for patients with low back pain. These exercises are also described in the literature as motor control exercises, transversus abdominis training, lumbar multifidus training, and dynamic lumbar stabilization exercises. In addition, these exercises are commonly prescribed for patients who have received the medical diagnosis of spinal instability.

I In a Cochrane review on exercise therapy for the treatment of nonspecific low back pain, Hayden and colleagues[147] examined the literature on exercise therapy for patients with acute (11 randomized clinical trials), subacute (6 randomized clinical trials), and chronic (43 randomized clinical trials) low back pain and reported that exercise therapy was effective in decreasing pain in the chronic population, graded activity improved absenteeism in the subacute population, and exercise therapy was as effective as other conservative treatments or no treatments in the acute population. The larger criticism that the Cochrane reviewers found with the current literature was that the outcome tools were heterogeneous and the reporting was poor and inconsistent, with the possibility of publication bias.

I In a systematic review of 14 randomized controlled trials examining the effectiveness of motor control exercises for nonspecific low back pain, Macedo et al[205] concluded that motor control, when used in isolation or with additional interventions, is effective at decreasing pain and disability related to nonspecific low back pain. However, there was insufficient evidence to find motor control exercises superior to manual therapy or other exercise interventions. The authors were unable to provide recommendations regarding the best strategies for implementing motor control exercise into clinical practice.

II A preliminary clinical prediction rule for the stabilization classification has been proposed to assist clinicians with accurately identifying patients who appear to be appropriate for a stabilization-focused exercise program.[152] The clinical prediction rule for stabilization classification was developed using similar methodology as for the manipulation rule. Variables that significantly predicted a 50% improvement in disability from low back pain at 4 weeks in a multivariate analysis were retained for the clinical prediction rule.[152] Four examination findings were identified:

- Age less than 40 years
- Positive prone instability test
- Presence of aberrant movements with motion testing
- Straight leg raise greater than 91°

A positive clinical prediction rule for stabilization was defined as presence of at least 3 of the findings (+LR = 4.0; 95% CI: 1.6, 10.0), while a negative clinical prediction rule was presence of fewer than 2 of the findings (–LR = 0.20; 95% CI: 0.03, 1.4).[152] Validation of this test-item cluster is required before it can be recommended for widespread clinical use.

I Costa et al[70] used a placebo-controlled randomized controlled trial to examine the use of motor-control exercises in 154 patients with chronic low back pain. Interventions consisted of either specific motor-control exercises directed to the multifidus and transversus abdominis or nontherapeutic modalities. Short-term outcomes demonstrated small but significant improvements in favor of the motor control group for both patient activity tolerance and global impression of recovery. The exercise interventions failed to reduce pain greater than nontherapeutic modalities over the same period.

I A randomized controlled trial was performed by Rasmussen-Barr et al[250] that compared a graded exercise program that emphasized stabilization exercises to a general walking program in the treatment of low back pain lasting greater than 8 weeks. At both the 12-month

and the 36-month follow-up, the stabilization group outperformed the walking group, with 55% of the stabilization group and only 26% of the walking group meeting the predetermined criteria for success. This research demonstrates that a graded exercise intervention emphasizing stabilizing exercises seems to improve perceived disability and health parameters at short and long terms in patients with recurrent low back pain.

I Choi and colleagues[53] performed a review of randomized controlled trials that examined the effectiveness of exercise in the prevention of low back pain recurrence. This was published in a Cochrane review. Treatments were defined as exercise including strengthening, endurance, and aerobic activity that occurred during the patient's episode of care with a healthcare practitioner as well as those that occurred following discharge from a healthcare practitioner. Specific types of exercise were not assessed individually. The group found 9 studies that met their criteria for inclusion. There was moderate-quality evidence that the number of recurrences was significantly reduced in 2 studies (mean difference, −0.35; 95% CI: −0.60, −0.10) at 0.5 to 2 years' follow-up. There was very low-quality evidence that the days on sick leave were reduced in patients who continued to perform low back exercises following discharge (mean difference, −4.37; 95% CI: −7.74, −0.99) at 0.5 to 2 years' follow-up. In summary, there was moderate-quality evidence that postdischarge exercise programs can prevent recurrences of low back pain.

I In a randomized controlled trial, Hides et al[156] compared a 4-week specific exercise training program to advice and medication in a group of patients with first-episode low back pain. The specific exercise group performed cocontraction exercises believed to facilitate training of the lumbar multifidus and transversus abdominis muscle groups. The specific exercise group reported recurrence rates of 30% at 1 year and 35% at 3 years, compared to 84% at 1 year and 75% at 3 years for the advice and medication control group.

I O'Sullivan et al[234] completed a randomized controlled trial involving subjects with radiologically confirmed spondylolysis or spondylolisthesis. A specific exercise group received weekly interventions directed at training to promote isolation and cocontraction of the deep abdominal muscles and the lumbar multifidus. A control group received usual care typically consisting of aerobic exercise, rectus abdominis training, and modalities. At the conclusion of the 10-week program, the specific exercise group demonstrated statistically significant improvements in both pain intensity and functional disability. These gains were maintained at a 30-month follow-up.

I Yilmaz and colleagues[326] investigated the efficacy of a dynamic lumbar stabilization exercise program in patients with a recent lumbar microdiscectomy. The results of their randomized trial indicated that lumbar spinal stabilization exercises under the direction of a physical therapist were superior to performing a general exercise program independently at home and to a control group of no prescribed exercises at 3 months. This study had a small sample size with 14 subjects in each group and did not describe any loss to follow-up.

I Kulig et al[190] performed a randomized clinical controlled trial comparing an intensive 12-week exercise program and education to education alone and to usual physical therapy care postmicrodiscectomy. In the 2-group analyses, exercise and education resulted in a greater reduction in Oswestry Disability Index scores and a greater improvement in distance walked compared to education alone. In the 3-group analyses, post hoc comparisons showed a significantly greater reduction in Oswestry Disability Index scores following exercise and education compared with the education-only and usual physical therapy groups. Limitations of this study included lack of adherence to group assignments and a disproportionate therapist contact time.

A Clinicians should consider utilizing trunk coordination, strengthening, and endurance exercises to reduce low back pain and disability in patients with subacute and chronic low back pain with movement coordination impairments and in patients post–lumbar microdiscectomy.

CENTRALIZATION AND DIRECTIONAL PREFERENCE EXERCISES AND PROCEDURES

I A systematic review by Clare et al[61] included 6 randomized/quasi-randomized controlled trials investigating the efficacy of centralization and directional preference exercises, also commonly described as McKenzie therapy, in the treatment of spinal pain. The authors concluded that the reviewed studies suggested that McKenzie therapy is more effective than comparison treatments (nonsteroidal anti-inflammatory drugs, educational booklet, strengthening, etc) at short-term follow-up. It should be noted that the studies in this review excluded trials where cointerventions were permitted and may not be generalizable to clinical practice. A second systematic review from Aina et al[4] examined centralization of spinal symptoms. They reported that centralization is a commonly encountered subgroup of low back pain, with good reliability during examination. Their meta-analysis resulted in a prevalence rate for centralization of 70% with subacute low back pain and 52% with chronic low back pain. The presence of centralization

was associated with good outcomes and lack of centralization with poor outcomes. Machado et al[206] performed a systematic review and meta-analysis of 11 trials utilizing the McKenzie treatment approach. Short-term results demonstrated improved outcomes compared to passive treatments. Long-term follow-up at 12 weeks favored advice to remain active over McKenzie exercise, raising questions on the long-term clinical effectiveness of the McKenzie methods for management of patients with low back pain.[206]

I Long and colleagues[202] investigated whether a McKenzie examination and follow-up on 312 patients with acute, subacute, and chronic low back pain would elicit a directional preference in these patients. Directional preference in this investigation was described as an immediate, lasting improvement in pain from performing repeated lumbar flexion, extension, or side glide/rotation spinal movements. Of the 312 patients, 230 participants (74%) had a directional preference, characterized as: extension (83%), flexion (7%), and lateral responders (10%). These patients were randomized into groups of (1) directional exercises matching the patient's directional preference, (2) directional exercises opposite the patient's directional preference, or (3) nondirectional exercises. Significant reductions in pain, pain medication use, and disability occurred in the directional exercise group that was matched to their directional preference. One-third of the patients in the nonconcordant exercise group dropped out because they were either not improving or worsening. The authors suggest that this study "adds further validity by demonstrating that a subject-specific treatment is superior to others in creating good outcomes."[202] One limitation of this study was that it only followed participants for 2 weeks postintervention, thus providing little insight into the long-term effects of directional preference–driven exercises.

III Long and colleagues[203] conducted a secondary analysis of a previous randomized controlled trial examining a range of factors that predict a favorable outcome where patients were subgrouped based on the presence or absence of directional preference. The authors concluded from the analyses that those subjects who exhibited a directional preference or centralization response who then received a matched treatment had a 7.8-times-greater likelihood of a good outcome at 2 weeks, which was defined as a minimal reduction of 30% on the Roland-Morris Disability Questionnaire.

I A multicenter randomized controlled trial by Browder et al[36] looked to examine the effectiveness of an extension-oriented treatment approach in patients with low back pain. The authors included a homogeneous subgroup of patients who responded with centralization to extension movements. Forty-eight patients were randomly allocated to receive either exercise/mobilization promoting lumbar spine extension or lumbopelvic strengthening. Subjects in both groups attended 8 physical therapy treatments and were given a home exercise program. The patients who received the extension-oriented treatment approach experienced greater reductions in disability compared to those subjects who received lumbopelvic strengthening exercises at 1 week, 4 weeks, and 6 months. The authors concluded that those patients who centralize with lumbar extension movements preferentially benefit from an extension-oriented treatment approach.

III Werneke and colleagues[313] performed a prospective, longitudinal cohort study aiming to determine baseline prevalence of directional preference or no directional preference in 584 patients with nonspecific low back pain who centralized, did not centralize, or could not be classified. The authors also sought to determine if these classifications predicted functional status and pain intensity at discharge. Therapists skilled in the use of the McKenzie methodology participated in the study. The authors found that the overall prevalence of directional preference and centralization was 60% and 41%, respectively. Results indicated that patients whose symptoms showed directional preference with centralization at intake reported better functional status and less pain compared to patients whose symptoms did not centralize and showed no directional preference. One key implication of this study is that the patient response criteria regarding directional preference and centralization should be considered as independent variables when analyzing patient outcomes.

I In a randomized controlled trial, Petersen et al[235] compared thrust manipulation along with general patient education to the McKenzie method along with general patient education in 350 patients who reported symptoms of low back pain for a duration of more than 6 weeks and who presented with centralization or peripheralization of symptoms, with or without signs of nerve root involvement. In addition to the patient education, the manipulation group received thrust and nonthrust manipulation as well as trigger-point massage at the discretion of the treating clinician, but they were not allowed to perform exercises or movements demonstrated to centralize the patient's symptoms. In addition to the patient education, the McKenzie method groups received interventions consistent with the McKenzie method (centralization exercises and procedures) at the discretion of the treating clinician but were not allowed to use mobilization/manipulation interventions. At 2 months' follow-up, the McKenzie treatment was superior to manipulation with respect to the number of patients who reported success after treatment (71% and 59%, respec-

tively). The McKenzie group showed improvement in level of disability compared to the manipulation group, reaching a statistical significance at 2 and 12 months' follow-up.

A Clinicians should consider utilizing repeated movements, exercises, or procedures to promote centralization to reduce symptoms in patients with acute low back pain with related (referred) lower extremity pain. Clinicians should consider using repeated exercises in a specific direction determined by treatment response to improve mobility and reduce symptoms in patients with acute, subacute, or chronic low back pain with mobility deficits.

FLEXION EXERCISES

Flexion-based exercises, also called Williams flexion exercises, have long been considered a standard treatment for patients with lumbar spinal stenosis. It has been reported that flexion-specific exercise classification appears to be less common and most often occurs in patients who are older, often with a medical diagnosis of lumbar spinal stenosis.[107] Current guidelines detailing conservative intervention for stenosis recommend repeated flexion exercises in the supine, seated, and standing positions.[30] A recent review article by Backstrom et al[14] note that flexion-based exercises have long been utilized to theoretically open or expand the cross-sectional area of the foraminal canals and central spinal canal, thus potentially relieving mechanical compression of the lumbar nerve roots, improving spinal flexibility, and improving hemodynamics.

II A multicenter randomized controlled trial by Whitman et al[316] compared 2 physical therapy programs for patients with both imaging studies and clinical presentation consistent with central lumbar spinal stenosis. The authors randomized 58 patients with lumbar spinal stenosis to 1 of 2 six-week physical therapy programs: (1) a manual therapy, exercise, and body weight–supported treadmill walking group; and (2) a lumbar flexion exercise, treadmill walking, and walking program group. Patients in the manual therapy group reported greater recovery at 6 weeks, with a number needed to treat of 2.6. At 1 year, 62% of the manual therapy group continued to have successful outcomes as compared to 41% in the flexion-based exercise group.

III A cohort study by Murphy et al[223] utilized flexion-based exercises as a component of a treatment program also utilizing long-axis distraction manipulation and nerve mobilization procedures in a population of patients with both clinical findings and imaging findings of central, lateral, or combined central and lateral lumbar spinal stenosis. Patients were instructed in a quadruped exercise emphasizing lumbar flexion and extension to improve overall joint mobility. The mean improvement in disability as measured by the Roland-Morris Disability Index score was 5.1 points from baseline to discharge, and 5.2 points from baseline to long-term follow-up, satisfying the criterion for minimum clinically important difference. Pain at worst was also reduced by a mean of 3.1 points using the 0-10 numeric pain rating scale.

III Simotas et al[273] performed a prospective cohort study following 49 patients with radiographic central canal lumbar spinal stenosis for a mean of 33 months, with treatment consisting of daily flexion-based exercises. At 3-year follow-up, 9 patients had undergone surgical intervention. Of the 40 patients who did not undergo surgery, 5 reported worsening of symptoms, 12 reported no change, 11 reported mild improvement, and 12 reported sustained improvement. Twelve of these 40 patients who did not undergo surgery reported having no pain or only mild pain.

C Clinicians can consider flexion exercises, combined with other interventions such as manual therapy, strengthening exercises, nerve mobilization procedures, and progressive walking, for reducing pain and disability in older patients with chronic low back pain with radiating pain.

LOWER-QUARTER NERVE MOBILIZATION PROCEDURES

IV George[121] published a case series of 6 patients with subacute low back pain and leg symptoms who (1) were unable to improve or worsen their symptoms with lumbar flexion and extension motions, and (2) had a positive slump test. All patients were treated with end-range nerve mobilization (passive slump and straight leg raise stretching) procedures. All patients demonstrated reductions in numeric pain rating. Five of 6 patients reported a reduction or elimination of their thigh, lower-leg, or foot symptoms, in which 2 patients no longer had symptoms and 3 patients reported the location of symptoms to be in a more proximal location at discharge. These 5 patients had an average of 8 treatment sessions each.

II Cleland et al[65] completed a randomized controlled trial (n = 30) using the same eligibility criteria as the George[121] case series. Patients with low back complaints, with symptoms distal to the buttocks, who had reproduction of symptoms with the slump test and had no change in symptoms with lumbar flexion or extension were randomized to receive nonthrust mobilization of the lumbar spine and exercise or slump stretching and exercise. Patients were treated for 6 sessions. At discharge, the slump-stretching group exhibited significantly reduced disability; overall

perceived pain; and thigh, lower-leg, or foot symptoms.

III Additionally, Murphy et al[223] utilized nerve mobilization procedures in a cohort of 55 consecutive patients with lumbar spinal stenosis as part of a treatment protocol and reported a mean improvement of 5.1 using the Roland-Morris Disability Questionnaire. Hall and colleagues[137,138] demonstrated an increase in straight leg raise range of motion following treatment using end-range nerve mobilization (straight leg raising combined with manual lower-limb traction) in a cohort of patients with neurogenic lower extremity complaints.

II A randomized controlled trial (n = 81) completed by Scrimshaw and Maher[269] compared standard care to standard care plus active and passive lower-limb mobilization procedures in patient status post–lumbar spine surgery (discectomy, laminectomy, or fusion). In addition to baseline measures, follow-up data for pain and disability were collected at 6 weeks, 6 months, and 12 months after surgery. The results showed no statistically significant differences between the groups for any of the outcomes at any point in time. Due to the heterogeneity of patient population and treatment, results must be interpreted with caution. However, presently, no other data suggest that nerve mobilization procedures are more effective than standard care for patients post–lumbar surgery.

IV Numerous other case studies have described utilization of lower extremity nerve mobilization procedures for lower-limb symptoms.[63,64,122,185,294] Diagnoses utilized in these reports included hamstring strain and complex regional pain syndrome.

C Clinicians should consider utilizing lower-quarter nerve mobilization procedures to reduce pain and disability in patients with subacute and chronic low back pain and radiating pain.

TRACTION

I A systematic review by Clarke and colleagues[62] investigated the use of traction compared to reference treatments, placebo/sham traction, or no treatment for patients with low back pain. The authors included 25 randomized controlled trials that included patients with acute, subacute, or chronic low back pain, with or without sciatica. Of the 25 selected randomized controlled trials, only 5 trials were considered high quality. Based on the available evidence, there is moderate evidence showing no statistically significant differences in short- or long-term outcomes between traction as a single treatment and a placebo, sham, or no treatment. The authors concluded that intermittent or continuous mechanical traction as a single treatment for low back pain cannot be recommended for heterogeneous groups of patients suffering from low back pain with or without sciatica.

I Several randomized controlled trials have compared traction to a sham traction intervention, with no significant differences found between groups. Beurskens et al[24] randomized 151 subjects with a 6-week history of nonspecific low back pain to receive either traction (35%-50% of body weight) or sham traction (maximum 20% body weight) for twelve 20-minute sessions over 5 weeks. Follow-up measures for pain, disability, and impression of perceived recovery were completed at 12 weeks and 6 months, with no statistically significant differences between the groups at either point. Schimmel et al[267] compared traction via the Intervertebral Differential Dynamics Therapy device (50% body weight + 10 lb of force) to sham intervention with the same device (10 lb of force) in subjects with a history of greater than 3 months of nonspecific low back and leg pain. Subjects received 20 visits over 6 weeks, with pain, disability, and quality of life measured at 2, 6, and 14 weeks. Both treatment regimens showed significant improvement versus baseline in all measures at 14 weeks. However, no significant between-group differences were present at follow-up.

II In a randomized clinical trial, Fritz et al[114] aimed to investigate whether there is a subgroup of patients with low back pain who benefit from mechanical traction along with extension-oriented exercise. Sixty-four patients with low back pain with radicular symptoms were assigned to receive either an extension-oriented treatment approach or an extension-oriented treatment approach with mechanical traction for a total of 6 weeks. The results showed a greater reduction in disability and fear-avoidance beliefs for subjects in the traction group at the 2-week follow-up. However, at 6 weeks, there was no statistical difference. But the investigators identified 2 variables that may help identify a subgroup of patients who can benefit from mechanical traction. Those patients who experienced peripheralization of symptoms with extension movement and had a positive crossed straight leg raise test had a better likelihood of success. Of these patients, 84.6% in the traction group had a successful outcome as compared to 45.5% of those allocated to the extension group. Although this subgroup of patients with low back pain is likely small, the authors conclude that this subgroup is characterized by the presence of sciatica, signs of nerve root compression, and either peripheralization with extension movements or a positive crossed straight leg raise test.

III Beattie et al[19] performed a prospective, longitudinal case series study involving 296 patients with low back pain and evidence of a degenerative and/or

herniated intervertebral disc at 1 or more levels of the lumbar spine. Each patient received prone lumbar traction using the vertebral axial decompression (VAX-D) system for 8 weeks. The numeric pain rating scale and the Roland-Morris Disability Questionnaire were completed at preintervention, at discharge, and at 30 days and 180 days after discharge. A total of 250 (84.4%) subjects completed the treatment protocol, so an intention-to-treat analysis was performed to account for the loss to follow-up. The investigators found that patients reported significantly improved pain and Roland-Morris Disability Questionnaire scores after 16 to 24 visits of prone traction at discharge, and at 30 days and 180 days postdischarge. It should be noted that there was no control group and that there were large variations in the magnitude of change in the outcome measures used.

D There is conflicting evidence for the efficacy of intermittent lumbar traction for patients with low back pain. There is preliminary evidence that a subgroup of patients with signs of nerve root compression along with peripheralization of symptoms or a positive crossed straight leg raise will benefit from intermittent lumbar traction in the prone position. There is moderate evidence that clinicians should not utilize intermittent or static lumbar traction for reducing symptoms in patients with acute or subacute, nonradicular low back pain or in patients with chronic low back pain.

PATIENT EDUCATION AND COUNSELING

V Education and advice have been traditional interventions given to patients with acute, subacute, and chronic low back pain. A survey of recognized clinical specialists in orthopaedic physical therapy identified that patient education strategies consisting of "Educate patient in home care treatment program" and "Recommends strategies to prevent recurrent problems" ranked as the highest 2 out of a list of 12 intervention strategies.[216] In addition, "Functional movement training/re-education" was ranked as a "very important strategy" for therapists to implement in their plan of care for patients.[216] For patients with low back pain, this commonly involves identifying movements that are associated with low back pain, such as excessive flexion of the lumbar spine when rising from a chair instead of utilizing flexion of the hip for executing the movement, then providing cuing and education on movement options that enable the activity to be performed with fewer, or no, symptoms.

Research in patient education and counseling strategies has focused on 3 main approaches: (1) general education and advice in acute and subacute populations; (2) behavioral education, including cognitive-behavioral theory, graded activity, and graded exposure, in a variety of populations; and (3) education of patients on the physiology of pain.

I Previous clinical practice guidelines generally recommend clinicians to counsel their patients to (1) remain active, (2) avoid bed-rest, and (3) acknowledge the positive natural history of acute low back pain. For example, the joint guidelines for the "Diagnosis and Treatment of Low Back Pain" from the American College of Physicians and the American Pain Society state, "Clinicians should provide patients with evidence-based information on low back pain with regard to their expected course, advise patients to remain active, and provide information about effective self-care options (strong recommendation, moderate-quality evidence)."[56] Several other systematic reviews have demonstrated moderate evidence for advising patients to remain active, as compared to bed-rest, for the best opportunity for pain reduction and functional improvements.[77,134,158]

I In 2007, Liddle et al[198] published a systematic review on advice for the management of low back pain. Major findings stated that general instructions to remain active are sufficient for patients with acute low back pain. More involved education relating to appropriate exercise and functional activities to promote active self-management is effective in patients with subacute and chronic low back pain.

I Burton et al[39] completed a randomized controlled trial (n = 162) exploring the efficacy of a novel educational booklet compared with a traditional booklet in patients with low back pain being seen in a primary care setting. Traditional information and advice about back pain have been based on a biomedical model with emphasis on anatomy, biomechanics, and pathology. The novel education booklet de-emphasized education on pathology and disease processes, provided reassurance regarding the likelihood of recovery, and promoted positive attitudes. The novel education booklet resulted in significantly greater early improvement in beliefs that were maintained at 1 year. For patients who had elevated fear-avoidance beliefs, there was a clinically important improvement in the Roland-Morris Disability Questionnaire at 3 months.

III Coudeyre et al[71] demonstrated in a large, nonrandomized controlled trial that utilization of pamphlet education was effective in reducing persistent low back pain and increasing patient satisfaction. Days of work missed, disability as measured by the Quebec Disability Scale, and fear-avoidance beliefs did not differ between the groups who received or did not receive the educational pamphlet.

II Albaladejo et al[6] completed a 3-group, clustered, randomized trial comparing 3 educational packages provided to 348 patients with low back pain, of which 265 (79.8%) had chronic low back pain. All patients received usual care administered by primary care physicians. One group received a booklet and brief education on health education that focused on nutrition. The 2 other groups received a booklet and brief education on active managements of low back pain. A third group also received 4 sessions of physiotherapy to establish a home exercise program. At the 6-month follow-up, both groups receiving the active management education had small but statistically significant reductions in disability and pain, and improved quality of life and mental quality of life scores. Scores in the education and exercise group at the 6-month follow-up were consistently better than the education-alone group, but the differences were not significant.

III Udermann and colleagues[295] completed a prospective trial of the effect of an educational booklet on a sample of patients with chronic low back pain (mean duration of 10.4 years). Patients were given educational literature on how to manage their back pain and completed a 1-week follow-up test on content and beliefs. At 9 and 18 months, there were statistically significant reductions in pain and frequency of low back pain episodes. Due to the study design, it is impossible to conclude that the observed effects were a result of the intervention; however, given the chronic nature of the patient population, it is less likely that results were due to natural history of the disorder.

Behavioral education, also known as cognitive behavioral theory, encompasses many aspects of patient education and counseling for patients with low back pain,[37] including:

- Activity pacing
- Attention diversion
- Cognitive restructuring
- Goal setting
- Graded exposure
- Motivational enhancement therapy
- Maintenance strategies
- Problem-solving strategies

I Several aspects of behavioral education and counseling are utilized in physical therapy practice.[259] Henschke et al,[151] in a recent Cochrane review, concluded there is moderate-quality evidence that operant therapy and behavioral therapy are more effective than waiting-list or usual care for short-term pain relief in patients with chronic low back pain, but no specific type of behavioral therapy is superior to another. In the intermediate to long term, there is no established difference between behavioral therapy and group exercise for management of pain or depressive symptoms in patients with chronic low back pain.

II Godges et al[127] completed a controlled trial specifically looking at the treatment of 36 patients with occupational-related acute low back pain with elevated fear-avoidance beliefs. All subjects received standard physical therapy, including strengthening and ergonomic exercise, with half of the workers additionally receiving ongoing education and counseling emphasizing the positive natural history of low back pain and that activity helps to decrease the duration of complaints. Results demonstrated that all workers in the education group returned to work within 45 days, compared to the control group, in which one-third of workers did not return to work at the 45-day mark. This study provides further evidence for the effectiveness of education and counseling for patients with low back pain with elevated fear-avoidance beliefs.

Another patient education and counseling model that has been presented in the literature is based on the philosophy of helping a patient to understand his/her symptoms. In this patient education model, there is a distinction between an anatomy lecture (on spinal structures) and the neurophysiologic processes involved in the perception of back pain.

III Moseley et al[221] assessed the efficacy of pain education against traditional back anatomy and physiology education. Subjects (n = 58) were randomized to treatment groups and assessed 15 days postintervention. At follow-up, the pain physiology group demonstrated statistically significant improvements in disability, pain catastrophization, pain beliefs, straight leg raise, and forward bending as compared to controls. Similar results were demonstrated by Moseley[220] in a study with shorter follow-up immediately following education interventions. Changes in physical function as assessed by the straight leg raise and forward bending were found to be highly correlated to changes in pain beliefs.

B Clinicians should not utilize patient education and counseling strategies that either directly or indirectly increase the perceived threat or fear associated with low back pain, such as education and counseling strategies that (1) promote extended bed-rest or (2) provide in-depth, pathoanatomical explanations for the specific cause of the patient's low back pain. Patient education and counseling strategies for patients with low back pain should emphasize (1) the promotion of the understanding of the anatomical/structural strength inherent in the human spine, (2) the neuroscience that explains pain perception, (3) the overall favorable prognosis of low back pain, (4) the use of active pain coping strategies that decrease fear and catastrophizing, (5) the early resumption of normal or vocational activities,

even when still experiencing pain, and (6) the importance of improvement in activity levels, not just pain relief.

PROGRESSIVE ENDURANCE EXERCISE AND FITNESS ACTIVITIES

I Presently, most national guidelines for patients with chronic low back pain endorse progressive aerobic exercise with moderate to high levels of evidence.[5,20,46,56,265] High-intensity exercise has also been demonstrated to have a positive effect on patients with chronic low back pain.[47,68,225,246-248,275,277] The samples of these studies included patients with long-term duration of symptoms that were primarily confined to the lumbopelvic region without generalized pain complaints.

Patients with low back pain and related generalized pain are believed to have increased neural sensitivity to afferent stimuli, including proprioception and movement. This sensitizing process has been termed *central sensitization*.[44,229,320] Along with underlying psychosocial factors, deficits in aerobic fitness,[91,162,274,299,322] and tissue deconditioning, this sensitizing process is believed to impact a person's functional status and pain perception. Aerobic fitness has been hypothesized to be an important component of reducing pain and improving/maintaining function of these patients.

I Findings in patients with generalized pain complaints have demonstrated altered central pain processing, supporting that these patients should be managed at lower-intensity levels of training.[228,229] Endurance exercise has been demonstrated to have a positive effect on global well-being (standardized mean difference [SMD], 0.44; 95% CI: 0.13, 0.75), physical functioning (SMD, 0.68; 95% CI: 0.41, 0.95), and pain (SMD, 0.94; 95% CI: −0.15, 2.03) associated with fibromyalgia syndrome.[40] Excessively elevated levels of exercise intensity may be responsible for increased symptom complaints due to increases in immune activation with release of proinflammatory cytokines,[208] blunted increases in muscular vascularity leading to widespread muscular ischemia,[93] and inefficiencies in the endogenous opioid and adrenergic pain-inhibitory mechanism.[281]

A Clinicians should consider (1) moderate- to high-intensity exercise for patients with chronic low back pain without generalized pain, and (2) incorporating progressive, low-intensity, submaximal fitness and endurance activities into the pain management and health promotion strategies for patients with chronic low back pain with generalized pain.

RECOMMENDED LOW BACK PAIN IMPAIRMENT/FUNCTION-BASED CLASSIFICATION CRITERIA WITH RECOMMENDED INTERVENTIONS*

Patients with low back pain often fit more than 1 impairment/function-based category, and the most relevant impairments of body function, primary intervention strategy, and the associated impairment/function-based category(ies) are expected to change during the patient's episode of care.

ICF-Based Category (With ICD-10 Associations)	Symptoms	Impairments of Body Function	Primary Intervention Strategies
***Acute* Low Back Pain with Mobility Deficits** Lumbosacral segmental/somatic dysfunction	• Acute low back, buttock, or thigh pain (duration 1 month or less) • Unilateral pain • Onset of symptoms is often linked to a recent unguarded/awkward movement or position	• Lumbar range of motion limitations • Restricted lower thoracic and lumbar segmental mobility • Low back and low back–related lower extremity symptoms are reproduced with provocation of the involved lower thoracic, lumbar, or sacroiliac segments	• Manual therapy procedures (thrust manipulation and other nonthrust mobilization techniques) to diminish pain and improve segmental spinal or lumbopelvic motion • Therapeutic exercises to improve or maintain spinal mobility • Patient education that encourages the patient to return to or pursue an active lifestyle
***Subacute* Low Back Pain with Mobility Deficits** Lumbosacral segmental/somatic dysfunction	• Subacute, unilateral, low back, buttock, or thigh pain • May report sensation of back stiffness	• Symptoms reproduced with *end-range* spinal motions • Symptoms reproduced with provocation of the involved lower thoracic, lumbar, or sacroiliac segments	• Manual therapy procedures to improve segmental spinal, lumbopelvic, and hip mobility • Therapeutic exercises to improve or maintain spinal and hip mobility

(continued)

ICF-Based Category (With ICD-10 Associations)	Symptoms	Impairments of Body Function	Primary Intervention Strategies
***Subacute* Low Back Pain with Mobility Deficits** Lumbosacral segmental/somatic dysfunction (continued)		• Presence of 1 or more of the following: - Restricted thoracic range of motion and associated segmental mobility - Restricted lumbar range of motion and associated segmental mobility - Restricted lumbopelvic or hip range of motion and associated accessory mobility	• Focus on preventing recurring low back pain episodes through the use of (1) therapeutic exercises that address coexisting coordination impairments, strength deficits, and endurance deficits, and (2) education that encourages the patient to pursue or maintain an active lifestyle
***Acute* Low Back Pain with Movement Coordination Impairments** Spinal instabilities	• Acute exacerbation of recurring low back pain that is commonly associated with referred lower extremity pain • Symptoms often include numerous episodes of low back and/or low back–related lower extremity pain in recent years	• Low back and/or low back–related lower extremity pain at rest or produced with *initial to mid-range* spinal movements • Low back and/or low back–related lower extremity pain reproduced with provocation of the involved lumbar segment(s) • Movement coordination impairments of the lumbopelvic region with low back flexion and extension movements	• Neuromuscular re-education to promote dynamic (muscular) stability to maintain the involved lumbosacral structures in less symptomatic, mid-range positions • Consider the use of temporary external devices to provide passive restraint to maintain the involved lumbosacral structures in less symptomatic, mid-range positions • Self-care/home management training pertaining to (1) postures and motions that maintain the involved spinal structures in neutral, symptom-alleviating positions, and (2) recommendations to pursue or maintain an active lifestyle
***Subacute* Low Back Pain with Movement Coordination Impairments** Spinal instabilities	• Subacute, recurring low back pain that is commonly associated with referred lower extremity pain • Symptoms often include numerous episodes of low back and/or low back–related lower extremity pain in recent years	• Lumbosacral pain with *mid-range* motions that *worsen with end-range* movements or positions • Low back and low back–related lower extremity pain reproduced with provocation of the involved lumbar segment(s) • Lumbar hypermobility with segmental mobility assessment may be present • Mobility deficits of the thorax and/or lumbopelvic/hip regions • Diminished trunk or pelvic-region muscle strength and endurance • Movement coordination impairments while performing self-care/home management activities	• Neuromuscular re-education to provide dynamic (muscular) stability to maintain the involved lumbosacral structures in less symptomatic, mid-range positions during *self–care*-related functional activities • Manual therapy procedures and therapeutic exercises to address identified thoracic spine, ribs, lumbopelvic, or hip mobility deficits • Therapeutic exercises to address trunk and pelvic-region muscle strength and endurance deficits • Self-care/home management training in maintaining the involved structures in mid-range, less symptom-producing positions • Initiate community/work reintegration training in pain management strategies while returning to community/work activities

(continued)

ICF-Based Category (With ICD-10 Associations)	Symptoms	Impairments of Body Function	Primary Intervention Strategies
***Chronic* Low Back Pain with Movement Coordination Impairments** Spinal instabilities	• Chronic, recurring low back pain and associated (referred) lower extremity pain	Presence of 1 or more of the following: • Low back and/or low back–related lower extremity pain that *worsens with sustained end-range* movements or positions • Lumbar hypermobility with segmental motion assessment • Mobility deficits of the thorax and lumbopelvic/hip regions • Diminished trunk or pelvic-region muscle strength and endurance • Movement coordination impairments while performing community/work-related recreational or occupational activities	• Neuromuscular re-education to provide dynamic (muscular) stability to maintain the involved lumbosacral structures in less symptomatic, mid-range positions during *household, occupational, or recreational* activities • Manual therapy procedures and therapeutic exercises to address identified thoracic spine, ribs, lumbopelvic, or hip mobility deficits • Therapeutic (strengthening) exercises to address trunk and pelvic-region muscle strength and endurance deficits • Community/work reintegration training in pain management strategies while returning to community/work activities
***Acute* Low Back Pain with Related (Referred) Lower Extremity Pain** Flatback syndrome Lumbago due to displacement of intervertebral disc	• Acute low back pain that is commonly associated with referred buttock, thigh, or leg pain • Symptoms are often worsened with flexion activities and sitting	• Low back and lower extremity pain that can be centralized and diminished with specific postures and/or repeated movements • Reduced lumbar lordosis • Limited lumbar extension mobility • Lateral trunk shift may be present • Clinical findings consistent with **subacute** or **chronic low back pain with movement coordination impairments** classification criteria	• Therapeutic exercises, manual therapy, or traction procedures that promote centralization and improve lumbar extension mobility • Patient education in positions that promote centralization • Progress to interventions consistent with the Subacute or Chronic Low Back Pain with Movement Coordination Impairments intervention strategies
***Acute* Low Back Pain with Radiating Pain** Lumbago with sciatica	• Acute low back pain with associated radiating (narrow band of lancinating) pain in the involved lower extremity • Lower extremity paresthesias, numbness, and weakness may be reported	• Lower extremity radicular symptoms that are present at rest or produced with *initial to mid-range* spinal mobility, lower-limb tension tests/straight leg raising, and/or slump tests • Signs of nerve root involvement may be present It is common for the symptoms and impairments of body function in patients who have **acute low back pain with radiating pain** to also be present in patients who have **acute low back pain with related (referred) lower extremity pain**	• Patient education in positions that reduce strain or compression to the involved nerve root(s) or nerves • Manual or mechanical traction • Manual therapy to mobilize the articulations and soft tissues adjacent to the involved nerve root(s) or nerves that exhibit mobility deficits • Nerve mobility exercises in the pain-free, non–symptom-producing ranges to improve the mobility of central (dural) and peripheral neural elements
***Subacute* Low Back Pain with Radiating Pain** Lumbago with sciatica	• Subacute, recurring, mid-back and/or low back pain with associated radiating pain in the involved lower extremity • Lower extremity paresthesias, numbness, and weakness may be reported	• Mid-back, low back, and back-related radiating pain or paresthesia that are reproduced with *mid-range* and worsen with *end range*: 1. Lower limb tension testing/straight leg raising tests, and/or... 2. Slump tests • May have lower extremity sensory, strength, or reflex deficits associated with the involved nerve(s)	• Manual therapy to mobilize the articulations and soft tissues adjacent to the involved nerve root(s) or nerves that exhibit mobility deficits • Manual or mechanical traction • Nerve mobility and slump exercises in the mid- to end ranges to improve the mobility of central (dural) and peripheral neural elements

(continued)

ICF-Based Category (With ICD-10 Associations)	Symptoms	Impairments of Body Function	Primary Intervention Strategies
***Chronic* Low Back Pain with Radiating Pain** Lumbago with sciatica	• Chronic, recurring, mid- and/or low back pain with associated radiating pain in the involved lower extremity • Lower extremity paresthesias, numbness, and weakness may be reported	• Mid-back, low back, or lower extremity pain or paresthesias that are reproduced with *sustained end-range* lower-limb tension tests and/or slump tests • Signs of nerve root involvement may be present	• Manual therapy and therapeutic exercises to address thoracolumbar and lower-quarter nerve mobility deficits • Patient education pain management strategies
***Acute* or *Subacute* Low Back Pain with Related Cognitive or Affective Tendencies** Low back pain Disorder of central nervous system, specified as central nervous system sensitivity to pain	• Acute or subacute low back and/or low back–related lower extremity pain	One or more of the following: • Two positive responses to Primary Care Evaluation of Mental Disorders screen and affect consistent with an individual who is depressed • High scores on the Fear-Avoidance Beliefs Questionnaire and behavioral processes consistent with an individual who has excessive anxiety or fear • High scores on the Pain Catastrophizing Scale and cognitive process consistent with rumination, pessimism, or helplessness	• Patient education and counseling to address specific classification exhibited by the patient (ie, depression, fear-avoidance, pain catastrophizing)
***Chronic* Low Back Pain with Related Generalized Pain** Low back pain Disorder of central nervous system Persistent somatoform pain disorder	• Low back and/or low back–related lower extremity pain with symptom duration for longer than 3 months • Generalized pain not consistent with other impairment-based classification criteria presented in these clinical guidelines	One or more of the following: • Two positive responses to Primary Care Evaluation of Mental Disorders screen and affect consistent with an individual who is depressed • High scores on the Fear-Avoidance Beliefs Questionnaire and behavioral processes consistent with an individual who has excessive anxiety and fear • High scores on the Pain Catastrophizing Scale and cognitive process consistent with rumination, pessimism, or helplessness	• Patient education and counseling to address specific classification exhibited by the patient (ie, depression, fear-avoidance, pain catastrophizing) • Low-intensity, prolonged (aerobic) exercise activities

**Recommendation for classification criteria based on moderate evidence.*

CLINICAL GUIDELINES

Summary of Recommendations

B RISK FACTORS

Current literature does not support a definitive cause for initial episodes of low back pain. Risk factors are multifactorial, population specific, and only weakly associated with the development of low back pain.

E CLINICAL COURSE

The clinical course of low back pain can be described as acute, subacute, recurrent, or chronic. Given the high prevalence of recurrent and chronic low back pain and the associated costs, clinicians should place high priority on interventions that prevent (1) recurrences and (2) the transition to chronic low back pain.

B DIAGNOSIS/CLASSIFICATION

Low back pain, without symptoms or signs of serious medical or psychological conditions, associated with clinical findings of (1) mobility impairment in the thoracic, lumbar, or sacroiliac regions, (2) referred or radiating pain into a lower extremity, and (3) generalized pain, is useful for classifying a patient with low back pain into the following International Statistical Classification of Diseases and Related Health Problems (ICD) categories: low back pain, lumbago, lumbosacral segmental/somatic dysfunction, low back strain, spinal instabilities, flatback syndrome, lumbago due to displacement of intervertebral disc, lumbago with sciatica, and the associated International Classification of Functioning, Disability, and Health (ICF) impairment-based category of low back pain (b28013 Pain in back, b28018 Pain in body part, specified as pain in buttock, groin, and thigh) and the following, corresponding impairments of body function:

- Acute or subacute low back pain with mobility deficits (b7101 Mobility of several joints)
- Acute, subacute, or chronic low back pain with movement coordination impairments (b7601 Control of complex voluntary movements)
- Acute low back pain with related (referred) lower extremity pain (b28015 Pain in lower limb)
- Acute, subacute, or chronic low back pain with radiating pain (b2804 Radiating pain in a segment or region)
- Acute or subacute low back pain with related cognitive or affective tendencies (b2703 Sensitivity to a noxious stimulus, b1522 Range of emotion, b1608 Thought functions, specified as the tendency to elaborate physical symptoms for cognitive/ideational reasons, b1528 Emotional functions, specified as the tendency to elaborate physical symptoms for emotional/affective reasons)
- Chronic low back pain with related generalized pain (b2800 Generalized pain, b1520 Appropriateness of emotion, b1602 Content of thought)

The ICD diagnosis of *lumbosacral segmental/somatic dysfunction* and the associated ICF diagnosis of **acute low back pain with mobility deficits** are made with a reasonable level of certainty when the patient presents with the following clinical findings:

- Acute low back, buttock, or thigh pain (duration of 1 month or less)
- Restricted lumbar range of motion and segmental mobility
- Low back and low back–related lower extremity symptoms reproduced with provocation of the involved lower thoracic, lumbar, or sacroiliac segments

The ICD diagnosis of *lumbosacral segmental/somatic dysfunction* and the associated ICF diagnosis of **subacute low back pain with mobility deficits** are made with a reasonable level of certainty when the patient presents with the following clinical findings:

- Subacute, unilateral low back, buttock, or thigh pain
- Symptoms reproduced with *end-range* spinal motions and provocation of the involved lower thoracic, lumbar, or sacroiliac segments
- Presence of thoracic, lumbar, pelvic girdle, or hip active, segmental, or accessory mobility deficits

The ICD diagnosis of *spinal instabilities* and the associated ICF diagnosis of **acute low back pain with movement coordination impairments** are made with a reasonable level of certainty when the patient presents with the following clinical findings:

- Acute exacerbation of recurring low back pain and associated (referred) lower extremity pain
- Symptoms produced with *initial* to *mid-range* spinal movements and provocation of the involved lumbar segment(s)
- Movement coordination impairments of the lumbopelvic region with low back flexion and extension movements

The ICD diagnosis of *spinal instabilities* and the associated ICF diagnosis of **subacute low back pain with movement coordination impairments** are made with a reasonable level of certainty when the patient presents with the following clinical findings:

- Subacute exacerbation of recurring low back pain and associated (referred) lower extremity pain
- Symptoms produced with *mid-range* motions that *worsen with end-range* movements or positions and provocation of the involved lumbar segment(s)
- Lumbar segmental hypermobility may be present
- Mobility deficits of the thorax and pelvic/hip regions may be present
- Diminished trunk or pelvic-region muscle strength and endurance
- Movement coordination impairments while performing self-care/home management activities

The ICD diagnosis of *spinal instabilities* and the associated ICF diag-

nosis of **chronic low back pain with movement coordination impairments** are made with a reasonable level of certainty when the patient presents with the following clinical findings:

- Chronic, recurring low back pain and associated (referred) lower extremity pain
- Presence of 1 or more of the following:
  - Low back and/or low back–related lower extremity pain that *worsens with sustained end-range* movements or positions
  - Lumbar hypermobility with segmental motion assessment
  - Mobility deficits of the thorax and lumbopelvic/hip regions
  - Diminished trunk or pelvic-region muscle strength and endurance
  - Movement coordination impairments while performing community/work-related recreational or occupational activities

The ICD diagnosis of *flatback syndrome*, or *lumbago due to displacement of intervertebral disc*, and the associated ICF diagnosis of **acute low back pain with related (referred) lower extremity pain** are made with a reasonable level of certainty when the patient presents with the following clinical findings:

- Low back pain, commonly associated with referred buttock, thigh, or leg pain, that worsens with flexion activities and sitting
- Low back and lower extremity pain that can be centralized and diminished with positioning, manual procedures, and/or repeated movements
- Lateral trunk shift, reduced lumbar lordosis, limited lumbar extension mobility, and clinical findings associated with the subacute or chronic low back pain with movement coordination impairments category are commonly present

The ICD diagnosis of *lumbago with sciatica* and the associated ICF diagnosis of **acute low back pain with radiating pain** are made with a reasonable level of certainty when the patient presents with the following clinical findings:

- Acute low back pain with associated radiating pain in the involved lower extremity
- Lower extremity paresthesias, numbness, and weakness may be reported
- Symptoms are reproduced or aggravated with *initial to mid-range* spinal mobility, lower-limb tension/straight leg raising, and/or slump tests
- Signs of nerve root involvement (sensory, strength, or reflex deficits) may be present

It is common for the symptoms and impairments of body function in patients who have **acute low back pain with radiating pain** to also be present in patients who have **acute low back pain with related (referred) lower extremity pain**.

The ICD diagnosis of *lumbago with sciatica* and the associated ICF diagnosis of **subacute low back pain with radiating pain** are made with a reasonable level of certainty when the patient presents with the following clinical findings:

- Subacute, recurring mid-back and/or low back pain with associated radiating pain and potential sensory, strength, or reflex deficits in the involved lower extremity
- Symptoms are reproduced or aggravated with *mid-range* and *worsen with end-range* lower-limb tension/straight leg raising and/or slump tests

The ICD diagnosis of *lumbago with sciatica* and the associated ICF diagnosis of **chronic low back pain with radiating pain** are made with a reasonable level of certainty when the patient presents with the following clinical findings:

- Chronic, recurring mid-back and/or low back pain with associated radiating pain and potential sensory, strength, or reflex deficits in the involved lower extremity
- Symptoms are reproduced or aggravated with *sustained end-range* lower-limb tension/straight leg raising and/or slump tests

The ICD diagnosis of *low back pain/low back strain/lumbago* and the associated ICF diagnosis of **acute or subacute low back pain with related cognitive or affective tendencies** are made with a reasonable level of certainty when the patient presents with the following clinical findings:

- Acute or subacute low back and/or low back–related lower extremity pain
- Presence of 1 or more of the following:
  - Two positive responses to Primary Care Evaluation of Mental Disorders for depressive symptoms
  - High scores on the Fear-Avoidance Beliefs Questionnaire and behavior consistent with an individual who has excessive anxiety or fear
  - High scores on the Pain Catastrophizing Scale and cognitive processes consistent with individuals with high helplessness, rumination, or pessimism about low back pain

The ICD diagnosis of *low back pain/low back strain/lumbago* and the associated ICF diagnosis of **chronic low back pain with related generalized pain** are made with a reasonable level of certainty when the patient presents with the following clinical findings:

- Low back and/or low back–related lower extremity pain with symptom duration for longer than 3 months
- Generalized pain not consistent with other impairment-based classification criteria presented in these clinical guidelines
- Presence of depression, fear-avoidance beliefs, and/or pain catastrophizing

A DIFFERENTIAL DIAGNOSIS

Clinicians should consider diagnostic classifications associated with serious medical conditions or psychosocial factors and initiate referral to the appropriate medical practitioner when (1) the patient's clinical findings are suggestive of serious medical or psychological pathology, (2) the reported activity limitations or impairments of body function and structure are not consistent with those presented in the diagnosis/classification section of these guidelines, or (3) the patient's symptoms are not resolving with interventions aimed at normalization of the patient's impairments of body function.

A **EXAMINATION – OUTCOME MEASURES**

Clinicians should use validated self-report questionnaires, such as the Oswestry Disability Index and the Roland-Morris Disability Questionnaire. These tools are useful for identifying a patient's baseline status relative to pain, function, and disability and for monitoring a change in a patient's status throughout the course of treatment.

F **EXAMINATION – ACTIVITY LIMITATION AND PARTICIPATION RESTRICTION MEASURES**

Clinicians should routinely assess activity limitation and participation restriction through validated performance-based measures. Changes in the patient's level of activity limitation and participation restriction should be monitored with these same measures over the course of treatment.

A **INTERVENTIONS – MANUAL THERAPY**

Clinicians should consider utilizing thrust manipulative procedures to reduce pain and disability in patients with mobility deficits and acute low back and back-related buttock or thigh pain. Thrust manipulative and nonthrust mobilization procedures can also be used to improve spine and hip mobility and reduce pain and disability in patients with subacute and chronic low back and back-related lower extremity pain.

A **INTERVENTIONS – TRUNK COORDINATION, STRENGTHENING, AND ENDURANCE EXERCISES**

Clinicians should consider utilizing trunk coordination, strengthening, and endurance exercises to reduce low back pain and disability in patients with subacute and chronic low back pain with movement coordination impairments and in patients post–lumbar microdiscectomy.

A **INTERVENTIONS – CENTRALIZATION AND DIRECTIONAL PREFERENCE EXERCISES AND PROCEDURES**

Clinicians should consider utilizing repeated movements, exercises, or procedures to promote centralization to reduce symptoms in patients with acute low back pain with related (referred) lower extremity pain. Clinicians should consider using repeated exercises in a specific direction determined by treatment response to improve mobility and reduce symptoms in patients with acute, subacute, or chronic low back pain with mobility deficits.

C **INTERVENTIONS – FLEXION EXERCISES**

Clinicians can consider flexion exercises, combined with other interventions such as manual therapy, strengthening exercises, nerve mobilization procedures, and progressive walking, for reducing pain and disability in older patients with chronic low back pain with radiating pain.

C **INTERVENTIONS – LOWER-QUARTER NERVE MOBILIZATION PROCEDURES**

Clinicians should consider utilizing lower-quarter nerve mobilization procedures to reduce pain and disability in patients with subacute and chronic low back pain and radiating pain.

D **INTERVENTIONS – TRACTION**

There is conflicting evidence for the efficacy of intermittent lumbar traction for patients with low back pain. There is preliminary evidence that a subgroup of patients with signs of nerve root compression along with peripheralization of symptoms or a positive crossed straight leg raise will benefit from intermittent lumbar traction in the prone position. There is moderate evidence that clinicians should not utilize intermittent or static lumbar traction for reducing symptoms in patients with acute or subacute, nonradicular low back pain or in patients with chronic low back pain.

B **INTERVENTIONS – PATIENT EDUCATION AND COUNSELING**

Clinicians should not utilize patient education and counseling strategies that either directly or indirectly increase the perceived threat or fear associated with low back pain, such as education and counseling strategies that (1) promote extended bed-rest or (2) provide in-depth, pathoanatomical explanations for the specific cause of the patient's low back pain. Patient education and counseling strategies for patients with low back pain should emphasize (1) the promotion of the understanding of the anatomical/structural strength inherent in the human spine, (2) the neuroscience that explains pain perception, (3) the overall favorable prognosis of low back pain, (4) the use of active pain coping strategies that decrease fear and catastrophizing, (5) the early resumption of normal or vocational activities, even when still experiencing pain, and (6) the importance of improvement in activity levels, not just pain relief.

A **INTERVENTIONS – PROGRESSIVE ENDURANCE EXERCISE AND FITNESS ACTIVITIES**

Clinicians should consider (1) moderate- to high-intensity exercise for patients with chronic low back pain without generalized pain, and (2) incorporating progressive, low-intensity, submaximal fitness and endurance activities into the pain management and health promotion strategies for patients with chronic low back pain with generalized pain.

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Low back pain and sciatica in over 16s: assessment and management

NICE guideline
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Your responsibility

The recommendations in this guideline represent the view of NICE, arrived at after careful consideration of the evidence available. When exercising their judgement, professionals and practitioners are expected to take this guideline fully into account, alongside the individual needs, preferences and values of their patients or the people using their service. It is not mandatory to apply the recommendations, and the guideline does not override the responsibility to make decisions appropriate to the circumstances of the individual, in consultation with them and their families and carers or guardian.

Local commissioners and providers of healthcare have a responsibility to enable the guideline to be applied when individual professionals and people using services wish to use it. They should do so in the context of local and national priorities for funding and developing services, and in light of their duties to have due regard to the need to eliminate unlawful discrimination, to advance equality of opportunity and to reduce health inequalities. Nothing in this guideline should be interpreted in a way that would be inconsistent with complying with those duties.

Commissioners and providers have a responsibility to promote an environmentally sustainable health and care system and should assess and reduce the environmental impact of implementing NICE recommendations wherever possible.

Contents

This guideline replaces CG88.

This guideline is the basis of QS155.

Overview

This guideline covers assessing and managing low back pain and sciatica in people aged 16 and over. It outlines physical, psychological, pharmacological and surgical treatments to help people manage their low back pain and sciatica in their daily life. The guideline aims to improve people's quality of life by promoting the most effective forms of care for low back pain and sciatica.

Who is it for?

- Healthcare professionals
- Commissioners and providers of healthcare
- People with low back pain or sciatica, and their families and carers

Recommendations

People have the right to be involved in discussions and make informed decisions about their care, as described in your care.

Making decisions using NICE guidelines explains how we use words to show the strength (or certainty) of our recommendations, and has information about prescribing medicines (including off-label use), professional guidelines, standards and laws (including on consent and mental capacity), and safeguarding.

1.1 Assessment of low back pain and sciatica

Alternative diagnoses

1.1.1 Think about alternative diagnoses when examining or reviewing people with low back pain, particularly if they develop new or changed symptoms. Exclude specific causes of low back pain, for example, cancer, infection, trauma or inflammatory disease such as spondyloarthritis. If serious underlying pathology is suspected, refer to relevant NICE guidance on:

- Metastatic spinal cord compression in adults
- Spinal injury
- Spondyloarthritis
- Suspected cancer

Risk assessment and risk stratification tools

1.1.2 Consider using risk stratification (for example, the STarT Back risk assessment tool) at first point of contact with a healthcare professional for each new episode of low back pain with or without sciatica to inform shared decision-making about stratified management.

1.1.3 Based on risk stratification, consider:

- simpler and less intensive support for people with low back pain with or without sciatica likely to improve quickly and have a good outcome (for example, reassurance, advice to keep active and guidance on self-management)

- more complex and intensive support for people with low back pain with or without sciatica at higher risk of a poor outcome (for example, exercise programmes with or without manual therapy or using a psychological approach).

Imaging

1.1.4 Do not routinely offer imaging in a non-specialist setting for people with low back pain with or without sciatica.

1.1.5 Explain to people with low back pain with or without sciatica that if they are being referred for specialist opinion, they may not need imaging.

1.1.6 Consider imaging in specialist settings of care (for example, a musculoskeletal interface clinic or hospital) for people with low back pain with or without sciatica only if the result is likely to change management.

1.2 Non-invasive treatments for low back pain and sciatica

Non-pharmacological interventions

Self-management

1.2.1 Provide people with advice and information, tailored to their needs and capabilities, to help them self-manage their low back pain with or without sciatica, at all steps of the treatment pathway. Include:

- information on the nature of low back pain and sciatica
- encouragement to continue with normal activities.

Exercise

1.2.2 Consider a group exercise programme (biomechanical, aerobic, mind–body or a combination of approaches) within the NHS for people with a specific episode or flare-up of low back pain with or without sciatica. Take people's specific needs, preferences and capabilities into account when choosing the type of exercise.

Orthotics

1.2.3 Do not offer belts or corsets for managing low back pain with or without sciatica.

1.2.4 Do not offer foot orthotics for managing low back pain with or without sciatica.

1.2.5 Do not offer rocker sole shoes for managing low back pain with or without sciatica.

Manual therapies

1.2.6 Do not offer traction for managing low back pain with or without sciatica.

1.2.7 Consider manual therapy (spinal manipulation, mobilisation or soft tissue techniques such as massage) for managing low back pain with or without sciatica, but only as part of a treatment package including exercise, with or without psychological therapy.

Acupuncture

1.2.8 Do not offer acupuncture for managing low back pain with or without sciatica.

Electrotherapies

1.2.9 Do not offer ultrasound for managing low back pain with or without sciatica.

1.2.10 Do not offer percutaneous electrical nerve simulation (PENS) for managing low back pain with or without sciatica.

1.2.11 Do not offer transcutaneous electrical nerve simulation (TENS) for managing low back pain with or without sciatica.

1.2.12 Do not offer interferential therapy for managing low back pain with or without sciatica.

Psychological therapy

1.2.13 Consider psychological therapies using a cognitive behavioural approach for managing low back pain with or without sciatica but only as part of a treatment package including exercise, with or without manual therapy (spinal manipulation, mobilisation or soft tissue techniques such as massage).

Combined physical and psychological programmes

1.2.14 Consider a combined physical and psychological programme, incorporating a cognitive behavioural approach (preferably in a group context that takes into account a person's specific needs and capabilities), for people with persistent low back pain or sciatica:

- when they have significant psychosocial obstacles to recovery (for example, avoiding normal activities based on inappropriate beliefs about their condition) **or**
- when previous treatments have not been effective.

Return-to-work programmes

1.2.15 Promote and facilitate return to work or normal activities of daily living for people with low back pain with or without sciatica.

Pharmacological interventions

1.2.16 For recommendations on pharmacological management of sciatica, see NICE's guideline on neuropathic pain in adults.

1.2.17 Consider oral non-steroidal anti-inflammatory drugs (NSAIDs) for managing low back pain, taking into account potential differences in gastrointestinal, liver and cardio-renal toxicity, and the person's risk factors, including age.

1.2.18 When prescribing oral NSAIDs for low back pain, think about appropriate clinical assessment, ongoing monitoring of risk factors, and the use of gastroprotective treatment.

1.2.19 Prescribe oral NSAIDs for low back pain at the lowest effective dose for the shortest possible period of time.

1.2.20 Consider weak opioids (with or without paracetamol) for managing acute low back pain only if an NSAID is contraindicated, not tolerated or has been ineffective.

1.2.21 Do not offer paracetamol alone for managing low back pain.

1.2.22 Do not routinely offer opioids for managing acute low back pain (see recommendation 1.2.20).

1.2.23 Do not offer opioids for managing chronic low back pain.

1.2.24 Do not offer selective serotonin reuptake inhibitors, serotonin–norepinephrine reuptake inhibitors or tricyclic antidepressants for managing low back pain.

1.2.25 Do not offer anticonvulsants for managing low back pain.

1.3 Invasive treatments for low back pain and sciatica

Non-surgical interventions

Spinal injections

1.3.1 Do not offer spinal injections for managing low back pain.

Radiofrequency denervation

1.3.2 Consider referral for assessment for radiofrequency denervation for people with chronic low back pain when:

- non-surgical treatment has not worked for them **and**
- the main source of pain is thought to come from structures supplied by the medial branch nerve **and**
- they have moderate or severe levels of localised back pain (rated as 5 or more on a visual analogue scale, or equivalent) at the time of referral.

1.3.3 Only perform radiofrequency denervation in people with chronic low back pain after a positive response to a diagnostic medial branch block.

1.3.4 Do not offer imaging for people with low back pain with specific facet join pain as a prerequisite for radiofrequency denervation.

Epidurals

1.3.5 Consider epidural injections of local anaesthetic and steroid in people with acute and severe sciatica.

1.3.6 Do not use epidural injections for neurogenic claudication in people who have central spinal canal stenosis.

Surgical interventions

Surgery and prognostic factors

1.3.7 Do not allow a person's BMI, smoking status or psychological distress to influence the decision to refer them for a surgical opinion for sciatica.

Spinal decompression

1.3.8 Consider spinal decompression for people with sciatica when non-surgical treatment has not improved pain or function and their radiological findings are consistent with sciatic symptoms.

Spinal fusion

1.3.9 Do not offer spinal fusion for people with low back pain unless as part of a randomised controlled trial.

Disc replacement

1.3.10 Do not offer disc replacement in people with low back pain.

Putting this guideline into practice

NICE has produced tools and resources to help you put this guideline into practice.

Putting recommendations into practice can take time. How long may vary from guideline to guideline, and depends on how much change in practice or services is needed. Implementing change is most effective when aligned with local priorities.

Changes recommended for clinical practice that can be done quickly – like changes in prescribing practice – should be shared quickly. This is because healthcare professionals should use guidelines to guide their work – as is required by professional regulating bodies such as the General Medical and Nursing and Midwifery Councils.

Changes should be implemented as soon as possible, unless there is a good reason for not doing so (for example, if it would be better value for money if a package of recommendations were all implemented at once).

Different organisations may need different approaches to implementation, depending on their size and function. Sometimes individual practitioners may be able to respond to recommendations to improve their practice more quickly than large organisations.

Here are some pointers to help organisations put NICE guidelines into practice:

1. **Raise awareness** through routine communication channels, such as email or newsletters, regular meetings, internal staff briefings and other communications with all relevant partner organisations. Identify things staff can include in their own practice straight away.

2. **Identify a lead** with an interest in the topic to champion the guideline and motivate others to support its use and make service changes, and to find out any significant issues locally.

3. **Carry out a baseline assessment** against the recommendations to find out whether there are gaps in current service provision.

4. **Think about what data you need to measure improvement** and plan how you will collect it. You may want to work with other health and social care organisations and specialist groups to compare current practice with the recommendations. This may also help identify local issues that will slow or prevent implementation.

5. **Develop an action plan**, with the steps needed to put the guideline into practice, and make sure it is ready as soon as possible. Big, complex changes may take longer to implement, but some may be quick and easy to do. An action plan will help in both cases.

6. **For very big changes** include milestones and a business case, which will set out additional costs, savings and possible areas for disinvestment. A small project group could develop the action plan. The group might include the guideline champion, a senior organisational sponsor, staff involved in the associated services, finance and information professionals.

7. **Implement the action plan** with oversight from the lead and the project group. Big projects may also need project management support.

8. **Review and monitor** how well the guideline is being implemented through the project group. Share progress with those involved in making improvements, as well as relevant boards and local partners.

NICE provides a comprehensive programme of support and resources to maximise uptake and use of evidence and guidance. See our into practice pages for more information.

Also see Leng G, Moore V, Abraham S, editors (2014) Achieving high quality care – practical experience from NICE. Chichester: Wiley.

Context

Low back pain that is not associated with serious or potentially serious causes has been described in the literature as 'non-specific', 'mechanical', 'musculoskeletal' or 'simple' low back pain. For consistency, we have used the term 'low back pain' throughout this guideline. However, 'non-specific low back pain' was used when creating the review questions. Worldwide, low back pain causes more disability than any other condition. Episodes of back pain usually do not last long, with rapid improvements in pain and disability seen within a few weeks to a few months. Although most back pain episodes get better with initial primary care management, without the need for investigations or referral to specialist services, up to one-third of people say they have persistent back pain of at least moderate intensity a year after an acute episode needing care, and episodes of back pain often recur.

One of the greatest challenges with low back pain is identifying risk factors that may predict when a single back pain episode will become a long-term, persistent pain condition. When this happens, quality of life is often very low and healthcare resource use high.

Unlike the previous NICE guidance on the management of persistent low back pain between 6 weeks and 12 months, we have moved away from the traditional duration-based classification of low back pain (acute, sub-acute and chronic) and have looked at low back pain as a whole where risk of poor outcome at any time point is almost always more important than the duration of symptoms.

This guideline gives guidance on the assessment and management of both low back pain and sciatica from first presentation onwards in people aged 16 years and over.

We use 'sciatica' to describe leg pain secondary to lumbosacral nerve root pathology rather than the terms 'radicular pain' or 'radiculopathy', although they are more accurate. This is because 'sciatica' is a term that patients and clinicians understand, and it is widely used in the literature to describe neuropathic leg pain secondary to compressive spinal pathology.

This guideline does not cover the evaluation or care of people with sciatica with progressive neurological deficit or cauda equina syndrome. All clinicians involved in the management of sciatica should be aware of these potential neurological emergencies and know when to refer to an appropriate specialist.

We hope to address the inconsistent provision and implementation of the previous guidance and provide patients, carers and healthcare professionals with sensible, practical and evidence-based advice for managing this important and common problem.

More information

You can also see this guideline in the NICE pathway on low back pain and sciatica.

To find out what NICE has said on topics related to this guideline, see our web page on low back pain.

Recommendations for research

The guideline committee has made the following recommendations for research. The committee's full set of research recommendations is detailed in the full guideline.

1 Pharmacological therapies

What is the clinical and cost effectiveness of benzodiazepines for the acute management of low back pain?

Why this is important

Guidelines from many countries have said that muscle relaxants should be considered for short-term use in people with low back pain when the paraspinal muscles are in spasm. The evidence for this mainly comes from studies on medications that are not licensed for this use in the UK. The 2009 NICE guideline on low back pain recommends to consider prescribing diazepam as a muscle relaxant in this situation, but the evidence base to support this particular medicine is extremely small. Benzodiazepines are not without risk of harm, even for short-term use. Because of this, there is a need to find out if diazepam is clinically and cost effective in the management of acute low back pain.

2 Pharmacological therapies

What is the clinical and cost effectiveness of codeine with and without paracetamol for the acute management of low back pain?

Why this is important

Codeine, often together with paracetamol, is commonly prescribed in primary care to people presenting with acute low back pain. This often happens with people who cannot tolerate non-steroidal anti-inflammatory drugs (NSAIDs) or when a person has contraindications to these medications. Although there is evidence that opioids are not effective in chronic low back pain, there are relatively few studies that look at their use for acute low back pain (a problem commonly seen in primary care). Also, it is not known if using paracetamol and codeine together has a synergistic effect in the treatment of back pain.

3 Radiofrequency denervation

What is the clinical and cost effectiveness of radiofrequency denervation for chronic low back pain in the long term?

Why this is important

Radiofrequency denervation is a minimally invasive and percutaneous procedure performed under local anaesthesia or light intravenous sedation. Radiofrequency energy is delivered along an insulated needle in contact with the target nerves. This focused electrical energy heats and denatures the nerve. This may allow axons to regenerate with time, requiring the repetition of the radiofrequency procedure.

The length of pain relief after radiofrequency denervation is uncertain. Data from randomised controlled trials suggest relief is at least 6–12 months but no study has reported longer-term outcomes. Pain relief for more than 2 years would not be an unreasonable clinical expectation. The economic model presented in this guideline suggested that radiofrequency denervation is likely to be cost effective if pain relief is above 16 months.

If radiofrequency denervation is repeated, we do not know whether the outcomes and duration of these outcomes are similar to the initial treatment. If repeated radiofrequency denervation is to be offered, we need to be more certain that this intervention is both effective and cost effective.

4 Epidurals

What is the clinical and cost effectiveness of image-guided compared with non-image-guided epidural injections for people with acute sciatica?

Why this is important

Epidural injection of treatments, including corticosteroids, is commonly offered to people with sciatica. Epidural injection might improve symptoms, reduce disability and speed up return to normal activities. Several different procedures have been developed for epidural delivery of corticosteroids. Some practitioners inject through the caudal opening to the spinal canal in the sacrum (caudal epidural), but others inject through the foraminal space at the presumed level of nerve root irritation (transforaminal epidural).

Some people believe transforaminal epidurals might be most effective because they deliver corticosteroids directly to the region where the nerve root might be compromised. But because

transforaminal epidural injection needs imaging, usually within a specialist setting, this potentially limits treatment access and increases costs. Caudal epidural injection can be done without imaging, or with ultrasound guidance in a non-specialist setting. But it has been argued the treatment might not reach the affected nerve root, meaning this method might not be as effective as transforaminal injection.

Evidence that one method is clearly better than the other is currently lacking. Use of the 2 methods varies between healthcare providers, and people whose sciatica does not respond to caudal corticosteroid injection might go on to have image-guided epidural injection. This means people with sciatica might currently experience unnecessary symptoms at unnecessary cost to the NHS than they would if the most clinically and cost-effective way of delivering epidural corticosteroid injections was always used.

5 Spinal fusion

Should people with low back pain be offered spinal fusion as a surgical option?

Why this is important

An increasing number of procedures have been proposed for surgically managing low back pain. One of these procedures is surgical fixation with internal metalwork applied from the back, front, side, or any combination of the 3 routes. The cost of these operations has risen, and now that minimally invasive approaches are used, more of these operations are done with uncertain benefit.

As well as the cost, surgery can lead to complications – some studies report around a 20% complication rate in the short to medium term. There have been several studies (both randomised and cohort) looking at the clinical effectiveness of spinal fusion versus usual care, no surgery, different surgeries, and other treatments. Overall, the studies do not show a clear advantage of fusion but do show some modest benefit for some elements of pain, function and quality of life. The studies also show healthcare use was lower. It is not known what treatments should be tried before surgery is considered. The evidence from the studies was weak because of low numbers of patients, large crossover and in-case selection bias. This means there is a need for a large, multicentre randomised trial with sufficient power to answer these important questions.

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Clinical guidelines for low back pain: A critical review of consensus and inconsistencies across three major guidelines

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Clinical guidelines for low back pain: A critical review of consensus and inconsistencies across three major guidelines

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A B S T R A C T

Given the scale and cost of the low back pain problem, it is imperative that healthcare professionals involved in the care of people with low back pain have access to up-to-date, evidence-based information to assist them in treatment decision-making. Clinical guidelines exist to promote the consistent best practice, to reduce unwarranted variation and to reduce the use of low-value interventions in patient care. Recent decades have witnessed the publication of a number of such guidelines. In this narrative review, we consider three selected international inter-disciplinary guidelines for the management of low back pain. Guideline development methods, consistent recommendations and inconsistencies between these guidelines are critically discussed.

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Introduction

Low back pain (LBP) is the leading cause of disability worldwide. This is now as apparent in low-income countries as it is in the more affluent and developed countries across the globe. Disappointingly, despite a significant increase in back pain expenditure over the last decade, the levels of disability associated with back pain over the same period have remained virtually unchanged [1]. In addition, the healthcare resource and economic burden that back pain and related disability present remain the same. A recent survey of nearly 200,000 people across 43 countries showed that people with back pain are at least twice as likely to have one of five mental health conditions (depression, anxiety, stress, psychosis and sleep deprivation) when compared to those without back pain [2].

Given the scale of the problem, it is imperative that healthcare professionals involved in the care of people with LBP have access to up-to-date, evidence-based information to assist them in treatment decision-making. Over the last few decades, a myriad of treatment options for back pain and an ever expanding repository of clinical trial data and scientific publications have emerged. The results of this global research effort into the causes and treatment of back pain are often conflicting and of variable quality. This heterogeneity in the data and its sheer scale imply that for an individual clinician in the pursuit of best clinical practice, making sense of the literature can be difficult and bewildering.

To assimilate and formally evaluate this information, an increasing number of clinical practice guidelines (CPGs) have been developed by different countries. Since the publication of the first LBP CPG by the Quebec Task Force in 1987 [3], more than a dozen 'national' multidisciplinary LBP guidelines that were sponsored by professional societies, government agencies and healthcare payers within their parent countries have emerged [4]. Each of the LBP guidelines is created by an expert panel through consensus.

In this chapter, we compare three clinical guidelines for the management of LBP. We outline where they agree on what comprises best practice for LBP. We consider inconsistencies in recommendations between these guidelines and some of the possible reasons for these; we also discuss the challenges faced in implementing the recommendations of guidelines and consider controversies and future directions of clinical guidelines for LBP.

We have selected three major, recent, well-recognised, multidisciplinary back pain guidelines. The three guidelines are as follows:

2016 NICE Guideline on Low Back Pain and Sciatica NG59 – United Kingdom [5]
2015 Evidence-Informed Primary Care Management of Low Back Pain – Canada [6]
2007/2009/2017 Diagnosis and Treatment of Low Back Pain: A Joint Clinical Practice Guideline from the American College of Physicians and the American Pain Society – USA [8–10]

These three guidelines were chosen either because they were judged as high-quality guidelines in a recent systematic review of clinical guidelines for back pain [4] or because at the time of writing they represented the most up-to-date clinical guidelines available. We illustrate the differences and similarities between these clinical guidelines in terms of development and their recommendations as well as the challenges faced in guideline implementation.

What is a clinical practice guideline?

CPGs have been defined as ' … systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances' [11] and 'statements that include recommendations, intended to optimise patient care, that are informed by a systematic review of evidence and an assessment of the benefits and harms of alternative care options' [12]

Clinical guidelines make an important contribution to effective dissemination and implementation science; CPGs provide the recommended information within the knowledge integration process [13]. The overarching goal of dissemination and implementation science is to ensure that advances in health science become standards for care in all populations and in all health care settings. By recommending effective and evidence-based interventions and discouraging interventions lacking in scientific

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support, clinical guidelines seek to optimise quality of care while reducing waste and the potential harm associated with ineffective or unsafe interventions. By adhering to guideline-recommended practice, it is hoped that clinicians and patients can be reassured that the best current practice, which is supported by the best available evidence, is being delivered. Clinical guidelines can reduce variations in practice, provide a rational basis for referral and act as a mechanism of quality control. Importantly, clinical guidelines can also identify areas of scientific uncertainty and make recommendations for future research.

Clinical guidelines for the same condition across the world should in principle be broadly similar. Guideline development groups have access to the same scientific data and evidence base after all. Conflicting guideline recommendations do, however, emerge. Some expected and reasonable sources of variation might be related to differences in the local economic and healthcare infrastructure in the country in which the guideline is developed. However, other less desirable sources of divergent recommendations may include variations in review methodology and subjective differences in the interpretation of benefits and harms, the local political landscape and, potentially, the constitution of the guideline committee, with the risk that recommendations might unduly reflect the work of those within the committee [14].

Approaches to guideline development

Clinical guidelines should be based on a systematic review of the available evidence developed by a panel of multidisciplinary experts. The review(s) should focus on the strength and quality of the evidence and result in a set of recommendations. This should involve both the evidence and value judgements regarding benefits and harms of alternative care options, thus addressing how patients with a particular condition ought to be managed, everything else being equal.

There are usually five steps in the initial development of a CPG [15].

1. Identifying and refining the subject area.
2. Convening and running a guideline development group.
3. Assessing the evidence about the clinical question or condition, on the basis of systematic reviews.
4. Translating the evidence into a recommendation within a CPG.
5. External review of the guideline.

Although these steps represent the broad principles of guideline development, there are variations in the processes and methodologies of different guideline groups and centres across the world. To illustrate some of the methodological variations in LBP CPG development, a summary of the processes adopted by NICE, the American Pain Society and American College of Physicians and the Canadian 'Towards Optimised Practice' program is presented below.

NICE Guideline on Low Back Pain and Sciatica (NG59) 2016

The National Institute of Health and Care Excellence is a state-funded organisation in the United Kingdom whose stated goal is to improve outcomes for people by using the NHS and other public health and social care services. One key aspect to this is the development of clinical guidelines. The remit for all NICE guidelines comes from NHS England, and published guidelines are usually reviewed for update every 2 years (with a guaranteed review at least every 4 years from the date of publication). NG59 was commissioned in response to the review of the 2009 NICE Low Back Pain guideline (CG88) in 2012.

NICE commissioned the National Clinical Guideline Centre (NCGC) to develop the guideline, and the NCGC produced a draft scope. The draft scope was reviewed by stakeholder groups, and the final scope was agreed. Review questions were agreed by the multidisciplinary Guideline Development Group (GDG). The GDG comprised 12 healthcare professionals from a range of backgrounds and two lay members. Conflicts of interest were declared at the start of the process and at the beginning of each of the 25 GDG meetings.

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The population covered by the guideline included people over the age of 16 years with LBP and/or sciatica. The duration of symptoms was not specified. People undergoing treatment for back pain prevention, those having persistent back pain following surgery and those having back pain during pregnancy were excluded. The NCGC technical team performed the literature searches and prepared the systematic reviews of the evidence and the economic analyses. Randomised controlled trials were given primacy, but uncontrolled cohort studies were reviewed where there was insufficient evidence from randomised trials. Existing systematic reviews were identified primarily to ensure adequate capture of the relevant data. Twenty-two *de novo* systematic reviews were performed by the technical team. The GDG discussed these systematic evidence reviews along with expert testimony (from within the guideline development group, from invited expert witnesses with particular specialist expertise not represented in the guideline development group and from this developed draft recommendations).

The methods used by NICE to conduct evidence reviews are transparent and explicit [16]. Where possible, data were meta-analysed and the quality of the body of evidence underpinning comparisons was assessed using the GRADE methodology [17]. The strength of each recommendation is reflected in the wording (e.g. 'offer' implies a strong recommendation, whereas 'consider' reflects a weaker recommendation, usually on the basis of the strength of the underpinning evidence). The strength of the evidence, the relative benefits and risks, cost effectiveness and, importantly, the patient perspective were also considered.

The draft guideline was submitted to the public for stakeholder consultation and revised where appropriate considering stakeholder comments. The revised guideline was submitted to NICE for internal peer review and sign off by the NICE executive. Once ratified by the NICE executive, the guideline was published.

2007/2009/2017 Diagnosis and treatment of low back pain: a joint clinical practice guideline from the American College of Physicians and the American Pain Society

This guideline was initiated by the American Pain Society. The first stage, published in October 2007 [7], focused on initial (primary care) evaluation and management of LBP and was conducted in partnership with the American College of Physicians (ACP). The second stage, published in May 2009, focused on the use of conservative management [8], interdisciplinary rehabilitation [14] and surgery and interventional therapies for LBP [9]. An updated version focusing on non-invasive pharmacologic and non-pharmacologic treatment was published in February 2017 [10]. A challenge in using the 2007/2009/2017 documents is that although the information was created by the same guideline group, the method of dissemination varies depending on the paper accessed. That said, there are seven papers that collectively introduce the ACP guidelines [7–10,18–20].

In the 2017 guidelines, the targeted population includes adults ($\geq$18 years of age) with acute, subacute and chronic LBP, radicular LBP or symptomatic spinal stenosis. In the original guidelines (2007–2009), the target population included adults (age >18 years) with acute and chronic LBP not associated with major trauma. Children or adolescents with LBP; pregnant women with LBP; patients with LBP from sources outside the back (non-spinal LBP), fibromyalgia or other myofascial pain syndromes, and thoracic or cervical back pain were not included.

For the 2017 update, The Agency for Healthcare Research and Quality's (AHRQ) Pacific Northwest Evidence-Based Practice Centre completed all evidence reviews. Key questions included 'what are the comparative benefits and harms of different pharmacologic therapies for acute or chronic non-radicular LBP, radicular back pain or spinal stenosis?' and 'what are the comparative benefits and harms of different non-pharmacologic therapies for acute or chronic non-radicular LBP, radicular back pain or spinal stenosis?' The review researched databases from 2008 through April 2015 and then updated the search through November 2016. The previously published 2007 APC guidelines were used to detail any studies published prior to 2007. The authors incorporated published controlled clinical trials and systematic reviews. The majority of the 2017 ACP LBP guidelines are similar to those reported in 2007. The most notable differences include a lack of endorsement of paracetamol (acetaminophen) and tricyclic antidepressants in the 2017 guidelines, which contrast with the 2007 guidelines.

Members of the Clinical Guidelines Committee included physicians trained in internal medicine and its subspecialties and clinical experts and experts in evidence synthesis and guideline development.

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The committee performed quality assessment of randomised trials by using a form created by the Cochrane Back Review Group and the AHRQ and evaluated systematic reviews by using AMSTAR. Although patient preferences were considered, no patient representation was reported. Evidence was trichotomised as high quality, moderate quality and low quality.

2015 Evidence-Informed Primary Care Management of Low Back Pain – Canada

This guideline is the third edition of the Alberta CPG for the Evidence-Informed Primary Care Management of Low Back Pain [6], which was developed as part of the second phase of the Alberta Health Technology Assessment Ambassador Program.

The guideline was developed by a steering committee and an update committee. The update committee comprised a multidisciplinary group of primary care practitioners—most of whom were members of the group who developed the first edition of the guideline in 2009. Both the steering and update committees were supported by a research team.

The target population included adults with LBP of any duration. Pregnant women were excluded. The focus was diagnosis and conservative non-surgical treatment of LBP for use in primary healthcare settings. The guideline covers the diagnosis and treatment of radicular pain and a number of invasive interventions and injection procedures despite the proposed focus on primary care management but excluded in-patient interventions, such as surgical treatments.

Uniquely, the first edition of the guideline was developed by adapting existing good quality international and national guidelines on the management of LBP. The so-called 'seed guidelines' were identified and critically appraised and used to formulate the recommendations. These guidelines included some non-randomised study designs. Subsequent updates have identified more recent seed guidelines and recently published systematic reviews of new interventions that were considered important but were not included in the first edition of the guideline, but no new reviews of original studies were conducted as part of the development process.

Each recommendation from the CPG was sourced from one or multiple seed guidelines, and the recommendations were categorised into three groups: *do*, *do not do* (not recommended) and *do not know*. The strength and quality of the underlying empirical evidence were not formally assessed, however, and could not be defined by terms such as good, fair, poor, insufficient or conflicting. It is not clear whether patient or stakeholder comment was invited.

Consistent recommendations across the three guidelines

In many areas, the guidelines essentially speak with a single voice and produce broadly similar recommendations. In this section, we outline these key similarities in terms of diagnosis and management.

Diagnosis

The primary target of all three guidelines is acute and chronic LBP. The NICE and Canadian guidelines defined non-specific LBP as pain in the low back that has no identifiable cause and no clear association with a specific, serious underlying anatomical impairment or disease process. The updated US guidelines only differentiated LBP as radicular, non-radicular or symptomatic spinal stenosis. The Canadian and NICE guidelines excluded conditions such as inflammatory systemic diseases (e.g. ankylosing spondylitis), structural spinal dysfunction (e.g. spondylosis, spondylolisthesis and scoliosis) and fractures associated with metabolic bone disease. While the US and Canadian guidelines separated studies and subsequent recommendations by the duration of symptoms (acute versus chronic), the NICE guideline broadly did not.

Diagnostic assessments

All three guidelines recommended consideration of potential alternative diagnoses such as specific spinal pathologies, although it is worth noting that it was necessary to review two affiliated sister publications [18,19] to fully understand the screening processes that were used in the US-based guidelines. Even if one includes the additional publications, then it remains evident that none of the

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guidelines provide notable detail on the best methods for screening. This reflects a broader inconsistency in the specific details for red flag screening advocated across guidelines for LBP [21]. The lack of consistent and detailed guidance in this area may be due, in part, to the limited diagnostic utility of red flag screening questions. Evidence suggests that tools used to screen for red flags lack the appropriate sensitivity (and subsequent negative likelihood ratio) to rule out the condition [22]. When combined with the very low prevalence, the change in post-test probability of the condition is minimal, which is a notable shortcoming in both CPGs and clinical practice.

The NICE and Canadian guidelines and the 2007 APC guidelines do not support the use of early, routine imaging. Imaging is recommended only if it is likely to change the management of the patient or where there is justifiable suspicion of specific disease. The guidelines vary on the level of specific detail offered with regard to suspicion of specific disease. While in the NICE guideline, a suspicion of red flags essentially takes patients out of the NICE back pain pathway, the Canadian guideline specifies a list of specific indications for MRI including major or progressive neurologic deficit, suspected cauda equina syndrome, progressive severe pain and debility despite non-interventional therapy, severe or incapacitating back or leg pain, and clinical or radiological suspicion of neoplasm or infection. They recommend CT scanning where MRI is contraindicated, to detect or characterise primary bone tumours, or following trauma to rule out or characterise fractures. The updated US guidelines make no mention of the use of imaging within its primary or sister publications. Routine advanced imaging was not recommended by any guideline. Electro-diagnostic testing was not supported by the older US and Canadian guidelines and not considered in the NICE guideline.

Patient management

Education and advice

Advice to stay active and return to normal activities as soon as possible is a core recommendation across these guidelines. The NICE and Canadian guidelines go further, specifically recommending early return to work. The older US and Canadian guidelines specifically advise against bed rest as a treatment option. All advocate education towards an 'expected' course of LBP, in which the probability of a rapid improvement in symptoms is high, potentially to reduce the risk of fear/catastrophising and to moderate expectations.

Pharmacological options

With regard to pharmaceutical interventions, all three guidelines recommend the use of non-steroidal anti-inflammatory drugs (NSAIDs) for acute and chronic LBP. The guidelines are consistent in advocating a cautious approach to the use of opioids for acute LBP. The new US guideline states that strong opioids are associated with small short-term improvements in pain, whereas the Canadian guideline states that 'short-acting' opioid be used rarely and only in severe cases. The NICE guideline recommends that a weak opioid, with or without paracetamol (acetaminophen), be considered only where NSAIDS are contraindicated, not tolerated or found to be ineffective. The updated US, NICE and Canadian guidelines recommended against long-term management of LBP using opioids. All three either recommend against or suggest only cautious use of antidepressants.

Non-pharmacological, non-invasive management

All the guidelines recommend some variation of exercise as therapy, and none of the guidelines could specify whether any approach to exercise therapy is superior. As such, they recommend various forms. The NICE guideline places exercise therapy at the centre of conservative back pain treatment to a greater extent. In this guideline, a small number of other non-pharmacological interventions, such as manual therapy or psychological interventions, are recommended to be considered; however, they are recommended only as part of a treatment package that includes exercise therapy and not as essential components. Manual therapies are also recommended in the US and Canadian guidelines, though for acute back pain specifically and without the caveat of being offered alongside exercise therapy. All three guidelines are consistent in recommending against the use of spinal traction.

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Multi-modal care options, in which more than one type of intervention are incorporated into a treatment package, that include self-management principles and psychological approaches in the management of pain-related symptoms are also recommended across guidelines. The Canadian and updated US guidelines recommend multidisciplinary pain management programmes for chronic LBP, and the NICE guideline recommends to consider combined psychological and physical rehabilitation where a patient presents with significant psychological obstacles to recovery or where previous treatments have not been effective.

Non-conservative interventions

There is an agreement between the NICE and Canadian guidelines that surgery should be considered only when conservative interventions have not shown improvement or resolution to normal functional status, and both do not recommend any surgical interventions for LBP. The older US guidelines provided much greater detail on management by using surgical and injection-based approaches, as two separate papers were provided as supplements to the primary guidelines. All three guidelines recommend surgery for non-resolving radicular symptoms. The Canadian and older US guidelines do not specify the type of surgery, whereas the NICE guideline recommends to consider spinal decompression surgery. Beyond this consensus, there is little consistency across the guidelines for these types of interventions.

Clinical pathways

Both the NICE and the Canadian guidelines provide some guidance on referral pathways from primary care. The Canadian guideline recommends referral to a musculoskeletal specialist where patients are not returning to function at a reassessment 1–6 weeks following the initial contact. The NICE guideline recommends using a risk stratification tool to inform shared decision-making about whether a patient can be managed with simpler and less-intensive support, for example, reassurance, advice to keep active and guidance on self-management or referral to a range of possible rehabilitation options including group or individual exercise with or without manual or psychological therapies or to a 'combined physical and psychological' rehabilitation programme. Inherent to both approaches is the implication that not all patients presenting in primary care require specialist musculoskeletal intervention, given the favourable prognosis for many cases of LBP.

Inconsistencies between guidelines

While there are clear commonalities across these guidelines, there are numerous examples where their recommendations diverge. There are many potential reasons for these inconsistencies.

Guideline development groups in LBP are required to generate recommendations in the face of substantial uncertainty. Where the evidence of benefit is marginal or inconsistent across studies and study quality is mixed, as is often the case across interventions for LBP, there is a large capacity for interpretive differences between different guideline development groups. These differences are likely to reflect the local clinical culture and the views of individuals comprising the guideline group. In the absence of evidence, guideline groups need to make pragmatic recommendations on the basis of their expertise. These again will reflect local differences in culture and healthcare delivery.

Interpretive differences

Such differences are apparent in recommendations for interventional and surgical procedures for LBP. While the NICE guideline recommends against the use of spinal injection therapies for LBP, facet joint injections, prolotherapy or intradiscal injections are recommended in the older US guideline, and prolotherapy in the Canadian guideline, both with the caveat that they should be offered in 'carefully selected patients'. In terms of surgery, while the older US guideline recommends both spinal fusion and the use of interspinous spacers, the Canadian and NICE guideline make no positive recommendations for any surgical procedure for LBP. Conversely, while the NICE guideline recommends considering radiofrequency denervation of the medial branch nerve for selected patients, both the US and Canadian guidelines concluded that there was insufficient evidence to support a recommendation. Similarly

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based on a very limited evidence base, the NICE guideline recommended against the use of TENS, back belts and corsets, whereas the older US and Canadian groups recommended against their use as a sole treatment, given the uncertainty.

The willingness of guideline groups to make recommendations driven by expertise, and opinion likely varies across groups and possibly differs across different interventions. Arguably, this can be observed in the range of pharmacological and interventional options recommended across guidelines. Compared to the NICE guideline, the new US and Canadian guideline recommend a broader range of drug options including short-term opioids, specific serotonin reuptake inhibitors, anticonvulsants and herbal remedies, and the Canadian guidelines advocate the use of tricyclic antidepressants (TCAs) and acetaminophen. For many of these, the evidence base is either limited or not promising. On that basis, NICE only recommends to consider the use of NSAIDs, and if NSAIDs are ineffective, contraindicated or not tolerated, then consider a weak opioid, with or without paracetamol for acute back pain. While this latter recommendation is based on very limited evidence, it arose out of recognition of the need for an alternative treatment option for people with severe acute back pain where an NSAID could not be used.

Date of publication

More recent guidelines (the updated US and NICE) reflect a more up-to-date reflection of the evidence base, and there are examples where this is enough to drive a change of policy. A good example of this is the use of paracetamol (acetaminophen) for back pain. This staple first line analgesic has a long history in LBP management, borne largely from tradition and experience, but the publication in 2015 of a large high-quality multicentre trial [23] demonstrated no benefit of paracetamol over placebo for LBP in primary care.

This trial now dominates the evidence base for this intervention but sits within a broader body of evidence [24,25] demonstrating a lack of efficacy. On this basis, the NICE guideline recommends against the use of paracetamol, but the older US and Canadian guideline predates these substantial additions to the evidence base and subsequently recommends paracetamol in acute and chronic LBP. The updated ACP guideline for non-invasive treatment, published at the time of writing this review [10], is now consistent with the NICE guideline in recommending against paracetamol (acetaminophen) for back pain.

Efficacy versus effectiveness

The importance of efficacy and effectiveness in guiding the decision of guideline groups may also vary. Acupuncture recommendations vary substantially across the guidelines. The older and updated US guideline recommends acupuncture for both acute and chronic LBP, the Canadian guideline recommends it as an adjunct treatment in chronic LBP, whereas the NICE guideline suggests 'do not use' acupuncture for LBP. Positive recommendations for acupuncture are based on comparisons with usual care or no treatment (effectiveness). In contrast, the NICE group prioritised evidence of effects over sham acupuncture (efficacy) in making their decision and concluded that there were no meaningful effects over sham acupuncture. This variability across guidelines speaks to a wider controversy regarding whether it is appropriate and ethical to offer, or withhold, known placebos for the treatment of a range of conditions [26], though a detailed discussion of that issue is beyond the scope of this article.

Size of treatment effects

In some cases, the use of predetermined thresholds for clinical importance to guide decisions may have an important influence. The use of these thresholds shifts attention away from statistical significance towards the size of beneficial treatment effects. The NICE guideline utilised a minimally important difference (MID) for between group change in pain of $\geq$1 point on a 0–10 pain scale and similar thresholds for other critical outcomes. These thresholds had a substantial impact on the number of observed comparisons for which results were considered positive and in part will have driven the frequently more conservative recommendations of the NICE guideline. A key example of this

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is opioids. Opioids are recommended in the 2007 US guideline for chronic LBP but are not recommended for this group in the NICE guideline. The analysis in the NICE guideline demonstrated a statistically significant effect of opioids over placebo, but both the point estimate of the treatment effect and the upper limit of the 95% confidence interval fell beneath the MID. This lack of an important effect coupled with concerns regarding the known risks of these drugs [27] helped drive a 'do not use' recommendation for chronic LBP. The updated US guideline takes a more cautious view of opioid use than the earlier version, suggesting that opioids should be the last treatment option considered and only in patients for whom other therapies have failed. This modified recommendation appears to be driven more by recognition of the potential harms.

Scope of guidelines

Finally, inconsistencies might arise on the basis of the scope of the guidelines. An example of this is found in the recommendation in the Canadian and older US guideline of herbal treatments such as Harpagophytum procumbens extracts (Devil's claw), Combo Salix daphnoides (Willow bark) and capsicum frutescens. These agents were not reviewed in the NICE guideline development process.

The reasons underpinning inconsistencies across guidelines are likely multifactorial and represent the date of the literature search, the influence of methodological approaches, the culture of the guideline development group and broader healthcare system, but, perhaps most strongly, the uncertain nature of the evidence of potential clinical benefits for many common interventions.

Challenge of implementation

The challenge of implementing back pain guidelines in clinical practice is substantial. Indeed, recognition of issues relating to implementation within clinical guidelines is included in the AGREE II quality assessment tool [28]. It is important to recognise that clinical guidelines are just one component in a more complex process of translating research into clinical practice [13]. Strategies are needed to successfully bring guidelines into clinical practice, but the potential barriers to implementation need to be understood. Glasgow et al. [13] emphasise the need for research that includes the study of interventions designed to increase implementation of evidence-based recommendations, the evaluation of the effectiveness and cost–effectiveness under 'real world' conditions and in diverse populations and ongoing surveillance of population health outcomes.

In a broad review of barriers to clinical guideline implementation, Fischer et al. [29] identified three themes. Personal factors relate to clinicians' knowledge of and familiarity with the guideline, their attitudes to the guidance provided and agreement (or lack thereof) with the guideline recommendations. Guideline factors relate to the plausibility of the recommendations of the guideline, its credibility and accessibility. External factors relate to constraints within the local organisation and resourcing of care that may restrict the capacity for changing practice.

In a systematic review and meta-synthesis of barriers to primary care clinicians' adherence to LBP guidelines, Slade et al. [30] found that time constraints and the sheer volume of guidelines clinicians are faced with represented barriers to implantation. The specific issue of spinal imaging emerged as a prominent issue. While guidelines universally recommend against the routine imaging of LBP, clinicians rationalised the use of imaging as a way to negotiate potential conflicts arising from patients' lack of acceptance of a non-structural diagnosis and to help explain symptoms and attempt to reduce anxiety through offering an 'unambiguous explanation'. Any evidence to suggest that this is a successful strategy is lacking. Clinicians felt that guidelines constrained clinical practice; that their own use of popular practices often superseded guideline recommendations. Clinicians also demonstrated a lack of knowledge of both the content of guidelines and the methodology underpinning them. Such views were also apparent in a recent qualitative study conducted in the UK [31], which focused on an earlier NICE guideline for the management of persistent LBP. Clinicians did not universally accept the evidence-based practice paradigm, felt that guidelines did not resonate with their personal experience and believed that the guideline imposed rigid treatment pathways that constrained practice. This, in addition to organisational constraints, led to the guideline having only a peripheral influence on clinical decision-making.

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From the patient perspective, a qualitative study of patients with osteoarthritis of the knee [32] found that poor comprehension of the disease process, negative experiences with drug therapies, poor communication by health professionals and disagreement with the recommendations of guidelines presented key barriers to adherence. Within those disagreements, an insistence on medical imaging and a fear that physiotherapy aggravates pain were important issues. The parallels with back pain care seem self-evident.

Fischer et al. [29] summarise what they refer to as central aspects for successful guideline implementation. These include dissemination (the supply of accessible information), education and training of health professionals, social interaction (in terms of outreach activities, marketing and the engagement of opinion leaders), decision support systems, standing orders and standardised documentation.

In a systematic review of implementation interventions designed to improve clinical practice for the management of LBP Mesner et al. [33] found that a range of interventions had been applied, but that single, one-off strategies were consistently unsuccessful, and there was no consistent pattern with regard to the differential effectiveness of the different types of implementation events utilised. Suman et al. [34] systematically reviewed the evidence for multifaceted guideline implementation strategies for back and neck pain and did not find consistent benefits when they were compared to either usual or minimal intervention. Mesner et al. [33] concluded that frequency of messaging may be important, as ongoing and regular interventions demonstrated greater success in changing practice and sustaining those changes. However they advised caution on the basis of between study heterogeneity and the risk of bias in the included literature.

The challenge of achieving lasting behavioural change in complex communities of clinicians is daunting, particularly perhaps if that change requires de-adoption of current practices. While the need to go beyond the simple act of publishing guidelines is uncontroversial, the best way to achieve implementation is a question that remains to be answered. This is reflected in the apparent failure, to date, of the recent 'Choosing Wisely' campaign to demonstrate any impact on the high rates of LBP imaging in the absence of red flag indications in the US [35].

Controversies and future directions

We have seen how inconsistencies arise from uncertainty regarding the value of many interventions for LBP. This uncertainty is likely the product of many factors including issues with the quality and size of many studies, diagnostic uncertainty, the largely unmet challenge of adequately targeting treatments to appropriate populations and marginal or absent treatment effects. It is sobering that across all the interventions reviewed by the NICE group, no intervention was considered to have strong enough evidence to warrant a clear 'offer' recommendation.

There are issues with regard to where the burden of proof lies in this process. It is always controversial and challenging to recommend against the use of interventions that are already established in the market. Guideline groups may be reluctant to make strong recommendations against the continued use of interventions where there is little reliable evidence of effectiveness but also no clear evidence of ineffectiveness and harm. Such reluctance is likely driven both by the wish to avoid withholding treatments that may be of benefit and by the agendas of professional groups and other stakeholders. However, the costs associated with LBP treatment have spiralled in recent decades and yet no major impact has been made in associated levels of disability. Logically, this speaks to a problem of over treatment; to an expanding global clinical industry, sections of which may be supported only by the confounders of natural recovery, regression to the mean and internal study biases, rather than genuine clinical utility.

How the balance between benefits and harms of interventions is weighed is not clear across these guidelines. The primary source of evidence used in guidelines is that derived from RCTs of interventions, which generally lack adequate power to detect rare harms. None of the included guidelines described a systematic approach to detecting adverse events that included observational studies or regulatory data. Indeed, the methodological challenges to systematically assessing treatment harms

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are considerable, and the methodology for reviewing these data remains underdeveloped [36]. In the absence of such an approach, which would substantially increase the complexity of the guideline process and the workload of any review group, judgements regarding the risk of harms are likely made from the limited evidence found in trials and the expert opinion of the guideline group.

Popular emerging management concepts such as shared decision-making receive little specific attention in guidelines. Shared decision-making (SDM) is characterised as a process involving at least two participants (patient and health care provider), who interact together and share information to make decisions where both parties agree [37]. In the United States, SDM is endorsed by government agencies, yet to date there is limited literature to help evaluate this proposition and what is available does not appear supportive. In a recent RCT [38], people with nonspecific LBP were randomised to receive either usual physiotherapy care or a physiotherapy care package that was developed through shared, informed decision-making, and the results suggest that the shared decision-making process resulted in worse outcomes. In an earlier study, Eisenberg et al. [39] randomised acute LBP patients to receive either usual care or usual care plus the patients' choice of adjunctive acupuncture, massage or manipulation and found no meaningful benefit with the addition of the patient's chosen adjuvant therapy.

Guidelines often focus on the evidence for discreet interventions, but studying the process of care may be a path to improved outcomes and reduced costs and harms. The Canadian and NICE guidelines offer detail on suggested care pathways though these are largely determined by expertise rather than evidence. Observational evidence from the US suggests that the timing of care and the type of provider that a patient sees may influence downstream costs and utilisation, specifically that early physical therapy was associated with reduced costs and healthcare utilisation [40,41]. However, in a recent randomised controlled trial of early physical therapy versus usual care, no such beneficial effects were apparent, and no meaningful impact was observed on clinical outcomes [42]. Studying management processes and clinical pathways may yet yield improved outcomes, a strategy endorsed in stratified care processes [43]. This evidence base is in its relative infancy, but may be valuable to the scope of future guidelines.

Finally, the role of population-level interventions is rarely within the scope of clinical guidance. Such interventions often aim to change behaviour in relation to a specific condition through mass marketing multimedia campaigns aimed at the general population and/or clinicians. The highest profile of these, delivered in Australia [44], successfully achieved lasting change in the attitudes and beliefs of physicians and the public and in the number of workers' compensation back claims and medical payments. Unfortunately, the results of other campaigns have failed to match this promise [45]. It remains an appealing idea that to successfully change practice may require the provision of accessible, appealing and convincing education to the public; that behaviour change might be positively driven through guiding patient demand as well as clinician behaviour.

Conclusions

In this narrative review, we have selected and reviewed three major interdisciplinary clinical guidelines for LBP. As such, our review does not represent a systematic review of current guidelines, but rather aims to use selected guidelines to inform a discussion of where they concur and diverge on what represents the best practice. In addition, at the time of writing, the ACP published a new guideline for non-invasive treatment. Here, we have discussed selected changes in that new guideline, but the focus of this review is on the earlier iteration of that guidance.

Clinical guidelines exist to promote consistent best practice in patient care, to reduce unwarranted variation in care and to reduce the use of low-value interventions. There seems to be little controversy that routine imaging is not advisable, nor that ruling out alternative diagnoses and offering high-quality education should represent the staple treatments for non-specific LBP. Indeed ensuring the widespread, global implementation of this simple core message might go some way to improving the huge burden of back pain-related disability and reducing the costs of low value clinical interventions. How that is actually achieved might be the great challenge of LBP.

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Practice points

- Guidelines consistently recommend ruling out alternative diagnoses and then offering high-quality education including the encouragement of an early return to activity.
- Guidelines consistently recommend against the routine use of imaging for non-specific LBP.
- Guidelines consistently recommend physical exercise for non-specific LBP.
- Guidelines consistently advocate a cautious approach to the use of opioids in non-specific LBP.

Research Agenda

- Further research into implementation strategies for guideline recommendations and optimal clinical pathways for LBP may be useful to guide future clinical guidelines for LBP.

Declarations of interest

NOC, BW and CC are qualified physiotherapists.

SW was the Chair of the recent NICE guideline development group for low back pain and sciatica, and NOC was a member of that guideline development group.

SW is a consultant in pain medicine and practices in both the public and private healthcare sectors.

This work was undertaken in part by Neil O'Connell and Stephen Ward, member and chair respectively of the NICE guideline committee (NG59 Low back pain and sciatica in over 16s: assessment and management). The development of this guideline was funded by the National Institute for Health and Care Excellence. The views expressed within this publication are those of the authors and not necessarily those of NICE.

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REVIEW

Clinical practice guidelines for the management of non-specific low back pain in primary care: an updated overview

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Abstract

Objective The aim of this study was to provide an overview of the recommendations regarding the diagnosis and treatment contained in current clinical practice guidelines for patients with non-specific low back pain in primary care. We also aimed to examine how recommendations have changed since our last overview in 2010.

Method The searches for clinical practice guidelines were performed for the period from 2008 to 2017 in electronic databases. Guidelines including information regarding either the diagnosis or treatment of non-specific low back pain, and targeted at a multidisciplinary audience in the primary care setting, were considered eligible. We extracted data regarding recommendations for diagnosis and treatment, and methods for development of guidelines.

Results We identified 15 clinical practice guidelines for the management of low back pain in primary care. For diagnosis of patients with non-specific low back pain, the clinical practice guidelines recommend history taking and physical examination to identify red flags, neurological testing to identify radicular syndrome, use of imaging if serious pathology is suspected (but discourage routine use), and assessment of psychosocial factors. For treatment of patients with acute low back pain, the guidelines recommend reassurance on the favourable prognosis and advice on returning to normal activities, avoiding bed rest, the use of nonsteroidal anti-inflammatory drugs (NSAIDs) and weak opioids for short periods. For treatment of patients with chronic low back pain, the guidelines recommend the use of NSAIDs and antidepressants, exercise therapy, and psychosocial interventions. In addition, referral to a specialist is recommended in case of suspicion of specific pathologies or radiculopathy or if there is no improvement after 4 weeks. While there were a few discrepancies across the current clinical practice guidelines, a substantial proportion of recommendations was consistently endorsed. In the current review, we identified some differences compared to the previous overview regarding the recommendations for assessment of psychosocial factors, the use of some medications (e.g., paracetamol) as well as an increasing amount of information regarding the types of exercise, mode of delivery, acupuncture, herbal medicines, and invasive treatments.

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Extended author information available on the last page of the article

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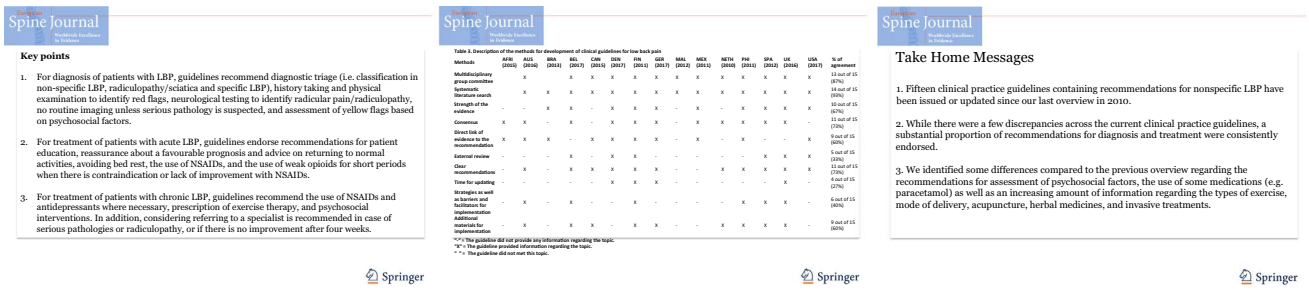
Graphical abstract These slides can be retrieved under Electronic Supplementary Material.



Keywords Low back pain · Clinical guidelines · Diagnosis · Treatment

Introduction

Low back pain (LBP) is the leading contributor to years lived with disability [14]. Non-specific LBP is defined as low back pain not attributable to a known cause [21] and represents 90–95% of the cases of LBP [4]. The estimated point prevalence of non-specific LBP is 18% [13]. Annually, total costs of LBP are estimated to be US $100 billion in the USA [8], €3.5 billion in the Netherlands [19], €6.6 billion in Switzerland [35], €17.4 billion in Germany [5], and AUD $9.17 billion in Australia [34]. Although LBP imposes an enormous economic burden on healthcare systems, this condition is responsible to affect individuals' daily lives. Hence, effective strategies play an important role to minimize the impact of LBP.

Clinical practice guidelines provide evidence-based recommendations to assist decision making about health interventions. These documents, developed by expert panels, are normally updated every 3 to 5 years or if the available evidence suggests a reformulation of the previous document is necessary [33]. A brief search of the Central Register of Controlled Trials (CENTRAL) reveals that the number of randomized controlled trials in LBP has nearly doubled since 2010. This finding suggests that some recommendations of clinical practice guidelines for the management of LBP may have changed in recent years.

Since 2001, we have been conducting overviews of clinical practice guidelines for the management of patients with non-specific LBP in primary care settings [17, 18]. These overviews have summarized the overall consensus messages, any differences between clinical practice guidelines, the scientific support for the recommendations, and changes in recommendations over time. The importance of these publications is evidenced by the number of citations received; *Web of Science citation index* notes that the 2001 review [18] was cited 377 times and the 2010 review [17] 316 times. It has been 8 years since our last review and some of the recommendations for the management of low back pain have likely changed. Therefore, the primary aim of this study was to provide an overview of the recommendations regarding the diagnosis and treatment of patients with non-specific LBP in primary care in current international clinical practice guidelines. We also aimed to examine if recommendations have changed since our last overview.

Methods

Searches

The searches for clinical guidelines were performed for the period from 2008 to 2017 in the following databases: MEDLINE via OVID (key words: combination of search terms regarding low back pain AND clinical guidelines), PEDro (key words: low back pain AND practice guidelines), National Guideline Clearinghouse (www.guideline.gov; key word: low back pain), and National Institute for Health and Clinical Excellence (NICE) (www.nice.org.uk; key word: low back pain). We also checked the guidelines included in our previous review for updates. Furthermore, we conducted citation tracking in the content and reference lists of relevant reviews on guidelines, completed a search of Web of Science citation index for articles citing the previous reviews, and asked experts in the field. Two authors (C.B.O. and C.G M.) independently screened titles and abstracts of the search results. In case of disagreement, a third author (B.W.K.) arbitrated.

Types of study included

Guidelines including information regarding either the diagnosis or treatment of non-specific LBP, and targeted at a multidisciplinary audience in the primary care setting, were considered eligible. Only guidelines available in English,

French, German, Portuguese, Spanish, Chinese, or Dutch were included because the authors can read these languages. For languages beyond these, we included English language summaries of the guideline if they contained sufficient information. We included one guideline per country unless there were separate guidelines for acute and chronic LBP. We also included guidelines issued by a multinational committee (e.g., Africa, Europe). If more than one guideline was considered eligible, we included the most recent issued by a national body (e.g., national pain society, or national health body).

Data extraction and data synthesis

Two independent authors extracted the following data using a standardised form: recommendations regarding diagnosis and treatment, target population, committee membership, the evidence base of the recommendations (e.g., literature search, grade of evidence), consensus methods (e.g., committee meetings, discussion groups), and dissemination of guidelines (e.g., publication in website or scientific journals). To examine changes in recommendations over time, we compared results of the previous overviews with the current review. We presented the recommendations from the included guidelines in tables.

Results

Electronic searches conducted on June 16, 2017 retrieved 1611 records after removing duplicates. After the screening of titles and abstracts, we assessed 61 full texts against our inclusion criteria. Of these, we excluded 46 full texts because they were: not the most recent guideline issued ($n=19$), not guidelines ($n=15$), not targeted at a multidisciplinary audience ($n=10$), and not in a language where we could obtain a translation ($n=2$). Finally, 15 clinical practice guidelines [1, 3, 7, 9–11, 15, 20, 24, 27, 30–32] for the management of LBP were included from the following countries: Africa (multinational), Australia, Brazil, Belgium, Canada, Denmark, Finland, Germany, Malaysia, Mexico, the Netherlands, Philippine, Spain, the USA, and the UK.

Six guidelines [1, 7, 11, 20, 26, 28] (40%) provided recommendations for patients with acute, subacute, and chronic LBP (i.e., Canada, Finland, Mexico, Philippine, Spain, and the USA), two guidelines [15, 31] (13%) focussed on acute and chronic LBP (i.e., Malaysia and the Netherlands), three guidelines [9, 25, 30] (20%) focussed on acute LBP (i.e., Australia, and Denmark), and one guideline [3] (7%) focussed on chronic LBP (i.e., Brazil). In addition, three guidelines [10, 24, 32] (20%) provided recommendations regardless of the duration of symptoms (i.e., Africa, Belgium, Germany and the UK). Therefore, ten guidelines contained recommendations for patients with acute LBP, six guidelines contained recommendations for patients with subacute LBP, and nine guidelines contained recommendations for patients with chronic LBP.

Three guidelines [1, 11, 28] defined acute LBP as less than 4 weeks duration, two guidelines [6, 26] specified less than 6 weeks duration and four guidelines [15, 25, 30, 31] defined acute LBP as less than 12 weeks duration. The Canadian guideline [7] defined acute and subacute LBP as less than 12 weeks duration but without specifying the cutoffs for each one. All guidelines defined chronic LBP as more than 12 weeks' duration.

Diagnostic recommendations

Table 1 describes the recommendations regarding diagnosis endorsed by each clinical practice guideline, and "supplementary material: Appendix 1" details these recommendations. Fourteen guidelines provided at least one recommendation regarding diagnosis of patients with LBP. The American guideline [28] did not provide any recommendation regarding diagnosis because the committee group was instructed to make only recommendations for treatment of LBP.

Recommendations for diagnostic triage were found in 13 guidelines. Over half of guidelines [1, 7, 24–26, 31, 32] (7 out of 13; 54%) recommend diagnostic triage to classify patients into one of three categories: non-specific LBP, radiculopathy/sciatica or specific LBP. Almost half of the guidelines [3, 9–11, 15, 20] (46%) recommend the classifications of non-specific LBP and specific LBP without distinguishing the group of patients with radicular pain/radiculopathy. Most guidelines [1, 7, 11, 15, 20, 24–26, 31, 32] (10 out of 12; 83%) recommend history taking and physical examination to identify patients with specific conditions as the cause of the LBP. Box 1 describes the red flags endorsed by most clinical practice guidelines to identify serious conditions in the assessment. In addition, most guidelines [1, 7, 11, 15, 25, 26, 31] (7 out of 9; 78%) recommend neurologic examination to identify radicular pain/radiculopathy including straight leg raise test [1, 7, 15, 26, 32] and assessment of strength, reflexes, and sensation [1, 11, 15]. Only three guidelines [11, 15, 26] (3 out of 12; 25%) recommend an assessment that also includes palpation, posture assessment, and spinal range of movement testing.

All guidelines recommend against the use of routine imaging for patients with non-specific LBP. Most guidelines [1, 7, 9–11, 25, 30] (7 out of 12; 58%) recommend that imaging should only be considered if red flags are present. In addition, five guidelines [1, 7, 10, 24, 32] (42%) suggest imaging when the results are likely to change or direct the treatment (e.g., invasive treatments), and two guidelines

Table 1 Recommendations of clinical guidelines for diagnosis of low back pain

Recommendations for diagnosis	AFRI (2015)	AUS (2016)	BRA (2013)	BEL (2017)	CAN (2015)	DEN (2017)	FIN (2011)	GER (2017)	MAL (2012)	MEX (2011)	NETH (2010)	PHI (2011)	SPA (2012)	UK (2016)	USA (2017)	% of agreement
Diagnostic triage into non-specific LBP; radiculopathy; and specific LBP.		X		X	X	-	X				X	X		X	-	7 out of 13 (54%)
Diagnostic triage into non-specific LBP; and specific LBP.	X		X			-		X	X	X			X		-	6 out of 13 (46%)
History taking and physical examination to identify patients with specific diseases		X	-	X	X	-	X		X	X	X	X	X	X	-	10 out of 12 (83%)
Neurologic examination to identify radicular pain		X	-		X	-	X		X	X	X	X			-	7 out of 9 (78%)
Against the use of routine imaging	X	X	-	X	X	X	X	X	-	X	X	X	X	X	-	12 out of 12 (100%)
Imaging only if serious pathology is suspected	X	X	-		X	X		X	-	X		X			-	7 out of 12 (58%)
Imaging only when the results are likely to change or direct the treatment			-	X	X			X	-			X		X	-	5 out of 12 (42%)
Imaging only if pain persists beyond a period			-		X		X		-						-	2 out of 12 (17%)
Assessment of psychosocial factors based on a list provided by the guideline	X		-		X	-	X		X	X	X	X	X		-	8 out of 12 (67%)
Assessment of psychosocial factors using validated prognostic screening		X	-	X		-		X						X	-	4 out of 12 (33%)
Against the assessment of psychosocial factors using validated prognostic screening					X											1 out of 12 (8%)
Assessment of yellow flags during the first or second consultation		X	-	X	X	-		X	X	X				X	-	7 out of 12 (58%)

"-" = The guideline did not provide any recommendation regarding the approach.

"X" = The guideline endorsed the recommendation regarding the approach.

" " = The guideline did not endorse the recommendation regarding the approach.

(17%) recommend imaging if pain persists beyond 4 to 6 weeks [7, 26].

Twelve guidelines contain recommendations for assessment of psychosocial factors, or yellow flags, to identify patients with poor prognosis and guide treatment. Most guidelines [1, 7, 9, 11, 15, 20, 26, 31] (8 out of 12; 67%) recommend the assessment based on a list of yellow flags reported in the guideline. Box 2 provides these yellow flags endorsed by most clinical practice guidelines. Four guidelines [10, 24, 25, 32] (33%) recommend assessment using validated prognostic screening tools (e.g., STarT Back and Orebro) which combine a number of yellow flags. The Danish guideline [30] recommends against targeted treatment for a subgroup of patients with specific prognostic factors. Regarding the optimal timing to assess yellow flags, most guidelines [7, 10, 11, 15, 24, 25, 32] (7 out of 12; 58%) recommend assessment during the first or second consultation.

Box 1 Red flags endorsed by most clinical practice guidelines

Malignancy	History of malignancy (e.g., cancer, neoplasm) [1, 7, 9–11, 15, 20, 24–26, 31, 32], Unexpected weight loss [1, 7, 9–11, 15, 25, 31, 32]
Fracture	Significant trauma [1, 7, 9, 11, 15, 24, 25, 31], prolonged use of corticosteroid [1, 9–11, 15, 20, 25, 31, 32]
Infection	Fever [1, 7, 9–11, 15, 20, 32], HIV [1, 7, 9, 11, 15, 20, 32]

Box 2 Yellow flags endorsed by most clinical practice guidelines

Beliefs that pain and activity are harmful [1, 7, 9, 11, 15, 20, 25, 26, 31, 32]
Treatment preferences that do not fit with the best practice (e.g., passive over active treatments) [1, 7, 9, 15, 20, 25, 26, 31, 32]
Lack of social support [1, 7, 9, 11, 15, 20, 25, 26]

Treatment recommendations

Table 2 provides the recommendations regarding treatment endorsed by each clinical practice guideline, and "supplementary material: Appendix 2" details these recommendations. All guidelines provided at least one recommendation regarding the treatment of LBP.

Recommendations regarding bed rest were provided in 12 guidelines. Most guidelines [7, 9, 11, 15, 25, 30, 31] (7 out of 11; 64%) recommend avoiding bed rest for patients with acute LBP, and four guidelines [1, 10, 20, 26] (36%) recommend for any duration of symptoms. The only exception was the Belgian guideline [32] (8%) which notes an absence of evidence on the benefits or harms of bed rest when used in the short term.

Recommendations on reassurance or advice for patients with non-specific LBP were identified in 14 guidelines. Most guidelines (7 out of 12; 58%) recommend advice to maintain normal activities for patients with acute LBP [1, 7, 10, 15, 25, 30, 32], and some guidelines (42%) recommend the same advice for patients with any duration of symptoms [20, 24, 26, 31, 32]. In addition, most guidelines (10 out of 14; 71%) recommend reassuring the patient that LBP is not a serious illness regardless of the duration of symptoms or reassuring patients with acute LBP of the favorable prognosis [7, 15, 20, 24–26, 28, 30–32].

The recommendations for the prescription of medication vary depending on the class of medication and symptom duration. Most guidelines (14 out of 15; 93%) recommend the use of nonsteroidal anti-inflammatory drugs (NSAIDs) for patients with acute and chronic LBP considering the risk of adverse events (e.g., renal, cardiovascular, and gastrointestinal) [1, 3, 7, 15, 24–26, 28, 32]. For paracetamol/acetaminophen, while most guidelines recommend in favor of this medication [1, 3, 7, 11, 15, 20, 26, 31] (8 out of 14; 57%), five guidelines [10, 24, 27, 30, 32] (36%) advise against the use of paracetamol. The Australian guideline [25] recommends the use of paracetamol but advises that clinicians and patients should be made aware that the medicine might not be effective. Most guidelines (13 out of 15; 87%) recommend weak opioids [1, 15, 24, 26, 31, 32] for short periods [3, 7, 10, 20, 31, 32], if there is no improvement with NSAIDs or other treatments. The guidelines recommend opioids for acute LBP [1, 7, 9–11, 24, 26, 32] (8 out of 13; 61%), chronic LBP [1, 3, 10, 27, 31] (38%), and for any symptom duration [15, 20] (23%). For antidepressants, most guidelines (6 out of 8; 75%) recommend its use for patients with chronic LBP where necessary [1, 3, 7, 11, 26, 28]. For muscle relaxants, most guidelines [1, 7, 11, 20, 26, 28] (6 out of 11; 54%) recommend this medication for acute LBP [1, 26, 28] (3 out of 6; 50%), chronic LBP [1, 7] (33%), and for any symptom duration [11, 20] (33%). In contrast, five guidelines (5 out of 11; 45%) recommend against muscle relaxants [3, 9, 10, 31, 32]. Two guidelines mentioned the use of herbal medicine for LBP (2 out of 15; 13%); one recommends its use for patients with chronic LBP [7], but the other recommends against it for any type of LBP [10].

Recommendations for referral to a specialist were found in 13 guidelines. Most guidelines [1, 7, 15, 20, 24, 26, 30, 32] (9 out of 13; 69%) recommend referral to a specialist in cases where there is suspicion of serious pathologies or radiculopathy. In addition, most guidelines [7, 9, 10, 20, 25, 30, 31] (7 out of 13; 54%) recommend referral to a specialist if there is no improvement after a time period that ranges from 4 weeks to 2 years.

Recommendations on invasive treatments (e.g., injections, surgery, and radiofrequency denervation) for non-specific LBP were identified in 8 guidelines. Of these, five guidelines (5 out of 8; 62%) recommended against the use of injections for non-specific LBP [7, 10, 24, 25, 31]. In addition, four guidelines [7, 10, 24, 25] (50%) recommend against surgery or radiofrequency denervation [7, 10, 25, 31] (50%) for non-specific LBP. In contrast, three guidelines [1, 24, 32] (37%) recommend radiofrequency denervation for chronic LBP; however, two guidelines [24, 32] (25%) recommended only in strict circumstances such as lack of improvement after conservative treatment, a positive response to a medial branch nerve block, and moderate to severe back pain. Some guidelines recommend surgery for chronic LBP due to disk herniation or spinal instability [1, 15] and common degenerative disorders [1].

Recommendations for multidisciplinary rehabilitation were identified in nine guidelines. Most guidelines (9 out 11; 90%) recommend multidisciplinary rehabilitation for patients with chronic LBP [7, 10, 11, 15, 24–26, 28, 32]. One guideline [20] recommends multidisciplinary rehabilitation

Table 2 Recommendations of clinical practice guidelines for treatment of low back pain

Recommendations for treatment	AFRI (2015)	AUS (2016)	BRA (2013)	BEL (2017)	CAN (2015)	DEN (2017)	FIN (2011)	GER (2017)	MAL (2012)	MEX (2011)	NETH (2010)	PHI (2011)	SPA (2012)	UK (2016)	USA (2017)	% of agreement
Avoiding bed rest	X	X	-		X	X	X	X	X	X	X	X	X	-	-	11 out of 12 (92%)
Acute LBP	X	X	-		X	X			X	X	X			-	-	7 out of 11 (64%)
Any duration of symptoms			-				X	X				X	X			4 out of 11 (36%)
Using patient education - advise to maintain normal activities		X	-	X	X	X	X	X	X		X	X	X	X	X	12 out of 14 (68%)
Acute LBP		X	-		X	X		X	X			X			X	7 out of 12 (58%)
Any symptom duration			-	X			X				X		X	X	-	5 out of 12 (42%)
Using patient education - reassurance		X	-	X	X	X	X		X		X		X	X	X	10 out of 14 (71%)
Prescription of NSAIDs for any symptom duration	X	X	X	X	X	X	X	X		X	X	X	X	X	X	14 out of 15 (93%)
Insufficient data regarding NSAIDs for chronic LBP									X							1 out of 15 (7%)
Prescription of paracetamol	-		X		X		X		X	X	X	X	X			8 out of 14 (57%)
Acute LBP	-				X		X				X	X				4 out of 8 (50%)
Chronic LBP	-		X		X							X				3 out of 8 (37%)
Any symptom duration	-								X	X			X			3 out of 8 (37%)
Against the prescription of paracetamol	-			X		X		X						X	X	5 out of 14 (36%)
Using opioids	X		X	X	X		X	X	X	X	X	X	X	X	X	13 out of 15 (87%)
Acute LBP	X			X	X		X	X		X		X		X		8 out of 13 (61%)
Chronic LBP			X					X			X	X			X	5 out of 13 (38%)
Any duration of symptoms									X				X			2 out of 13 (23%)
Against the prescription of opioids		X				X								X		3 out of 15 (23%)
Acute LBP		X				X										2 out of 3 (66%)
Chronic LBP														X		1 out of 3 (33%)

for any duration of symptoms, and one guideline [31] recommends if there is no improvement after monodisciplinary approach.

Recommendations for psychosocial strategies were found across eleven guidelines. Most guidelines (10 out of 11; 91%) endorse the use of a cognitive behavior approach [7, 10, 11, 20, 24–26, 28, 31, 32]. In addition, most guidelines (9 out of 11; 82%) recommend these therapies for patients with chronic LBP [7, 10, 15, 20, 24, 26, 28, 31, 32] with some of them recommending only if psychosocial factors are identified [15, 24, 31, 32].

All clinical practice guidelines provided recommendations for exercise therapy. Most guidelines (10 out of 14; 71%) recommend exercise therapy for patients with chronic LBP [1, 3, 7, 11, 15, 20, 26, 28, 31]. Noteworthy, we identified great discrepancy in the type of exercise program (e.g.,

Table 2 (continued)

Using antidepressants	-	-	X		X	-	X	X	-	X	-	X	X		X	8 out of 10 (80%)
Chronic LBP	-	-	X		X	-	X		-	X	-	X			X	6 out of 8 (75%)
Against the prescription of antidepressants	-	-		X		-			-		-			X		2 out of 10 (20%)
Using muscle relaxants		-			X	-	X		-	X		X	X	-	X	6 out of 11 (54%)
Acute LBP		-				-	X		-			X		-	X	3 out of 6 (50%)
Chronic LBP		-			X	-			-			X		-		2 out of 6 (33%)
Any duration of symptoms		-				-			-	X			X	-		2 out of 6 (33%)
Against the prescription of muscle relaxants	X	-	X	X		-		X	-		X			-		5 out of 11 (45%)
Using herbal medicines	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	1 out of 2 (50%)
Against the prescription of herbal medicines	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	1 out of 2 (50%)
Referral to specialist in case of suspicion of specific pathologies or radiculopathy			-	X	X	X	X	X	X			X	X	X	-	9 out of 13 (69%)
Referral to specialist if there is no improvement after four weeks to two years	X	X	-		X	X		X			X		X		-	7 out of 13 (54%)
Against injections	-	X	-		X	-	-	X		-	X		-	X	-	5 out of 8 (62%)
Using surgery	-		-			-	-		X	-		X	-		-	2 out of 8 (25%)
Against surgery	-	X	-		X	-	-	X		-			-	X	-	4 out of 8 (50%)
Using radiofrequency denervation for chronic LBP.	-		-	X		-	-			-		X	-	X	-	3 out of 8 (37%)
Against radiofrequency denervation for nonspecific LBP.	-	X	-		X	-	-	X		-	X		-		-	4 out of 8 (50%)
Using multidisciplinary rehabilitation	-	X	-	X	X	-	X	X	X	X	X	-	X	X	X	11 out of 11 (100%)
Chronic LBP	-	X	-	X	X	-	X	X	X	X		-		X	X	9 out of 11 (81%)
Any duration of symptoms	-		-			-						-	X			1 out of 11 (9%)
Patients not recovered after monodisciplinary approach	-		-			-					X	-				1 out of 11 (9%)

aquatic exercises, stretching, back schools, McKenzie exercise approach, yoga, and tai-chi) and mode of delivery (e.g., individually designed programs, supervised home exercise, and group exercise). Guidelines provided inconsistent recommendations on exercise therapy for acute LBP.

The recommendations for spinal manipulation and acupuncture vary across clinical practice guidelines. Eleven guidelines provided recommendations for spinal manipulation, and nine guidelines recommended its use. Most guidelines (6 out of 9; 66%) recommend spinal manipulation for

Table 2 (continued)

Using psychosocial therapy	-	X	-	X	X	-	X	X	X	X	X	-	X	X	X	11 out of 11 (100%)
Chronic LBP	-		-	X	X	-	X	X	X		X	-	X	X	X	9 out of 11 (82%)
Acute LBP	-	X	-			-						-				1 out of 11 (9%)
Any duration of symptoms	-		-			-				X		-				1 out of 11 (9%)
Using exercise therapy	X		X	X	X	X	X	X	X	X	X	X	X	X	X	14 out of 15 (93%)
Chronic LBP			X		X		X	X	X	X	X	X	X		X	10 out of 14 (71%)
Acute LBP	X					X					X					3 out of 14 (21%)
Any duration of symptoms				X										X		2 out of 14 (14%)
Using spinal manipulation		-	-	X	X	X		X	X	-	X	X	-	X	X	9 out of 11 (81%)
Acute LBP		-	-		X	X		X		-	X	X	-		X	6 out of 9 (66%)
Chronic LBP								X				X			X	3 out of 9 (33%)
Any duration of symptoms				X					X					X		3 out of 9 (33%)
Against the use of spinal manipulation	X	-	-							-	X		-			2 out of 11 (19%)
Chronic LBP											X					1 out of 2 (50%)
Acute LBP	X															1 out of 2 (50%)
Using acupuncture	X	X	-	-		X	-		-	-	-		-		X	4 out 8 (50%)
Against the use of acupuncture			-	-	X		-	X	-	-	-	X	-	X		4 out 8 (50%)

"-" = The guideline did not provide any recommendation regarding the approach.

"X" = The guideline endorsed the recommendation regarding the approach.

" " = The guideline did not endorse the recommendation regarding the approach.

acute LBP, but there are some discrepancies on the indications. The guidelines recommend spinal manipulation in addition to usual care [30], if there is no improvement after other treatments [7, 31], or in any circumstance [10, 28]. Three guidelines [15, 24, 32] (33%) recommend spinal manipulation as a component of a multimodal or active treatment program for patients with any symptom duration. Three guidelines (33%) recommend spinal manipulation as a component of a multimodal treatment program [10] or in any circumstance for chronic LBP [28]. In contrast, two guidelines recommend against spinal manipulation for acute LBP [9] or chronic LBP [31].

Similarly, the recommendations for acupuncture were inconsistent. Four guidelines [1, 7, 10, 28] recommend the use of acupuncture. Of these, three guidelines recommend acupuncture for patients with acute and chronic LBP [1, 28]. One guideline [7, 10] recommends acupuncture as an adjunct of an active rehabilitation program for patients with chronic LBP. Four out of eight guidelines do not recommend acupuncture [9, 24, 30] (37%) or state that acupuncture should be avoided [25] (13%).

Methods of development of the clinical practice guidelines

Table 3 provides the methods of development and implementation reported by each clinical practice guideline, and "supplementary material: Appendix 3" details these methods. Most guidelines [1, 7, 10, 11, 15, 20, 24–26, 28, 30–32] were issued by a multidisciplinary group including healthcare professionals such as primary care physicians, physical and manual therapists, chiropractors, psychologists, orthopaedic surgeons, rheumatologists, and radiologists. The African guideline [9] was developed by a medical group, and the Brazilian guideline [3] was developed by an association comprised of physiatrists.

Table 3 Description of the methods for development of clinical guidelines for low back pain

Methods	AFRI (2015)	AUS (2016)	BRA (2013)	BEL (2017)	CAN (2015)	DEN (2017)	FIN (2011)	GER (2017)	MAL (2012)	MEX (2011)	NETH (2010)	PHI (2011)	SPA (2012)	UK (2016)	USA (2017)	% of agreement
Multidisciplinary group committee		X		X	X	X	X	X	X	X	X	X	X	X	X	13 out of 15 (87%)
Systematic literature search		X	X	X	X	X	X	X	X	X	X	X	X	X	X	14 out of 15 (93%)
Strength of the evidence	–	–	X	X	–	X	X	X	–	X	–	X	X	X	X	10 out of 15 (67%)
Consensus	X	X	–	X	–	X	X	X	–	X	X	X	X	X	–	11 out of 15 (73%)
Direct link of evidence to the recommendation	X	X	X	–	X	X	X	X	–	X	–	X	–	–	X	9 out of 15 (60%)
External review	–	–	–	X	–	X	X	–	–	–	–	–	X	X	X	5 out of 15 (33%)
Clear recommendations	–	X	–	X	X	X	X	X	–	–	X	X	X	X	X	11 out of 15 (73%)
Time for updating	–	–	–	–	–	X	X	X	–	–	–	–	–	X	–	4 out of 15 (27%)
Strategies as well as barriers and facilitators for implementation	–	X	–	X	–	–	X	–	–	–	–	X	X	X	–	6 out of 15 (40%)
Additional materials for implementation	–	X	–	X	X	–	X	X	–	–	X	X	X	X	–	9 out of 15 (60%)

"-" The guideline did not provide any information regarding the topic

"X" The guideline provided information regarding the topic

" " The guideline did not met this topic

Most guidelines based their recommendations on systematic literature searches of electronic databases and previous version of guidelines (14 out of 15; 93%) [1, 3, 7, 10, 11, 15, 20, 24–26, 28, 30–32], evaluated the strength of the evidence (10 out of 15; 67%) [1, 3, 10, 11, 20, 24–28, 30, 32], and used consensus in the working group when necessary (11 out of 15; 73%) [1, 9–11, 20, 24–26, 30–32]. In addition, most guidelines gave direct links between the recommendations and the evidence (9 out of 15; 60%) [1, 3, 7, 9–11, 25, 30] and provided clear and specific recommendations (11 out of 15; 73%) [1, 7, 10, 20, 24–26, 28, 30–32]. In contrast, few guidelines provided sufficient information regarding their external review process (5 out of 15; 33%) [20, 24, 28, 30, 32] and the time frame for updates (4 out of 15; 27%) [10, 24, 26, 30]. Where it was reported, this ranged from 2 to 5 years.

Most guidelines were available on the website of the participating organization, and some guidelines [3, 10, 11, 28, 30] were published in scientific journals. Most guidelines (9 out of 15; 60%) were accompanied by additional materials for dissemination [1, 7, 10, 20, 24–26, 31, 32] such as different versions for patients and clinicians, a care pathway, a summary version, an interactive flowchart, or videos. A few guidelines (6 out of 15; 40%) reported strategies or the barriers and facilitators for implementation [1, 20, 24, 26, 32].

Changes in recommendations over time

Few changes were identified in the recommendations on diagnosis of non-specific LBP compared to the previous guidelines. Currently, most guidelines still recommend the assessment of psychosocial factors based on yellow flags at the first or second consultation. Of note, an increasing proportion (33%) of guidelines are recommending the use of validated prognostic screening tools (e.g., STarT Back screening tool or Örebro).

Some recommendations changed compared to the previous guidelines for the use of medications for non-specific LBP. Our 2010 overview found a hierarchical order including paracetamol as the first choice and NSAIDs as the second choice. In this review, we identified that most guidelines recommend only the use of NSAIDs as the first choice for any duration of symptoms. Of note, most current guidelines recommend antidepressants, where necessary, for chronic LBP which was not endorsed by the previous guidelines. The recommendations regarding the NSAIDs and antidepressants were consistent across guidelines included in this review.

We also identified more details on the recommendations regarding some approaches compared to the past guidelines. The current clinical practice guidelines suggest some types of exercise and modes of delivery for patients with chronic LBP compared to the previous guidelines which only noted the preference for using intensive training. We also found recommendations regarding some approaches in this review which were not previously cited in past guidelines such as the use of herbal medicines, acupuncture, and invasive treatments. However, the recommendations regarding these approaches were inconsistent or cited in a small proportion of guidelines (i.e., less than 50% of the guidelines).

Discussion

Fifteen clinical practice guidelines containing recommendations for non-specific LBP have been issued or updated since our last overview in 2010. For the diagnostic recommendations, guidelines recommend diagnostic triage (i.e., classification in non-specific LBP, radiculopathy/sciatica, and specific LBP), history taking and physical examination to identify red flags, neurological testing to identify radicular pain/radiculopathy, no routine imaging unless serious pathology is suspected, and assessment of yellow flags based on psychosocial factors cited in the guidelines in the first or second evaluation. For treatment of patients with acute LBP, most guidelines endorse recommendations for patient education, reassurance about a favourable prognosis and advice on returning to normal activities, avoiding bed rest, the use of NSAIDs and weak opioids for short periods when there is contraindication or lack of improvement with NSAIDs. For treatment of patients with chronic LBP, most guidelines recommend the use of NSAIDs and antidepressants where necessary, prescription of exercise therapy, and psychosocial interventions. In addition, considering referring to a specialist is recommended in case of serious pathologies or radiculopathy, or if there is no improvement after 4 weeks to 2 years.

Discrepancies in the recommendations across the guidelines

We identified discrepancies in the recommendations for the use of paracetamol, muscle relaxants, and herbal medicines. For paracetamol, the most recent guidelines [10, 24, 28, 30, 32] do not recommend this medication. This change might be attributable to recent studies demonstrating the lack of efficacy of paracetamol for non-specific LBP [29, 36]. In addition, the inconsistent recommendations for the use of muscle relaxants, and herbal medicines might be attributable to different care settings and cultural context across the countries.

Most guidelines recommend the use of weak opioids for short periods if NSAIDs are contraindicated or not effective for patients with acute LBP, despite an absence of relevant clinical trials as demonstrated by a recent systematic review [2]. Considering the rising prescription of opioids [22], the use of this pain medication has been discouraged due to

the small benefit on pain intensity in chronic LBP as well as potential side effects (e.g., misuse or physical dependence) [2, 23]. Although the current review found that most guidelines recommend opioids for acute LBP, this recommendation is not supported by the evidence and may result in increased harms for patients with non-specific LBP.

The recommendations on spinal manipulation and acupuncture are inconsistent but in different aspects. The recommendations on spinal manipulation vary mainly regarding the circumstances in which the intervention should be administered (e.g., any circumstance, in addition to usual care, after lack of improvement). The recommendations on acupuncture have discrepancies related to its use in patients with non-specific LBP. In addition, four guidelines [1, 7, 10, 28] recommend acupuncture, but disagree regarding duration of symptoms. These discrepancies might be attributable to the lack of high-quality evidence which may result in recommendations based on group consensus considering different aspects. Future studies should be conducted to clarify these recommendations.

Few changes in the recommendations over time

Although the number of randomised controlled trials has nearly doubled since 2010, the recommendations regarding management remain similar compared to the previous review. We identified an increasing proportion (33%) of guidelines recommending the assessment of yellow flags using prognostic screening tools [10, 24, 25, 32]. This might be attributable to a recent randomised clinical trial that showed small improvements from targeting treatment based on responses to a validated prognostic screening tool [12]. However, this was based on one study only, and a recent review [16] found that screening tools poorly identify patients who will develop chronic pain and worse outcomes in patients with LBP. Future studies should be conducted before any definitive conclusion can be made regarding the use of prognostic models.

The guidelines still uniformly recommend exercise for chronic LBP. However, the clinical practice guidelines are now suggesting a greater variety of types of exercise. For example, guidelines include options such as sports rehabilitation, physical activity as tolerated, aquatic exercises, stretching, aerobic, strength training, endurance, motor control exercise, yoga, and tai-chi. Although the guidelines endorsing some types of exercise increased [1, 7, 20, 24, 26, 28], there is no consistency in the recommendations favouring one particular modality. Hence, we would argue that the choice may rely on patients' preferences and therapists' experience.

Future developments in research and guideline development

Our overview included clinical practice guidelines that issued recommendations for patients with nonspecific LBP. Although some guidelines also include recommendations for different types of LBP, future studies should investigate the recommendations for radicular pain/radiculopathy and specific LBP. Another limitation of this review is the absence of quality assessment of the guidelines using a validated tool (e.g., AGREE). Nevertheless, we provided an overview of the methods of the clinical practice guidelines included in the current review.

Based on the recommendations for the development of guidelines for LBP provided by the previous review, the methods for developing the guidelines seem to have improved over the years (Box 3). Most guidelines provided a description for obtaining the evidence to be used in the recommendations, with some describing the method for assessing the strength of the evidence (Recommendation 1). However, only two guidelines [20, 30] (13%) included non-English publications (Recommendation 2). The target group and the committee of the guideline were well described (Recommendations 3 and 4). A substantial proportion (53%) of guidelines provided a direct link between the evidence and recommendations (Recommendation 5). Although an increasing number of guidelines reported details regarding the consensus methods, this topic was still not appropriately described by the guidelines (Recommendation 6). One issue that remained over the years was that the clinical practice guidelines did not often incorporate information regarding effectiveness and health benefits as well as the cost-effectiveness (Recommendation 7). As mentioned earlier, the strategies for dissemination of the guidelines have improved substantially with several types of materials available for patients and clinicians. However, although the details regarding implementation also improved, most guidelines did not specify the strategies as well as the barriers and facilitators for implementation in the clinical practice (Recommendation 8). In addition, few guidelines [10, 24, 26, 30] provided the methods and time frame for updating (Recommendation 9).

Conclusion

The current clinical practice guidelines recommend diagnostic triage using history taking and physical examination to identify red flags and neurological testing to identify radicular pain/radiculopathy, against routine imaging unless serious pathology is suspected, and assessment of yellow flags based on psychosocial factors cited in the guidelines in the first or second evaluation. For acute LBP, most guidelines

Box 3 Recommendations for the development of future guidelines in the field of low back pain

1. Make use of available evidence-based reviews and previous clinical guidelines
2. Include relevant non-English publications (if available)
3. Determine in advance the intended target groups (healthcare professions, patient population, and policy makers)
4. Be aware that the makeup of the guideline committee may have a direct impact on the content of the recommendations
5. Specify exactly which recommendations are evidence based and supply the correct references to each of these recommendations
6. Specify exactly which recommendations are consensus based and explain the process
7. Specify effectiveness and cost-effectiveness of the recommendations
8. Determine barriers, facilitators, and action for implementing in clinical practice strategy
9. Provide a time frame for future updates of the guideline

endorsed recommendations for patient education, reassurance about the favourable prognosis and advice on returning to normal activities, avoiding bed rest, the use of NSAIDs and weak opioids for short periods where necessary. For chronic LBP, most guidelines recommended the use of NSAIDs and antidepressants where necessary, prescription of exercise therapy, and psychosocial interventions. In addition, referring to a specialist is recommended in cases where there is suspicion of serious pathologies or radiculopathy or if there is no improvement after 4 weeks to 2 years.

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Compliance with ethical standards

Conflict of interest C.G.M. reports receiving lecture fees from Pfizer. No other conflict of interest relevant to this article was declared.

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VA/DoD CLINICAL PRACTICE GUIDELINE FOR DIAGNOSIS AND TREATMENT OF LOW BACK PAIN

Department of Veterans Affairs

Department of Defense

QUALIFYING STATEMENTS

The Department of Veterans Affairs and the Department of Defense guidelines are based upon the best information available at the time of publication. They are designed to provide information and assist decision making. They are not intended to define a standard of care and should not be construed as one. Neither should they be interpreted as prescribing an exclusive course of management.

This Clinical Practice Guideline is based on a systematic review of both clinical and epidemiological evidence. Developed by a panel of multidisciplinary experts, it provides a clear explanation of the logical relationships between various care options and health outcomes while rating both the quality of the evidence and the strength of the recommendation.

Variations in practice will inevitably and appropriately occur when clinicians take into account the needs of individual patients, available resources, and limitations unique to an institution or type of practice. Every healthcare professional making use of these guidelines is responsible for evaluating the appropriateness of applying them in the setting of any particular clinical situation.

These guidelines are not intended to represent Department of Veterans Affairs or TRICARE policy. Further, inclusion of recommendations for specific testing and/or therapeutic interventions within these guidelines does not guarantee coverage of civilian sector care. Additional information on current TRICARE benefits may be found at www.tricare.mil or by contacting your regional TRICARE Managed Care Support Contractor.

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Version 2.0 – 2017

Based on evidence reviewed through October 21, 2016

Table of Contents

I. Introduction

The Department of Veterans Affairs (VA) and Department of Defense (DoD) Evidence-Based Practice Work Group (EBPWG) was established and first chartered in 2004, with a mission to advise the "…Health Executive Council on the use of clinical and epidemiological evidence to improve the health of the population across the Veterans Health Administration and Military Health System," by facilitating the development of clinical practice guidelines (CPGs) for the VA and DoD populations.[1] This CPG is intended to provide healthcare providers with a framework by which to evaluate, treat, and manage the individual needs and preferences of patients with low back pain (LBP).

In 2007, the VA and DoD published the Clinical Practice Guideline for diagnosis and treatment of Low Back Pain (2007 LBP CPG), which was based on evidence reviewed through November 2006. Since the release of that guideline, a growing body of research has expanded the general knowledge and understanding of LBP. Improved recognition of the complex nature of these conditions has led to the adoption of new strategies for diagnosis and treatment of LBP.

Consequently, a recommendation to update the 2007 LBP CPG was initiated in 2016. The updated CPG, titled Clinical Practice Guideline for Diagnosis and Treatment of Low Back Pain (2017 LBP CPG), includes objective, evidence-based information on the diagnosis and management of acute and chronic LBP. It is intended to assist healthcare providers in all aspects of patient care, including, but not limited to, diagnosis, treatment, and management. The system-wide goal of this guideline is to improve the patient's health and wellbeing by providing evidence-based guidance to providers who are diagnosing or treating patients with LBP. The expected outcome of successful implementation of this guideline is to:

- Assess the patient's condition and determine, in collaboration with the patient, the best treatment method
- Optimize each individual's health outcomes and improve quality of life
- Minimize preventable complications and morbidity
- Emphasize the use of patient-centered care

II. Recommendations

#	Recommendation	Strength*	Category†
A. Diagnostic Approach			
1.	For patients with low back pain, we recommend that clinicians conduct a history and physical examination, that should include identifying and evaluating neurologic deficits (e.g., radiculopathy, neurogenic claudication), red flag symptoms associated with serious underlying pathology (e.g., malignancy, fracture, infection), and psychosocial factors.	Strong for	Reviewed, Amended
2.	For patients with low back pain, we suggest performing a mental health screening as part of the low back pain evaluation and taking results into consideration during selection of treatment.	Weak for	Reviewed, New-replaced
3.	For patients with acute axial low back pain (i.e., localized, non-radiating), we recommend against routinely obtaining imaging studies or invasive diagnostic tests.	Strong against	Reviewed, Amended
4.	For patients with low back pain, we recommend diagnostic imaging and appropriate laboratory testing when neurologic deficits are serious or progressive or when red flag symptoms are present.	Strong for	Reviewed, Amended
5.	For patients with low back pain greater than one month who have not improved or responded to initial treatments, there is inconclusive evidence to recommend for or against any diagnostic imaging.	Not applicable	Reviewed, New-added
B. Education and Self-care			
6.	For patients with chronic low back pain, we recommend providing evidence-based information with regard to their expected course, advising patients to remain active, and providing information about self-care options.	Strong for	Reviewed, Amended
7.	For patients with chronic low back pain, we suggest adding a structured education component, including pain neurophysiology, as part of a multicomponent self-management intervention.	Weak for	Reviewed, New-added
C. Non-pharmacologic and Non-invasive Therapy			
8.	For patients with chronic low back pain, we recommend cognitive behavioral therapy.	Strong for	Reviewed, New-replaced
9.	For patients with chronic low back pain, we suggest mindfulness-based stress reduction.	Weak for	Reviewed, New-replaced
10.	For patients with acute low back pain, there is insufficient evidence to support the use of specific clinician-directed exercise.	Not applicable	Reviewed, New-replaced
11.	For patients with chronic low back pain, we suggest offering clinician-directed exercises.	Weak for	Reviewed, New-replaced
12.	For patients with acute or chronic low back pain, we suggest offering spinal mobilization/manipulation as part of a multimodal program.	Weak for	Reviewed, New-replaced
13.	For patients with acute low back pain, there is insufficient evidence to support the use of acupuncture.	Not applicable	Reviewed, New-replaced
14.	For patients with chronic low back pain, we suggest offering acupuncture.	Weak for	Reviewed, New-replaced
15.	For acute or chronic low back pain, there is insufficient evidence for or against the use of lumbar supports.	Not applicable	Reviewed, Amended
16.	For patients with chronic low back pain, we suggest offering an exercise program, which may include Pilates, yoga, and tai chi.	Weak for	Reviewed, New-replaced
17.	For patients with low back pain, there is insufficient evidence to support the use of ultrasound.	Not applicable	Reviewed, New-added

#	Recommendation	Strength*	Category†
18.	For patients with low back pain, there is inconclusive evidence to support the use of transcutaneous electrical nerve stimulation (TENS).	Not applicable	Reviewed, New-added
19.	For patients with low back pain, there is insufficient evidence to support the use of lumbar traction.	Not applicable	Reviewed, New-added
20.	For patients with low back pain, there is insufficient evidence to support the use of electrical muscle stimulation.	Not applicable	Reviewed, New-added
D. Pharmacologic Therapy			
21.	For patients with acute or chronic low back pain, we recommend treating with nonsteroidal anti-inflammatory drugs, with consideration of patient-specific risks.	Strong for	Reviewed, Amended
22.	For patients with chronic low back pain, we suggest offering treatment with duloxetine, with consideration of patient-specific risks.	Weak for	Reviewed, New-added
23.	For patients with acute low back pain or acute exacerbations of chronic low back pain, we suggest offering a non-benzodiazepine muscle relaxant for short-term use.	Weak for	Reviewed, New-added
24.	For patients with chronic low back pain, we suggest against offering a non-benzodiazepine muscle relaxant.	Weak against	Reviewed, New-added
25.	For patients with low back pain, we recommend against benzodiazepines.	Strong against	Reviewed, New-replaced
26.	For patients with acute or chronic low back pain with or without radiculopathy, we recommend against the use of systemic corticosteroids (oral or intramuscular injection).	Strong against	Reviewed, Amended
27.	For patients with low back pain, we recommend against initiating long-term opioid therapy. For patients who are already prescribed long-term opioid therapy, refer to the VA/DoD CPG for the Management of Opioid Therapy for Chronic Pain.[1]	Strong against	Reviewed, New-replaced
28.	For patients with acute low back pain or acute exacerbations of chronic low back pain, there is insufficient evidence to recommend for or against the use of time-limited opioid therapy. Given the significant risks and potential benefits of opioid therapy, patients should be evaluated individually, including consideration of psychosocial risks and alternative non-opioid treatments. Any opioid therapy should be kept to the shortest duration and lowest dose possible.	Not applicable	Reviewed, New-replaced
29.	For patients with acute or chronic low back pain, there is insufficient evidence to recommend for or against the use of time-limited (less than seven days) acetaminophen therapy.	Not applicable	Reviewed, New-replaced
30.	For patients with chronic low back pain, we recommend against the chronic use of oral acetaminophen.	Strong against	Reviewed, New-replaced
31.	For the treatment of acute or chronic low back pain, including patients with both radicular and non-radicular low back pain, there is insufficient evidence to recommend for or against the use of antiepileptics including gabapentin and pregabalin.	Not applicable	Reviewed, New-replaced
32.	For the treatment of low back pain, there is insufficient evidence to recommend for or against the use of topical preparations.	Not applicable	Reviewed, New-added
E. Dietary Supplements			
33.	For the treatment of low back pain, there is insufficient evidence to recommend for or against nutritional, herbal, and homeopathic supplements.	Not applicable	Reviewed, New-added

[1] See the VA/DoD Clinical Practice Guideline for the Management of Opioid Therapy for Chronic Pain. Available at: http://www.healthquality.va.gov/guidelines/Pain/cot/

#	Recommendation	Strength*	Category†
F. Non-surgical Invasive Therapy			
34.	For the long-term reduction of radicular low back pain, non-radicular low back pain, or spinal stenosis, we recommend against offering spinal epidural steroid injections.	Strong against	Reviewed, New-added
35.	For the very short-term effect (less than or equal to two weeks) of reduction of radicular low back pain, we suggest offering epidural steroid injection.	Weak for	Reviewed, New-added
36.	For the treatment of low back pain, we suggest against offering intra-articular facet joint steroid injections.	Weak against	Reviewed, New-added
37.	For patients with low back pain, there is inconclusive evidence to recommend for or against medial branch blocks and radiofrequency ablative denervation.	Not applicable	Reviewed, New-added
G. Team Approach to Treatment of Chronic Low Back Pain			
38.	For selected patients with chronic low back pain not satisfactorily responding to more limited approaches, we suggest offering a multidisciplinary or interdisciplinary rehabilitation program which should include at least one physical component and at least one other component of the biopsychosocial model (psychological, social, occupational) used in an explicitly coordinated manner.	Weak for	Reviewed, New-replaced

*For additional information, please refer to Grading Recommendations.

†For additional information, please refer to Recommendation Categorization and Appendix A.

III. Background

A. Description of Low Back Pain

While LBP is a symptom, rather than a disease or a syndrome, the diagnosis and treatment approaches for most patients with axial/non-radiating (previously referred to as non-specific) LBP is similar regardless of the underlying etiology. Therefore, this CPG focuses mainly on the management of patients with axial/non-radiating LBP rather than specific underlying diagnoses.

LBP is often categorized as acute (pain up to four weeks), subacute (4-12 weeks), or chronic (more than 12 weeks), and as such, the management of patients differs with the duration of the pain (see the Glossary in Appendix D for additional definitions). Axial/non-radiating LBP can be caused by mechanical problems, degenerative disc disease, facet joint arthropathy, or bulging or herniated intervertebral discs.[2] LBP may occur in the presence of radiculopathy or neurogenic claudication. The nature of pain in some patients may be myofascial, a symptom of fibromyalgia, and for some have an important underlying psychological component.

Signs and symptoms that indicate serious underlying pathology requiring additional diagnostic workup and prompt treatment are generally referred to as "red flags." Table 1 lists some common serious spinal conditions and the red flags that indicate further investigation may be needed.

The various treatments of axial/non-radiating LBP are categorized for this CPG as education and self-care, non-pharmacologic and non-invasive, pharmacologic, dietary supplements, non-surgical invasive procedures, and team approach. Other than surgery, which is out of scope for this CPG, the above-listed therapeutic approaches are discussed in detail in this CPG.

Table 1: Serious Underlying Conditions for LBP and Associated Red Flags or Risk Factors

Possible causes or conditions	Red flags or risk factors on history or physical examination
Cancer	▪ History of cancer with new onset of LBP ▪ Unexplained weight loss ▪ Failure of LBP to improve after one month ▪ Age greater than 50 years
Infection	▪ Fever ▪ Intravenous drug use ▪ Recent infection ▪ Immunosuppression
Fracture	▪ History of osteoporosis ▪ Chronic use of corticosteroids ▪ Older age (75 years or older) ▪ Recent trauma ▪ Younger patients with overuse at risk for stress fracture
Ankylosing spondylitis	▪ Morning stiffness ▪ Improvement with exercise ▪ Alternating buttock pain ▪ Awakening due to low back pain during the second part of the night (early morning awakening) ▪ Younger age
Herniated disc	▪ Radicular back pain (e.g., sciatica) ▪ Lower extremity dysesthesia and/or paraesthesia ▪ Positive straight-leg-raise test or crossed straight-leg-raise test ▪ Severe/progressive lower extremity neurologic deficits ▪ Symptoms present for more than one month
Spinal stenosis	▪ Radicular back pain (e.g., sciatica) ▪ Lower extremity dysesthesia and/or paraesthesia ▪ Neurogenic claudication ▪ Older age ▪ Severe/progressive lower extremity neurologic deficits ▪ Symptoms present for more than one month
Cauda equina or conus medullaris syndrome	▪ Urinary retention ▪ Urinary or fecal incontinence ▪ Saddle anesthesia ▪ Changes in rectal tone ▪ Severe/progressive lower extremity neurologic deficits

Abbreviation: LBP: low back pain

B. Epidemiology and Impact

a. General Population

LBP is one of the most frequently experienced medical conditions in the general population, with up to 84% of adults in the United States (U.S.) experiencing LBP at some point in their lives.[3] In 2010, of all diseases and injuries contributing to disability-adjusted life years in the U.S., LBP was ranked third.[4]

In 2012, approximately 27.5% of adults 18 years and older in the U.S. reported experiencing LBP in the last three months. This was slightly lower than in 1997 (29.2%) and 2010 (28.4%). Additionally, women are more likely than men to experience LBP (29.6% versus 25.4%, respectively).[5] More than two-thirds of pregnant women experience LBP and symptoms typically increase with advancing pregnancy;[6] however, pregnancy-related LBP often resolves itself in the post-partum period and may require specialist care when LBP persists or red flags are present.

In a study of U.S. healthcare costs from 1996 through 2013, spending related to LBP and neck pain was the third highest out of 155 conditions. In 2013, the estimated spending related to LBP and neck pain was $87.6 billion, an increase of $57.2 billion over the past 18 years.[7]

b. Veterans Affairs Population

The National Institutes of Health 2014 National Health Interview Survey provided national prevalence estimates of U.S. Veterans with severe pain (including back pain). The survey showed that 33% of Veterans reported significant back pain in the prior three months. The back pain was axial in 20% of Veterans and had features of sciatica in 12%. Among Veterans with back pain, 22% reported it as severe, and were more likely to have severe back pain compared to Non-Veterans.[8]

c. Department of Defense Population

A study of LBP in U.S. Armed Forces found that LBP diagnoses were associated with over six million outpatient visits and over 25,000 hospitalizations among Active Duty Service Members during the years 2010-2014.[9] The overall annual incidence of LBP was 12.0%. Of patients with LBP, 88.3% received a diagnosis of "non-specific LBP," but many received more than one diagnosis for LBP, including degenerative changes (14.1%), herniated disc (9.7%), and spinal stenosis (1.8%). A breakdown of the annual incidence of LBP by gender, service, race, and occupation is available in Table 2.[9]

Table 2: Incidence of Low Back Pain in U.S. Armed Forces, 2010-2014[9]

Category	Subgroup	Rate per year in percent
Gender	Male	11.3%
	Female	16.3%
Service	Army	15.8%
	Navy	7.9%
	Air Force	12.6%
	Marine Corps	8.7%
	Coast Guard	10.5%
Race	Black, non-Hispanic	13.8%
	White, non-Hispanic	11.9%
	Other	11.1%
Military Occupation	Combat	10.8%
	Healthcare	14.8%
	Admin/supply	14.7%
	Other	10.8%

IV. About this Clinical Practice Guideline

This LBP CPG is intended for VA and DoD healthcare practitioners including physicians, nurse practitioners, physician assistants, physical and occupational therapists, psychologists, social workers, nurses, chiropractors, clinical pharmacists, and others involved in the care of Service Members and their beneficiaries, retirees and their beneficiaries, or Veterans with LBP.

As with other CPGs, there are limitations, including significant evidence gaps, and a need to develop effective strategies for guideline implementation and evaluation of the effect of guideline adherence on clinical outcomes. Thus, as stated in the qualifying statements at the beginning of the CPG, this CPG is not intended to serve as a standard of care. Standards of care are determined on the basis of all clinical data available for an individual patient and are subject to change as scientific knowledge and technology advance and patterns evolve. This CPG is based on evidence available through October 2016 and is intended to provide a general guide to best practices. The guideline can assist healthcare providers, but the use of a CPG must always be considered as a recommendation, within the context of a provider's clinical judgment and patient values and preferences, for the care of an individual patient.

A. Scope of this Clinical Practice Guideline

This LBP CPG is designed to assist healthcare providers in diagnosing or treating patients with LBP. This CPG is not intended for and does not provide recommendations for the diagnosis and treatment of LBP in children or adolescents, or pregnant women. Surgical procedures (including procedures using spinal cord stimulators) are outside the scope of this guideline and excluded from the evidence review. Any patient in the VA or DoD healthcare system should be offered access to the interventions that are recommended in this guideline after taking into consideration the patient's specific circumstances.

Implementation of this guideline is intended to be patient centered. Thus, treatment and care should take into account a patient's needs and preferences. Good communication between healthcare professionals and the patient about the patient's pain experience, treatment goals, and challenges is essential and should be guided by evidence-based information tailored to the patient's needs. An empathetic and non-judgmental approach to communication with a patient is highly recommended in order to build trust and facilitate frank discussions relating to the social, economic, emotional, and cultural factors that influence patients' perceptions, behaviors, and decision making.

The information that patients are given about treatment and care should be culturally appropriate and also appropriate to the patient's level of education or understanding. It should also be accessible to people with additional needs such as physical, sensory, or learning disabilities. Family and/or caregiver involvement should be considered if appropriate.

The systematic review (SR) conducted for the update of this CPG encompassed intervention studies (primarily randomized controlled trials [RCTs]) and observational studies published between December 1, 2006 and October 21, 2016 and targeted nine key questions (KQs) focusing on the means by which the delivery of healthcare could be optimized for patients with LBP. Because a comprehensive review of the evidence related to LBP was not feasible, the nine selected KQs were prioritized from many possible KQs. The section on Recommendations delineates whether or not the current CPG recommendations were based on an updated evidence review. Appendix E delineates whether the 2007 CPG recommendations

were categorized based on an updated evidence review or whether the evidence support is from the previous version of the guideline. The section on Recommendation Categorization further describes the methodology used for the categorization.

B. Methods

The current document is an update to the 2007 VA/DoD LBP CPG. The methodology used in developing the 2017 LBP CPG follows the VA/DoD Guideline for Guidelines,[1] an internal document of the VA and DoD EBPWG. The VA/DoD Guideline for Guidelines can be downloaded from http://www.healthquality.va.gov/policy/index.asp. This document provides information regarding the process of developing guidelines, including the identification and assembly of the Guideline Champions (Champions) and other subject matter experts from within the VA and DoD, known as the Work Group, and ultimately, the development and submission of an updated LBP CPG. The VA Office of Quality, Safety and Value, in collaboration with the Office of Evidence Based Practice, U.S. Army Medical Command, the proponent for CPGs for the DoD, identified four clinical leaders, Sanjog Pangarkar, MD and Friedhelm Sandbrink, MD from the VA and MAJ Adam Bevevino, MD and MAJ Daniel Kang, MD from the DoD, as Champions for the 2017 LBP CPG.

The Champions and the Work Group for this CPG were charged with developing evidence-based clinical practice recommendations, and writing and publishing a guideline document to be used by providers within the VA and DoD healthcare systems. Specifically, the Champions and the Work Group were responsible for identifying the KQs – those considered most clinically relevant, important, and interesting with respect to the diagnosis and management of patients with LBP. The Champions and the Work Group also provided direction on inclusion and exclusion criteria for the evidence review and assessed the level and quality of the evidence. The amount of new scientific evidence that had accumulated since the previous version of the CPG was taken into consideration in the identification of the KQs. In addition, the Champions assisted in:

- Identifying appropriate disciplines of individuals to be included as part of the Work Group
- Directing and coordinating the Work Group
- Participating throughout the guideline development and review processes

The Lewin Team, including The Lewin Group, Duty First Consulting, ECRI Institute, and Sigma Health Consulting, LLC, was contracted by the VA and DoD to support the development of this CPG and conduct the evidence review. The first conference call was held in June 2016, with participation from the contracting officer's representative (COR), leaders from the VA Office of Quality, Safety and Value and the DoD Office of Evidence Based Practice, and the Champions. During this call, participants discussed the scope of the guideline initiative, the roles and responsibilities of the Champions, the project timeline, and the approach for developing and prioritizing specific research questions on which to base an SR about the diagnosis and treatment of LBP. The group also identified a list of clinical specialties and areas of expertise that were important and relevant to the diagnosis and treatment of LBP, from which Work Group members were recruited. The specialties and clinical areas of interest included: chiropractic care, integrative medicine, neurology, nursing, pain medicine, pharmacy, physical medicine and rehabilitation, physical therapy, primary care, radiology, and surgery.

The guideline development process for the 2017 LBP CPG update consisted of the following steps:

1. Formulating and prioritizing evidence questions (KQs)
2. Conducting the systematic review of the literature
3. Convening a face-to-face meeting with the CPG Champions and Work Group members
4. Drafting, revising, and submitting a final CPG about the diagnosis and treatment of LBP to the VA/DoD EBPWG

Appendix A provides a detailed description of each of these tasks.

a. Grading Recommendations

The Champions and Work Group used the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) approach to assess the quality of the evidence base and assign a grade for the strength for each recommendation. The GRADE system uses the following four domains to assess the strength of each recommendation:[10]

- Balance of desirable and undesirable outcomes
- Confidence in the quality of the evidence
- Patient or provider values and preferences
- Other implications, as appropriate, e.g.,:
    - Resource use
    - Equity
    - Acceptability
    - Feasibility
    - Subgroup considerations

Using this system, the Champions and the Work Group determined the direction (for or against) and relative strength (strong or weak) of each recommendation.[10] The direction indicates that the desirable effects of the recommendation outweigh the undesirable effects of the recommendation (for) or that the opposite is true (against). The strength indicates the Work Group's level of confidence in the balance of desirable and undesirable effects of the recommendation among the intended patient population.[11] A strong recommendation indicates the Work Group is confident in this balance (e.g., that the desirable effects outweigh the undesirable effects). A weak recommendation indicates that the balance is still likely, but the Work Group's confidence in the balance is lower than for a strong recommendation.

Occasionally, instances may occur when the Work Group feels there is insufficient evidence to make a recommendation for or against a particular therapy or preventive measure. This can occur when there is an absence of studies on a particular topic that met evidence review inclusion criteria, studies included in the evidence review report conflicting results, or studies included in the evidence review report inconclusive results regarding the desirable and undesirable outcomes.

Using these elements, the grade of each recommendation is presented as part of a continuum:

- Strong For (or "We recommend offering this option …")
- Weak For (or "We suggest offering this option …")
- No recommendation for or against (or "There is insufficient evidence …")
- Weak Against (or "We suggest not offering this option …")
- Strong Against (or "We recommend against offering this option …")

The grade of each recommendation made in the 2017 LBP CPG can be found in the section on Recommendations. Additional information regarding the use of the GRADE system can be found in the section on Grading Recommendations in Appendix A.

b. Reconciling 2007 Clinical Practice Guideline Recommendations

Evidence-based CPGs should be current, which typically requires revisions of previous guidelines based on new evidence or as scheduled, subject to time-based expirations.[12] For example, the United States Preventive Services Task Force (USPSTF) has a process for refining or otherwise updating its recommendations pertaining to preventive services.[13] Further, the inclusion criteria for the National Guideline Clearinghouse specify that a guideline must have been developed, reviewed, or revised within the past five years.

The 2017 LBP CPG is an update of the 2007 LBP CPG. Thus, the content of the 2017 LBP CPG is reflective of the previous version of the CPG, but modified where necessary to reflect new evidence and new clinical priorities.

The Work Group focused largely on developing new and updated recommendations based on the evidence review conducted for the priority areas addressed by the KQs. In addition to those new and updated recommendations, the Work Group considered the current applicability of other recommendations that were included in the previous 2007 LBP CPG without complete review of the relevant evidence, subject to evolving practice in today's environment.

To indicate which recommendations were developed based on the updated review of the evidence versus recommendations that were carried forward from the 2007 version of the CPG, a set of recommendation categories was adapted from those used by the National Institute for Health and Care Excellence (NICE).[14,15] These categories, along with their corresponding definitions, were used to account for the various ways in which older recommendations could have been updated. In brief, the categories took into account whether or not the evidence that related to a recommendation was systematically reviewed, the degree to which the recommendation was modified, and the degree to which a recommendation is relevant in the current patient care environment and within the scope of the CPG. Additional information regarding these categories and their definitions can be found in the section on Recommendation Categorization. The categories for the recommendations included in the 2017 version of the guideline can be found in the section on Recommendations. The categorizations for each 2007 LBP CPG recommendation can be found in Appendix E.

In cases where a 2007 LBP CPG recommendation was covered by a 2017 KQ, peer-reviewed literature published since the 2007 LBP CPG was considered along with the evidence base used for the 2007 LBP

CPG. Where new literature was considered when assessing the strength of the recommendation, it is referenced in the discussion following the corresponding recommendation, as well as in Appendix C.

The CPG Work Group recognizes that, while there are practical reasons for incorporating findings from a previous SR, previous recommendations, or recent peer-reviewed publications into an updated CPG, doing so does not involve an original, comprehensive SR and, therefore, may introduce bias.[16]

c. Peer Review Process

The CPG was developed through an iterative process in which the Work Group produced multiple drafts of the CPG. The process for developing the initial draft is described in more detail in Drafting and Submitting the Final Clinical Practice Guideline.

Once a near-final draft of the guideline was agreed upon by the Champions and the Work Group members, the draft was sent out for peer review and comment. The draft was posted on a wiki website for a period of 14 business days. The peer reviewers comprised individuals working within the VA and DoD health systems as well as experts from relevant outside organizations designated by the Work Group members. External organizations that participated in the peer review included the following:

- Oregon Health & Science University
- Parker University
- Stanford Health Care
- University of California San Francisco School of Medicine
- Yale University

VA and DoD Leadership reached out to both the internal and external peer reviewers to solicit their feedback on the CPG. Reviewers were provided a hyperlink to the wiki website where the draft CPG was posted. For transparency, all reviewer feedback was posted in tabular form on the wiki site, along with the name of the reviewer. All feedback from the peer reviewers was discussed and considered by the Work Group. Modifications made throughout the CPG development process were made in accordance with the evidence.

C. Summary of Patient Focus Group Methods and Findings

When forming guideline recommendations, consideration should be given to the values of those most affected by the recommendations: patients. Patients bring perspectives, values, and preferences into their healthcare experience, and more specifically their pain care experience, that can vary from those of clinicians. These differences can affect decision making in various situations, and should thus be highlighted and made explicit due to their potential to influence a recommendation's implementation.[17,18] Focus groups can be used as an efficient method to explore ideas and perspectives of a group of individuals with an *a priori set* of assumptions or hypotheses and collect qualitative data on a thoughtfully predetermined set of questions.

Therefore, as part of the effort to update this CPG, VA and DoD Leadership, along with the LBP CPG Work Group, held a patient focus group prior to finalizing the KQs for the evidence review. The group met on September 7, 2016, at the William Beaumont Army Medical Center in El Paso, Texas. The aim of the focus

group was to further the understanding of the perspectives of patients with LBP within the VA and/or DoD healthcare systems. The focus group explored a set of topics related to diagnosis and treatment of LBP, including knowledge of LBP and other pain treatment options, delivery of care, and the impact of and challenges with LBP.

It is important to note the focus group was a convenience sample and the Work Group recognizes the limitations inherent in the small sample size. Less than 10 people were included in the focus group consistent with the requirements of the federal Paperwork Reduction Act, 1980. The Work Group acknowledges that the sample of patients included in this focus group may not be representative of all VA and DoD patients with LBP. Further, time limitations for the focus group prevented exhaustive exploration of all topics related to pain care in the VA and DoD and the patients' broader experiences with their care. Thus, the Work Group made decisions regarding the priority of topics to discuss at the focus group. These limitations, as well as others, were considered as the information collected from the discussion was used for guideline development. Recruitment for participation in the focus group was managed by the Champions and VA and DoD Leadership, with assistance from coordinators at the facility at which the focus group took place.

The following concepts are ideas and suggestions about aspects of care that are important to patients and family caregivers and that emerged from the discussion. These concepts were needed and important parts of the participants' care and added to the Work Group's understanding of patient values and perspectives. The Work Group considered the focus group feedback while assessing the strength of each recommendation and continued to consider the feedback throughout the LBP CPG development process. Additional details regarding the patient focus group methods and findings can be found in Appendix G.

LBP CPG Patient Focus Group Concepts	
A.	Consider patient-specific goals, values, and preferences and use shared decision making to develop a patient-centered plan for timely diagnosis, treatment, and lifestyle adaptation
B.	Address strategies for pain management across all phases of treatment and educate patients about the use of pain medications, particularly opioids
C.	Recognize the importance of communication and collaboration among providers of an interdisciplinary care team
D.	Involve family caregivers to create support and motivation for patients with LBP
E.	Work with providers to ensure continuity of care and ease of access to preferred providers
F.	Reduce the stigma experienced by patients with LBP

D. Conflict of Interest

At the start of this guideline development process and at other key points throughout, the project team was required to submit disclosure statements to reveal any areas of potential conflict of interest (COI) in the past 24 months. Verbal affirmations of no COI were also used as necessary during meetings throughout the guideline development process. The project team was also subject to random web-based surveillance (e.g., ProPublica, CMS Open Payments).

If a project team member reported a COI (actual or potential), then it was reported to the Office of Evidence Based Practice. It was also discussed with the LBP CPG Work Group in tandem with their review of the evidence and development of recommendations. The Office of Evidence Based Practice and the LBP

CPG Work Group determined whether or not action, such as restricting participation and/or voting on sections related to the conflict or removal from the Work Group, was necessary. If it was deemed necessary, action to mitigate the COI was taken by the Champions and Office of Evidence Based Practice, based on the level and extent of involvement. No conflicts of interest were identified for the LBP CPG Work Group members or Champions. Disclosure forms are on file with the Department of Veterans Affairs Evidence Based Practice Program office and available upon request.

E. Highlighted Features of this Clinical Practice Guideline

The 2017 edition of the VA/DoD LBP CPG is the first update to the original CPG. It provides practice recommendations for the diagnosis and treatment of populations with LBP. A particular strength of this CPG is the multidisciplinary stakeholder involvement from its inception, ensuring representation from the broad spectrum of clinicians engaged in the diagnosis and treatment of LBP.

The framework for recommendations in this CPG considered factors beyond the strength of the evidence, including balancing desired outcomes with potential harms of treatment, equity of resource availability, and the potential for variation in patient values and preferences. Applicability of the evidence to VA/DoD populations was also taken into consideration. A structured algorithm accompanies the guideline to provide an overview of the recommendations in the context of the flow of patient care and clinician decision making and to assist with training providers. The algorithm may be used to help facilitate translation of guideline recommendations into effective practice.

F. Patient-centered Care

VA/DoD CPGs encourage clinicians to use a patient-centered care approach that is tailored to the patient's capabilities, needs, goals, prior treatment experience, and preferences. Regardless of setting, all patients in the healthcare system should be offered access to evidence-based interventions appropriate to that patient. When properly executed, patient-centered care may decrease patient anxiety, increase trust in clinicians,[19] and improve treatment adherence.[20] Improved patient-clinician communication through patient-centered care can be used to convey openness to discuss any future concerns.

As part of the patient-centered care approach, clinicians should review the outcomes of past treatment experiences and outcomes of possible future treatments with the patient. Additionally, they should involve the patient in prioritizing and setting specific goals regardless of the selected setting or level of care.

G. Shared Decision Making

Throughout this VA/DoD CPG, the authors encourage clinicians to focus on shared decision making (SDM). The SDM model was introduced in *Crossing the Quality Chasm,* an Institute of Medicine (now the National Academy of Medicine) report, in 2001.[21] It is readily apparent that patients with LBP, together with their clinicians, make decisions regarding the type of treatment they choose to engage in; however, these patients require sufficient information to be able to make informed decisions. Clinicians must be adept at presenting information to their patients regarding individual treatment plans and appropriate locations of care.

H. Implementation

This CPG and algorithm are designed to be adapted by healthcare providers for the treatment of individual patients, bearing in mind patient-level considerations as well as local needs and resources. The algorithm serves as a tool to prompt providers to consider key decision points in the course of care.

Although this CPG represents the recommended practice on the date of its publication, medical practice is evolving and this evolution requires continuous updating based on published information. New technology and more research will improve patient care in the future. Identifying areas where evidence was lacking for the 2017 CPG can help identify priority areas for future research. Future studies examining the results of LBP CPG implementation may lead to the development of new evidence particularly relevant to clinical practice.

V. Guideline Work Group

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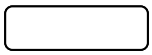
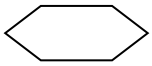
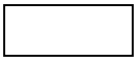
*Additional contributor contact information is available in Appendix F.

VI. Algorithm

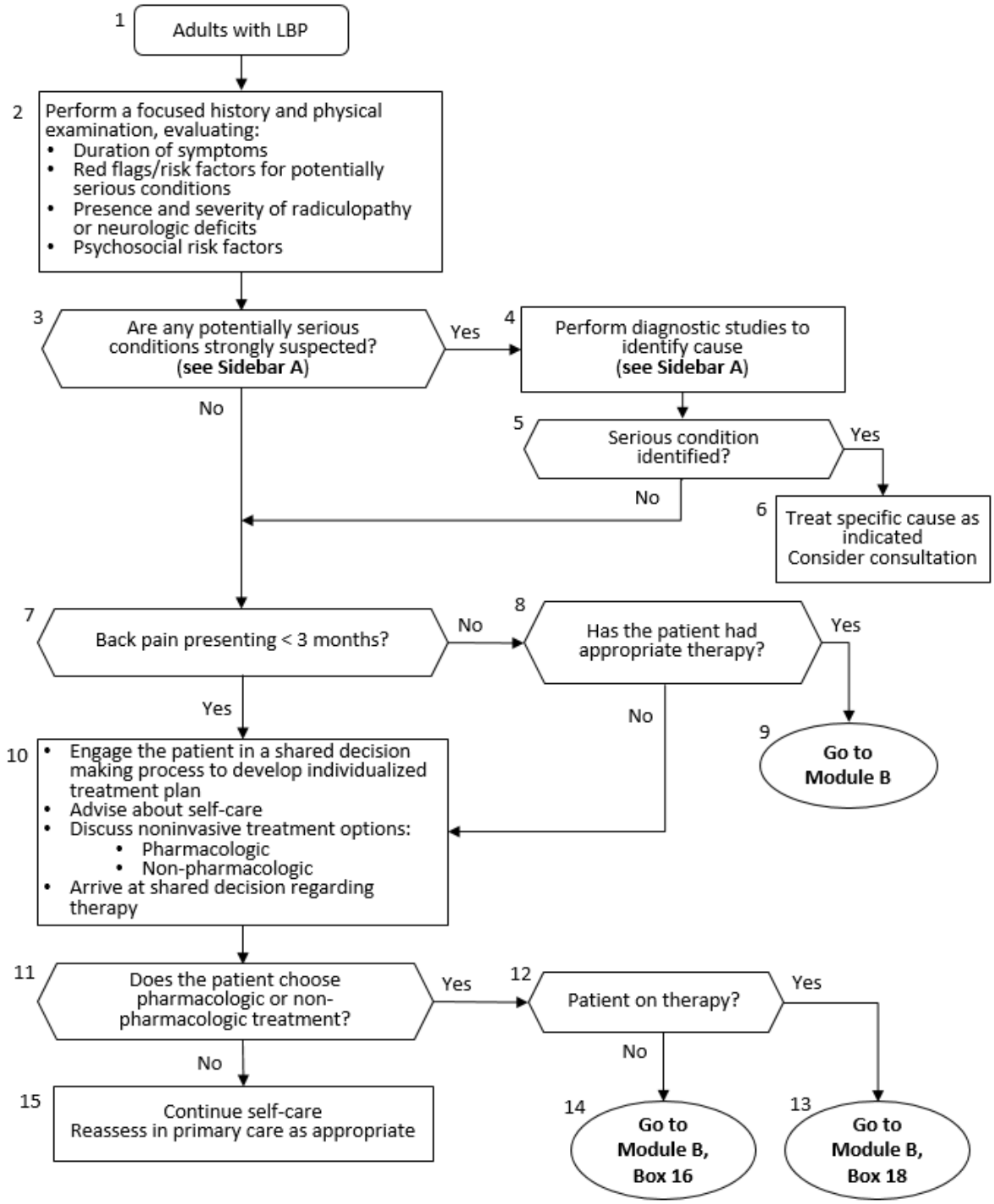
This CPG follows an algorithm which is designed to facilitate understanding of the clinical pathway and decision-making process used in the diagnosis and treatment of LBP. The use of the algorithm format as a way to represent patient management was chosen based on the understanding that such a format may promote more efficient diagnostic and therapeutic decision making and has the potential to change patterns of resource use. Although the Work Group recognizes that not all clinical practices are linear, the simplified linear approach depicted through the algorithm and its format allows the provider to assess the critical information needed at the major decision points in the clinical process. It includes:

- An ordered sequence of steps of care
- Recommended observations and examinations
- Decisions to be considered
- Actions to be taken

For each guideline, there is corresponding clinical algorithm that is depicted by a step-by-step decision tree. Standardized symbols are used to display each step in the algorithm, and arrows connect the numbered boxes indicating the order in which the steps should be followed.[22]

	Rounded rectangles represent a clinical state or condition.
	Hexagons represent a decision point in the guideline, formulated as a question that can be answered Yes or No.
	Rectangles represent an action in the process of care.

Module A: Initial Evaluation of Low Back Pain



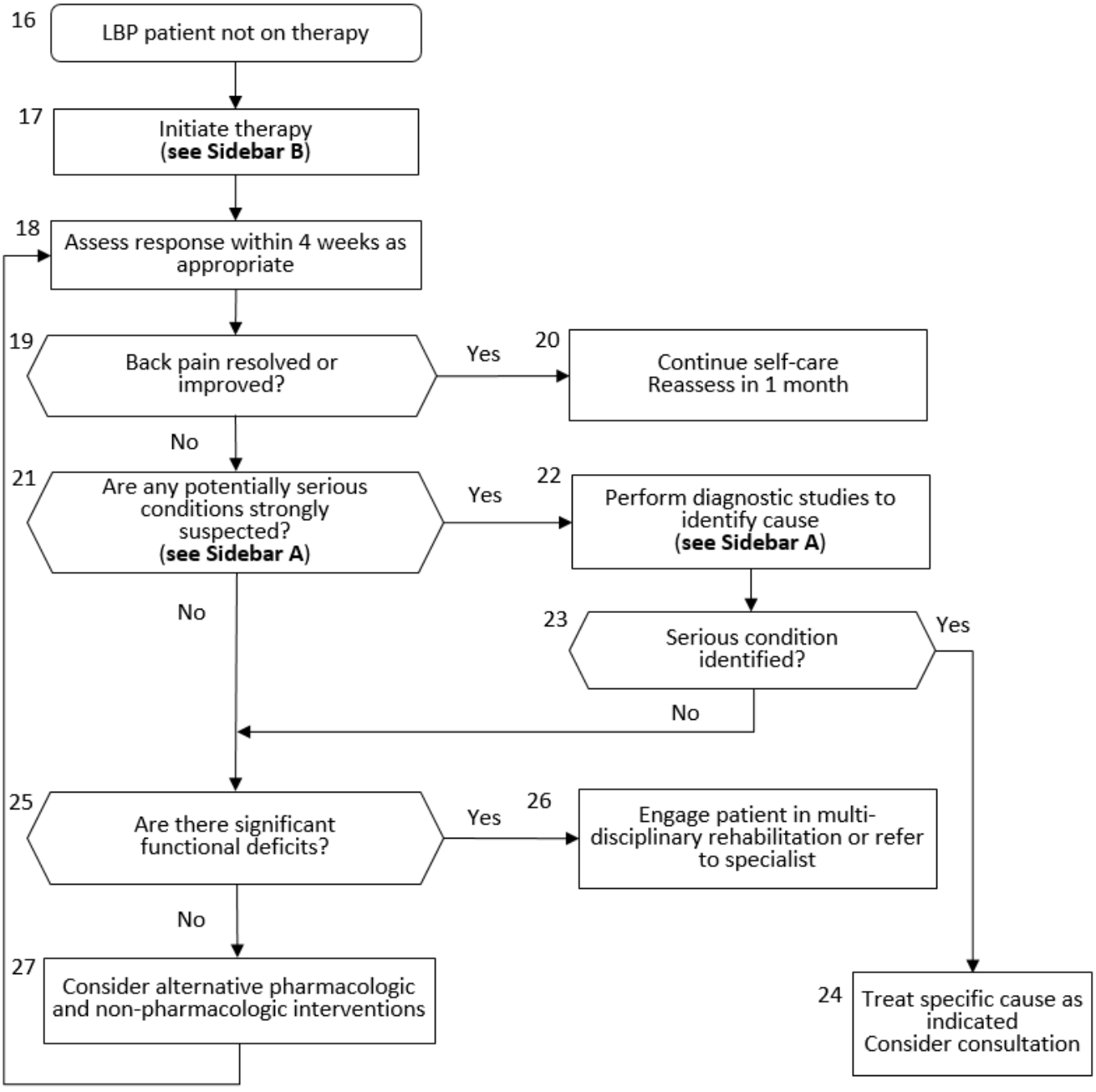
Sidebar A: Diagnostic Work-up		
Possible causes or conditions	**Red flags or risk factors on history or physical examination**	**Suggested diagnostic imaging**
Cancer	History of cancer with new onset of LBP Unexplained weight loss Failure of LBP to improve after 1 month Age > 50 years Multiple risk factors present	Lumbosacral plain radiography For inconclusive results, advanced imaging such as MRI with contrast* as appropriate
Infection	Fever Intravenous drug use Recent infection Immunosuppression	MRI with contrast* ESR
Fracture	History of osteoporosis Chronic use of corticosteroids Older age (≥75 years old) Recent trauma Younger patients with overuse at risk for stress fracture	Lumbosacral plain radiography For inconclusive results, advanced imaging such as MRI †, CT, or SPECT as appropriate
Ankylosing spondylitis	Morning stiffness Improvement with exercise Alternating buttock pain Awakening due to low back pain back pain during the second part of the night (early morning awakening) Younger age	Anterior-posterior pelvis plain radiography
Herniated disc	Radicular back pain (e.g., sciatica) Lower extremity dysesthesia and/or paraesthesia Positive straight-leg-raise test or crossed straight-leg-raise test	None
	Severe/progressive lower extremity neurologic deficits Symptoms present > 1 month	MRI †
Spinal stenosis	Radicular back pain (e.g., sciatica) Lower extremity dysesthesia and/or paraesthesia Neurogenic claudication Older age	None
	Severe/progressive lower extremity neurologic deficits Symptoms present > 1 month	MRI †
Cauda equina or conus medullaris syndrome	Urinary retention Urinary or fecal incontinence Saddle anesthesia Changes in rectal tone Severe/progressive lower extremity neurologic deficits	Emergent MRI † (preferred)

Abbreviations: CT: computed tomography; ESR: electron spin resonance; LBP: low back pain; MRI: magnetic resonance imaging; SPECT: single-photon emission computed tomography

*MRI with contrast, except where contraindicated (e.g., renal insufficiency), otherwise MRI without contrast

†MRI, except where contraindicated, (e.g., patients with pacemakers), otherwise CT or CT myelogram

Module B: Management of Low Back Pain



Sidebar B: Interventions			
		Low Back Pain Duration	
Category	**Intervention**	**Acute < 4 Weeks**	**Subacute or Chronic > 4 Weeks**
Self-care	Advice to remain active	X	X
	Books, handout	X	X
	Application of superficial heat	X	
Non-pharmacologic therapy	Spinal manipulation		X
	Clinician-guided exercise		X
	Acupuncture		X
	CBT and/or mindfulness-based stress reduction		X
	Exercise which may include Pilates, tai chi, and/or yoga		X
Pharmacologic therapy	NSAIDs	X	X
	Non-benzodiazepine skeletal muscle relaxants	X	
	Antidepressants (duloxetine)		X
Other therapies	Intensive interdisciplinary rehabilitation		X

Abbreviations: CBT: cognitive behavioral therapy; NSAIDs: nonsteroidal anti-inflammatory drugs

VII. Discussion of Recommendations

A. Diagnostic Approach

Recommendation

1. For patients with low back pain, we recommend that clinicians conduct a history and physical examination, that should include identifying and evaluating neurologic deficits (e.g., radiculopathy, neurogenic claudication), red flag symptoms associated with serious underlying pathology (e.g., malignancy, fracture, infection), and psychosocial factors.
   (Strong for | Reviewed, Amended)

Discussion

Conducting a history and physical examination is considered standard practice and the cornerstone of clinical decision making. The vast majority of patients initially presenting with LBP experience self-limited episodes with substantial improvement of symptoms within the first month.[23-25] However, a small proportion of LBP may be caused by a specific underlying condition (e.g., malignancy 0.7%, infection 0.01%, vertebral compression fracture 4%, spinal stenosis 3%, symptomatic herniated disc 4%),[26] including the possibility of referred pain from a proximate organ system (e.g., pancreatitis, nephrolithiasis, aortic aneurysm, endocarditis). Clinicians should also consider referred pain from the sacroiliac joint, hip joint or trochanteric bursa, which can sometimes manifest as LBP. LBP could also be a manifestation of a systemic condition (e.g., ankylosing spondylitis, rheumatoid arthritis) or multifocal underlying pain disorders (e.g., in patients with myofascial pain or fibromyalgia) that might be missed by addressing individual pain regions in isolation. Therefore, when evaluating LBP, clinicians should use a whole person approach and ask about the location of pain, frequency of symptoms, duration of pain, as well as any history of previous symptoms, treatment, response to treatment, and also evaluate psychosocial factors.

Clinicians should specifically identify the presence, duration, progression, and severity of neurologic symptoms and inquire about red flag symptoms. Rapidly progressive or severe neurologic deficits or LBP associated with a serious underlying condition (e.g., malignancy, fracture, infection, cauda equina syndrome [CES]) may necessitate additional diagnostic workup and prompt treatment.[26] The confidence in available evidence was rated moderate regarding the utility of red flag symptoms to determine the likelihood of two serious underlying conditions (malignancy and fracture). There was insufficient evidence regarding the utility of red flag symptoms for identifying other serious underlying conditions; however, when assessing the strength of the recommendation, the Work Group also considered that the benefits far outweigh potential harms to the patient.

A recent SR, which was rated fair quality and included 14 studies of 14,860 patients with acute LBP, analyzed red flag symptoms for malignancy and fracture.[27] A history of malignancy was the only red flag with significantly increased probability (7% in primary care and 33% in emergency setting) of malignancy as the serious underlying condition for LBP. Other risk factors for malignancy, including unexplained weight loss, failure to improve after one month, and age greater than 50 years, had a post-test probability below 3%.[27] In patients with any one of the other three risk factors, the likelihood of cancer increased to approximately 1.2%.[28]

The evidence review also identified a study that included 669 patients and used a multivariate analysis to

investigate red flag symptoms for fracture.[29] Data from the multivariate analysis suggests the following red flags for fracture: (1) older age (≥75 years old), (2) recent trauma, (3) osteoporosis, (4) severe back pain score ≥7 out of 10, and (5) thoracic pain. The evidence also suggests that the presence of multiple red flags increases the probability of fracture to between 42% and 90%.[29]

Red flag symptoms of LBP associated with infection have not been well studied, but may include fever, intravenous drug use, or recent infection.[26] CES is a rare condition, typically from an acute massive midline disc herniation, with an estimated prevalence of 0.04% among patients presenting with LBP. The most frequent finding in CES is urinary retention (90% sensitivity), although the constellation of symptoms may include: severe/progressive bilateral radiating leg pain, severe/progressive neurologic deficits at more than one level, saddle anesthesia, and fecal incontinence. In patients without urinary retention, the probability of CES is approximately 1 in 10,000.[28]

The Work Group felt a "Strong for" recommendation was warranted because the benefits of identifying serious underlying pathology outweigh the harms. The main benefit is the identification of a specific condition that requires a different treatment approach targeted at the underlying condition. The harms are the potential false positive red flag symptoms that may cause unnecessary additional diagnostic workup and the inherent risks and increased costs with those modalities, plus the fear or anxiety that may be experienced by the individual when undergoing diagnostic testing. The quality of evidence was moderate regarding the utility of red flag symptoms to determine the likelihood of malignancy and fracture, but was insufficient regarding other serious underlying conditions. Patients and providers have similar values, as both groups highly value and would likely choose to identify a possible serious underlying pathology to optimize outcomes.

Feasibility does not seem to be a major hurdle, given that clinicians perform a history and physical exam as standard practice, and a practical approach may be a screening questionnaire for patients presenting with LBP to reduce the possibility of overlooking neurologic deficits or red flag symptoms. However, the second order consequence on resource burden may be from false positive red flag symptoms, and the over-ordering of additional diagnostic workup for patients with axial LBP. Additional areas of research include utility of red flag symptoms for infection as a serious underlying condition given the potential response to early treatment, as well as predictive modeling to help identify specific causes of LBP based on patient factors.

Recommendation

2. For patients with low back pain, we suggest performing a mental health screening as part of the low back pain evaluation and taking results into consideration during selection of treatment. **(Weak for | Reviewed, New-replaced)**

Discussion

Available evidence indicates that the existence of behavioral health disorders such as depression, anxiety, and posttraumatic stress disorder (PTSD) influence pain and outcomes for those with chronic LBP. For adults with LBP, there is evidence indicating a greater risk of developing chronic LBP when associated with the existence of pre-pain major depressive disorder or generalized anxiety disorder.[30] A VA study

reported that 51% of patients with chronic LBP had PTSD symptoms.[2] An SR of fair quality included 17 studies that showed that symptoms of depression at baseline are related to worse LBP outcomes.[31] Patients with depression showed greater pain interference, lower quality of life, more sleep problems, and greater functional disability than the non-depressed patients.[32] It appears that screening is appropriate in patients with acute, subacute, or chronic LBP.

The VA/DoD CPG for The Management of Major Depressive Disorder[3] recommends patients not currently receiving treatment be screened for depression with the Patient Health Questionnaire-2 (PHQ-2). For those with a diagnosis of depression, the Patient Health Questionnaire-9 (PHQ-9) can be used as a quantitative measure of depression severity.

When assessing the strength of the recommendation, the Work Group considered that there are important benefits of mental health screening that outweigh the potential harms of not identifying LBP that is linked to or exacerbated by a coexisting mental health condition. Providers should be sensitive to the large variation of patient preferences, as some patients may worry that there is stigma attached to mental health conditions. Future research is needed on whether or not patients with co-occurring LBP and mental health conditions who are treated for their mental health conditions have improvement in the progression of their LBP over time.

Recommendation

3. For patients with acute axial low back pain (i.e., localized, non-radiating), we recommend against routinely obtaining imaging studies or invasive diagnostic tests.
   (Strong against | Reviewed, Amended)

Discussion

Patients presenting with less than three months of back pain, that is centered within the lumbar spine (i.e., axial LBP) and does not extend beyond the lower back, do not benefit from routine plain radiographs, computed tomography (CT), magnetic resonance imaging (MRI), or invasive diagnostic testing (discograms and other diagnostic injections).[26,33-37] There is moderate confidence in the quality of evidence to support this recommendation.

This patient population should be distinguished from those with chronic LBP and those with radiating pain. The timeline for distinguishing patients with acute, sub-acute, and chronic LBP is difficult to define based on available evidence. While not absolute, we describe acute and sub-acute symptoms as those that have lasted for less than three months, and it is for this population that the recommendation is intended. Axial/non-radiating LBP is centered within the lower back (mid-spinal or para-spinal) and extends in a lateral direction into the ipsilateral and contralateral para-spinal muscle regions. This is distinctly different from radiating back pain, in which patients endorse symptoms that radiate outside of the lower back region and into the lower extremities.

[2] See the VA National Center for PTSD Guide for Patients on Chronic Pain and PTSD: https://www.ptsd.va.gov/public/problems/pain-ptsd-guide-patients.asp

[3] See the VA/DoD Clinical Practice Guideline for the Management of Major Depressive Disorder. Available at: http://www.healthquality.va.gov/guidelines/MH/mdd/

The Work Group assessed that routine imaging or diagnostic testing in acute axial/non-radiating back pain has harms/burdens that outweigh potential benefits. Advanced imaging, such as MRI, is associated with an extremely high rate of false positive clinically asymptomatic findings.[38] However, once a finding is discovered on imaging, there is pressure on both healthcare provider and patient for further workup and potential specialty referral. This may lead to unnecessary resource utilization and further treatments with associated risks.[39] Although literature regarding "yellow flags" was not included in the evidence review, patients with psychosocial risk factors may be more likely to catastrophize and feel fearful of benign imaging results, leading to worse outcomes.[40] In regard to radiography and CT, the risk of radiation exposure is well established, and the tests should be reserved for circumstances that will affect clinical outcome. The potential for harm is particularly true in the case of discography, which is sometimes used for further evaluation of patients with LBP and MRI findings of disc disease and may lead to unnecessary treatment. There is no high quality evidence to support its use in the management of acute LBP and, in fact, there is evidence to suggest that it may lead to premature disc degeneration.[41]

The Work Group acknowledges that there is some variation in the values and preferences of patients with acute LBP, and understands that many patients present requesting diagnostic testing in hopes of finding an answer for their symptomatology. The Work Group does not advocate discrediting patient complaints, but rather endorses a method of educating patients regarding the lack of clinical benefit that routine diagnostic testing and imaging will provide them. Discussing other treatments for LBP that are associated with clinical benefit is more useful than ordering a diagnostic test.

It is critical to take into account the feasibility and the resource utilization of routine imaging tests and diagnostics. Acute LBP is a common presenting complaint and obtaining diagnostic imaging/testing that is not associated with a clinical benefit can lead to unneeded resource use. Furthermore, many providers do not have easy access to advanced imaging or testing, and routine use of these unindicated studies places an unnecessary burden on providers. The points above are primarily where future research on this topic should focus; specifically, the economic impact of imaging/diagnostics, the amount of spending attributed to these tests and on the subsequent referrals, and determining the main driver for ordering the tests given the lack of medical evidence for their utility (e.g., patient satisfaction, referral patterns/networks, health-care provider compensation).

When determining this recommendation to be a "Strong against," the Work Group considered the moderate confidence in the quality of available evidence, the potential for burdens to outweigh the benefits, and the feasibility and resource constraints of routine imaging. Patient preferences may vary, but patient education and discussion of treatment options are generally preferred over diagnostic imaging without an accompanying SDM approach.

Recommendation

4. For patients with low back pain, we recommend diagnostic imaging and appropriate laboratory testing when neurologic deficits are serious or progressive or when red flag symptoms are present. **(Strong for | Reviewed, Amended)**

Discussion

Most patients with lumbar disc herniation and radiculopathy will improve in the first four weeks with noninvasive management.[42,43] Additionally, the use of lumbar imaging (e.g., radiographs, CT, MRI) without indications of serious underlying conditions does not significantly improve outcomes.[37]

For patients with LBP and severe/progressive neurologic deficits indicative of a focal neurologic lesion (e.g., acute onset of foot drop) or when underlying serious pathology is suspected, MRI or CT are recommended. Although MRI and CT have similar sensitivity and specificity for the detection of spinal canal stenosis, MRI is preferred due to the increased soft tissue resolution and lack of ionizing radiation.[44,45] Plain radiography cannot visualize discs or accurately evaluate the degree of spinal stenosis to the same extent as MRI or CT, but may be considered as an adjunct imaging modality.[26] See Sidebar A for suggested diagnostic imaging for red flags or risk factors on history or physical examination.

Clinicians should be aware that findings on MRI or CT (e.g., bulging disc without nerve root impingement) are often nonspecific and may not be the cause of LBP. Decisions should be based on the clinical correlation between symptoms and imaging findings, severity of symptoms, patient preferences, costs, surgical risks (including the patient's comorbid conditions), and whether specialist input will be available.[46]

Moderate quality evidence supports the recommendation to perform diagnostic imaging and appropriate laboratory testing when patients have serious or progressive neurologic deficits or when red flag symptoms are present. When assessing the strength of the recommendation, the Work Group also considered the benefits to the patient to greatly outweigh the harms of not detecting a serious underlying condition when neurologic deficits or red flag symptoms are present. In this case, patients will strongly prefer to have imaging or testing to either diagnose or rule out potential serious underlying conditions.

Recommendation

5. For patients with low back pain greater than one month who have not improved or responded to initial treatments, there is inconclusive evidence to recommend for or against any diagnostic imaging.
   (Not applicable | Reviewed, New-added)

Discussion

Routine diagnostic imaging for the patient with LBP and no red flags is not recommended during the acute period.[37] However, once patients have failed to improve or respond to initial therapies, many patients and/or clinicians consider diagnostic imaging. In these patients beyond the acute period, diagnostic imaging may identify pathologies that warrant further investigation by other specialists as specific treatments may be of benefit. Pathologies of the spinal cord and/or nerve roots such as spinal dysraphism should prompt evaluation by a neurosurgeon. Pathologies of the spinal column beyond age-appropriate degenerative changes, such as severe spondylolisthesis,[47] may necessitate evaluation by a spine surgeon. Adjacent pathology mimicking LBP may warrant subspecialty evaluation, such as nephrolithiasis. Patients with a history of prior lumbar fusion or minor trauma, such as a fall, may benefit from imaging to rule out hardware failure, adjacent segment degeneration, compression fractures, or worsened spondylolisthesis.

Diagnostic imaging in the LBP patient who has failed to improve or respond to initial therapies may identify or confirm suspected etiologies of LBP that may help to guide further therapy. Facet or sacroiliac arthropathy may suggest continued judicious use of nonsteroidal anti-inflammatory drugs (NSAIDs) (see Recommendation 21).[48] Even though efficacy studies are lacking for non-surgical invasive procedures, diagnostic imaging may be used by some clinicians in specific scenarios to guide therapies (see Recommendations 34-37).[49] Spinal manipulation clinicians may benefit from assessing the degree of osteoporosis (e.g., in patients with history of steroid use).[50]

The evidence review did not specifically address the question of whether diagnostic imaging could identify all potential specific pathologies of interest in patients with LBP; however, as previously discussed, some data obtained during this review did provide information regarding some pathologies. The benefits of plain radiographs seem to outweigh the potential harms to the patients. The benefits largely encompass the potential to identify specific pathologies that warrant treatments beyond the scope of this CPG (e.g., surgical stabilization of spondylolisthesis). Importantly, routine diagnostic imaging for LBP with no red flags will most likely reveal nonspecific findings unrelated to LBP. For example, lumbar stenosis, degenerative disc changes, or Tarlov cysts are often asymptomatic radiographic findings. There is limited data to suggest that imaging without correlative pathology can help address the psychological impact of coping with LBP beyond the acute period. These harms are important as some suggest that imaging may lead to unnecessary invasive procedures. Excessive imaging may lead to concerns of radiation exposure.[36,51] The values of patients and providers are likely similar in that most would expect imaging if LBP persists beyond the acute period. Feasibility is not a major concern, as most medical treatment facilities have the ability to perform initial diagnostic imaging when indicated. Clinicians should base their decision for imaging studies on an assessment of the individual patient's needs, values, and preferences.

B. Education and Self-care

Recommendation

6. For patients with chronic low back pain, we recommend providing evidence-based information with regard to their expected course, advising patients to remain active, and providing information about self-care options.
   (Strong for| Reviewed, Amended)

Discussion

Providing information on LBP, including expected duration of symptoms, evidence-based self-care advice, and appropriate interventions, may reduce patient anxiety and positively affect attitudes regarding future outcomes.[23,25,52,53] Advice based predominantly on anatomic considerations is discouraged in favor of a biopsychosocial model that discusses pain physiology.

Patients with LBP should be advised to remain active and limit bedrest as much as reasonably possible. Use of thermal modalities, such as a heating pad, may increase comfort along with the use of a medium-firm mattress;[54] however, there is not enough evidence about the effect of the application of heat for LBP that lasts longer than three months or the application of cold for any duration. Individualized self-care education and interventions, along with more general information through an appropriate source, such as the Back

Book,[55] may improve patient understanding.[56] For patients with overweight or obesity, discuss weight management (see the VA/DoD CPG on Management of Obesity and Overweight).[4] Smoking or tobacco cessation should be discussed with patients who smoke or use other tobacco products (see the VA/DoD CPG for Treating Tobacco Use and Dependence and the VA/DoD SUD CPG).[5,6] Patients should be advised that in most cases the pain will improve in the first month.[23,25]

Additionally, patients should be made aware that routine imaging does not often provide useful information, may have adverse health consequences (e.g., radiation exposure), and can lead to additional, possibly unnecessary, medical interventions and costs.[36,51] Occupation-specific restrictions and/or limitations may be appropriate for certain patients and can be referenced through a number of guidelines.

When assessing the strength of the recommendation, the Work Group considered the moderate confidence in quality of evidence and also that the benefits to patients outweigh any harms. Providing education to patients may require extra time from clinicians, but the intervention does not have major feasibility or resource concerns. Most patients will value the communication from their providers regarding how to care for themselves and alleviate their LBP.

Recommendation

7. For patients with chronic low back pain, we suggest adding a structured education component, including pain neurophysiology, as part of a multicomponent self-management intervention. **(Weak for| Reviewed, New-added)**

Discussion

One SR and six RCTs evaluated the effectiveness of adding a structured education component to self-care interventions for improving LBP outcomes. Studies evaluating a physically active lifestyle, weight loss, and tobacco cessation did not meet inclusion criteria for the evidence review informing this CPG update and were therefore not considered in the development of this recommendation. The overall confidence in the quality of evidence was low, but the strongest available evidence suggested that education plus active treatment was beneficial compared to active treatment alone.

An RCT evaluated the effectiveness of combining aquatic exercise and pain neurophysiology education with aquatic exercise alone in 62 chronic LBP patients. Education was used to reduce the effects of kinesiophobia and catastrophizing as well as improve outcomes.[57] The education, based on work by Butler and Moseley[58] as well as Nijs et al.,[59] was provided in two 90-minute sessions performed prior to the onset of an aquatic exercise program. The findings demonstrated that adding neurophysiology education to an aquatic exercise program results in less pain and disability.[57]

An SR in adults with chronic LBP compared back school with usual care, active control other than back school, and multimodal treatments. Back school programs were of different duration and content, with

[4] See the VA/DoD Clinical Practice Guideline for the Management of Obesity and Overweight. Available at: https://www.healthquality.va.gov/guidelines/CD/obesity/

[5] See the VA/DoD Clinical Practice Guideline for Treating Tobacco Use and Dependence. Available at: https://www.healthquality.va.gov/guidelines/CD/mtu/

[6] See the VA/DoD Clinical Practice Guideline for Management of Substance Use Disorder. Available at: https://www.healthquality.va.gov/guidelines/MH/sud/

treatment of patients of variable chronicity of LBP, but all involved education by a therapist with the aim of treating LBP. Evidence suggested that adding back school to an exercise program improved disability scores but was inconclusive regarding effects on pain.[60]

One study evaluated the efficacy of web-based interventions on office workers with subacute and nonspecific LBP. Education was performed through the Preventative Medicine Service website as well as personal e-mail interventions plus standard care. The program was available for nine months, Monday through Friday, compared with the control group which only had access to standard care. The treatment group demonstrated significant improvement in disability, health-related quality of life, and lumbar endurance test compared to controls.[61]

C. Non-pharmacologic and Non-invasive Therapy

Recommendation

8. For patients with chronic low back pain, we recommend cognitive behavioral therapy. **(Strong for| Reviewed, New-replaced)**

9. For patients with chronic low back pain, we suggest mindfulness-based stress reduction. **(Weak for| Reviewed, New-replaced)**

Discussion

As our understanding of pain within the biopsychosocial model has increased, behavioral interventions for chronic LBP have become commonplace. Cognitive behavioral therapy (CBT) has accumulated a sufficient evidence base to justify a "Strong for" recommendation based on moderate quality evidence.[62] Mindfulness-based stress reduction (MBSR) has some evidence to support a "Weak for" recommendation.[62] The overall benefits of MSBR or CBT outweigh any harms or burdens to the patient.

While several types of psychotherapy-based treatment may be helpful for chronic LBP, only CBT garners a "Strong for" recommendation based on moderate confidence in the quality of evidence. CBT is typically delivered by a mental health clinician, usually in an individual setting for eight to 12 visits. CBT for pain involves identifying and changing cognitions and behaviors that perpetuate pain as well as using relaxation and exposure techniques to reduce symptom-related distress.

MBSR is a structured intervention focused on the concept of mindfulness (i.e., being in the present moment, without judgment). The coursework is manualized and the supporting evidence included the following components: education, meditative practices, simple yoga poses over eight 2.5 hour group sessions plus a longer retreat, and daily home practice.[62] MBSR requires a mindfulness instructor with specialized MBSR training and experience, often a licensed independent practitioner. There is evidence for intermediate and long-term benefit of MBSR for pain and function in chronic LBP patients compared to usual care and equivalence of MBSR to CBT for pain, function, and quality of life.[62] Based on the 2014 Quality Enhancement Research Initiative's evidence review of MBSR, there is also a potential benefit of MBSR for several comorbid disorders related to chronic LBP including depression, anxiety, somatization, and pain.[63]

The following factors should be considered when determining whether CBT or MBSR should be recommended to a specific patient: patient preference, appropriateness of the group setting, and

practitioner expertise. Based on low to moderate quality evidence, biofeedback, progressive relaxation, telephone-based health coaching, or transtheoretical model-based behavioral change may be used as alternative treatments for chronic LBP based on patient preferences and availability.[3,64,65]

Evaluation of long-term (greater than one year) benefits of MBSR and CBT for LBP has been insufficient. The 2017 American College of Physicians SR led to a strong recommendation for MBSR as an intervention for LBP;[66] however, a more recent meta-analysis showed lack of long-term benefits from MBSR compared to usual care or an active comparator.[67] A follow-up study to a large trial comparing MBSR to CBT for LBP recently reported that CBT maintained a small benefit over usual care at two years while the benefits from MBSR were no longer statistically significant.[68] No studies have evaluated whether follow-up or "booster" sessions of either intervention might improve the long-term outcomes for pain and disability.

While both MBSR and CBT are treatments with low risk of adverse events, the time required to participate can be a burden and may present a barrier to participation. Further, the availability of practitioners with expertise in MBSR and pain-based CBT are not readily available at all health clinics. Future research on behavioral interventions for chronic LBP should include an emphasis on optimal dose, validation of shorter treatment protocols, and incorporation of technology to minimize patient burden and maximize access to treatment. Acceptance and Commitment Therapy (ACT), a contextual behavior therapy, has become increasingly common as an intervention for the management of mood disorder and chronic pain, suggesting that research specifically looking at ACT for chronic LBP is needed.[69-71] No evidence for the use of these interventions for LBP in the acute phase were identified.

Recommendation

10. For patients with acute low back pain, there is insufficient evidence to support the use of specific clinician-directed exercise.
    (Not applicable| Reviewed, New-replaced)

11. For patients with chronic low back pain, we suggest offering clinician-directed exercises.
    (Weak for | Reviewed, New-replaced)

Discussion

Clinician-directed exercise is recommended as it is generally favorable for the treatment of chronic LBP. Overall, the demonstrated improvements are small, but may provide meaningful clinical benefit with minimal or no risk as compared to other interventions. The confidence in the quality of evidence was moderate for the effects of exercise to result in modest improvements in pain when compared to placebo, but there were no meaningful changes in function for patients with chronic LBP.[3] When exercise intervention was compared to usual medical care, patients demonstrated moderate short-term improvements in pain, small intermediate and long-term improvements in function, and a lower likelihood of work disability at 12 months.[3]

For specific forms of exercise, one SR reported moderate quality evidence favoring motor control exercise over usual care for intermediate and long-term reduction in both pain and disability.[3] There is moderate to low quality evidence that motor control exercise is only modestly better than general exercise for

patient function, and no important difference in terms of pain, disability, or quality of life when compared to general exercise or progressive graded activity.[3] One study with moderate quality evidence suggested that motor control exercise can effectively be delivered in a group setting compared to individualized treatment.[72] Regardless of symptom duration, low quality evidence suggests that patients receiving a symptom-guided exercise program compared to sham exercise were more likely to experience a global improvement.[3] This recommendation is consistent with patient preference to align treatment with patient tolerance and specific goals.

For patients with acute LBP, the effects of clinician-directed exercise are inconclusive and it is unclear if there is any added benefit to the patient. As compared to usual medical care, one SR found low to moderate quality evidence that specific clinician-directed exercise provides no meaningful benefit for pain levels, function, or disability.[3] There is, however, some indication based on moderate evidence that specific motor control exercise may provide a small long-term benefit over general exercise for patient function and need for pain medication,[73] but it is not known how this compares to usual care. Early access to physical therapy, which would include clinician-directed exercise as well as other supported interventions (e.g., education), as compared to usual care results in inconclusive or no important differences for long-term pain, disability, or global perceived effect of intervention.[74,75] However, there is some research, not included in our evidence review, showing that early access to physical therapy in the military healthcare system results in lower healthcare utilization and LBP-related costs over the course of care.[76]

Recommendation

12. For patients with acute or chronic low back pain, we suggest offering spinal mobilization/manipulation as part of a multimodal program.
    (Weak for | Reviewed, New-replaced)

Discussion

Spinal mobilization/manipulation delivered as an isolated intervention does not provide relevant improvements for patients with chronic LBP as compared to sham interventions.[77] However, when combined with other treatments (e.g., self-care instruction, clinician-directed exercise), there is an indication based on low quality evidence that the addition of spinal mobilization/manipulation may provide long-term benefits in perceived improvement, satisfaction with care, and lower medication use.[77,78] The additive effect of spinal mobilization/manipulation to other treatments provides only small, and not clinically relevant, improvements in pain and disability.

When spinal mobilization/manipulation is compared to other conservative interventions thought to be effective (e.g., supervised exercise, home exercises, McKenzie repeated motion exercise or back school training), there does not appear to be any clear advantage of one form of treatment over another.[77,79-81] Moderate quality data on pain and disability suggest a small, but likely not clinically relevant, advantage of spinal mobilization/manipulation over these other interventions.[82] Regarding other outcomes, there does not appear to be any conclusive findings for spinal mobilization/manipulation as compared with other conservative treatments. Similar to exercise, the use of spinal mobilization/manipulation is a relatively low-risk intervention for patients with LBP, and the benefits likely

outweigh potential harms.[83] The feasibility of spinal mobilization/manipulation should be considered on an individual basis, as the availability of providers at nearby medical facilities may vary.

The evidence for spinal mobilization/manipulation for the treatment of acute LBP demonstrates small effect sizes for pain and short-term function. For patients with acute LBP, spinal mobilization/manipulation appears to improve long-term pain intensity, but results in no change in disability when compared to inert interventions (moderate quality evidence).[82] The addition of spinal mobilization/manipulation to other interventions appears to yield short-term improvements in function but no clinically relevant difference for reducing long-term pain levels or disability [82] and results in similar outcomes as usual medical care.[84]

Recommendation

13. For patients with acute low back pain, there is insufficient evidence to support the use of acupuncture.
    (Not applicable | Reviewed, New-replaced)

14. For patients with chronic low back pain, we suggest offering acupuncture.
    (Weak for | Reviewed, New-replaced)

Discussion

Acupuncture appears to help patients in the long term (three to six months). There is moderate quality evidence based on two trials to support the use of acupuncture for modest long-term improvements in disability and the perceived impact of pain associated with chronic LBP.[3] Data were inconclusive regarding general quality of life and adverse events. There was variation in comparator groups; standard acupuncture was compared to sham acupuncture with blunt needles, intensive inpatient rehabilitation, or back pain acupuncture.[3] There is also large variation in patient preferences and acceptance of acupuncture. Clinicians should consider personal preferences and focus on SDM when offering acupuncture to patients.

Recommendation

15. For acute or chronic low back pain, there is insufficient evidence for or against the use of lumbar supports.
    (Not applicable | Reviewed, Amended)

Discussion

There was low confidence in the quality of evidence to support offering lumbar supports for acute or chronic LBP, with no reported associated harms or serious adverse events. Lumbar supports include lumbar braces, commercial lumbar belts and ready-to-use lumbar canvas corsets. One SR included three fair quality RCTs showing favorable results for lumbar supports for long-term disability.[3] In LBP of less than eight weeks duration, low quality evidence slightly favors lumbar supports with a back health educational program compared to a back health educational program alone. There was no statistically significant difference in pain or disability.[85] Low quality evidence favors lumbar support with subacute LBP (one to three months) for less pain, disability, and need for analgesics.[86] In the elderly population, one RCT supports using lumbar support for chronic LBP to improve pain and increase muscle endurance for a short period of time.[87] Paravertebral muscle fatigue was not increased by long-term wearing for

chronic LBP and weakening of the paravertebral muscles was not observed up to six months after the start of corset wearing.

Clinicians should explain the proper selection and use of lumbar supports when indicated. Lumbar supports may be used for the temporary relief from LBP or activities that would increase or potentially cause back discomfort (e.g., heavy or repetitive lifting). The harms and benefits are balanced; patients may experience temporary relief while using lumbar supports, but may become less mobile while using supports. There is also large variation in patient preferences, as some individuals may be opposed to using lumbar supports, while others may prefer trying lumbar supports over other interventions. Providing lumbar supports requires appropriate resources, and this medical equipment may not be readily available or accessible to all individuals. The feasibility of using lumbar supports should be assessed on an individual basis with special attention being given to adequate compliance.

Recommendation

16. For patients with chronic low back pain, we suggest offering an exercise program, which may include Pilates, yoga, and tai chi.
    (Weak for| Reviewed, New-replaced)

Discussion

Pilates, tai chi, and yoga have evidence to support better outcomes when compared to minimal interventions, wait list (a control group, randomized to a waiting list, that receives intervention after the active treatment group), no exercise, and controls. Yoga has some evidence to support better outcomes than strengthening exercise. In addition, other exercise options may provide benefit in patients with chronic LBP, including strength/resistance, coordination/stabilization, aquatics, cycling, and walking.

The SRs for Pilates, tai chi and yoga, were graded very low to moderate quality due to variations of study limitations, inconsistency in findings, and imprecision. Studies addressing Pilates and yoga mostly enrolled females which may limit the generalizability of the results to the VA/DoD population.

Given that there is potential for improved outcomes and minimal to no harm with Pilates, tai chi, or yoga, clinicians can suggest one of them as a possible exercise option for patients with chronic LBP. Three SRs, which were not part of the evidence review due to being superseded by the Chou SR,[3] found evidence supporting other types of exercise that may be relevant and useful to consider in addition to Pilates, tai chi, and yoga. These studies found that in patients with chronic LBP, participation in strength/resistance, coordination/stabilization,[88] aquatic,[89] and cycling[90] exercise may also be beneficial. In addition, a study that was not specific to LBP, and therefore not included in our evidence report, found that walking may be beneficial in patients with chronic musculoskeletal pain.[91]

Yoga

Evidence was inconclusive regarding yoga versus usual care alone, but short-term pain, disability, and quality of life generally improved in studies of yoga compared to education.[92] Data from one RCT showed yoga yields slightly better quality of life than a back book plus advice.[93] Data from one SR favored yoga over all comparators of usual care, education, and exercise for short- and long-term pain and disability.[92] There is low quality evidence favoring yoga over strengthening exercises for pain levels,[3]

and quality of life,[93] and moderate quality evidence that was inconclusive for disability comparisons between yoga and exercise.[92]

Pilates

Pilates was associated with slightly better outcomes of pain, disability, and short-term function compared to minimal interventions and controls in two SRs.[94,95] Evidence is unclear or inconclusive comparing Pilates to other types of exercise,[94,95] massage therapy, and usual care.[96]

Tai Chi

Evidence favored tai chi over no exercise, wait list, and backward walking and jogging, but not swimming, for improvement in chronic LBP.[3] Evidence also favored tai chi over physical rehabilitation for improvement in pain in two studies; however, the types of rehabilitation are unknown as the SR did not describe the details of the programs and the included studies were not available in English.[97]

Recommendation

17. For patients with low back pain, there is insufficient evidence to support the use of ultrasound.
    (Not applicable| Reviewed, New-added)

The use of ultrasound for LBP was included in the evidence search; however, there was insufficient evidence to make a recommendation for or against its use for patients with LBP.[3] The existing evidence base, while small and of primarily low quality, suggests that there is there is no difference in outcomes between ultrasound and sham ultrasound.

Recommendation

18. For patients with low back pain, there is inconclusive evidence to support the use of transcutaneous electrical nerve stimulation (TENS).
    (Not applicable| Reviewed, New-added)

The use of transcutaneous electrical nerve stimulation (TENS) for LBP was included in the evidence search; however, the evidence was inconclusive and the data did not find a significant difference in patient outcomes.[98] The evidence reviewed suggests an improvement in both radicular and non-radicular pain but is inconclusive regarding other outcomes. TENS is a passive modality that can be applied by the individual as part of a self-management strategy.

Recommendation

19. For patients with low back pain, there is insufficient evidence to support the use of lumbar traction.
    (Not applicable| Reviewed, New-added)

Lumbar traction as an intervention to improve LBP was included in the evidence search; however, the evidence was insufficient to support the use of lumbar traction.[99-102]

Recommendation

20. For patients with low back pain, there is insufficient evidence to support the use of electrical muscle stimulation.
    (Not applicable| Reviewed, New-added)

Electrical muscle stimulation was included in the evidence review; however there was no evidence found to support the use of this intervention for LBP.[3,103]

D. Pharmacologic Therapy

Recommendation

21. For patients with acute or chronic low back pain, we recommend treating with nonsteroidal anti-inflammatory drugs, with consideration of patient-specific risks.
    (Strong for | Reviewed, Amended)

Discussion

Evidence favors the use of NSAIDs for both acute and chronic LBP; most comparative trials showed no differences in pain relief among NSAIDs. Statistically significantly fewer adverse effects were observed with the cyclooxygenase-2 (COX-2) NSAIDs versus the traditional NSAIDs. We suggest the use of relatively COX-2 selective NSAIDs over non-selective NSAIDs based on patient risk factors.

For the outcome change in pain intensity, data favors NSAIDs over placebo in patients with both acute and chronic LBP (low to moderate quality evidence). An SR reported that NSAID use improved pain intensity (on visual analog scale [VAS], 0-100 mm) at ≤12 weeks compared to placebo.[3] An RCT reported that naproxen was superior to placebo with regards to improvement in lower back pain intensity (LBPI) from baseline to 16 weeks.[104]

The data for disability and functional outcomes is inconclusive. Pooled results from seven studies that followed patients for three weeks or less found a higher proportion of patients taking NSAIDs reporting global improvements versus placebo. One study reported inconclusive data between naproxen versus placebo with regard to disability and function as measured by the mean change in Roland-Morris Disability Questionnaire (RMDQ) score from baseline to 16 weeks and the mean change in Pain Global Assessment score from baseline to 16 weeks.[104]

An SR found that most trials of comparisons of NSAIDs showed no differences in pain relief in patients with acute or chronic LBP.[3] Five studies compared COX-2 NSAIDs with traditional NSAIDs; no statistically significant difference for pain relief for acute LBP was seen in four of these studies. A fifth, high quality study found moderate evidence that there were no differences in pain relief between COX-2 and traditional NSAIDs for chronic LBP.[3,105]

RCTs reported inconclusive evidence of any differences regarding adverse effects between naproxen and placebo (very low quality evidence, no between-group confidence interval [CI])[104] and dexketoprofen (the dextrorotatory enantiomer of ketoprofen, unavailable in the U.S.) and diclofenac (low quality evidence, no between-group CI).[106] COX-2 NSAIDs had statistically significantly fewer adverse effects than traditional NSAIDs.[3] See Appendix B for a list of select VA and DoD National Formulary NSAIDs.

Gastrointestinal (GI) safety continues to be a high priority when choosing an NSAID treatment for pain. We suggest the use of relatively COX-2 selective NSAIDs over non-selective NSAIDs based on patient risk factors, primarily GI toxicity. The use of relatively COX-2 selective inhibitors may reduce the risk for GI events; however, this benefit is negated if the patient is using aspirin.[107]

All NSAIDs, selective and non-selective, have box warnings for increased risk of cardiovascular (CV) events. If an NSAID is required in a patient with CV risk, naproxen with a proton pump inhibitor may be a viable option.[107,108] RCTs of relatively COX-2 selective agents in meta-analyses that did not meet inclusion criteria for the evidence review that informed this guideline reinforce the concern regarding CV events with COX-2 inhibitors.[108] More recently, a large trial that randomized 24,081 patients to receive celecoxib, naproxen, or ibuprofen found that the CV risk associated with the selective COX-2 inhibitor celecoxib is not greater than that associated with non-selective NSAIDs.[109] Any conclusions from this trial are limited by the high rates of drug discontinuation (68.8%), study dropout (27.4%), and the restrictions on the doses of celecoxib. Ninety percent of the patients in the trial had osteoarthritis and the dose of celecoxib was limited to 200mg/day in this group, but dose escalation was allowed for ibuprofen and naproxen.

Recommendation

22. For patients with chronic low back pain, we suggest offering treatment with duloxetine, with consideration of patient-specific risks.
    (Weak for | Reviewed, New-added)

Discussion

The benefit of duloxetine for chronic LBP in terms of both pain and function improvement is small as demonstrated by moderate to high quality evidence.[3] In one RCT, duloxetine was associated with improvement in back pain intensity (BPI) from baseline to 14 weeks with a higher proportion of patients at 14 weeks experiencing 50% improvement in the BPI.[110] However, when function was measured with the RMDQ, the comparative data were inconclusive.[3] It is important to keep in mind that the effects of selective serotonin reuptake inhibitors (SSRI) on LBP are inconclusive.[3] Of the serotonin and norepinephrine reuptake inhibitors (SNRI) class, only duloxetine has been studied in LBP; theoretically, the SNRI class may demonstrate some benefit given a similar mechanism of action to duloxetine.

Tricyclic antidepressants (TCAs) may be considered for use in certain patients. In a recent SR, no benefit was found with TCAs for either pain or function[3]; however, older studies have shown that TCAs as a class provide a small improvement in pain intensity, but were inconclusive in regards to function, quality of life, or healthcare utilization.[111,112] Consideration of medical or psychiatric comorbidities are important and may influence the selection of SNRI or TCA. For some patients, addition of a low dose TCA to SSRI may be helpful, depending on medical or psychiatric comorbidities.

There are more adverse effects associated with duloxetine when compared to placebo. These include nausea, insomnia, dry mouth, constipation, somnolence, and fatigue.[3] Additionally, duloxetine has a risk of hepatotoxicity and should not be used in individuals with liver disease. Per the VA/DoD CPG on PTSD, duloxetine may not help to improve PTSD symptoms of patients with concomitant PTSD (see the VA/DoD

PTSD CPG).[7] Caution should be used when prescribing TCAs to individuals with cardiac risk factors, and anticholinergic burden should also be taken into account when used in geriatric patients.[113] Additionally, combining TCAs with other serotonergic medications increases the risk of serotonin syndrome and should be used with caution. In patients with LBP with or without radiculopathy, duloxetine and TCAs have been shown to have a small positive effect on both pain and function. Adverse effect burden between agents vary greatly and should be taken into account when choosing an antidepressant. In general, TCAs are not recommended in the elderly population.[114] Using TCAs at bedtime in low dosages may reduce side effects, but limit effectiveness for pain therapy that is dosage related.

Recommendation

23. For patients with acute low back pain or acute exacerbations of chronic low back pain, we suggest offering a non-benzodiazepine muscle relaxant for short-term use.
    (Weak for | Reviewed, New-added)

24. For patients with chronic low back pain, we suggest against offering a non-benzodiazepine muscle relaxant.
    (Weak against | Reviewed, New-added)

Discussion

Moderate evidence supports offering a non-benzodiazepine muscle relaxant for acute LBP. The benefits of skeletal muscle relaxants were demonstrated in two SRs, although the evidence indicates benefit is limited to short-term use of three to seven days.[3,115] There is limited evidence that suggests benefit of one agent over the other; however, it is important to recognize that the agents differ significantly in adverse effect profiles. Moderate evidence demonstrates no effect on disability in the short term.[115] When comparing an NSAID alone to a combination of an NSAID and the skeletal muscle relaxant cyclobenzaprine, evidence demonstrates no difference in acute LBP.[116]

We suggest against offering a non-benzodiazepine muscle relaxant for chronic LBP. In regard to long-term use, there is no evidence to suggest benefit for the use of skeletal muscle relaxants for chronic LBP. One SR included one low quality study showing that there was no benefit of skeletal muscle relaxants when compared to placebo in patients with chronic LBP;[115] another SR also showed no benefit of skeletal muscle relaxants in outcomes for chronic LBP.[3]

Muscle relaxants were associated with higher rates of adverse events, such as central nervous system (CNS) effects including sedation, nausea, dizziness, and headache.[3,115] While it is important to note that one agent does not confer benefit over another agent, we do not recommend the use of carisoprodol for acute or chronic LBP due to its adverse effect profile, including CNS depression, as well as its risk of dependence. Carisoprodol is metabolized to an agent that binds to the barbiturate receptor and is classified as a Schedule IV controlled substance by the U.S. Drug Enforcement Agency. When considering a skeletal muscle relaxant, clinicians should consider the adverse effect profile that includes risk for CNS depression, particularly in patients taking other CNS depressant medications. Agents such as

[7] See the VA/DoD Clinical Practice Guideline for Management of Posttraumatic Stress Disorder and Acute Stress Reaction. Available at: https://www.healthquality.va.gov/guidelines/mh/ptsd

cyclobenzaprine pose higher anticholinergic burden which may be of concern in the geriatric population. This agent in combination with other serotonergic medications may increase risk of serotonin syndrome.

Recommendation

25. For patients with low back pain, we recommend against benzodiazepines.
    (Strong against | Reviewed, New-replaced)

Discussion

There is insufficient evidence to support the use of benzodiazepines for acute LBP; the evidence in chronic LBP is less conclusive. There is low quality data indicating that the harms/burden of benzodiazepine use outweigh the benefits. The potential for abuse, addiction/dependence, overdose potentially resulting in death, respiratory depression, and sleep apnea do not justify their use. Some patients may prefer benzodiazepines, but the potential harms outweigh the benefits. These associated risks are further compounded when combined with opioids (see the VA/DoD CPG on the Management of Opioid Therapy for Chronic Pain).[8]

A good quality SR found inconclusive evidence between diazepam and placebo with respect to LBP improvement.[3] The SR identified one RCT[117] which reported efficacy outcome data for 60 patients randomized to receive placebo or diazepam two times 5 mg daily, followed by a taper. Follow-up examinations were scheduled at six weeks and one year after discharge. The median duration of the stay in hospital was shorter in the placebo arm (8 versus 10 days, p= 0.008), and the probability of pain reduction on the VAS by more than 50% was twice as high in placebo patients (p= 0.0015). Other outcome measures, though inconclusive, tended to favor placebo over diazepam including workdays lost, disability, and healthcare utilization.

There is little evidence regarding adverse events with the use of benzodiazepines for LBP specifically, but an expanded review of pain management and pharmacology literature outside the LBP CPG evidence review suggests potential harms.[118] An SR reporting low quality evidence found CNS adverse events such as somnolence, fatigue, and lightheadedness were reported more frequently with benzodiazepines versus placebo.[3]

Recommendation

26. For patients with acute or chronic low back pain with or without radiculopathy, we recommend against the use of systemic corticosteroids (oral or intramuscular injection).
    (Strong against | Reviewed, Amended)

Discussion

The use of systemic corticosteroids for the treatment of acute or chronic LBP with or without radiculopathy is not recommended. There is a lack of evidence for efficacy related to pain or disability.[3,119] There is no compelling evidence that the use of corticosteroids improves quality of life or decreases healthcare utilization in those receiving this treatment.[3,119] The overall quality of the

[8] See the VA/DoD Clinical Practice Guideline for the Management of Opioid Therapy for Chronic Pain. Available at: http://www.healthquality.va.gov/guidelines/Pain/cot/

evidence addressing disability and quality of life was low. Studies finding no important difference related to pain and mixed results related to healthcare utilization were of moderate quality.

There are risks associated with corticosteroid use in the short term, and repeated use may have more significant implications.[120] A moderate quality study demonstrated significantly more adverse events when comparing prednisone to placebo in the short term.[119] Adverse events included insomnia, nervousness, increased appetite, indigestion, headache, joint pain, and sweating. An SR was inconclusive regarding adverse events, but the included studies were of low to very low quality.[3] While providers and patients may wish to try systemic corticosteroids for LBP or radiculopathy, the evidence suggests that efficacy does not outweigh the potential risks.

Recommendation

27. For patients with low back pain, we recommend against initiating long-term opioid therapy. For patients who are already prescribed long-term opioid therapy, refer to the VA/DoD CPG for the Management of Opioid Therapy for Chronic Pain.[9]
    (Strong against | Reviewed, New-replaced)

28. For patients with acute low back pain or acute exacerbations of chronic low back pain, there is insufficient evidence to recommend for or against the use of time-limited opioid therapy. Given the significant risks and potential benefits of opioid therapy, patients should be evaluated individually, including consideration of psychosocial risks and alternative non-opioid treatments. Any opioid therapy should be kept to the shortest duration and lowest dose possible.
    (Not applicable | Reviewed, New-replaced)

Discussion

While the current literature for patients with acute LBP or acute exacerbations of chronic LBP shows insufficient evidence to support time-limited (less than seven days) opioid therapy, on average, the potential harms of short-term opioid therapy (less than six months) outweigh the potential benefits in patients with LBP. Findings of two SRs that showed that opioid therapy for acute or chronic LBP produced small additional analgesic effects beyond those seen with placebo (moderate quality evidence).[3,115] In a meta-analysis, the mean difference between single-ingredient opioids and placebo in pain intensity was –8.1 on a 0–100 VAS scale.[115] In an SR, the standardized mean difference between strong opioids (i.e., hydromorphone, morphine, oxycodone, oxycodone/naltrexone combination, oxymorphone, and tapentadol) and placebo was –0.43 (seven trials), equivalent to a mean difference of about one point on a 0–10 numeric rating scale.[3] Neither study reported the percentage of patients who achieved clinically important (≥ 30%) improvements from baseline in pain intensity. See the VA/DoD CPG on Opioid Therapy for further discussion pertaining to prescribing opioid therapy.[9]

According to a meta-analysis, opioid therapy produced no clinically important improvements in function relative to placebo at 30 to 91 days; however, results were inconclusive (wide CI; three RCTs).[115] In an SR, short-term therapy (less than six months) with strong opioids resulted in small, clinically unimportant,

[9] See the VA/DoD Clinical Practice Guideline for the Management of Opioid Therapy for Chronic Pain. Available at: http://www.healthquality.va.gov/guidelines/Pain/cot/

additional improvements in function over placebo. The standardized mean difference relative to placebo was –0.26 (four trials), representing a difference of about one point on a 24-point RMDQ scale.[3]

Trials that compared opioids and other drug therapies (e.g., acetaminophen, NSAIDs, antidepressants) were limited and the strength of evidence was insufficient to make conclusions for either pain or functional outcomes. No clear differences were seen between long-acting opioids compared to other long-acting opioids or short-acting opioids.[3]

The small differential benefits of short-term opioid therapy were counterbalanced by increases in risks of adverse effects typically seen with short-term opioid therapy. The meta-analysis showed that the median incidence of adverse events was 68.9% for opioid treatment groups and 49.1% for placebo groups, with a risk ratio of 1.3 (eight trials).[115] In four of eight trials, 50% of study patients discontinued treatment because of adverse events or lack of efficacy.[115]

The trials included in the SRs did not assess the risks of long-term opioid therapy. Opioid risks and risk assessment for chronic non-cancer pain are discussed in more detail in the VA/DoD CPG for Management of Opioid Therapy for Chronic Pain.[10] Based on what is known for chronic non-cancer pain in general (not specific to LBP), the small effects of short-term opioid therapy seen in LBP trials may be substantially outweighed by serious risks including potentially fatal respiratory depression, overdose, misuse, abuse, addiction, and diversion — risks that pose considerable harms not only to the patient, but also relatives, friends, and the public. The risks of addiction during opioid therapy, which may start with the first dose administered, need to be taken into consideration and weighed against the actual therapeutic benefits in individual cases.

No clinical trials identified by the evidence review evaluated time-limited (less than seven days) opioid therapy. Some trials may have been omitted from our evidence review if they did not evaluate outcomes after 12 weeks. While the benefits and harms of time-limited opioid therapy for acute LBP are unclear, there is a high likelihood of rapid spontaneous improvement in pain, function, and return to work in the first month.[23] The severity of pain, level of pain-related disability, refractoriness to other therapies, co-occurring medical conditions, current or prior psychiatric or substance use disorders, social history, age, frailty, opioid dose, formulation, route of administration, drug interactions, and other factors may influence decisions regarding whether or not to try a time-limited course. For acute LBP refractory to NSAIDs and non-benzodiazepine skeletal muscle relaxants (see Recommendation 21 and Recommendation 23), opioids are the only remaining drug treatment with evidence of effectiveness, although the analgesic effects were small relative to placebo and pertained to short-term, not necessarily time-limited (greater than seven days), therapy.

Patients' values, preferences, and treatment goals regarding opioid therapy can vary widely, both between individuals and in the same individual over time. Some patients may be reluctant to take opioids because of the risk of addiction or fear of stigma, while others may seek a therapeutic opioid trial despite the marginal benefits over placebo.

[10] See the VA/DoD Clinical Practice Guideline for the Management of Opioid Therapy for Chronic Pain. Available at: http://www.healthquality.va.gov/guidelines/Pain/cot/

The patient focus group participants indicated a desire for education about pain medications, particularly opioids. When clinicians educate patients about opioid therapy, they can also provide information on some of the questions that remain unanswered. Research gaps specific to LBP include the evaluation of the immediate benefits and harms of a time-limited course of opioid therapy for acute LBP; the risks of hormonal effects, hyperalgesia, overdose, respiratory depression, death, misuse, abuse, addiction, and diversion during long-term opioid therapy; the utility of opioid therapy in patients with risk factors for harm (e.g., substance use disorder); the efficacy of opioid therapy in patients with radicular symptoms; and factors that affect the magnitude of treatment responses in patient subgroups.

Recommendation

29. For patients with acute or chronic low back pain, there is insufficient evidence to recommend for or against the use of time-limited (less than seven days) acetaminophen therapy.
    (Not applicable | Reviewed, New-replaced)

30. For patients with chronic low back pain, we recommend against the chronic use of oral acetaminophen.
    (Strong against | Reviewed, New-replaced)

Discussion

A large SR found no difference between acetaminophen and placebo on the outcomes of mean pain, disability, quality of life, or function at 12 weeks (moderate quality evidence).[121] A high quality, large RCT (N= 1,652) included in an SR [3] also showed no difference between acetaminophen and placebo at all time points.[122]

As no benefits were shown in the evidence, the consideration of harm/burden predominates because of the risks associated with taking acetaminophen (e.g., long-term liver effects at high dosage). The balance of harms associated with other options that can be provided to patients and the harms of removing acetaminophen as a viable treatment option need to be considered. There is some variation in values and preferences, with some patients thinking that acetaminophen is for pain that is not “serious” and are unaware of the adverse effects of taking too much.

Other implications include easy accessibility, as acetaminophen is inexpensive and therefore available at a relatively low cost to the patient and the system, and also available both over the counter (OTC) and in formulary. It is easily overused without proper education, thus risks and adverse effects may not be well understood by the public. In addition, elderly individuals and patients with hepatic insufficiency are subgroups that may be at the most risk for harm.

Recommendation

31. For the treatment of acute or chronic low back pain, including patients with both radicular and non-radicular low back pain, there is insufficient evidence to recommend for or against the use of antiepileptics including gabapentin and pregabalin.
    (Not applicable | Reviewed, New-replaced)

Discussion

The evidence for the use of antiepileptics is mixed and we cannot recommend for or against their use in the treatment of LBP. There was no evidence included in our evidence review for the use of antiepileptic agents other than gabapentin or pregabalin. In one moderate quality study, there was no difference in pain intensity between placebo and gabapentin.[123] This study evaluated patients with both radicular and non-radicular chronic LBP. There were two low to very low quality RCTs that indicated a small difference in pain in the short term but the differences were not clinically relevant.[124,125] There were no trials that addressed the use of antiepileptics in acute non-radicular pain. It was shown that pregabalin may have a greater impact on pain and disability when compared to amitriptyline, but the study is not of high enough quality to determine benefit of pregabalin over an antidepressant.[3]

There are significant adverse effects associated with the use of gabapentin or pregabalin. An RCT found significantly higher adverse effects with gabapentin, including fatigue, dry mouth, difficulties with mental concentration, memory, visual accommodation, and loss of balance.[123] The SR reported inconclusive results regarding the difference in adverse events between pregabalin and amitriptyline, although this evidence was rated as very low quality.[3] An RCT studying the treatment of pregabalin in patients with radiculopathy, which was published after the closure of our evidence review, reported no significant reduction in leg pain intensity and a higher incidence of adverse events.[126] It is important to note that pregabalin is a controlled substance, indicating some potential for abuse and dependence. Gabapentin is not a scheduled medication, however there is literature to indicate its misuse and abuse as well. While the use of gabapentin and pregabalin may provide small, short-term benefits, we cannot substantiate that the benefits outweigh the adverse effects due to the lack of efficacy demonstrated in the available literature.

Recommendation

32. For the treatment of low back pain, there is insufficient evidence to recommend for or against the use of topical preparations.
    (Not applicable | Reviewed, New-added)

Discussion

Topical pharmacotherapy preparations were included in the evidence search. However, the search yielded no studies that met inclusion criteria for the evidence review. Therefore, no recommendations can be made about these agents due to the lack of evidence at the time this CPG was published.

E. Dietary Supplements

Recommendation

33. For the treatment of low back pain, there is insufficient evidence to recommend for or against nutritional, herbal, and homeopathic supplements.
    (Not applicable | Reviewed, New-added)

Glucosamine

The evidence review identified one SR with very low quality of evidence that included three trials.[127] Two of the studies showed no difference between glucosamine and placebo. However, there was concern that the doses used in the studies were not sufficient to produce clinically significant results (1500 mg used

in the studies versus 2000 mg daily). In addition, the studies were sponsored by pharmaceutical companies and the supplement was supplied by the manufacturer, which may increase the risk of bias.

The benefits and harms/burden are balanced. One study considered adverse effects and found they were not significantly different between glucosamine and placebo (both groups had approximately 30% mild and transient GI and dermatological symptoms).[127] For the subgroup consideration of patients with hip and/or knee osteoarthritis, clinicians should not prescribe chondroitin sulfate, glucosamine, and/or any combination of the two, to treat joint pain or improve function (see the VA/DoD CPG for the Non-Surgical Management of Hip & Knee Osteoarthritis).[11]

There is likely to be variation in patient values and preferences regarding the use of glucosamine. Some patients may prefer it as a "natural" supplement, while others may not want to consider using it because they do not see it as a "real" medicine. Moreover, supplements are not regulated by the U.S. Food and Drug Administration (FDA), so the quality may be inconsistent. Finally, although easily accessible OTC, they are not on VA/DoD formularies and therefore may involve costs to the patient.

Other Nutritional, Herbal, or Homeopathic Supplements

There were no studies nutritional, herbal, or homeopathic supplements identified in the evidence review for this guideline that met inclusion criteria.

The degree of harms/burdens depends on the specific supplement being considered. As a category, due to the wide variety of preparations and their possible bioactivity, it is likely that many supplements used have harms that outweigh benefits (e.g., kava, ephedra). Given the wide range of supplements used, there is concern about the known and unknown adverse effects; drug-to-drug interactions; and the dosage, active ingredient, and purity of the supplements.

As with glucosamine, there is variation in values and preferences regarding the use of nutritional, herbal, and homeopathic supplements; some patients may prefer "natural" supplements, while others may not want to consider using supplements if they are not perceived as "real" medicine. Moreover, supplements are not regulated by the FDA, so the quality may be inconsistent. Finally, although easily accessible OTC, nutritional, herbal, and homeopathic supplements may not be on the VA/DoD formularies and therefore may involve costs to the patient. Realizing that many patients use supplements, it is important for the provider to have a conversation with the patient about their individual use of supplements to identify potential harms that may be associated with specific supplements.

[11] See the VA/DoD Clinical Practice Guideline for the Non-Surgical Management of Hip & Knee Osteoarthritis. Available at: http://www.healthquality.va.gov/guidelines/CD/OA/

F. Non-surgical Invasive Therapy

Recommendation

34. For the long-term reduction of radicular low back pain, non-radicular low back pain, or spinal stenosis, we recommend against offering spinal epidural steroid injections.
(Strong against | Reviewed, New-added)

35. For the very short-term effect (less than or equal to two weeks) of reduction of radicular low back pain, we suggest offering epidural steroid injection.
(Weak for | Reviewed, New-added)

36. For the treatment of low back pain, we suggest against offering intra-articular facet joint steroid injections.
(Weak against | Reviewed, New-added)

37. For patients with low back pain, there is inconclusive evidence to recommend for or against medial branch blocks and radiofrequency ablative denervation.
(Not applicable | Reviewed, New-added)

Discussion

Epidural steroid injections (ESI) are an option at many VA/DoD facilities for treating LBP, including lumbar radiculopathy. Studies assessing the efficacy of epidural steroid joint injections were generally rated as low in quality. ESI did not generally perform better than saline or local anesthetic injections for pain, function, return to work, or quality of life, though wide CIs could not exclude a real difference between groups.[128,129] Individual studies finding between-group differences for comparators versus ESI (including saline injection as placebo, anesthetic injection, usual care, or oral medication) found small effects, but wide CIs for comparisons.[128,129] These results were consistent even in patient groups thought to benefit from injections. For example, a trial of ESI versus usual medical care for lumbar radiculopathy failed to show a benefit of injections.[130] Additionally, an SR did not show a clear reduction in surgical risk for patients undergoing ESI.[129] While the overall evidence was not conclusive for ESI, there is moderate quality evidence that in the immediate term (defined as 5-14 days), ESI provided improved pain relief compared to placebo; however, the size of the pain reduction effect was small, did not meet predefined thresholds for minimum clinically important differences, and most of the patient groups studied had chronic symptoms.[3] Trials examining the transforaminal approach to ESI were of higher quality and more likely to show an improvement versus placebo.

Facet injections are utilized at many VA/DoD facilities in the treatment LBP and in the identification of painful structures in the lumbar spine. Studies assessing the efficacy of facet joint injections and therapeutic medial branch block injections, were generally rated as low or very low quality. Facet injections of steroid did not generally perform better than saline injections for pain, function, return to work, or quality of life.[129] While some individual studies found small effects for pain or function, these differences generally did not meet the threshold for clinical significance (i.e., saline injection, hyaluronic injection, oral NSAID, and oral steroid).[129] One multi-armed comparative trial showed that facet injection and oral NSAID resulted in superior outcomes to oral NSAID alone, though there was no sham control for injection in the study.[131]

Selective nerve root block (SNRB) injections and radiofrequency ablation denervation (RFA) are options at many VA/DoD facilities for treating LBP. Studies assessing the efficacy of SNRBs and RFA were rated from very low to moderate in quality. There was inconclusive evidence that SNRB and RFA procedures improve pain, function, return to work, or quality of life.[132-134] One trial comparing SNRB to caudal epidural steroid injection found better results for the caudal epidural injection, but the between-group differences had uncertain clinical significance.[133] The highest quality study reviewed on RFA found no between-group differences for pain versus a placebo comparator (though there was a large variation in response) and a small, but likely not clinically significant, difference favoring RFA for function.[132]

These overall unclear benefits of injection and ablation therapies were assessed against their cost and risk. There were a small number of adverse events reported, although harms were reported inconsistently across trials. There is expected to be some variation in patient values and preferences regarding injection/ablation as the patient focus group revealed preferences for a precise diagnosis and treatment, and these interventions may assist in meeting those expectations. There may be patients who prefer not to undergo an invasive procedure like injection/ablation when there is no clear benefit, and comparable alternatives include oral medication or other noninvasive approaches, including advice on activity and self-management and/or a noninvasive option like physical exercise or behavioral therapy. A SDM approach with discussion of the realistic expectations and risks is suggested. In evaluating patients that require interventional procedures, the clinician should ensure that the history, exam, and imaging studies are supportive and congruent with the procedure being performed. There may be subgroups of patients whose LBP complaint arises primarily from nociception from the lumbar nerve root(s) and who could uniquely benefit from these procedures; however, the evidence to date does not indicate an accurate and reliable way to determine if this subgroup exists, especially considering the reviewed evidence on radiculopathy. Patients with acute and intolerable radicular pain may benefit from referral to a specialist for ESI and may be more likely to benefit from the procedure than patients with more chronic symptoms, though that has yet to be validated in a clinical trial. Based on the evidence reviewed for ESI, and taking into account the recommendations for non-pharmacologic and non-invasive therapies, the primary role for ESI may be to provide a very short-term reduction in pain to support participation in active non-pharmacologic therapies. Given the limited duration of expected benefit and the modest expected effect size, use of ESI for chronic LBP outside of an active rehabilitation treatment plan is not recommended. Feasibility is an important consideration because not all medical treatment facilities will have the appropriate specialists, space, or equipment to perform these non-surgical invasive therapies due to the added costs, maintenance, and space/resource utilization.

Future research in this area should focus on high quality randomized trials comparing injection/ablation to credible comparators such as sham injection and/or noninvasive care, with evaluation of both short-term measures of pain and function, long-term outcomes, and the value of these procedures. Further studies should be performed regarding the targets of ablation and techniques for administration of injection (e.g., interlaminar versus transforaminal), particularly given the trend for improved outcomes with the transforaminal technique. The risk for surgical intervention after these procedures (such as the design of the Spijker-Huiges trial [130]) should be assessed and reported.

Our description of the limited evidence for these procedures should not be taken as a recommendation to pursue surgical consultation for patients without a thorough risk/benefit consideration and SDM for such surgical options.

G. Team Approach to Treatment of Chronic Low Back Pain

Recommendation

38. For selected patients with chronic low back pain not satisfactorily responding to more limited approaches, we suggest offering a multidisciplinary or interdisciplinary rehabilitation program which should include at least one physical component and at least one other component of the biopsychosocial model (psychological, social, occupational) used in an explicitly coordinated manner.
    (Weak for | Reviewed, New-replaced)

Discussion

According to the available evidence, a multidisciplinary biopsychosocial rehabilitation (MBR) approach that targets physical and behavioral/psychological care may be beneficial for patients with chronic LBP. Studies examining these programs recognize their varying constitution. The available evidence provided no general consensus regarding the definition of a multidisciplinary treatment approach.[135] The term interdisciplinary was used interchangeably in some cases, but multidisciplinary was most consistently used to describe a team approach to chronic LBP treatment. In a study by Nazzal et al., MBR consisted of education, occupational therapy, and massage with a combined exercise program (i.e., aerobic, resistive, stretching, flexibility, and postural exercises with time-limited continuous mode ultrasound and TENS).[136] A total of 36 hours of physical exercise, 12 hours of occupational therapy, and 12 hours of education were provided. Another study comparing an MBR program with active-only treatment described a group-based, 12-week program including 35 hours of hard physical exercise (e.g., aerobic and circuit training), 22 hours of light exercise/occupational therapy, and 16 hours of education.[137]

The effectiveness of MBR programs are evaluated using various outcomes. An SR of 16 trials reported that patients receiving MBR had statistically significantly greater reductions in pain compared to those receiving usual care at both medium-term (≥ 3 months to ≤ 12 months) and long-term (≥ 12 months) follow-up.[135] In addition, patients receiving MBR had statistically significantly greater reductions in disability scores versus patients who received usual care at both medium-term (≥ 3 months to ≤ 12 months) and long-term (≥ 12 months) follow-up.[135] Empirical evidence found statistically significant improvements in work-related outcomes for patients receiving MBR programs compared to patients receiving physical treatment.[135,136]

In addition to the findings that favored use of MBR, an SR and meta-analysis comparing MBR with physical-only and behavioral/psychological-only interventions found no clinically significant differences between pain and disability for the three approaches.[138]

MBR treatment programs may be most appropriate for patients with severe or complex chronic LBP due to their intensity and significant time and resource commitment from both the patient and healthcare staff.[135] Additional considerations in suggesting MBR for treatment of LBP include a favorable risk to benefit ratio. The evidence indicates that MBR programs pose limited to no risk but yield significant

benefit. When weighing the values and preferences of patients, the Work Group determined there may be some variability in patient preferences and that some patients may have limiting factors (e.g., non-flexible work schedules) to allow time for participation in an MBR program. Others may have concerns regarding the stigma associated with missing work or other activities due to the time commitment required to fully partake in MBR. Other implications for MBR programs include a potentially high cost when compared to standard treatment and access limitations for patients who are not within proximity to larger medical centers where a multidisciplinary team may be available to host a program. However, given the national need to emphasize biopsychosocially informed, low-risk, non-pharmacologically based treatment options for chronic pain management, MBR programs provide an option that should be considered, especially for patients with severe or complex LBP or those who have failed a more limited approach.

VIII. Knowledge Gaps and Recommended Research

During the development of the 2017 LBP CPG, the Work Group identified numerous areas for future research, including areas requiring stronger evidence to support current recommendations as well as research exploring new areas to guide future CPGs.

Serious Underlying Conditions

Additional areas of research include utility of red flag symptoms for infection as a serious underlying condition given the potential response to early treatment, as well as predictive modeling to help identify specific causes of LBP based on patient factors.

Diagnostic Imaging

Current imaging, namely plain radiographs, nuclear medicine bone scans, CT, or MRI provide some anatomical information; however, emphasis should remain on clinical correlation to radiographic findings that are secondary to the high rate of false positive findings. In the future, more research is needed in the area of imaging-activated pain physiology neural structures. Further advancements in functional or physiological imaging that can map activated central and peripheral pain neural structures may enhance our understanding of this field.

Future research on diagnostic imaging of LBP should focus on the health risks and economic impact of imaging/diagnostics in this patient population, the cost attributed to these tests and on the subsequent referrals, and determining the main driver for ordering the tests given the lack of medical evidence for their utility (e.g., patient satisfaction, referral patterns/networks, healthcare provider compensation).

Behavioral Interventions

Future research on behavioral interventions for chronic LBP should include an emphasis on optimal dose, validation of shorter treatment protocols, and incorporation of technology to minimize patient burden and maximize access to treatment.

Exercise

More evidence regarding which groups of patients might respond better to a certain exercise intervention is needed. In addition, the dosing of exercise to include duration, intensity, and frequency is required to help guide treatment programs.

Comorbid conditions

Future research is needed on whether or not patients with co-occurring LBP and mental health conditions who are treated for their mental health conditions have improvement in the progression of their LBP over time.

Dietary Supplements

Other than for glucosamine, the evidence review for this guideline update did not identify any studies that met inclusion criteria for the use of nutritional, herbal, and homeopathic supplements. High quality research in this area may help future guideline Work Groups develop recommendations for or against supplements for the treatment of LBP.

Pharmacotherapy

No studies on topical pharmacotherapy preparations met inclusion criteria for the evidence review for this guideline update. High quality research in this area could help future Work Groups develop recommendations for or against the use of topical pharmacotherapy preparations.

Additional research on opioid therapy for LBP is needed to evaluate the immediate benefits and harms of a time-limited course of opioid therapy for acute LBP, the efficacy of opioid therapy in patients with radicular symptoms, and factors that affect the magnitude of treatment responses in patient subgroups.

Injection and Ablation Therapies

Future research in this area should focus on high quality randomized trials comparing injection/ablation to credible comparators such as sham injection and/or noninvasive care and include both short-term measures of pain and function as well as longer-term effects. Different routes of administration of injection (e.g., interlaminar versus transforaminal) or targets of ablation should be studied further to determine whether the technique or approach matters, and whether the trend for improved outcomes with transforaminal approaches continues. The risk for surgical intervention after these should be assessed and reported. This additional evidence would enable a clearer recommendation on the value of these procedures.

MBR Programs

Research on dosing for MBR programs is needed to mitigate the logistic issues of patients participating. It would be useful to know the best intensity, frequency, and components of the program. In addition, research could confirm whether there are yellow flags or other patient factors that make one level of intensity more desirable than others.

Appendix A: Evidence Review Methodology

A. Developing the Scope and Key Questions

The CPG Champions, along with the Work Group, were tasked with identifying KQs to guide the systematic evidence review of the literature on LBP. These questions, which were developed in consultation with the Lewin Team, addressed clinical topics of the highest priority for the VA and DoD populations. The KQs follow the population, intervention, comparison, outcome, timing and setting (PICOTS) framework for evidence questions, as established by the Agency for Healthcare Research and Quality (AHRQ). Table A-1 provides a brief overview of the PICOTS typology.

Table A-1. PICOTS [139]

P	Patients, Population, or Problem	A description of the patients of interest. It includes the condition(s), populations or sub-populations, disease severity or stage, co-occurring conditions, and other patient characteristics or demographics.
I	Intervention or Exposure	Refers to the specific treatments or approaches used with the patient or population. It includes doses, frequency, methods of administering treatments, etc.
C	Comparison	Describes the interventions or care that is being compared with the intervention(s) of interest described above. It includes alternatives such as placebo, drugs, surgery, lifestyle changes, standard of care, etc.
O	Outcome	Describes the specific results of interest. Outcomes can include short, intermediate, and long-term outcomes, or specific results such as quality of life, complications, mortality, morbidity, etc.
(T)	Timing, if applicable	Describes the duration of time that is of interest for the particular patient intervention and outcome, benefit, or harm to occur (or not occur).
(S)	Setting, if applicable	Describes the setting or context of interest. Setting can be a location (such as primary, specialty, or inpatient care).

The Champions, Work Group, and evidence review team carried out several iterations of this process, each time narrowing the scope of the CPG and the literature review by prioritizing the topics of interest. Due to resource constraints, all developed KQs were not able to be included in the SR. Thus, the Champions and Work Group determined which questions were of highest priority, and those were included in the review. Table A-4 contains the final set of KQs used to guide the SR for this CPG.

a. Population(s)

For KQ 1, the population of interest is adults 18 years or older with undiagnosed LBP. For all other KQs, the population is adults 18 years or older with LBP.

b. Intervention(s)

Table A-2. Key Question Specific Interventions

Question	Interventions
1 (Diagnosis)	Red flags to screen for serious pathology (e.g., fracture, malignancy) Whether smoking history is associated with specific causes of LBP Whether coronary artery disease history is associated with specific causes of LBP Physical exam: Straight leg raise (a.k.a. Lasègue) Physical exam: Facet loading test (a.k.a. Kemp's, Quadrant) Physical exam: FABER test (a.k.a. Patrick's) Other noninvasive test: X-ray Other noninvasive test: CT Other noninvasive test: MRI Other noninvasive test: EMG Other noninvasive test: Blood test Diagnostic injection: facet Diagnostic injection: trigger point Diagnostic injection: transforaminal Discography
2 (Self-care)	Physically active life style Weight loss Tobacco cessation Work place ergonomics Tai chi Self-guided exercise program Aquatic therapy Education Yoga
3 (Other noninvasive non-pharmacologic interventions but requiring the participation of a trained professional)	Guided therapeutic exercises (physical therapy, core strengthening, back strengthening, lumbar stabilization, stretching) Spinal manipulation/mobilization Acupuncture TENS Lumbar traction (non-surgical spinal decompression) Hot pack Lumbar supports E-stim Therapeutic ultrasound Cryotherapy Trigger point dry needling

Question	Interventions
4 (Pharmacologic agents)	Capsaicin or lidoderm Opioid analgesics (any) Antidepressants (TCAs, SNRIs, SSRIs, bupropion, mirtazapine, vilazodone, vortioxetine) Anticonvulsants (Carbamazepine, Lacosamide, Lamotrigine, Levetiracetam, Oxcarbazepine, Pregabalin/gabapentin, Tiagabine, Topiramate, Zonisamide, Valproic acid, Felbamate, Ethosuximide, Rufinamide) NSAIDs (any) Cannabinoids Skeletal muscle relaxants (any, for example Cyclobenzaprine, Metaxalone, Methocarbamol, Orphenadrine citrate, Carisoprodol, Tizanidine, Baclofen, Diazepam, Dantrolene) NMDA antagonists (Amantadine, Memantine, Ketamine, Dextromethorphan) Acetaminophen Salicylates Oral or topical corticosteroids Benzodiazepines Ketamine Ketoprofen OTC topicals (Camphor, Menthol, Paractin, Trolamine)
5 (Supplements)	Willow bark Devil's claw Cayenne Glucosamine N-3 fatty acids EPA DHA Cod liver oil Vitamin C Vitamin E Resveratrol Flavonoids Turmeric Curcumin Ginger Anti-inflammatory diet Low arachidonic acid diet Chondroiten Emu oil
6 (Injections for locally-acting agents)	Epidural injections Facet blocks Medial branch blocks Nerve root blocks Sacroiliac joint blocks Radiofrequency ablation

Question	Interventions
7 (Combination treatment)	Cross-modality treatment (two or more treatments from different modalities, such as physical therapy combined with opioid analgesics)
8 (Behavioral treatment)	Psychotherapy Cognitive behavioral therapy Biofeedback Mindfulness based stress reduction Relaxation therapy
9 (Psychosocial factors as prognostic)	Depression Anxiety ADHD PTSD TBI Divorce Death of spouse or family member Job loss

c. Comparator(s)

The table below lists the comparators of interest to this SR. The comparators are listed by the KQ they address.

Table A-3. Key Question Specific Comparators

Question	Comparators
1 (Diagnosis)	Reference standard (diagnostic accuracy), test vs no test (clinical utility)
2 (Self-care)	Usual care with no self-care and education, other type of self-care / education compared to one-another
3 (Other noninvasive non-pharmacologic interventions but requiring the participation of a trained professional)	Usual care or standard care or a different non-invasive therapy compared to one another
4 (Pharmacologic agents)	Placebo therapy, non-pharmacologic approaches, or a different drug
5 (Supplements)	Placebo therapy, non-pharmacologic approaches, or a different drug
6 (Injections)	Usual care or standard care
7 (Cross-modality treatment)	Typical or usual care; Step-wise approach to treatment with one modality at a time
8 (Behavioral treatment)	Usual care
9 (Psychosocial factors as prognostic)	Those without the psychosocial factor

d. Outcomes

The following outcomes were of interest in the SR:

- Diagnostic accuracy (sensitivity and specificity using a gold standard)
- Influence of a diagnostic test on the choice of treatment or post-treatment outcomes
- Timing of care (wait or recovery time; speed of intervention)

- Pain
- Time to reduction of pain
- Resolution of pain with minimal pharmacotherapy approaches
- Functional status and activities of daily living
- Quality of life
- Disability and work status (including work days lost)
- Reduction in analgesics, healthcare utilization and non-pharmacotherapy treatments;
- Reduction in recurrence of LBP
- Patient satisfaction
- Harms

e. Timing

The minimum follow-up for effectiveness outcome was 12 weeks, and for diagnostics and harms we set no minimum follow-up. We extracted harms data from any studies reporting effectiveness data for 12 or more weeks.

f. Setting

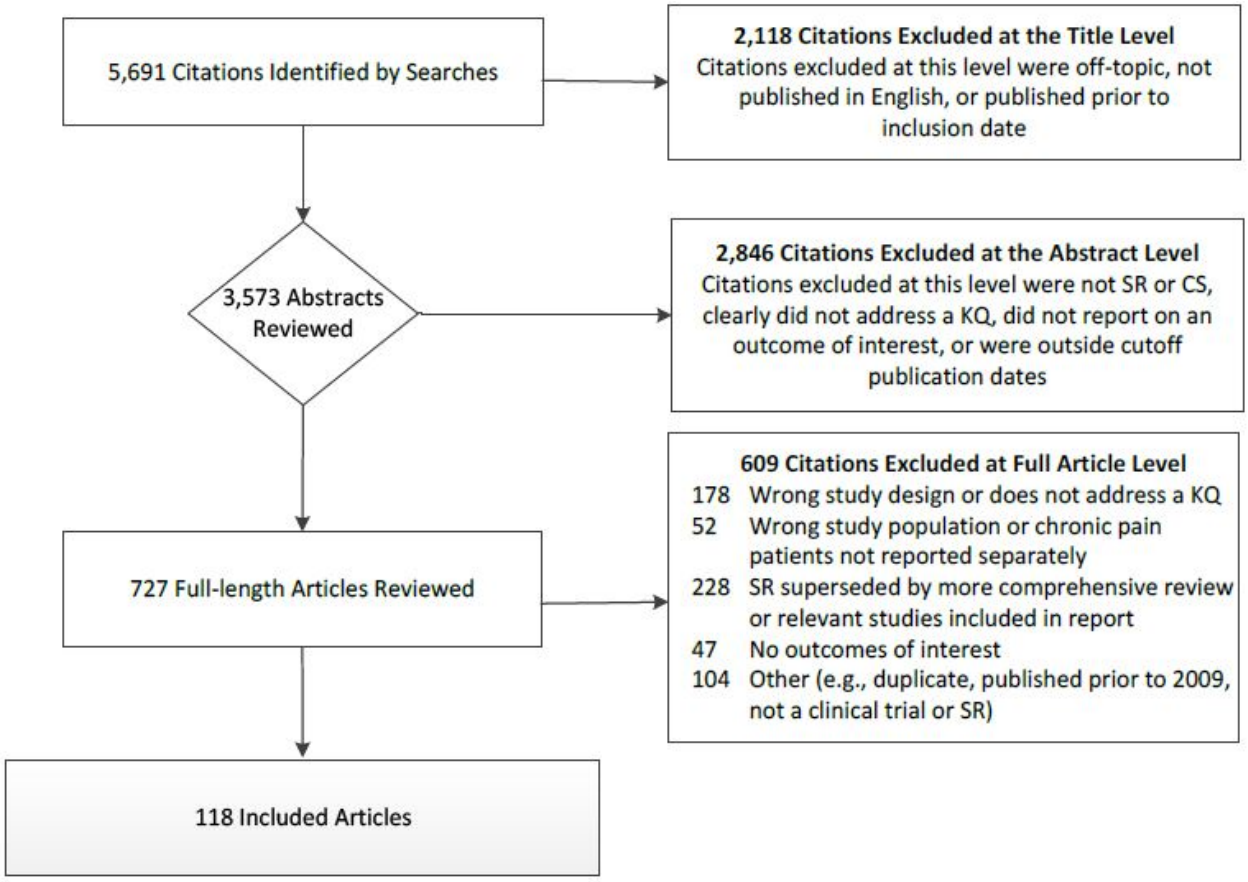
Any setting.

B. Conducting the Systematic Review

Extensive literature searches using the search terms and strategy included in Appendix H identified 5,691 citations potentially addressing the KQs of interest to this evidence review. Of those, 2,118 were excluded upon title review for clearly not meeting inclusion criteria (e.g., not pertinent to the topic, not published in English, published prior to study inclusion publication date, not a full-length article). Overall, 3,573 abstracts were reviewed with 2,846 of those being excluded for the following reasons: not an SR or clinical study, did not address a KQ of interest to this review, did not enroll a population of interest, or published prior to December 1, 2006. A total of 727 full-length articles were reviewed. Of those, 609 were excluded after a full article review for the following: wrong study design or not addressing a KQ of interest, wrong study population or not reporting chronic pain patients separately, SR superseded by more comprehensive review or relevant studies included in report, no outcomes of interest, or other (e.g., being a duplicate). Reasons for their exclusion are presented in Figure A-1 below.

Overall, 118 articles addressed one or more of the KQs and were considered as evidence in this review. Table A-4 indicates the number of studies that addressed each of the questions.

Figure A-1. Study Flow Diagram



Abbreviations: CS: clinical study; KQ: key question; SR: systematic review

Table A-4. Evidence Base for Key Questions

Question Number	Question	Number of Studies and Type of Studies
1a	For adults who present with or have LBP (acute, sub-acute, and chronic LBP), what is the accuracy of history, physical examination, and diagnostic tests, in identifying the underlying condition?	15 SRs 7 diagnostic studies
1b	For adults who present with or have LBP (acute, sub-acute, and chronic LBP), what is the clinical utility of history, physical examination, and diagnostic tests in improving treatment choices and patient outcomes?	1 SR 2 RCTs
2	What is the effectiveness of self-care advice, education, or other self-care (weight loss, tobacco cessation, work place ergonomics, yoga, tai chi, and exercise programs) interventions for improving patient outcomes?	7 SRs 13 RCTs
3	What is the effectiveness of different non-surgical and non-pharmacologic interventions for non-radicular low back pain, radicular low back pain, or spinal stenosis, and under what circumstances?	3 SRs 27 RCTs
4	For adults with LBP, what is the effect of pharmacotherapy treatment?	5 SR 7 RCTs
5	For adults with LBP, what is the effect of nutritional, herbal, and homeopathic supplements?	1 SR
6	For adults with LBP, what is the treatment effectiveness of epidural injections, facet blocks, nerve root blocks, radiofrequency ablation (RFA)?	4 SR 9 RCTs
7	For adults with LBP, which cross-modality combination therapy (e.g., pharmacologic and non-pharmacologic) is most effective?	4 SR 3 RCTs
8	For adults with chronic LBP, what is the effectiveness of behavioral interventions?	4 SR 3 RCTs
9	For adults with low back pain, what is the impact of mental health diagnoses (e.g., depression, anxiety, ADHD, PTSD, TBI) or psychosocial stressors (e.g., divorce, death, job loss) on treatment outcomes?	1 SR 4 prognostic studies
	Total Evidence Base	**118 articles**

a. Criteria for Study Inclusion/Exclusion

i. General Criteria

- Clinical studies or SRs published on or after December 1, 2006 to October 21, 2016. If multiple SRs addressed a key question, the most recent and/or comprehensive review was selected. SRs were supplemented with clinical studies published subsequent to the search dates of the SR.
- Studies must have been published in English.
- Publication must have been a full clinical study or SR; abstracts alone were not included. Similarly, letters, editorials, and other publications that were not full-length clinical studies were not accepted as evidence.
- Studies of diagnostic tests must have provided data on at least 50 patients. Studies of treatments must have reported outcome data on at least 50 patients (and at least 25 per study group) unless otherwise noted (see Key Question Specific Criteria below)
- Study must have reported an outcome of interest.

- Study must have enrolled a patient population in which at least 80% of patients had LBP and were age 18 years or older. If the percentage was less than 80%, then data must have been reported separately for this patient subgroup. Study must have reported in its abstract that patients had LBP. For studies of treatments, patients must not have had spondylolisthesis, postoperative LBP, or pregnancy-related LBP.

For each treatment or diagnostic test of each KQ, it was first determined whether any SRs addressed the question. If so, only the most comprehensive SR was included. Studies published after the SR's last search date were also considered. If there was not an SR that addressed the KQ, studies from December 2006 onward that met all the inclusion criteria for that KQ were included.

ii. Key Question Specific Criteria

- For studies of accuracy (KQ1a), studies/reviews must have reported both sensitivity and specificity (or sufficient information to calculate both values), and must have used a reference standard that was independent of the index test.
- For studies of clinical utility (KQ1b), studies/reviews must have compared two groups of patients: one that received the diagnostic test of interest, and one that did not, in order to measure the influence of the test on treatment choice and/or patient outcomes.
- For KQs 2 through 8, reviews must have been SRs directly addressing a KQ, and studies must have randomly assigned patients to different treatments (the comparator could have been a placebo treatment). The minimum follow-up was 12 weeks for effectiveness outcomes, and there was no minimum follow-up for harms outcomes. Harms data were extracted from any studies reporting effectiveness data beyond 12 weeks follow-up.
- For KQ 9, studies/reviews did not have to be randomized, but did have to compare the post-treatment outcomes of patients who had a psychosocial risk factor to the post-treatment outcomes of patients who did not have that psychosocial risk factor but were otherwise similar.

b. Literature Search Strategy

Information regarding the bibliographic databases, date limits, and platform/provider can be found in Table A-5, below. Additional information on the search strategies, including topic-specific search terms and search strategies can be found in Appendix H.

Table A-5. Bibliographic Database Information

Name	Date Limits	Platform/Provider
Agency for Healthcare Research and Quality (AHRQ)	2006 – September 2016	U.S. Department of Health & Human Services
Canadian Agency for Drugs and Technologies in Health (CADTH)	2006 – September 2016	Canadian Agency for Drugs and Technologies in Health
CINAHL	2006 – September 2016	EBSCO Host
Cochrane Library	2006 – September 2016	John Wiley & Sons, Ltd.
Embase.com (Includes EMBASE and Medline Records)	2006 – September 2016	Elsevier
Healthcare Standards (HCS)	2006 – September 2016	ECRI Institute
National Guideline Clearinghouse (NGC)	2006 – September 2016	AHRQ
National Institute for Health and Care Excellence (NICE)	2006 – September 2016	National Institute for Health and Care Excellence
PsycINFO	2006 – September 2016	OVID Technologies, Inc.
PubMed (In-process and publisher supplied records)	2006 – September 2016	National Library of Medicine

C. Convening the Face-to-face Meeting

In consultation with the COR, the Champions, and the Work Group, the Lewin Team convened a three and a half day face-to-face meeting of the CPG Champions and Work Group members on December 6-9, 2016. These experts were gathered to develop and draft the clinical recommendations for an update to the 2007 LBP CPG. Lewin presented findings from the evidence review of KQs 1-9 in order to facilitate and inform the process.

Under the direction of the Champions, the Work Group members were charged with interpreting the results of the evidence review, and asked to categorize and carry forward recommendations from the 2007 LBP CPG, modifying the recommendations as necessary. The members also developed new clinical practice recommendations not presented in the 2007 LBP CPG, based on the 2016 evidence review. The subject matter experts were divided into three smaller subgroups at this meeting.

As the Work Group members drafted clinical practice recommendations, they also assigned a grade for each recommendation based on a modified GRADE and USPSTF methodology. Each recommendation was graded by assessing the quality of the overall evidence base, the associated benefits and harms, the variation in values and preferences, and other implications of the recommendation.

In addition to developing recommendations during the face-to-face meeting, the Work Group members also revised the 2007 LBP CPG algorithm to reflect the new and amended recommendations. They discussed the available evidence as well as changes in clinical practice since 2007, as necessary, to update the algorithm.

D. Grading Recommendations

This CPG uses the GRADE methodology to assess the quality of the evidence base and assign a grade for the strength for each recommendation. The GRADE system uses the following four domains to assess the strength of each recommendation:[10]

- Balance of desirable and undesirable outcomes
- Confidence in the quality of the evidence
- Values and preferences
- Other implications, as appropriate, e.g.,:
    - Resource Use
    - Equity
    - Acceptability
    - Feasibility
    - Subgroup considerations

The following sections further describe each domain.

Balance of desirable and undesirable outcomes refers to the size of anticipated benefits (e.g., increased longevity, reduction in morbid event, resolution of symptoms, improved quality of life, decreased resource use) and harms (e.g., decreased longevity, immediate serious complications, adverse event, impaired quality of life, increased resource use, inconvenience/hassle) relative to each other. This domain is based on the understanding that the majority of clinicians will offer patients therapeutic or preventive measures as long as the advantages of the intervention exceed the risks and adverse effects. The certainty or uncertainty of the clinician about the risk-benefit balance will greatly influence the strength of the recommendation.

Some of the discussion questions that fall under this domain include:

- Given the best estimate of typical values and preferences, are you confident that the benefits outweigh the harms and burden or vice versa?
- Are the desirable anticipated effects large?
- Are the undesirable anticipated effects small?
- Are the desirable effects large relative to undesirable effects?

Confidence in the quality of the evidence reflects the quality of the evidence base and the certainty in that evidence. This second domain reflects the methodological quality of the studies for each outcome variable. In general, the strength of recommendation follows the level of evidence, but not always, as other domains may increase or decrease the strength. The evidence review used for the development of recommendations for LBP, conducted by ECRI, assessed the confidence in the quality of the evidence base and assigned a rate of “High,” “Moderate,” “Low,” or “Very Low.”

The elements that go into the confidence in the quality of the evidence include:

- Is there high or moderate quality evidence that answers this question?
- What is the overall certainty of this evidence?

Values and preferences is an overarching term that includes patients' perspectives, beliefs, expectations, and goals for health and life. More precisely, it refers to the processes that individuals use in considering the potential benefits, harms, costs, limitations, and inconvenience of the therapeutic or preventive measures in relation to one another. For some, the term "values" has the closest connotation to these processes. For others, the connotation of "preferences" best captures the notion of choice. In general, values and preferences increase the strength of the recommendation when there is high concordance and decrease it when there is great variability. In a situation in which the balance of benefits and risks are uncertain, eliciting the values and preferences of patients and empowering them and their surrogates to make decisions consistent with their goals of care becomes even more important. A recommendation can be described as having "similar values," "some variation," or "large variation" in typical values and preferences between patients and the larger populations of interest.

Some of the discussion questions that fall under the purview of values and preferences include:

- Are you confident about the typical values and preferences and are they similar across the target population?
- What are the patient's values and preferences?
- Are the assumed or identified relative values similar across the target population?

Other implications consider the practicality of the recommendation, including resources use, equity, acceptability, feasibility and subgroup considerations. Resource use is related to the uncertainty around the cost-effectiveness of a therapeutic or preventive measure. For example statin use in the frail elderly and others with multiple co-occurring conditions may not be effective and depending on the societal benchmark for willingness to pay, may not be a good use of resources. Equity, acceptability, feasibility, and subgroup considerations require similar judgments around the practically of the recommendation.

The framework below (Table A-6) was used by the Work Group to guide discussions on each domain.

Table A-6. Evidence to Recommendation Framework

Decision Domain	Judgment
Balance of desirable and undesirable outcomes	
▪ Given the best estimate of typical values and preferences, are you confident that the benefits outweigh the harms and burden or vice versa? ▪ Are the desirable anticipated effects large? ▪ Are the undesirable anticipated effects small? ▪ Are the desirable effects large relative to undesirable effects?	Benefits outweigh harms/burden Benefits slightly outweigh harms/burden Benefits and harms/burden are balanced Harms/burden slightly outweigh benefits Harms/burden outweigh benefits

Decision Domain	Judgment
Confidence in the quality of the evidence	
▪ Is there high or moderate quality evidence that answers this question? ▪ What is the overall certainty of this evidence?	High Moderate Low Very low
Values and preferences	
▪ Are you confident about the typical values and preferences and are they similar across the target population? ▪ What are the patient's values and preferences? ▪ Are the assumed or identified relative values similar across the target population?	Similar values Some variation Large variation
Other implications (e.g., resource use, equity, acceptability, feasibility, subgroup considerations)	
▪ Are the resources worth the expected net benefit from the recommendation? ▪ What are the costs per resource unit? ▪ Is this intervention generally available? ▪ Is this intervention and its effects worth withdrawing or not allocating resources from other interventions? ▪ Is there lots of variability in resource requirements across settings?	Various considerations

The strength of a recommendation is defined as the extent to which one can be confident that the desirable effects of an intervention outweigh its undesirable effects and is based on the framework above, which combines the four domains.[10] GRADE methodology does not allow for recommendations to be made based on expert opinion alone. While strong recommendations are usually based on high or moderate confidence in the estimates of effect (quality of the evidence) there may be instances where strong recommendations are warranted even when the quality of evidence is low.[140] In these types of instances where the balance of desirable and undesirable outcomes and values and preferences played large roles in determining the strength of a recommendation, this is explained in the discussion section for the recommendation.

The GRADE of a recommendation is based on the following elements:

- Four decision domains used to determine the strength and direction (described above)
- Relative strength (Strong or Weak)
- Direction (For or Against)

The relative strength of the recommendation is based on a binary scale, "Strong" or "Weak." A strong recommendation indicates that the Work Group is highly confident that desirable outcomes outweigh undesirable outcomes. If the Work Group is less confident of the balance between desirable and undesirable outcomes, they present a weak recommendation.

Similarly, a recommendation for a therapy or preventive measure indicates that the desirable consequences outweigh the undesirable consequences. A recommendation against a therapy or preventive measure indicates that the undesirable consequences outweigh the desirable consequences.

Occasionally, instances may occur when the Work Group feels there is insufficient evidence to make a recommendation for or against a particular therapy or preventive measure. This can occur when there is an absence of studies on a particular topic that met evidence review inclusion criteria, studies included in the evidence review report conflicting results, or studies included in the evidence review report inconclusive results regarding the desirable and undesirable outcomes.

Using these elements, the grade of each recommendation is presented as part of a continuum:

- Strong For (or "We recommend offering this option …")
- Weak For (or "We suggest offering this option …")
- No recommendation for or against (or "There is insufficient evidence …")
- Weak Against (or "We suggest not offering this option …")
- Strong Against (or "We recommend against offering this option …")

Note that weak (For or Against) recommendations may also be termed "Conditional," "Discretionary," or "Qualified." Recommendations may be conditional based upon patient values and preferences, the resources available, or the setting in which the intervention will be implemented. Recommendations may be at the discretion of the patient and clinician, or they may be qualified with an explanation about the issues that would lead decisions to vary.

E. Recommendation Categorization

a. Categorizing Recommendations with an Updated Review of the Evidence

Recommendations were first categorized by whether or not they were based on an updated review of the evidence. If evidence had been reviewed, recommendations were categorized as "New-added," "New-replaced," "Not changed," "Amended," or "Deleted."

"Reviewed, New-added" recommendations were original, new recommendations that were not in the 2007 LBP CPG. "Reviewed, New-replaced" recommendations were in the previous version of the guideline, but were modified to align with the updated review of the evidence. These recommendations could have also included clinically significant changes to the previous version. Recommendations categorized as "Reviewed, Not changed" were carried forward from the previous version of the CPG unchanged.

For recommendations carried forward to the updated CPG with review of the evidence and slightly modified wording, the "Reviewed, Amended" recommendation category was used. This allowed for non-substantive (i.e., not clinically meaningful) language changes deemed necessary. The evidence used to support these recommendations was carried forward from the previous version of the CPG and/or was identified in the evidence review for the update.

Recommendations could have also been designated "Reviewed, Deleted." These were recommendations from the previous version of the CPG that were not brought forward to the updated guideline after review of the evidence. This occurred if the evidence supporting the recommendations was out of date, to the extent that there was no longer any basis to recommend a particular course of care and/or new evidence suggests a shift in care, rendering recommendations in the previous version of the guideline obsolete.

b. Categorizing Recommendations without an Updated Review of the Evidence

There were also cases in which it was necessary to carry forward recommendations from the previous version of the CPG without an SR of the evidence. Due to time and budget constraints, the update of the LBP CPG could not review all available evidence on the diagnosis and treatment of LBP, but instead focused its KQs on areas of new or updated scientific research or areas that were not previously covered in the CPG.

For areas of research that have not changed, and for which recommendations made in the previous version of the guideline were still relevant, recommendations could have been carried forward to the updated guideline without an updated SR of the evidence. The support for these recommendations in the updated CPG was thus also carried forward from the previous version of the CPG. These recommendations were categorized as "Not reviewed." If evidence had not been reviewed, recommendations could have been categorized as "Not changed," Amended," or "Deleted."

"Not reviewed, Not changed" recommendations refer to recommendations from the previous version of the LBP CPG that were carried forward unchanged to the updated version. The category of "Not reviewed, Amended" was used to designate recommendations which were modified with non-substantive language changes from the 2007 LBP CPG.

Recommendations could also have been categorized as "Not reviewed, Deleted" if they were determined to be out of scope. A recommendation was out of scope if it pertained to a topic (e.g., population, care setting, treatment, condition) outside of the scope for the updated CPG as defined by the Work Group.

The categories for the recommendations included in the 2017 version of the guideline are noted in the Recommendations. The categories for the recommendations from the 2007 LBP CPG are noted in Appendix E.

c. Recommendation Categories and Definitions

For use in the 2017 LBP CPG, a set of recommendation categories was adapted from those used by the United Kingdom National Institute for Health and Clinical Excellence (NICE).[14,15] These categories, along with their corresponding definitions, were used to account for the various ways in which recommendations could have been updated from the 2007 LBP CPG. The categories and definitions can be found in Table A-7.

Table A-7. Recommendation Categories and Definitions

Evidence Reviewed*	Recommendation Category*	Definition*
Reviewed	New-added	New recommendation following review of the evidence
	New-replaced	Recommendation from previous CPG that has been carried over to the updated CPG that has been changed following review of the evidence
	Not changed	Recommendation from previous CPG that has been carried forward to the updated CPG where the evidence has been reviewed but the recommendation is not changed
	Amended	Recommendation from the previous CPG that has been carried forward to the updated CPG where the evidence has been reviewed and a minor amendment has been made
	Deleted	Recommendation from the previous CPG that has been removed based on review of the evidence
Not reviewed	Not changed	Recommendation from previous CPG that has been carried forward to the updated CPG, but for which the evidence has not been reviewed
	Amended	Recommendation from the previous CPG that has been carried forward to the updated CPG where the evidence has not been reviewed and a minor amendment has been made
	Deleted	Recommendation from the previous CPG that has been removed because it was deemed out of scope for the updated CPG

*Adapted from the NICE guideline manual (2012) [14] and Garcia et al. (2014) [15]
Abbreviation: CPG: clinical practice guideline

F. Drafting and Submitting the Final Clinical Practice Guideline

Following the face-to-face meeting, the Champions and Work Group members were given writing assignments to craft discussion sections to support each of the new recommendations and/or to update discussion sections from the 2007 LBP CPG to support the amended "carried forward" recommendations. The Work Group also considered tables, appendices, and other sections from the 2007 LBP CPG for inclusion in the update. During this time, the Champions and Work Group also made additional revisions to the algorithm, as necessary.

After developing the initial draft of the updated CPG, an iterative review process was used to solicit feedback on and make revisions to the CPG. Once they were developed, the first two drafts of the CPG were posted on a wiki website for a period of 14-20 business days for internal review and comment by the Work Group. All feedback submitted during each review period was reviewed and discussed by the Work Group and appropriate revisions were made to the CPG.

Draft 3 of the CPG was made available for peer review and comment. This process is described in Peer Review Process. After revisions were made based on the feedback received during the peer review and comment period, the Champions presented the CPG to the EBPWG for their approval. Changes were made based on feedback from the EBPWG and the guideline was finalized.

The Work Group also produced a set of guideline toolkit materials which included a provider summary, pocket card, and a patient summary. The final 2017 LBP CPG was submitted to the EBPWG in September 2017.

Appendix B: Dosing for Select Pharmacologic Agents[1]

Generic	Starting Dose	Max/Day	Half-life (t½) (hrs)
Muscle Relaxants			
TIZANIDINE	2-4 mg TID	36 mg	2.5
BACLOFEN	5 mg TID	80 mg	~ 3.75
CYCLOBENZAPRINE[2]	5 mg TID	30 mg	18
METAXALONE[2]	800 mg TID	3,200 mg	~ 9
METHOCARBAMOL[2]	1.5 gm QID	4.5 gm	1-2
ORPHENADRINE[2]	100 mg BID	200 mg	14-16
Antidepressants			
AMITRIPTYLINE[2]	10-25 mg QHS	150 mg	~ 13-36
DESPIRAMINE[2]	10-25 mg QHS	150 mg	15-24
NORTRIPTYLINE[2]	10-25 mg QHS	150 mg	14-51
DULOXETINE[2]	30 mg QD	60 mg	~ 12
VENLAFAXINE ER	37.5 mg QD	225 mg	~ 11
NSAIDs[3]			
KETOROLAC	10 mg q 4-6H	40 mg	~ 5
KETOPROFEN	50 mg QID	300 mg	2-4
INDOMETHACIN	25 mg q 8H	200 mg	2.6-11.2
NAPROXEN	250 mg BID	1500 mg	12-17
IBUPROFEN	400 mg q 4-6H	3200 mg	~ 2
NABUMETONE	1000 mg QD	2000 mg	~ 24
PIROXICAM	20 mg QD	20 mg	50
SALSALATE	1000 mg TID	3000 mg	~ 1
SULINDAC	150mg BID	400 mg	7.8
DICLOFENAC NA	50-75 mg BID	150-200 mg	~ 2
CELECOXIB	100 mg BID	400 mg	~ 11
MELOXICAM	5-7.5 mg QD	15 mg	~ 15-22
ETODOLAC	200 mg q 8H	1000 mg	6.4

Dosing recommendations obtained from the FDA individual product prescribing information.
Listed in order of increased COX-2 Selectivity, more selective at the bottom:[107,141,142]

More COX 1 Selective | < 5-fold COX-2 Selective | 5-50 fold COX-2 Selective

[1] Consult full prescribing information for individual drugs; dosing and half-life may be altered by patient age, renal and hepatic function, and product formulation; consider reduced dosing and/or frequency in the elderly.

[2] Use not recommended in patients > 65 years of age per American Geriatrics Society 2015 Updated Beers Criteria.[114]

[3] Avoid chronic use in the elderly, unless other alternatives are not effective and patient can take a gastroprotective agent (proton pump inhibitor or misoprostol).

Abbreviations: BID: twice a day; COX-2: cyclooxygenase-2; gm: gram; hrs: hours; max: maximum; mg: milligram; NSAIDs: nonsteroidal anti-inflammatory drug; q 4-6H: every 4-6 hours; q 8H: every 8 hours; QD: one a day; QID: four times a day; QHS: nightly at bedtime; TID: three times a day

Appendix C: Evidence Table

Recommendation	2007 Grade[12]	Evidence[13]	Strength of Recommendation[14]	Recommendation Category[15]
1. For patients with low back pain, we recommend that clinicians conduct a history and physical examination, that should include identifying and evaluating neurologic deficits (e.g., radiculopathy, neurogenic claudication), red flag symptoms associated with serious underlying pathology (e.g., malignancy, fracture, infection), and psychosocial factors.	Strong recommendation	[23-29]	Strong for	Reviewed, Amended
2. For patients with low back pain, we suggest performing a mental health screening as part of the low back pain evaluation and taking results into consideration during selection of treatment.	Weak recommendation	[30-32]	Weak for	Reviewed, New-replaced
3. For patients with acute axial low back pain (i.e., localized, non-radiating), we recommend against routinely obtaining imaging studies or invasive diagnostic tests.	Strong recommendation	[26,33-37,39,41] **Additional References:** [38,40]	Strong against	Reviewed, Amended
4. For patients with low back pain, we recommend diagnostic imaging and appropriate laboratory testing when neurologic deficits are serious or progressive or when red flag symptoms are present.	Strong recommendation	[26,37,42-46]	Strong for	Reviewed, Amended
5. For patients with low back pain greater than one month who have not improved or responded to initial treatments, there is inconclusive evidence to recommend for or against any diagnostic imaging.	Not applicable	[36,37,47,48,51] **Additional References:** [49,50]	Not applicable	Reviewed, New-added
6. For patients with chronic low back pain, we recommend providing evidence-based information with regard to their expected course, advising patients to remain active, and providing information about self-care options.	Strong recommendation	[23,25,36,51-54,56] **Additional Reference:** [55]	Strong for	Reviewed, Amended

[12] The 2007 VA/DoD LBP CPG also used the GRADE evidence grading system.

[13] The evidence column indicates studies that support each recommendation. For new recommendations, developed by the 2017 guideline Work Group, the literature cited corresponds directly to the 2016 evidence review. For recommendations that have been carried over from the 2007 VA/DoD LBP CPG, slight modifications were made to the language in order to better reflect the current evidence and/or the change in grading system used for assigning the strength of each recommendation (USPSTF to GRADE). For these "modified" recommendations, the evidence column indicates "additional evidence," which can refer to either 1) studies that support the recommendation and which were identified through the 2016 evidence review, or 2) relevant studies that support the recommendation, but which were not systematically identified through a literature review.

[14] Refer to the Grading Recommendations section for more information on how the strength of the recommendation was determined using GRADE methodology.

[15] Refer to the Recommendation Categorization section for more information on the description of the categorization process and the definition of each category.

Recommendation	2007 Grade[12]	Evidence[13]	Strength of Recommendation[14]	Recommendation Category[15]
7. For patients with chronic low back pain, we suggest adding a structured education component, including pain neurophysiology, as part of a multicomponent self-management intervention.	Not applicable	[57,60,61] **Additional Reference:** [58,59]	Weak for	Reviewed, New-added
8. For patients with chronic low back pain, we recommend cognitive behavioral therapy.	Weak recommendation	[3,62,64,65] **Additional References:** [63,66-71]	Strong for	Reviewed, New-replaced
9. For patients with chronic low back pain, we suggest mindfulness-based stress reduction.	Weak recommendation	[3,62,64,65] **Additional References:** [63,66-71]	Weak for	Reviewed, New-replaced
10. For patients with acute low back pain, there is insufficient evidence to support the use of specific clinician-directed exercise.	Not applicable	[3,72-75] **Additional Reference:** [76]	Not applicable	Reviewed, New-replaced
11. For patients with chronic low back pain, we suggest offering clinician-directed exercises.	Weak recommendation	[3,72-75] **Additional Reference:** [76]	Weak for	Reviewed, New-replaced
12. For patients with acute or chronic low back pain, we suggest offering spinal mobilization/manipulation as part of a multimodal program.	Weak recommendation	[77-84]	Weak for	Reviewed, New-replaced
13. For patients with acute low back pain, there is insufficient evidence to support the use of acupuncture.	Not applicable	[3]	Not applicable	Reviewed, New-replaced
14. For patients with chronic low back pain, we suggest offering acupuncture.	Weak recommendation	[3]	Weak for	Reviewed, New-replaced
15. For acute or chronic low back pain, there is insufficient evidence for or against the use of lumbar supports.	Not applicable	[3,85-87]	Not applicable	Reviewed, Amended
16. For patients with chronic low back pain, we suggest offering an exercise program, which may include Pilates, yoga, and tai chi.	Weak recommendation	[3,92-97] **Additional References:** [88-91]	Weak for	Reviewed, New-replaced
17. For patients with low back pain, there is insufficient evidence to support the use of ultrasound.	Not applicable	[3]	Not applicable	Reviewed, New-added
18. For patients with low back pain, there is inconclusive evidence to support the use of transcutaneous electrical nerve stimulation (TENS).	Not applicable	[98]	Not applicable	Reviewed, New-added

Recommendation	2007 Grade[12]	Evidence[13]	Strength of Recommendation[14]	Recommendation Category[15]
19. For patients with low back pain, there is insufficient evidence to support the use of lumbar traction.	Not applicable	[99-102]	Not applicable	Reviewed, New-added
20. For patients with low back pain, there is insufficient evidence to support the use of electrical muscle stimulation.	Not applicable	[3,103]	Not applicable	Reviewed, New-added
21. For patients with acute or chronic low back pain, we recommend treating with nonsteroidal anti-inflammatory drugs, with consideration of patient-specific risks.	Strong recommendation	[3,104-106] **Additional References:** [107-109]	Strong for	Reviewed, Amended
22. For patients with chronic low back pain, we suggest offering treatment with duloxetine, with consideration of patient-specific risks.	Not applicable	[3,110-112] **Additional References:** [113,114]	Weak for	Reviewed, New-added
23. For patients with acute low back pain or acute exacerbations of chronic low back pain, we suggest offering a non-benzodiazepine muscle relaxant for short-term use.	Not applicable	[3,115,116]	Weak for	Reviewed, New-added
24. For patients with chronic low back pain, we suggest against offering a non-benzodiazepine muscle relaxant.	Not applicable	[3,115,116]	Weak against	Reviewed, New-added
25. For patients with low back pain, we recommend against benzodiazepines.	Strong recommendation	[3,117] **Additional Reference:** [118]	Weak against	Reviewed, New-replaced
26. For patients with acute or chronic low back pain with or without radiculopathy, we recommend against the use of systemic corticosteroids (oral or intramuscular injection).	Strong recommendation	[3,119] **Additional Reference:** [120]	Strong against	Reviewed, Amended
27. For patients with low back pain, we recommend against initiating long-term opioid therapy. For patients who are already prescribed long-term opioid therapy, refer to the VA/DoD CPG for the Management of Opioid Therapy for Chronic Pain.[16]	Strong recommendation	[3,23,115]	Strong against	Reviewed, New-replaced

[16] See the VA/DoD Clinical Practice Guideline for the Management of Opioid Therapy for Chronic Pain. Available at: http://www.healthquality.va.gov/guidelines/Pain/cot/

Recommendation	2007 Grade[12]	Evidence[13]	Strength of Recommendation[14]	Recommendation Category[15]
28. For patients with acute low back pain or acute exacerbations of chronic low back pain, there is insufficient evidence to recommend for or against the use of time-limited opioid therapy. Given the significant risks and potential benefits of opioid therapy, patients should be evaluated individually, including consideration of psychosocial risks and alternative non-opioid treatments. Any opioid therapy should be kept to the shortest duration and lowest dose possible.	Strong recommendation	[3,23,115]	Not applicable	Reviewed, New-replaced
29. For patients with acute or chronic low back pain, there is insufficient evidence to recommend for or against the use of time-limited (less than seven days) acetaminophen therapy.	Strong recommendation	[3,121,122]	Not applicable	Reviewed, New-replaced
30. For patients with chronic low back pain, we recommend against the chronic use of oral acetaminophen.	Strong recommendation	[3,121,122]	Strong against	Reviewed, New-replaced
31. For the treatment of acute or chronic low back pain, including patients with both radicular and non-radicular low back pain, there is insufficient evidence to recommend for or against the use of antiepileptics including gabapentin and pregabalin.	Strong recommendation	[3,123-125] **Additional Reference:** [126]	Not applicable	Reviewed, New-replaced
32. For the treatment of low back pain, there is insufficient evidence to recommend for or against the use of topical preparations.	Strong recommendation	None	Not applicable	Reviewed, New-added
33. For the treatment of low back pain, there is insufficient evidence to recommend for or against nutritional, herbal, and homeopathic supplements.	Not applicable	[127]	Not applicable	Reviewed, New-added
34. For the long-term reduction of radicular low back pain, non-radicular low back pain, or spinal stenosis, we recommend against offering spinal epidural steroid injections.	Not applicable	[3,128-134]	Strong against	Reviewed, New-added
35. For the very short-term effect (less than or equal to two weeks) of reduction of radicular low back pain, we suggest offering epidural steroid injection.	Not applicable	[3,128-134]	Weak for	Reviewed, New-added
36. For the treatment of low back pain, we suggest against offering intra-articular facet joint steroid injections.	Not applicable	[3,128-134]	Weak against	Reviewed, New-added
37. For patients with low back pain, there is inconclusive evidence to recommend for or against medial branch blocks and radiofrequency ablative denervation.	Not applicable	[3,128-134]	Not applicable	Reviewed, New-added

Recommendation	2007 Grade[12]	Evidence[13]	Strength of Recommendation[14]	Recommendation Category[15]
38. For selected patients with chronic low back pain not satisfactorily responding to more limited approaches, we suggest offering a multidisciplinary or interdisciplinary rehabilitation program which should include at least one physical component and at least one other component of the biopsychosocial model (psychological, social, occupational) used in an explicitly coordinated manner.	Not applicable	[135-138]	Weak for	Reviewed, New-replaced

Appendix D: Glossary

Term		Definition
General	Acute low back pain	LBP present for fewer than four weeks, sometimes grouped with subacute LBP as symptoms present for fewer than three months.
	Cauda equina syndrome	Compression on nerve roots in the lumbosacral spine, usually due to a massive, centrally herniated disc, which can result in urinary retention or incontinence from loss of sphincter function, bilateral motor weakness of the lower extremities, and saddle anesthesia.
	Chronic low back pain	LBP present for more than three months.
	Herniated disc	Herniation of the nucleus pulposus of an intervertebral disc through its fibrous outer covering, which can result in compression of adjacent nerve roots or other structures.
	Neurogenic claudication	Symptoms of leg pain (and occasionally weakness) while walking or standing, relieved by sitting or spinal flexion, associated with spinal stenosis.
	Non-radicular back pain	Pain perceived as arising from the vertebral column or related tissues, not including clear disorders or diseases of the nerve roots and their ganglions.
	Non-specific low back pain	Axial/non-radiating pain occurring primarily in the back with no signs of a serious underlying condition (such as cancer, infection, or cauda equina syndrome), spinal stenosis or radiculopathy, or another specific spinal cause (such as vertebral compression fracture or ankylosing spondylitis). Degenerative changes on lumbar imaging are usually considered nonspecific, as they correlate poorly with symptoms.
	Radicular back pain	Pain in the back and lower limb with a component below the knee, associated with a disorder of the spinal nerve root and/or its ganglion. This pain may or may not be accompanied by objective evidence of impaired conduction (radiculopathy).
	Radiculopathy	Radiculopathy is objectively determined, impaired conduction down a spinal nerve or its roots. This can be diagnosed by clinical exam (loss of sensation, muscle stretch reflexes, or strength) or via electrodiagnostic testing. Radiculopathy may or may not be accompanied by radicular pain.
	Referred pain	Pain which the patient reports spreads away from the primary site such as to the limbs, and is perceived in regions other than the primary site. Referred pain may have a radiating quality but does not involve stimulation of nerve roots, which differentiates it from radicular pain.
	Sciatica	An outdated term for referred pain into the lower limbs associated with lumbar back pain.
	Spinal stenosis	Pain in the back thought to be related to degenerative narrowing of the spinal canal and neural foramina. Spinal stenosis pain is thought to be from compression of neurovascular structures and involves referred pain into the lower limbs and may or may not include radicular pain or radiculopathy.
	Straight-leg-raise test	A procedure in which the hip is flexed with the knee extended in order to passively stretch the sciatic nerve and elicit symptoms suggesting nerve root tension. A positive test is usually considered reproduction of the patient's sciatica when the leg is raised between 30 and 70 degrees. Reproduction of the patient's sciatica when the unaffected leg is lifted is referred to as a positive "crossed" straight-leg-raise test.

Term		Definition
Interventions	Acupuncture	An intervention consisting of the insertion of needles at strategic points on a body, most commonly used to treat pain.
	Back school	An intervention consisting of education and a skills program, including exercise therapy, in which all lessons are given to groups of patients and supervised by a paramedical therapist or medical specialist.
	Clinician-directed exercise	A supervised exercise program or formal home exercise regimen, ranging from programs aimed at general physical fitness or aerobic exercise to programs aimed at muscle strengthening, flexibility, stretching, or a combination of these elements.
	Cognitive behavioral therapy	An intervention that involves examining and changing cognitions and behaviors that perpetuate pain as well as using relaxation and exposure techniques to reduce symptom-related distress.
	Mindfulness-based stress reduction	A structured intervention based on the concept of mindfulness (i.e., attending to the present moment, without judgment) with components of relaxation, exercise and meditation.
	Motor control exercise	A form of rehabilitative exercise that aims to restore coordinated and efficient use of the muscles that control and support the spine. Patients are initially guided to practice normal use of the muscles during simple tasks. As the patient's skill increases the exercises are progressed to more complex and functional tasks.
	Multidisciplinary/ interdisciplinary rehabilitation program	An intervention that combines and coordinates physical, vocational, and behavioral/psychological components and is provided by multiple health care professionals with different clinical backgrounds. The intensity and content of the program varies widely. Interdisciplinary emphasizes collaboration among providers from different disciplines in implementing a joint treatment plan.
	Pilates	A system of exercise using special apparatus, designed to improve physical strength, flexibility, and posture.
	Progressive relaxation	A technique which involves the deliberate tensing and relaxation of muscles, in order to facilitate the recognition and release of muscle tension.
	Self-care options	Interventions that can be readily implemented by patients without seeing a clinician or that can be implemented on the basis of advice provided at a routine clinic visit.
	Self-care education book	Reading material (e.g., books, leaflets) that provide education and self-care advice for patients with LBP. Although the specific content varies, self-care materials are generally based on principles from published CPGs and encourage a return to normal activity, adoption of a fitness program, appropriate lifestyle modification, and provide advice on coping strategies and managing flares.
	Spinal manipulation	Manual therapy in which loads are applied to the spine by using short- or long-lever methods and high-velocity thrusts are applied to a spinal joint beyond its restricted range of movement. Spinal mobilization, or low-velocity, passive movements within or at the limit of joint range, is often used in conjunction with spinal manipulation.
	Tai chi	A form of stylized, meditative exercise, characterized by methodically slow circular and stretching movements and positions of bodily balance.
	Transcutaneous electrical nerve stimulation	Use of a small, battery-operated device to provide continuous electrical impulses via surface electrodes, with the goal of providing symptomatic relief by modifying pain perception.
	Yoga	An intervention distinguished from traditional exercise therapy by the use of specific body positions, breathing techniques, and an emphasis on mental focus. Many styles of yoga are practiced, each emphasizing different postures and techniques.

Appendix E: 2007 Recommendation Categorization Table

2007 Number	2007 Recommendation Text[17]	2007 Grade[18]	Category[19]	2017 Recommendation[20]
1	Clinicians should conduct a focused history and physical examination to help place patients with low back pain into 1 of 3 broad categories: nonspecific low back pain, back pain potentially associated with radiculopathy or spinal stenosis, or back pain potentially associated with another specific spinal cause. The history should include assessment of psychosocial risk factors, which predict risk for chronic disabling back pain.	Strong recommendation	Reviewed, Amended	Recommendation 1
2	Clinicians should not routinely obtain imaging or other diagnostic tests in patients with nonspecific low back pain.	Strong recommendation	Reviewed, Amended	Recommendation 3
3	Clinicians should perform diagnostic imaging and testing for patients with low back pain when severe or progressive neurologic deficits are present or when serious underlying conditions are suspected on the basis of history and physical examination.	Strong recommendation	Reviewed, Amended	Recommendation 4
4	Clinicians should evaluate patients with persistent low back pain and signs or symptoms of radiculopathy or spinal stenosis with magnetic resonance imaging (preferred) or computed tomography only if they are potential candidates for surgery or epidural steroid injection (for suspected radiculopathy).	Strong recommendation	Reviewed, Ameded	Recommendation 4
5	Clinicians should provide patients with evidence-based information on low back pain with regard to their expected course, advise patients to remain active, and provide information about effective self-care options.	Strong recommendation	Reviewed, Amended	Recommendation 6
6	For patients with low back pain, clinicians should consider the use of medications with proven benefits in conjunction with back care information and self-care. Clinicians should assess severity of baseline pain and functional deficits, potential benefits, risks, and relative lack of long-term efficacy and safety data before initiating therapy. For most patients, first-line medication options are acetaminophen or nonsteroidal anti-inflammatory drugs.	Strong recommendation	Reviewed, New-replaced	Recommendations 21-32

[17] The 2007 Recommendation Text column contains the wording of each recommendation from the 2007 LBP CPG.
[18] The 2007 VA/DoD LBP CPG also used the GRADE evidence grading system.
[19] The Category column indicates the way in which each 2007 LBP CPG recommendation was updated.
[20] For recommendations that were carried forward to the 2007 LBP CPG, this column indicates the new recommendation(s) to which they correspond.

2007 Number	2007 Recommendation Text[17]	2007 Grade[18]	Category[19]	2017 Recommendation[20]
7	For patients who do not improve with self- care options, clinicians should consider the addition of non-pharmacologic therapy with proven benefits—for acute low back pain, spinal manipulation; for chronic or sub-acute low back pain, intensive interdisciplinary rehabilitation, exercise therapy, acupuncture, massage therapy, spinal manipulation, yoga, cognitive-behavioral therapy, or progressive relaxation.	Weak recommendation	Reviewed, New-replaced	Recommendations 8-16, 38

Appendix F: Participant List

Adam Bevevino, MD (Champion) Major, U.S. Army Chief, Spine Surgery Service William Beaumont Army Medical Center El Paso, TX	Daniel Kang, MD (Champion) Major, U.S. Army Orthopedic Spine Surgeon Madigan Army Medical Center Tacoma, WA
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Curtis Aberle, RN, MSN, FNP Chief, McWethy Troop Medical Clinic and Readiness Center Brooke Army Medical Center Fort Sam Houston, TX	David Cory Adamson, MD, PhD Chair, Neurosurgery Advisory Board Atlanta VA Medical Center Atlanta, GA
Chris Allen, DPT, DSc, FAAOMPT Major, U.S. Army Program Director and Associate Professor, Army-Baylor University Brooke Army Medical Center Fort Sam Houston, TX	Rachael Coller, PharmD, BCPS, BCPP Clinical Pharmacist Naval Medical Center San Diego San Diego, CA
Francine Goodman, PharmD, BCPS Clinical Pharmacy Specialist VA Pharmacy Benefits Management Services Hines VA Medical Center Hines, IL	Valerie Johnson, DC, DABCI Chiropractic Residency Director Greater Los Angeles VA Healthcare System Los Angeles, CA
Lisa Konitzer, PT, DSc, OCS, FAAOMPT Lieutenant Colonel, US Army Chief, Physical Therapy DiLorenzo TRICARE Health Clinic Washington, DC	Lex Mitchell, MD Major(P), U.S. Army Diagnostic Neuroradiologist Tripler Army Medical Center Honolulu, HI
Mitchell Nazario, PharmD VISN 8 PBM Clinical Program Manager, Pain Management West Palm Beach VA Medical Center West Palm Beach, FL	Jeremiah Samson, PT, ScD(C), OCS, COMT, FAAOMPT Major, U.S. Air Force Surgical Services Flight Commander Keesler Air Force Base Biloxi, MS
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Kirsten Tillisch, MD Chief, Integrative Medicine, GLA VHA G. Oppenheimer Center for Neurobiology of Stress and Resilience David Geffen School of Medicine at UCLA Los Angeles, CA	Rebecca Vogsland, DPT, OCS Program Coordinator, Comprehensive Pain Center and Clinical Specialist Minneapolis Veterans Affairs Medical Center Minneapolis, MN

Appendix G: Patient Focus Group Methods and Findings

A. Methods

On September 7, 2016, as part of the effort to update this CPG, the VA and DoD Leadership, along with the LBP CPG Work Group, held a patient focus group at the William Beaumont Army Medical Center, in El Paso, Texas. Focus group participants comprised seven patients, including one female.

The aim of the focus group was to further the understanding of the perspective of patients undergoing diagnosis and treatment for LBP within the VA and/or DoD healthcare systems, as patients are most affected by the recommendations put forth in the CPG. The focus group explored patient perspectives on a set of topics related to the diagnosis and treatment of LBP in the VA and DoD healthcare systems, including patients' knowledge of LBP treatment options, views on the delivery of care, and the impact of LBP on patients' careers and daily life.

Participants for the focus group were recruited by the LBP CPG Champions and Work Group members. Patient focus group participants were not intended to be a representative sample of VA and DoD patients who have experienced LBP. However, recruitment focused on eliciting a range of perspectives likely to be relevant and informative in the guideline development process. Patients were not incentivized for their participation or reimbursed for travel expenses.

The LBP CPG Champions and Work Group, with support from Lewin, developed a set of questions to help guide the focus group. The focus group facilitator, Frances Murphy, MD, MPH, led the discussion using the previously prepared questions as a general guide to elicit the most important information from the patients regarding their experiences and views about their treatment and overall care. Given the limited time and the range of interests of the focus group participants, not all of the listed questions were addressed. Notes taken during the meeting were synthesized for the following report.

Seven patients participated in the focus group, including one woman. The individuals ranged in age from approximately the 20s age group to the 60s age group. Four participants were active duty in the Army and receiving care in the DoD healthcare system, and three were primarily receiving care through the VA system at the time of the focus group discussion. The patients reported having been told of one or more LBP diagnoses, including bulging discs, torn discs, degenerative discs, lumbar stenosis, vertebral fractures, and arthritis. The length of time the participants' had been experiencing LBP varied from one year to over 25 years. Most of the participants had tried many different treatments, including pharmacologic therapies, surgery, injections, physical therapy, chiropractic care, exercise programs, acupuncture, and many self-care strategies. Participants reported receiving treatment from VA providers, Military Health System providers and from private sector providers.

The following concepts are aspects of care that patients indicated were important during the course of the focus group discussion. Each of these themes was an important and needed aspect of participants' healthcare.

B. Patient Focus Group Findings

Consider patient-specific goals, values, and preferences and use shared decision making to develop a patient-centered plan for timely diagnosis, treatment, and lifestyle adaptation

- Identify patient-specific goals and preferences associated with diagnosis and treatment for LBP.
- Understand the importance that patients place on accurate and timely diagnosis, enabling them to understand the cause of their LBP.
- Discuss the harms, benefits, and likely outcomes of different diagnostic and treatment options, particularly imaging tests, and potential treatments.
- Educate patients about self-care strategies and tools that will help increase their quality of life with LBP.

Address strategies for pain management across all phases of treatment and educate patients about the use of pain medications, particularly opioids

- Discuss pharmacologic options in depth with the patient; seek to understand patient preference regarding reducing or eliminating certain medicines from their treatment plan.
- Be prepared to adjust or otherwise change treatment (e.g., tapering pain medication) subject to patient response, preferences, and changes in priorities and goals.
- When prescribing opioids, educate patients about the potential harms and alternatives to opioid therapy.
- Consider that VA/DoD patients may under-report pain intensity.

Recognize the importance of communication and collaboration among providers of an interdisciplinary care team

- Patients value the expertise and treatment options available from multiple specialists on their care team (e.g., primary care provider, physical therapist, surgeon).
- Patients benefit when the care team is in close communication and agreement regarding the individualized treatment plan.
- Providers should work together to ensure each patient receives timely referrals and smooth transitions between different members of their care team.

Involve family caregivers to create support and motivation for patients with low back pain

- Include family members early in discussions about what to expect during each stage of diagnosis and treatment, especially with regards to lifestyle adaptation and self-care.
- Build and maintain trust, respect, and support with the patient and their family.

Work with providers to ensure continuity of care and ease of access to preferred providers

- When planning treatment, consider proximity of care sites and try to minimize travel and time requirements as appropriate.
- Work with providers to ensure continuity of care and ease of access to preferred specialists.

- Recognize that the active duty populations that may face unique challenges in continuity of and access to care, especially with physically demanding jobs and frequent regional relocation.

Reduce the stigma experienced by patients with LBP

- Clinicians should acknowledge the potential difficulty the military and Veteran populations face when describing pain.
- Patients feel they are not taken seriously when providers assume they are using pain to get out of work, which impacts the diagnosis and treatment for their LBP.
- Patients may experience workplace stigma, particularly military populations who may struggle with feeling they are no longer valued.
- Active duty populations may be particularly concerned about medical boards and loss of benefits once they are being treated for LBP.

Appendix H: Literature Review Search Terms and Strategy

A. Topic-specific Search Terms

The search strategies employed combinations of free-text keywords as well as controlled vocabulary terms including (but not limited to) the following concepts. Strategies for each bibliographic database follow this table.

Table G-1. EMTREE, Medical Subject Headings (MeSH), PsycInfo, and Keywords

Concept	Controlled Vocabulary	Keywords
Patient population		
Low Back Pain and Associated Indications	low back pain lumbar disk hernia lumbar spinal stenosis	low back lower back lumbar lumbosacral pain*
Lumbar Spine	fifth lumbar vertebrae first lumbar vertebrae fourth lumbar vertebrae lumbar disk lumbar spinal cord lumbar spine lumbosacral spine	low back lower back lumbar lumbosacral
Associated Indications	intervertebral disk degeneration intervertebral disk disease intervertebral disk hernia nerve root compression radiculopathy	degenerat* hernia* radicular radiculo* stenos* stenotic

Concept	Controlled Vocabulary	Keywords
KQ1a For adults who present with or have LBP (acute, sub-acute, and chronic LBP), what is the accuracy of history, physical examination, and diagnostic tests, in identifying the underlying condition? **KQ1b** For adults who present with or have LBP (acute, sub-acute, and chronic LBP), what is the clinical utility of history, physical examination, and diagnostic tests in improving treatment choices and patient outcomes?	bone scintiscanning computer assisted tomography diagnostic imaging diagnostic test diffusion weighted imaging diskography echography electromyography four dimensional computed tomography medical history musculoskeletal diagnosis myelography nuclear magnetic resonance imaging physical examination radiodiagnosis radiography single photon emission computer tomography spine radiography thermography three dimensional imaging x ray	assess* comput* CT scan* diagnos* discogra* diskogra* electromyogr* electrophysiologic test* emg episode* exam* faber* facet load* film* flexion abduction and external rotation health history image* imaging inciden* kemp* lasegue magnetic resonance medical* mri* myelogr* occur* patrick* physical* previous* prior quadrant* radiograph* scan* spect-ct straight leg raise* symptom* test* tomogra* ultraso* x-ray* xray*

Concept	Controlled Vocabulary	Keywords
KQ2 What is the effectiveness of self-care advice, education, or other self-care (weight loss, tobacco cessation, work place ergonomics, exercise programs) interventions for improving patient outcomes?	behavior modification coping behavior ergonomics lifestyle modification patient education self care self monitoring smoking cessation smoking cessation program support group weight reduction	adjust* back school* behav* care* change* cope* coping ergonomic* help* lifestyle lose losing loss lost manag* modif* pound* reduc* self* shed* smok* support group* tobacco weight*

Concept	Controlled Vocabulary	Keywords
KQ3 What is the effectiveness of different non-surgical and non-pharmacologic interventions for non-radicular low back pain, radicular low back pain, or spinal stenosis, and under what circumstances?	acupuncture aerobic exercise anaerobic exercise aquatic exercise arm exercise athletic tape body posture brace chiropractic circuit training conservative treatment cryotherapy electroacupuncture electrostimulation exercise exercise intensity exercise tolerance hyperthermic therapy isokinetic exercise isometric exercise isotonic exercise kinesiotherapy leg exercise low level laser therapy manipulative medicine massage muscle exercise open kinetic chain exercise physiotherapy pilates plyometrics rehabilitation medicine reiki resistance training spinal cord decompression static exercise stretching exercise tai chi traction therapy transcutaneous nerve stimulation ultrasound therapy yoga	acupressure acupuncture brace* chiropract* conservative* core cryother* decompression dry needl* e-stim* electroacupuncture electrostim* exercise* heating pad* hot pack* laser* lumbar manip* mechanical* neuroreflexotherapy non-invasiv* noninvasiv* non-operativ* nonoperativ* non-surgical* nonsurgical* out pens physical therap* physiotherap pilates rehab* spinal strength* stretch* superficial heat tai chi tape* taping tens therap* thermother* traction* train* trigger point* ultrasound* work* workout* yoga

Concept	Controlled Vocabulary	Keywords
KQ4 For adults with LBP, what is the effect of pharmacotherapy treatment?	General Terminology drug therapy Analgesics/Anesthetics/ Anti-inflammatories (Oral/Topical) analgesic agent anti-inflammatory agent bipuvacaine capsaicin dronabinol etanercept infliximab lidocaine local anesthetic agents Anticonvulsants anticonvulsive agent carbamazepine ethosuximide etiracetam felbamate gabapentin harkoseride lamotrigine oxcarbazepine pregabalin rufinamide tiagabine topiramate valproic acid zonisamide Corticosteroids betamethasone corticosteroid cortisone dexamethasone fludrocortisone hydrocortisone methylprednisolone prednisolone prednisone triamcinolone Muscle Relaxants baclofen benzodiazepine derivative carisoprodol central muscle relaxant chlorzoxazone cyclobenzaprine	General Terminology drug therap* medication* medicin* pharmacotherap* Analgesics/Anesthetics/ Anti-inflammatories (Oral/Topical) agent* amitriptyline anaesth* analges* anesth* anti inflam* antiinflam* baclofen bipuvacaine camphor capsaicin chondroitin compound* corticosteroid* cream* diclofenac dronabinol embrel emu oil etanercept gabapentin gel* glucosamine hydromorphone hydrophilic infliximab ketamine ketoprofen lidocaine lidoderm lotion* medication* medicin* menthol* opioid* paractin patch* qutenza remicade rofenac salicylate* spray* topical*

Concept	Controlled Vocabulary	Keywords
	dantrolene diazepam directly acting muscle relaxant flexeril metaxalone methocarbamol muscle relaxant agent neuromuscular blocking agent neuromuscular depolarizing agent orphenadrin tizanidine NMDA Antagonists amantadine dextromethorphan ketamine memantine n methyl dextro aspartic acid receptor blocking agent Non-prescription acetylsalicylic acid ibuprofen naproxen non prescription drug paracetamol NSAIDs celecoxib choline magnesium choline magnesium trisalicylate diclofenac diflunisal etodolac flurbiprofen ketoprofen meclofenamate meloxicam nonsteroid antiinflammatory agent oxaprzin piroxicam salicylic acid derivative salsalate sulindac tolmetin trilisate Opioids acetylmethadol alfentanil alphaprodine beta-casomorphin carfentanil	transdermal* trolamine Anticonvulsants anti convuls* anti seizure* anticonvuls* antiseizure* carbamazepine ethosuximide etiracetam felbamate gabapentin harkoseride lacosamide lamotrigine levetiracetam lyrica oxcarbazepine pregabalin rufinamide tiagabine topiramate valproic acid zonisamide Corticosteroids aristospan betamethasone celestone cortef corticosteroid* cortisone dexamethasone ethamethasoneb florinef fludrocortisone hydrocortisone kenalog medrol methylprednisolone orapred prednisolone prednisone prelone triamcinolone Muscle Relaxants amrix baclofen benzodiazepine*

Concept	Controlled Vocabulary	Keywords
	codeine deltorphin dextropropoxyphene dezocine dihydrocodeine dihydromorphine etorphine ethylketocyclazocine ethylmorphine hydrocodone hydromorphone ketobemidone levorphanol lofentanil meptazinol methadone morphine nalbuphine narcotic analgesic agent opiate oxycodone oxymorphone pentazocine pethidine phenazocine phenoperidine pirinitramide remifentanil sufentanil tapentadol tilidine tramadol trimeperidine	carisoprodol chlorzoxazone cyclobenzaprine dantrolene diazepam flexeril lioresal mephenamine metaxalone methocarbamol 'muscle relax*' orphenadrin orphenadrine paraflex parafon robaxin skelaxin tizanidine zanaflex <u>NMDA Antagonists</u> amantadine dextromethorphan ketamine memantine 'nmda antagonist* <u>Non-prescription</u> acetaminophen aleve aspirin dantrium duragesic ibuprofen naproxen non prescription non-prescription nonprescription over the counter over-the-counter paracetamol tylenol <u>NSAIDs</u> clinoril daypro diclofenac disalcid feldene lodine mobic non-steroid*

Concept	Controlled Vocabulary	Keywords
		nonsteroid* nsaid* ocufen orudis oruvail salicylate* salicylic acid solaraze tolectin trilisate voltaren Opioids alfenta buprenex dalgan darvon demerol dicodid dilaudid dolophine hydrostat ir levo-droman meperidine methadose methadyl acetate narcotic* nubain numphan opana opiate* opioid* oxycodone oxycontin oxyfast oxyir percolone promedol propoxyphene roxicodone talwin ultiva ultram

Concept	Controlled Vocabulary	Keywords
KQ5 For adults with LBP, what is the effect of nutritional, herbal, and homeopathic supplements?	arachidonic acid arnica ascorbic acid cannabinoid cayenne pepper chinese medicine cod liver oil curcuma longa diet supplementation diet therapy docosahexaenoic acid fish oil flavonoid ginger harpagophytum harpagophytum extract herbaceous agent icosapentaenoic acid omega 3 fatty acid omega 6 fatty acid resveratrol vitamin d	anti-inflam* antiinflam* arachidonic acid arnica cannabi* cayenne claw curcumin* devil* dha diet* eicosapentaenoic acid epa fish oil flavonoid ginger harpagophytum herb* holistic homeopath n 3 fatty acid* nutrition* omega* resveratrol supplement* tumeric vitamin c vitamin d willow bark
KQ6 For adults with LBP, what is the treatment effectiveness of epidural injections, facet blocks, nerve root blocks, radio frequency ablation (RFA)?	epidural anesthesia epidural drug administration intraspinal drug administration nerve block radiofrequency ablation spinal anesthesia	anaesthes* anesthes* block* corticosteroid* epidural facet foraminal inject* interspin* intraspin* lumbar nerve paraspin* radiofrequency* rf rfa spinal trigger point* zygapophyseal

Concept	Controlled Vocabulary	Keywords
KQ7 For adults with LBP, what combination therapy (pharmacologic and non-pharmacologic) is most effective?	drug combination	care combin* drug* integrat* modalit* multi* pharm* therap* treat*
KQ8 For adults with chronic LBP, what is the effectiveness of behavioral interventions?	behavior therapy cognitive therapy feedback system meditation mental health care mindfulness psychiatric treatment psychologic assessment psychological distress assessment psychological well being psychological well being assessment psychosocial rehabilitation psychotherapy relaxation training	behavior* biofeedback cognitive* counsel* mbsr meditat* mental health mindful* psych* psychother* relax* stress* therap* treat*

Concept	Controlled Vocabulary	Keywords
KQ8 Antidepressants	amfebutamone amitriptyline amoxapine antidepressant activity antidepressant agent citalopram clomipramine desipramine desvenlafaxine doxepin duloxetine escitalopram fluvoxamine imipramine maprotiline mianserin milnacipran mirtazapine monoamine oxidase inhibitor nefazodone noradrenalin update inhibitor nortriptyline paroxetine protriptyline selegiline serotonin noradrenalin reuptake inhibitor serotonin uptake inhibitor tetracyclic antidepressant agent trazodone tricyclic antidepressant agent trimipramine triple reuptake inhibitor venlafaxine vilazodone vortioxetine	amfebutamone amitriptyline amoxapine anafranil antidepres* asendin aventyl bupropion brintellix celexa cymbalta desyrel effexor emsam fetzima fluoxetine lexapro levomilnacipran maoi mao inhibitor* norpramin oleptro pamelor paroxetine paxil pristiq protriptyline prozac prudoxin remeron savella sertraline serzone sinequan sndri ssri tofranil tricyclic trimipramine trintellix viibryd vivactil wellbutrin zoloft zonalon zyban

Concept	Controlled Vocabulary	Keywords
KQ9 For adults with low back pain, what is the impact of mental health diagnoses (e.g., depression, anxiety, ADHD, PTSD, TBI) or psychosocial stressors (e.g., divorce, death, job loss) on treatment outcomes?	anxiety anxiety disorder attention deficit disorder catastrophizing depression family stress mental disease mental stress posttraumatic stress disorder psychosocial care psychosocial disorder psychosocial environment psychosocial withdrawal social psychology traumatic brain injury unemployment	adhd anxiety anxious* attention deficit catastrophiz* death* depress* divorce* post-traumatic post traumatic psychosocial ptsd stress* tbi traumatic brain unemploy*

B. Search Strategies

Table G-2. EMBASE/Medline Search Strategies Conducted using EMBASE Syntax

Set #	Concept	Search Statement
1	Low Back Pain and Defined Lumbar Indications	(('low back' OR 'lower back' OR lumbar OR lumbosacral) AND pain*):ti OR 'low back pain'/exp OR 'lumbar disk hernia'/exp OR 'lumbar spinal stenosis'/exp
2	Lumbar Spine	'fifth lumbar vertebrae' OR 'first lumbar vertebrae' OR 'fourth lumbar vertebrae' OR 'lumbar disk'/exp OR 'lumbar spinal cord'/exp OR 'lumbar spine'/exp OR 'lumbosacral spine'/exp OR ('low back' OR 'lower back' OR lumbar OR lumbosacral):ti
3	Associated Spinal Indications	'intervertebral disk degeneration'/exp OR 'intervertebral disk disease'/exp OR 'intervertebral disk hernia'/exp OR 'nerve root compression'/exp OR 'radiculopathy'/exp OR (degenerat* OR hernia* OR radicular OR radiculo* OR stenos* OR stenotic):ti
4	**KQ1a** For adults who present with or have LBP (acute, sub-acute, and chronic LBP), what is the accuracy of history, physical examination, and diagnostic tests, in identifying the underlying condition? **KQ1b** For adults who present with or have LBP (acute, sub-acute, and chronic LBP), what is the clinical utility of history, physical examination, and diagnostic tests in improving treatment choices and patient outcomes?	'bone scintiscanning'/exp OR 'computer assisted tomography'/exp OR 'diagnostic imaging'/exp OR 'diagnostic test'/exp OR 'diffusion weighted imaging'/exp OR diskography/exp OR echography/exp OR electromyography/exp OR 'four dimensional computed tomography'/exp OR 'medical history'/exp OR 'musculoskeletal diagnosis'/exp OR myelography/exp OR 'nuclear magnetic resonance imaging'/exp OR 'physical examination'/exp OR radiodiagnosis/exp OR radiography/exp OR 'single photon emission computer tomography'/exp OR 'spine radiography'/exp OR thermography/exp OR 'three dimensional imaging'/exp OR 'x ray'/exp OR ((health OR medical* OR physical* OR previous* OR prior) NEAR/2 (assess* OR episode* OR exam* OR history OR inciden* OR occur* OR symptom*)):ab,ti OR (comput* NEXT/1 tomogra*):ab,ti OR (diagnos* NEAR/2 (film* OR imag* OR scan* OR test*)):ab,ti OR ('CT scan*' OR discogra* OR diskogra* OR electromyogr* OR faber* OR 'facet load*' OR 'electrophysiologic test*' OR emg OR 'flexion abduction and external rotation' OR image* OR imaging OR kemp* OR lasegue OR 'magnetic resonance' OR MRI* OR myelogr* OR patrick* OR quadrant OR 'straight leg raise' OR radiograph* OR scan* OR spect-ct OR ultraso* OR 'x-ray*' OR xray*):ab,ti

Set #	Concept	Search Statement
5	**KQ2** What is the effectiveness of self-care advice, education, or other self-care (weight loss, tobacco cessation, work place ergonomics, exercise programs) interventions for improving patient outcomes?	'behavior modification'/exp OR 'coping behavior'/exp OR ergonomics/exp OR 'lifestyle modification'/exp OR 'patient education'/exp OR 'self care'/exp OR 'self monitoring'/exp OR 'smoking cessation'/exp OR 'smoking cessation program'/exp OR 'support group'/exp OR 'weight reduction'/exp OR ('back school*' OR cope* OR coping OR ergonomic* OR smok* OR tobacco OR 'support group*'):ab,ti OR ((behav* OR lifestyle) NEAR/2 (adjust* OR change* OR modif*)):ab,ti OR ((weight OR pound*) NEAR/2 (lose OR losing OR loss OR lost OR reduc* OR shed*)):ab,ti OR (self* NEXT/1 (care* OR help* OR manag*)):ab,ti
6	**KQ3** What is the effectiveness of different non-surgical and non-pharmacologic interventions for non-radicular low back pain, radicular low back pain, or spinal stenosis, and under what circumstances?	acupuncture/exp OR 'aerobic exercise'/exp OR 'anaerobic exercise'/exp OR 'aquatic exercise'/exp OR 'arm exercise'/exp OR 'athletic tape'/exp OR 'body posture'/exp OR brace/exp OR chiropractic/exp OR 'circuit training'/exp OR 'conservative treatment'/exp OR cryotherapy/exp OR electroacupuncture/exp OR electrostimulation/exp OR exercise/exp OR 'exercise intensity'/exp OR 'exercise tolerance'/exp OR 'hyperthermic therapy'/exp OR 'isokinetic exercise'/exp OR 'isometric exercise'/exp OR 'isotonic exercise'/exp OR kinesiotherapy/exp OR 'leg exercise'/exp OR 'low level laser therapy'/exp OR 'manipulative medicine'/exp OR massage/exp OR 'muscle exercise'/exp OR 'open kinetic chain exercise'/exp OR physiotherapy/exp OR pilates/exp OR plyometrics/exp OR 'rehabilitation medicine'/exp OR reiki/exp OR 'resistance training'/exp OR 'spinal cord decompression'/exp OR 'static exercise'/exp OR 'stretching exercise'/exp OR 'tai chi'/exp OR 'traction therapy'/exp OR 'transcutaneous nerve stimulation'/exp OR 'ultrasound therapy'/exp OR yoga/exp OR (core NEAR/2 (strength* OR train*)):ab,ti OR ((spinal OR lumbar) NEXT/2 manipulat*) OR (acupressure OR acupuncture OR brace* OR chiropractic* OR conservative* OR cryother* OR 'dry needl*' OR 'e-stim' OR electrostim* OR electroacupuncture OR electrostim* OR exercise* OR 'heating pad*' OR 'hot pack*' OR laser* OR lumbar OR manip* OR neuroreflexotherapy OR non-invasiv* OR noninvasiv* OR non-operativ* OR nonoperativ* OR non-surgical* OR nonsurgical* OR pens OR 'physical therap*' OR physiotherap* OR pilates OR rehab* OR spinal OR stretch* OR 'superficial heat' OR 'tai chi' OR tape* OR taping OR tens OR therap* OR thermother* OR traction* OR train* OR 'trigger point*' OR ultrasound* OR workout* OR yoga):ab,ti OR (decompression NEAR/1 (mechanical* OR non-operativ* OR nonoperativ* OR non-surg* OR nonsurg*)):ab,ti OR (work* NEXT/1 out*):ab,ti
7	**KQ4** For adults with LBP, what is the effect of pharmacotherapy treatment? (General Terminology)	'drug therapy'/mj OR ('drug therap*' OR medication* OR medicine* OR pharmacotherap*):ti

Set #	Concept	Search Statement
8	**KQ4** Analgesics/Anesthetics/ Antiinflammatories (Misc. Drug Classes - Oral/Topical)	'analgesic agent'/exp OR 'antiinflammatory agent'/exp OR bipuvacaine/exp OR capsaicin/exp OR dronabinol/exp OR etanercept/exp OR infliximab/exp OR lidocaine/exp OR 'local anesthetic agents'/exp OR (analges* OR 'anti inflam*' OR antiinflam* OR bipuvacaine OR capsaicin OR dronabinol OR embrel OR etanercept OR infliximab OR lidocaine OR lidoderm OR remicade):ab,ti OR ((compound*) NEAR/2 (cream* OR gel* OR lotion* OR patch* OR spray* OR topical*)):ab,ti OR ((compound* OR cream* OR gel* OR lotion* OR patch* OR spray*) NEAR/2 (amitriptyline OR baclofen OR camphor OR capcaicin OR chondroitin OR corticosteroid* OR diclofenac OR 'emu oil ' OR gabapentin OR glucosamine OR hydromorphone OR hydrophilic OR ketamine OR ketoprofen OR lidocaine OR lidoderm OR menthol* OR opioid* OR paractin OR qutenza OR rofenac OR salicylate* OR trolamine)):ab,ti OR ((topical* OR transdermal*) NEAR/2 (agent* OR amitriptyline OR anaesth* OR analges* OR anesth* OR 'anti inflam*' OR antiinflam* OR baclofen OR camphor OR capcaicin OR chondroitin OR corticosteroid* OR cream* OR diclofenac OR 'emu oil ' OR gabapentin OR gel* OR glucosamine OR hydromorphone OR hydrophilic OR ketamine OR ketoprofen OR lidocaine OR lidoderm OR lotion* OR medication* OR medicin* OR menthol* OR opioid* OR paractin OR patch* OR qutenza OR rofenac OR salicylate* OR spray* OR trolamine)):ab,ti
9	**KQ4** Anticonvulsants	'anticonvulsive agent'/exp OR carbamazepine/exp OR ethosuximide/exp OR etiracetam/exp OR felbamate/exp OR gabapentin/exp OR harkoseride/exp OR lamotrigine/exp OR oxcarbazepine/exp OR pregabalin/exp OR rufinamide/exp OR tiagabine/exp OR topiramate/exp OR 'valproic acid'/exp OR zonisamide/exp OR ('anti convuls*' OR 'anti seizure*' OR anticonvuls* OR antiseizure* OR carbamazepine OR ethosuximide OR etiracetam OR felbamate OR gabapentin OR harkoseride OR lacosamide OR lamotrigine OR levetiracetam OR lyrica OR oxcarbazepine OR pregabalin OR rufinamide OR tiagabine OR topiramate OR 'valproic acid' OR zonisamide):ab,ti
10	**K4** Corticosteroids	betamethasone/exp OR corticosteroid/exp OR cortisone/exp OR dexamethasone/exp OR fludrocortisone/exp OR hydrocortisone/exp OR methylprednisolone/exp OR prednisolone/exp OR prednisone/exp OR triamcinolone/exp OR (aristospan OR betamethasone OR celestone OR cortef OR corticosteroid* OR cortisone OR dexamethasone OR ethamethasoneb OR florinef OR fludrocortisone OR hydrocortisone OR kenalog OR medrol OR methylprednisolone OR orapred OR prednisolone OR prednisone OR prelone OR triamcinolone):ab,ti
11	**KQ4** Muscle Relaxants	baclofen/exp OR 'benzodiazepine derivative'/exp OR carisoprodol/exp OR 'central muscle relaxant'/exp OR chlorzoxazone/exp OR cyclobenzaprine/exp OR dantrolene/exp OR diazepam/exp OR 'directly acting muscle relaxant'/exp OR flexeril/exp OR metaxalone/exp OR methocarbamol/exp OR 'muscle relaxant agent'/exp OR 'neuromusclular blocking agent'/exp OR 'neuromuscular depolarizing agent'/exp OR orphenadrine/exp OR tizanidine/exp OR (amrix OR baclofen OR benzodiazepine* OR carisoprodol OR chlorzoxazone OR cyclobenzaprine OR dantrolene OR diazepam OR flexeril OR lioresal OR mephenamine OR metaxalone OR methocarbamol OR 'muscle relax*' OR orphenadrin OR orphenadrine OR paraflex OR parafon OR robaxin OR skelaxin OR tizanidine OR zanaflex):ab,ti
12	**KQ4** NMDA Antagonists	amantadine/exp OR dextromethorphan/exp OR ketamine/exp OR memantine/exp OR 'n methyl dextro aspartic acid receptor blocking agent'/exp OR (amantadine OR dextromethorphan OR ketamine OR memantine OR 'nmda antagonist*'):ab,ti

Set #	Concept	Search Statement
13	**KQ4** Non-prescription Drugs	'acetylsalicylic acid'/exp OR ibuprofen/exp OR naproxen/exp OR 'non prescription drug'/exp OR paracetamol/exp OR (acetaminophen OR aleve OR aspirin OR dantrium OR duragesic OR ibuprofen OR naproxen OR 'non prescription' OR non-prescription OR 'nonprescription' OR 'over the counter' OR over-the-counter OR paracetamol OR tylenol):ab,ti
14	**KQ4** NSAIDs	celecoxib/exp OR 'choline magnesium '/exp OR 'choline magnesium trisalicylate'/exp OR diclofenac/exp OR diflunisal/exp OR etodolac/exp OR flurbiprofen/exp OR ketoprofen/exp OR meclofenamate/exp OR meloxicam/exp OR 'nonsteroid antiinflammatory agent'/exp OR oxaprzin/exp OR piroxicam/exp OR 'salicylic acid derivative'/exp OR salsalate/exp OR sulindac/exp OR tolmetin/exp OR trilisate/exp OR (clinoril OR daypro OR diclofenac OR disalcid OR feldene OR lodine OR mobic OR non-steroid* OR nonsteroid* OR nsaid* OR ocufen OR orudis OR oruvail OR salicylate* OR 'salicylic acid' OR solaraze OR tolectin OR trilisate OR voltaren):ab,ti
15	**KQ4** Opioids	acetylmethadol/exp OR alfentanil/exp OR alphaprodine/exp OR 'beta-casomorphin'/exp OR carfentanil/exp OR codeine/exp OR deltorphin/exp OR dextropropoxyphene/exp OR dezocine/exp OR dihydrocodeine/exp OR dihydromorphine/exp OR etorphine/exp OR ethylketocyclazocine/exp OR ethylmorphine/exp OR hydrocodone/exp OR hydromorphone/exp OR ketobemidone/exp OR levorphanol/exp OR lofentanil/exp OR meptazinol/exp OR methadone/exp OR morphine/exp OR nalbuphine/exp OR 'narcotic analgesic agent'/exp OR opiate/exp OR oxycodone/exp OR oxymorphone/exp OR pentazocine/exp OR pethidine/exp OR phenazocine/exp OR phenoperidine/exp OR pirinitramide/exp OR remifentanil/exp OR sufentanil/exp OR tapentadol/exp OR tilidine/exp OR tramadol/exp OR trimeperidine/exp OR (alfenta OR buprenex OR dalgan OR darvon OR demerol OR dicodid OR dilaudid OR dolophine OR 'hydrostat ir' OR 'levo-droman' OR meperidine OR methadose OR 'methadyl acetate' OR narcotic* OR nubain OR numphan OR opana OR opiate* OR opioid* OR oxycodone OR oxycontin OR oxyfast OR oxyir OR percolone OR promedol OR propoxyphene OR roxicodone OR talwin OR ultiva OR ultram):ab,ti
16	**KQ5** For adults with LBP, what is the effect of nutritional, herbal, and homeopathic supplements?	'arachidonic acid'/exp OR arnica/exp OR 'ascorbic acid'/exp OR cannabinoid/exp OR 'cayenne pepper'/exp OR 'chinese medicine'/exp OR 'cod liver oil'/exp OR 'curcuma longa'/exp OR 'diet supplementation' OR 'diet therapy'/exp OR 'docosahexaenoic acid'/exp OR 'fish oil'/exp OR 'flavonoid'/exp OR ginger/exp OR harpagophytum/exp OR 'harpagophytum extract'/exp OR 'herbaceous agent'/exp OR 'icosapentaenoic acid'/exp OR 'omega 3 fatty acid'/exp OR 'omega 6 fatty acid'/exp OR 'resveratrol'/exp OR 'vitamin d'/exp OR ((diet* OR herb* OR holistic* OR homeopath* OR nutrition* OR omega*) NEAR/2 (supplement*)):ab,ti OR (('anti inflam*' OR antiinflam* OR 'arachidonic acid') NEXT/1 diet*):ab,ti OR (devil* NEXT/1 claw):ab,ti OR (arnica OR cannabi* OR cayenne OR curcumin* OR dha OR 'eicosapentaenoic acid' OR epa OR 'fish oil' OR flavonoid OR ginger OR harpagophytum OR 'n 3 fatty acid*' OR resveratrol OR tumeric OR 'vitamin c' OR 'vitamin d' OR 'willow bark'):ab,ti
17	**KQ6** For adults with LBP, what is the treatment effectiveness of epidural injections, facet blocks, nerve root blocks, radio frequency ablation (RFA)?	'epidural anesthesia'/exp OR 'epidural drug administration'/exp OR 'intraspinal drug administration'/exp OR 'nerve block'/exp OR 'radiofrequency ablation'/exp OR 'spinal anesthesia'/exp OR ((corticosteroid* OR epidural OR facet OR foraminal OR interspin* OR intraspin* OR lumbar OR nerve OR paraspin* OR spinal OR 'trigger point' OR zygapophyseal) NEAR/2 (anaesthes* OR anesthes* OR block* OR inject*)):ab,ti OR (radiofreq* OR rf OR rfa):ab,ti

Set #	Concept	Search Statement
18	**KQ7** For adults with LBP, what combination therapy (pharmacologic and non-pharmacologic) is most effective?	'drug combination'/exp OR ((combin* OR integrat* OR multi*) NEAR/1 (care OR drug* OR modalit* OR pharm* OR therap* OR treat*)):ab,ti
19	**KQ8** For adults with chronic LBP, what is the effectiveness of behavioral interventions?	'behavior therapy'/exp OR 'cognitive therapy'/exp OR 'feedback system'/exp OR 'meditation'/exp OR 'mindfulness'/exp OR 'mental health care'/exp OR 'psychiatric treatment'/exp OR 'psychologic assessment'/exp OR 'psychological distress assessment'/exp OR 'psychological well being'/exp OR 'psychological well being assessment'/exp OR 'psychosocial rehabilitation'/exp OR psychotherapy/exp OR 'relaxation training'/exp OR ((cognitive* OR behavior* OR 'mental health' OR psych*) NEAR/2 (counsel* OR psychother* OR therap* OR treat*)):ab,ti OR (biofeedback* OR mbsr OR meditat* OR mindful* OR relax*):ab,ti
20	**KQ8** Antidepressants	amfebutamone/exp OR amitriptyline/exp OR amoxapine/exp OR 'antidepressant activity'/exp OR 'antidepressant agent'/exp OR citalopram/exp OR clomipramine/exp OR desipramine/exp OR desvenlafaxine/exp OR doxepin/exp OR duloxetine/exp OR escitalopram/exp OR fluvoxamine/exp OR imipramine/exp OR maprotiline/exp OR mianserin/exp OR milnacipran/exp OR mirtazapine/exp OR 'monoamine oxidase inhibitor'/exp OR nefazodone/exp OR 'noradrenalin update inhibitor'/exp OR nortriptyline/exp OR paroxetine/exp OR protriptyline/exp OR selegiline/exp OR 'serotonin noradrenalin reuptake inhibitor'/exp OR 'serotonin uptake inhibitor'/exp OR 'tetracyclic antidepressant agent'/exp OR trazodone/exp OR 'tricyclic antidepressant agent'/exp OR trimipramine/exp OR 'triple reuptake inhibitor'/exp OR venlafaxine/exp OR vilazodone/exp OR vortioxetine/exp OR (amfebutamone OR amitriptyline OR amoxapine OR anafranil OR antidepres* OR asendin OR aventyl OR bupropion OR brintellix OR celexa OR cymbalta OR desyrel OR effexor OR emsam OR fetzima OR fluoxetine OR lexapro OR levomilnacipran OR maoi OR 'mao inhibitor*' OR norpramin OR **oleptro** OR pamelor OR paroxetine OR paxil OR pristiq OR protriptyline OR prozac OR prudoxin OR remeron OR savella OR sertraline OR serzone OR sinequan OR sndri OR ssri OR tofranil OR tricyclic OR trimipramine OR trintellix OR viibryd OR vivactil OR wellbutrin OR zoloft OR zonalon OR zyban):ab,ti
21	**KQ9** For adults with low back pain, what is the impact of mental health diagnoses (e.g., depression, anxiety, ADHD, PTSD, TBI) or psychosocial stressors (e.g., divorce, death, job loss) on treatment outcomes?	anxiety/exp OR 'anxiety disorder'/exp OR 'attention deficit disorder'/exp OR catastrophizing/exp OR depression/exp OR 'family stress'/exp OR 'mental disease'/exp OR 'mental stress'/exp OR 'posttraumatic stress disorder'/exp OR 'psychosocial care'/exp OR 'psychosocial disorder'/exp OR 'psychosocial environment'/exp OR 'psychosocial withdrawal'/exp OR 'social psychology'/exp OR 'traumatic brain injury'/exp OR unemployment/exp OR (adhd OR anxiety OR anxious* OR 'attention deficit' OR catastrophiz* OR death* OR depress* OR divorce* OR post-traumatic OR 'post traumatic' OR psychosocial OR ptsd OR stress* OR tbi OR 'traumatic brain' OR unemploy*):ab,ti
22	Lumbar Set	S1 OR (S2 AND S3)
23	Lumbar Set Combined with Key Questions	S22 AND (S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21)
24	Apply Limits	S23 AND [english]/lim AND [2006-2016]/py AND ([article in press]/lim OR [humans]/lim OR [in process]/lim)

Set #	Concept	Search Statement
25	Remove Youth and Selected Subgroup Populations	S24 NOT (adolescen* OR bifida OR birth* OR boy OR boys OR case* OR child* OR comment* OR cyst* OR dysmenor* OR editorial OR errata OR erratum OR girl OR girls OR infan*OR letter OR menopaus* OR neonat* OR newborn* OR paediatric* OR pediatric* OR pregnan* OR premenstrual OR postmenopaus* OR puerperal OR rat OR rats OR reply OR 'school age*' OR 'school-age*' OR scoliosis OR teen* OR toddler* OR withdrawn OR 'year-old ' OR young* OR youth*):ti
26	Remove Specific Study Designs	S25 NOT (abstract:nc OR annual:nc OR book/exp OR case*:ti OR 'case report'/exp OR 'case study'/exp conference:nc OR 'conference abstract':it OR 'conference paper'/exp OR 'conference paper':it OR 'conference proceeding':pt OR 'conference review':it OR congress:nc OR editorial/exp OR editorial:it OR erratum/exp OR letter:it OR note/exp OR note:it OR meeting:nc OR sessions:nc OR 'short survey'/exp OR symposium:nc)
27	Apply Therapy Study Design Filter	S26 AND (metaanaly*:ti OR 'meta anal*':ti OR 'meta-anal*':ti OR 'meta analysis'/exp OR random*:ti OR 'randomized controlled trial'/exp OR systematic*:ti OR 'systematic review'/exp)
28	Lumbar Set Combined with Diagnostic Tests Set	S22 AND S4
29	Apply Limits	S28 AND [english]/lim AND [2006-2016]/py AND ([article in press]/lim OR [humans]/lim OR [in process]/lim)
30	Remove Youth and Selected Subgroup Populations	S29 NOT (adolescen* OR bifida OR birth* OR boy OR boys OR case* OR child* OR comment* OR cyst* OR dysmenor* OR editorial OR errata OR erratum OR girl OR girls OR infan*OR letter OR menopaus* OR neonat* OR newborn* OR paediatric* OR pediatric* OR pregnan* OR premenstrual OR postmenopaus* OR puerperal OR rat OR rats OR reply OR 'school age*' OR 'school-age*' OR scoliosis OR teen* OR toddler* OR withdrawn OR 'year-old ' OR young* OR youth*):ti
31	Remove Unwanted Study Designs	S30 NOT (abstract:nc OR annual:nc OR book/exp OR case*:ti OR 'case report'/exp OR 'case study'/exp conference:nc OR 'conference abstract':it OR 'conference paper'/exp OR 'conference paper':it OR 'conference proceeding':pt OR 'conference review':it OR congress:nc OR editorial/exp OR editorial:it OR erratum/exp OR letter:it OR note/exp OR note:it OR meeting:nc OR sessions:nc OR 'short survey'/exp OR symposium:nc)
32	Apply Diagnostic Filter	S31 AND (accuracy:ti OR 'area under the curve'/exp OR diagnos*:ti OR 'diagnostic accuracy'/exp OR 'diagnostic error'/exp OR 'diagnostic test accuracy study'/exp OR 'false negative result'/exp OR 'observer variation'/exp OR 'predictive value':ab,ti OR 'predictive value'/exp OR probability/exp OR 'receiver operating characteristic'/exp OR reproducibility/exp OR sensitivity:ti OR 'sensitivity analysis'/exp OR 'sensitivity and specificity'/exp OR specificity:ti OR test*:ti OR (false NEXT/1 (negativ* OR positiv*)):ab,ti OR (likelihood NEXT/1 (function OR ratio*)):ab,ti)
33	Remove Selected Populations and Study types	S32 NOT (adolescen*:ti OR bifida:ti OR birth*:ti OR boy:ti OR boys:ti OR case*:ti OR child*:ti OR comment:ti OR cyst*:ti OR dysmenor*:ti OR editorial:ti OR errata:ti OR erratum:ti OR girl:ti OR girls:ti OR infan*:ti OR letter:ti OR menstrua*:ti OR menopaus*:ti OR neonat*:ti OR newborn*:ti OR paediatric*:ti OR pediatric*:ti OR postmenopaus*:ti OR pregnan*:ti OR premenstrual:ti OR puerperal:ti OR rat:ti OR rats:ti OR reply:ti OR 'school age*':ti OR scoliosis:ti OR teen*:ti OR toddler*:ti OR withdrawn:ti OR 'year-old':ti OR young*:ti OR youth*:ti)
34	Combine Therapy and Diagnostic Sets	S27 OR S33

EMBASE.com Syntax:

* (within or following a term) = truncation character (wildcard)

:ab = limit to abstract

:ab,ti = limit to abstract and title

NEAR/n = search terms within a specified number (n) of words from each other in any order

/exp = "explodes" controlled vocabulary term (e.g., expands search to all more specific related terms in the vocabulary's hierarchy)

:it. = limit to publication type

:ti. = limit to title

Appendix I: Abbreviation List

Abbreviation	Definition
ACT	acceptance and commitment therapy
AHRQ	Agency for Healthcare Research and Quality
BPI	back pain intensity
CBT	cognitive behavioral therapy
CES	cauda equina syndrome
CI	confidence interval
CNS	central nervous system
COI	conflict of interest
COR	contracting officer's representative
COX-2	cyclooxygenase-2
CPG	clinical practice guideline
CT	computerized tomography
CV	cardiovascular
DoD	Department of Defense
EBPWG	Evidence-Based Practice Work Group
ESI	epidural steroid injection
ESR	electronic spin resonance
FDA	Food and Drug Administration
GI	gastrointestinal
GRADE	Grading of Recommendations Assessment, Development and Evaluation
KQ	key question
LBP	low back pain
LBPI	lower back pain intensity
MBR	multidisciplinary biopsychosocial rehabilitation
MBSR	mindfulness-based stress reduction
MeSH	Medical Subject Headings
MRI	magnetic resonance imaging
NICE	National Institute for Health and Care Excellence
NSAID	nonsteroidal anti-inflammatory drugs
OTC	over the counter
PHQ	Patient Health Questionnaire
PICOTS	population, intervention, comparison, outcome, timing and setting
RCT	randomized controlled trial
RFA	radiofrequency ablation denervation
RMDQ	Roland-Morris Disability Questionnaire
SNRB	selective nerve root blocks
SNRI	serotonin and norepinephrine reuptake inhibitors
SR	systematic review
SSRI	selective serotonin reuptake inhibitors

Abbreviation	Definition
TCA	tricyclic antidepressants
TENS	transcutaneous electrical nerve stimulation
U.S.	United States
USPSTF	United States Preventive Services Task Force
VA	Department of Veterans Affairs
VAS	visual analog scale
VHA	Veterans Health Administration

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Performance of the Craniocervical Flexion Test, Forward Head Posture, and Headache Clinical Parameters in Patients With Chronic Tension-Type Headache: A Pilot Study

DESIGN: Case-control, descriptive pilot study.

OBJECTIVE: To describe the differences in the performance of the craniocervical flexion test (CCFT) between individuals with chronic tension-type headache (CTTH) and healthy controls. To assess the relationship between the CCFT, forward head posture, and several clinical variables related to the intensity and temporal profile of headache.

BACKGROUND: Musculoskeletal impairments of the craniocervical region might play an important role on the pathogenesis of CTTH. Deficits in the performance of the CCFT have been reported in patients with cervicogenic headache, nonspecific neck pain, and whiplash injury, but not in individuals with CTTH.

MATERIAL AND METHODS: Ten patients with CTTH and 10 comparable controls without headache were studied. A headache diary was kept for 4 weeks to substantiate the diagnosis and to record the pain history. The CCFT was performed with the subject supine and required performing a gentle head-nodding action of craniocervical flexion. The activation pressure score (pressure that the subject can achieve and hold for 10 seconds), the performance pressure index (calculated by multiplying the activation pressure score by the number of successful repetitions), and the highest pressure score (the highest level that each subject was able to hold for 10 seconds from 20 to 30 mm Hg) were measured. Side-view pictures of each subject were taken in both sitting and standing positions to assess forward head posture (FHP) by measuring the craniovertebral angle. All measures were taken by an assessor blinded to the subject's condition.

RESULTS: Patients with CTTH had significantly lower values in both active pressure score and performance pressure index ($P<.001$), but not in the highest pressure score ($P = .057$), compared to controls. Patients with CTTH had a smaller craniovertebral angle (mean ± SD, 42.0° ± 6.6°), indicating a more FHP than controls (48.8° ± 2.5°), in the standing position ($P<.01$); but not in the sitting position (CTTH, 39° ± 8.9°; controls, 42.8° ± 8.9°, $P = .10$). No association between FHP and any of the CCFT variables was found ($P>.05$). Headache intensity and frequency did not seem to be related to the CCFT variables, but there was a positive association between headache duration and activation pressure score ($r_s = 0.746$, $P = .02$) and highest pressure score ($r_s = 0.743$, $P = .02$).

CONCLUSIONS: These findings suggest possible impairments of the musculoskeletal system in individuals with CTTH, although it is not possible to determine if these impairments contributed to the etiology of CTTH or are as a result of the chronic headache condition. *J Orthop Sports Phys Ther 2007;37(2):33-39. doi:10.2519/jospt.2007.2401*

KEY WORDS: cervical spine, head, neck, pain

Headache disorders are one of the most common problems seen in medical practice. Among the many types of headache disorders, tension-type headache (TTH) is the most frequent in adults. Population-based studies suggest 1-year prevalence rates of 38.3% for episodic TTH (less than 15 headaches per month) and 2.2% for chronic tension-type headache (CTTH) (more than 15 headache attacks per month).[33]

Despite some advances, the pathogenesis of TTH is not clearly understood. Cervical musculoskeletal abnormalities have been traditionally linked to other types of headaches.[25,26,37] An excessive forward head position, or forward head posture (FHP), has been related to cervicogenic headache (CeH),[36] chronic tension-type headache (CTTH),[14] and unilateral migraine.[15] FHP is usually associated with shortening of the posterior cervical extensor muscles and weakening of the anterior cervical flexor muscles. Our re-

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FIGURE 1. Inflatable air-filled pressure sensor (Stabilizer; Chattanooga Group, Hixon, TN) used for the craniocervical flexion test.

search group has recently demonstrated that FHP was associated with referred pain elicited by suboccipital muscle trigger points in individuals with CTTH.[12] In addition, Hallgren et al[16] and McPartland et al[28] determined that subjects with chronic neck pain showed atrophy and fatty infiltration of the suboccipital muscles. Because the suboccipital muscles have a greater concentration of muscle spindles (36 spindles per g for rectus capitis posterior minor; 30.5 spindles per g for rectus capitis posterior major)[30] and act as "proprioception monitors" of the upper cervical spine, patients with CTTH may show motor control dysfunction in the deep neck flexor muscles.[10]

A low-load craniocervical flexion test (CCFT) is clinically used to investigate the anatomical action of the deep cervical flexors, particularly the longus colli and longus capitis muscles. This clinical test is typically used to assess a person's ability to perform and hold a precise upper cervical flexion motion without flexion of the mid and lower cervical spine. For that purpose, an inflatable air-filled pressure sensor (**FIGURE 1**) is used to guide an individual through 5 pressure stages (20-30 mm Hg). The sensor is placed behind the neck and inflated to 20 mm Hg. Clinical use of the test suggests that an ideal controlled performance of the deep cervical flexors can increase the pressure to 30 mm Hg and hold this pressure for 10 seconds without any compensation strategy.[22] Different authors have found, using this clinical test, deficits in the performance of the CCFT in patients with CeH,[21] nonspecific neck pain,[2,9] and whiplash injury.[20,23]

This paper describes and compares the differences in the performance of the CCFT in patients with CTTH and healthy controls. In addition, we assess the relationship between the CCFT, FHP, and several clinical variables related to the intensity and temporal profile of headache.

METHODS

Subjects

A total of 10 patients with CTTH (2 men, 8 women; age range, 29-45 years; mean ± SD age, 38 ± 5 years) and 10 comparable controls (3 men, 7 women; age range, 28-43 years; mean ± SD age, 36 ± 5 years) without headache history participated in this study. Patients were recruited from the Neurology Department of the Fundación Hospital Alcorcón and control subjects were recruited from hospital staff. No significant differences were found for gender or age between groups. All subjects were right handed. Patients with CTTH were diagnosed according to the criteria of the International Headache Society (IHS) by an experienced neurologist.[18] Key elements of headache history were ascertained, including family history, headache features, temporal profile, and current and past medications. To be included, patients had to report bilateral pressing and tightening pain of mild to moderate intensity (no more than 7 on a 0-to-10 visual analogue scale [VAS]), with no aggravation during routine physical activity. Patients with CTTH had to have headaches for at least 15 days per month. A headache diary was kept for 4 weeks to substantiate the diagnosis and to record the pain history.[32] Medication overuse headache as defined by the International Headache Society[18] was ruled out in all cases. None of the patients received physical therapy or took antidepressants during the time of the study. Patients were not allowed to take analgesics or muscle relaxants 24 hours prior to the examination. All patients were examined on days in which headache intensity was less than 4 on a 10-cm horizontal VAS. The health status of all participants was clinically stable, without current symptoms of any other concomitant illness.

This study was supervised by the Department of Physical Therapy, Occupational Therapy, Rehabilitation and Physical Medicine, in collaboration with the Esthesiology Laboratory, Universidad Rey Juan Carlos. The protocol was approved by the Human Research Committee of the Universidad Rey Juan Carlos. All subjects signed an informed consent prior to participation.

FHP

A picture of the lateral view of each subject was taken to objectively assess FHP. The base of the camera was set at the height of the subject's shoulder. The tragus of the ear was clearly marked and a plastic pointer was taped to the skin overlying the spinous process of the seventh cervical vertebra (C7). The picture was used to measure the craniovertebral angle: the angle between the horizontal line passing through C7 and a line extending from the tragus of the ear to C7 (**FIGURE 2**).[1] A smaller craniovertebral angle is associ-

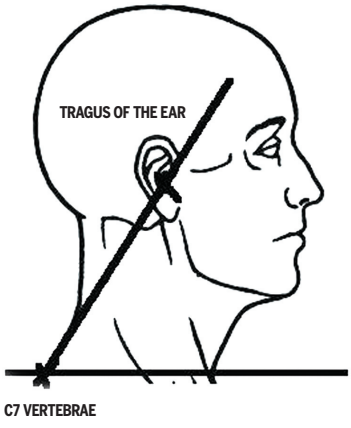

FIGURE 2. The craniovertebral angle was assessed directly from a side-view picture using a protractor and a straight edge.

ated with a greater FHP. High reliability of this procedure (ICC = 0.88) has been previously reported.[31] FHP was assessed in a relaxed sitting and a relaxed standing position. Details of this protocol can be found elsewhere.[12,14] A picture of the lateral view of each subject was taken in both positions.

CCFT

An inflatable air-filled pressure biofeedback sensor (Stabilizer; Chattanooga Group, Hixon, TX) was used to assess the performance of the deep neck flexors of the cervical spine (**FIGURE 1**). The sensor is placed behind the neck and is inflated to 20 mm Hg, which is sufficient to fill the space between the testing surface and the neck, without pushing the neck into a lordosis. The pressure sensor is used to monitor the slight flattening of the cervical lordosis that occurs with the contraction of the deep neck flexors[27]—particularly the longus colli muscle—and registers the muscular effort and associated small movement of the cervical spine as an increase in pressure. Any unwanted head lift or general cervical flexion results in a decrease in pressure.

The CCFT is performed with the subject supine. The subject performs a gentle head-nodding action of craniocervical flexion (an action indicating yes) for 5 incremental stages of increasing range (2 mm Hg each stage), each stage being held for 10 seconds. A suggested ideal controlled performance of the deep cervical flexors should increase the pressure to 30 mm Hg (an increase of 10 mm Hg). The linear relationship between the incremental pressure targets of the CCFT and the craniocervical flexion range of motion has been demonstrated, supporting the clinical use of this test.[6] Moreover, Falla et al[7] demonstrated that each stage of the CCFT was accompanied by increased electromyography amplitude in the deep cervical flexor muscles. Such increase in the EMG activity of the deep cervical flexors did not occur during other neck or jaw movements, supporting the muscle specificity of this test.[8]

The pressure that the subject can achieved and hold in a steady manner for 10 seconds is called the activation pressure score.[21] The tonic capacity of the deep neck flexors is assessed by monitoring the subject's ability to sustain the upper cervical flexion position at the achievable pressure (activation pressure score) in a preset task of attempting 10 repetitions of 10-set holds. The holding capacity is judged by the number of successful 10-set holds the subject can achieve (performance pressure index). Loss of pressure of greater than 20% of the target (usually 2 mm Hg of pressure) is regarded as failure, and the number of repetitions to that point is used in the calculation of the holding capacity.

The holding capacity is presented as a performance pressure index, which is calculated by multiplying the target pressure achieved (activation pressure score) by the number of successful repetitions. For example, if a subject can achieve an increase in pressure of 8 mm Hg with the upper cervical flexion action (activation pressure score) and repeat this performance 10 times, the subject will receive a performance pressure index of 80. A recent study[17] found intraexaminer reliability (ICC) of 0.78 and an interexaminer (ICC) of 0.54 for the performance pressure index, and an intraexaminer reliability of 0.78 and an interexaminer of 0.57 for the activation pressure score.

The hand dial of the pressure sensor was mounted on a stand to provide the subject with visual feedback to target the desired pressure levels during testing (**FIGURE 3**).

Study Protocol

All subjects, controls, and patients had 2 appointments within a 4-week period. At the first visit assessor 1 gave a headache diary to the patients with CTTH. Each patient registered on the diary daily headache intensity on a 10-cm horizontal VAS[19] (range, 0 [no pain] to 10 [maximum pain]), the headache duration (in hours per day), and the number of days with headache. This headache diary was kept for 4 weeks. Assessor 1 also informed control subjects about physical therapy and headache, but did not give them a headache diary. A second assessor, blinded to the subjects' condition, took 2 pictures of each subject, 1 in sitting and 1 in standing.

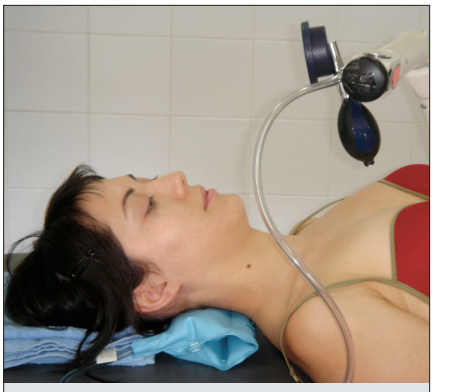

FIGURE 3. Position of the subjects at the beginning of the craniocervical flexion test.

At the second visit 4 weeks later, the second assessor repeated the same head posture assessment and examined the performance on the CCFT as follows. Subjects were explained how to perform the CCFT by taking a 5-minute training session. The subject was positioned in supine. The cervical spine was supported in a neutral position, which was determined visually by maintaining a horizontal plane between the forehead and the chin, ensuring that a line bisecting the neck longitudinally was parallel to the treatment plinth.[6,20,21] The pressure biofeedback unit was placed behind the neck and inflated to a baseline of 20 mm Hg (**FIGURE 3**). Subjects were taught the action of a slow and gentle head flexion as though nodding to indicate "yes" and to hold the end position. A trained examiner observed and corrected any substitution movement to insure that all subjects could perform the test correctly. Signs of incorrect performance, such as jerking the chin down with a fast movement or performing a chin retraction action to push the neck onto the sensor, were corrected during the instruction phase. Each subject was reminded to relax the neck musculature and to concentrate on performing a gentle head-nodding movement.

TABLE 1 CCFT in Patients With Chronic Tension-Type Headache (n = 10) and Controls (n = 10)

	CTTH (MEAN ± SD)	CONTROL (MEAN ± SD)	*P* VALUE*
Activation pressure score (mm Hg)	6.6 ± 2.3	12.6 ± 4.3	<.001
Performance pressure index	32.4 ± 15.8	66.8 ± 23.5	<.001
Highest pressure score (mm Hg)	25.8 ± 3.6	28.4 ± 1.8	.057†

Abbreviations: CCFT, craniocervical flexion test; CTTH, chronic tension-type headache.
** Differences between groups using an unpaired Student t test.*
† Nonsignificant.

The CCFT was divided into 2 phases. In the first phase, the pressure increase that the subject could achieve and hold with a controlled upper cervical flexion action was assessed (activation pressure score). This pressure was then used as the target pressure for the subject to achieve 10 repetitions of a 10-second hold (performance pressure index). A 30-second rest was provided between each repetition. Subjects viewed the dial of the pressure sensor to target the desired pressure level (**FIGURE 3**).

In the second phase, 10 minutes later, each subject was instructed to perform the CCFT at 5 different pressure levels (22, 24, 26, 28, and 30 mm Hg) and to hold each level for 10 seconds. A 45-second rest was provided between each pressure level. The testing procedure ended when the subject could not hold a specific pressure level for 10 seconds (loss of pressure greater than 20% of the targeted pressure, that is, 2 mm Hg) or the maximum pressure score of 30 mm Hg was achieved. The highest pressure score each subject could achieve was recorded.

A VAS (range, 0 [no pain] to 10 [maximum pain]) was used to assess head or neck pain evoked during the performance of the CCFT in both patients and controls.

Finally, subjects with CTTH returned the headache diary to the first assessor, who calculated the following variables: (1) headache intensity, which was calculated from the mean of the VAS of the days with headache; (2) headache frequency, which was calculated dividing the number of days with headache by 4 weeks (days per week); and (3) headache duration (hours per day), which was calculated dividing the sum of the total hours of headache by the number of days with headache (hours per day).

Reliability of the CCFT

Reliability of the CCFT was determined on 10 additional healthy subjects (5 females and 5 males, aged 30 to 50 years [mean ± SD age, 39 ± 6 years]). The activation pressure score, the performance pressure index, and the highest pressure score were tested twice by the same assessor, with a 1-week interval between testing sessions. The intraclass correlation coefficient ($ICC_{2,1}$) was calculated for each variable. The results showed a high degree of intraexaminer reliability for the 3 CCFT variables (ICC = 0.84 for the activation pressure score, ICC = 0.90 for the performance pressure index, and ICC = 0.88 for the highest pressure score).

Statistical Analysis

Data were analyzed with the SPSS statistical package (Version 12.0). A normal distribution of quantitative data was assessed by means of the Kolmogorov-Smirnov test. Quantitative data without a normal distribution (ie, headache intensity, duration, and frequency) were analyzed with nonparametric tests, whereas quantitative data with a normal distribution (ie, FHP, activation pressure score, performance pressure index, and highest pressure score) were analyzed with parametric tests. Differences in both FHP and the 3 CCFT variables between groups were assessed with an unpaired Student *t* test. A Pearson correlation test (*r*) was used to analyze the association between the craniovertebral angle (FHP) and the CCFT variables (activation pressure score, performance pressure index, highest pressure score) in both patient and control groups. Finally, the Spearman rho (r_s) test was used to analyze the association between the 3 CCFT variables and the clinical variables relating to headache (headache intensity, frequency, or duration) in the headache group. A *P* value less than .05 was considered statistically significant.

TABLE 2 Highest Pressure Score During the CCFT Achieved for Each Subject

	NUMBER OF SUBJECTS ABLE TO ACHIEVE TARGET PRESSURE (%)	
PRESSURE LEVEL	CTTH GROUP	CONTROL GROUP
22 mm Hg	4 (40%)	0 (0%)
24 mm Hg	0 (0%)	0 (0%)
26 mm Hg	2 (20%)	3 (30%)
28 mm Hg	1 (10%)	2 (20%)
30 mm Hg	3 (30%)	5 (50%)

Abbreviation: CCFT, craniocervical flexion test; CTTH, chronic tension-type headache.

RESULTS

Headache Diary

History of CTTH ranged from 2 to 18 years (mean ± SD duration, 9.4 ± 5.3 years). Headache frequency during the 4-week study period ranged from 4 to 6 days per week (mean ± SD, 4.7 ± 0.7). The mean duration of headache episodes

was 7.3 hours (range, 4-10 hours), and the mean intensity (VAS) was 6 (range, 4-7). Patients with CTTH were examined on days in which headache intensity was less than 4 on the VAS (mean ± SD, 3.0 ± 0.4). No correlation was found between headache history and the other headache clinical parameters.

CCFT

The CTTH group had significantly lower values in both active pressure score and performance pressure index as compared to the control group ($P<.001$). The highest pressure score was not statistically significant different between groups ($P = .057$). The activation pressure score, the performance pressure index, and the mean highest pressure score for each group are detailed in **TABLE 1**. **TABLE 2** summarizes the percentage of subjects in each group who achieved each of the pressure levels (22, 24, 26, 28, or 30 mm Hg) as their highest pressure score during the CCFT.

FHP

To verify if the head posture remained stable during the study, 2 separate sets of pictures were taken from each subject with a 4-week interval. No differences were found between the 2 measurements (paired Student *t* test) (seated: $P = .60$, ICC = 0.90; standing, $P = .7$, ICC = 0.95). Therefore, data for further analysis were derived from the average of the 2 values corresponding to each position.

Patients with CTTH showed a smaller craniovertebral angle (mean ± SD, 42° ± 6.6°), indicating a more FHP than healthy controls (mean ± SD, 48.8° ± 2.5°) in the standing position ($P<.01$). There was no significant difference between groups for the craniovertebral angle in the sitting position (CTTH mean ± SD angle, 39° ± 8.9° versus 42.8° ± 8.9°; $P = .10$). The control group showed a more FHP in standing as compared to sitting (mean ± SD angle, 48.8° ± 2.5° versus 42.8° ± 8.9°; $P = .001$). No difference in FHP between positions was found in the CTTH group (standing mean ± SD angle, 42° ± 6.6° versus sitting, 39° ± 8.9°; $P = .10$).

We also assessed the degree of association between the 3 variables of the CCFT and FHP (**TABLE 3**). No significant association was found ($P>.05$).

TABLE 3 Pearson Correlation Coefficients Between the Variables of the Craniocervical Flexion Test

	Performance Pressure Index	Highest Pressure Score
Activation pressure score	$r = .93$; $P<.001$	$r = .87$; $P<.001$
Performance pressure index		$r = .80$; $P<.001$

Headaches

Headache intensity and frequency were not associated with any of the CCFT variables; but there was a positive association between headache duration and both activation pressure score ($r_s = 0.746$; $P = .02$) and the highest pressure score ($r_s = 0.743$; $P = .02$): the greater the values of the CCFT, the greater the headache duration. Further, the craniovertebral angle in the sitting position was negatively related to length of headache disease ($r_s = -0.645$; $P = .04$): the lesser the craniovertebral angle, the greater the FHP and the greater the headache history (ie, the more chronic were the symptoms).

Finally, 9 patients with CTTH (90%) reported head pain during the CCFT (mean ± SD, 4.3 ± 2.1), whereas no control subject reported pain during the test ($P<.001$). In 8 of these 9 patients with CTTH (89%), the pain evoked during the CCFT was recognized as their usual headache pain. In addition, the pain elicited during the CCFT was spread to the posterior part of the neck in all patients (n = 9), and to the dorsal region (interscapular area) in 4 of 9 patients (45%).

DISCUSSION

Our results are very similar to those previously reported, in which authors found impairment of deep neck flexor muscles in a group of individuals with CeH.[21] Deficits in the performance of the CCFT have also been found in studies of patients with chronic neck pain[2,9,20,23] but in 1 exception.[17] Surprisingly, we found that patients with CTTH with longer headache duration performed better on the CCFT. These findings are in contrast with the findings from Jull et al,[21] in which an association between duration of headache and scores on the CCFT was not found. One possible reason for this contradictory result could be that CeH, but not CTTH, is usually increased by neck movement.[18]

In the present study, 3 (30%) patients with CTTH reached the maximum pressure score (of 30 mm Hg), in contrast to none of the patients with chronic neck pain in the study by Chiu et al.[2] It may be that chronic neck pain can have a more direct influence on muscle endurance of the neck flexors than CTTH.

Previous studies analyzing the CCFT in chronic conditions have evaluated the electromyographic (EMG) activity of the superficial neck flexor muscles.[9,20,23] Patients with chronic neck pain showed significantly higher EMG amplitude in the sternocleidomastoid and anterior scalene muscles as compared to healthy subjects, probably as a strategy to compensate for dysfunction of the deep neck flexors.[9,20,23] It is known that nociceptive inputs can alter motoneuron pool net excitability, which could modify motor unit recruitment and EMG amplitude.[4] We have recently demonstrated that the referred pain elicited by manual exploration of trigger points in the sternocleidomastoid muscle share similar characteristics with CTTH.[11] Because trigger points are responsible for the liberation of algogenic substances (ie, bradykinin, calcitonin gene-related peptide, substance *P*, tumor necrosis factor-α, interleukin-1β,

serotonin, and norepinephrine)[34] it is possible that superficial neck flexors may inhibit deep neck flexors in patients with CTTH. In the present study we did not include EMG analysis of the superficial neck flexors. In future studies it would be interesting to assess if patients with CTTH show greater EMG amplitude in the superficial neck flexors during the performance of the CCFT.

In addition, the performance of the CCFT evoked usual head pain in 8 out of our 10 patients (80%). In our previous work, we found that manual palpation of the suboccipital muscles elicited a referred pain with similar pain characteristics as headache attacks in patients with CTTH.[12] It is plausible that suboccipital muscle stretching that occurs during the craniocervical flexion action elicited the patients' usual head pain. O'Leary et al[29] demonstrated that both healthy subjects and patients with neck pain performing the CCFT exert a similar dorsal head contact force during testing. It is possible that the dorsal head force likely exerted during the CCFT in our sample of patients could have stimulated the suboccipital and other posterior neck muscles, eliciting referred pain to the head. It is also possible that the observed difference in performance on the CCFT between patients and controls was due to pain during the test procedure in the CTTH group, muscle inhibition from long-lasting pain in the area, or tightness of the dorsal structures such as facet joints, muscles, or ligaments.

We also found that patients with CTTH had a greater FHP than control subjects in standing, but not in sitting. In the sitting position, the more FHP noted in the CTTH group was not statistically significant (P = .10), likely due to the small sample size. FHP has been previously associated with other headache disorders.[14,15,36] Some authors suggest that poor postural habits,[14] pain (headache), and low-force repetitive overuse[14] could all contribute to chronic pain.[3] We also found that FHP changed less from standing to sitting in the CTTH group as compared to controls, which may indicate less neck flexibility of the patients with CTTH. This possible lack of neck flexibility may affect the ability to perform the CCFT and explain our results. The relationship between FHP and deep cervical flexor strength has not been previously investigated in individuals with CTTH. Our preliminary results only showed a certain degree of correlation between the CCFT and headache duration, but not between the CCFT, FHP, and the remaining headache clinical parameters. But the CTTH group's significantly greater FHP in standing and reduced holding capacity on the CCFT may imply an association, despite the nonsignificant correlation coefficient. It is possible that motor control dysfunction, interpreted as decreased neck flexor endurance, can be a contributing factor for CTTH. Whether motor control dysfunction contributes to the perpetuation of CTTH must be verified by future research.

Finally, as a result of several clinical studies, low-load therapeutic exercises emphasizing motor control rather than muscle strength has been advocated for effective management of patients presenting with nonspecific neck pain[5] and CeH.[24] However, there are no studies analyzing the effectiveness of these low-load therapeutic exercises in patients with CTTH.[13] Determination of the clinical significance of the musculoskeletal impairments identified in this study in individuals with CTTH and the most effective intervention to correct these impairments would require the development and testing of specific physical therapy programs.

There are some limitations to our study. First, only patients with CTTH were included. Hence, our results cannot be extrapolated to the episodic form of TTH or to other headache disorders. It would certainly be interesting to repeat the same procedure with patients suffering from other headache conditions. The second limitation was the small sample size. To definitely establish a link between motor control dysfunction, head posture, and headache clinical parameters in patients with CTTH, our findings must be confirmed in a larger sample. Finally, the assessment of physical therapy interventions targeting the deep neck flexors muscles might eventually help elucidate the influence of neck posture and deep neck flexors endurance in the clinical course of CTTH.

CONCLUSIONS

Patients with CTTH showed reduced holding capacity of the deep neck flexor muscles, assessed by the CCFT, as compared to healthy subjects. In addition, 8 (80%) patients with CTTH reported that the CCFT evoked their usual head pain. Patients with CTTH showed greater FHP in the standing position, than healthy subjects. These findings suggest possible impairments of the musculoskeletal system in individuals with CTTH although it is not possible to determine if these impairments contributed to the etiology of CTTH or are as a result of the chronic headache condition. ◉

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