Article Title: Clinical Practice Guidelines for the Treatment and Management of Low Back Pain: A Systematic Review of Quantity and Quality

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Highlights

• Low back pain (LBP) is highly prevalent and results in healthcare costs, and impairment of activity.

• We identified the quantity and assessed the quality of clinical practice guidelines (CPGs) for LBP.

• From 181 unique search results, 22 CPGs on the treatment and/or management of LBP were eligible.

• CPGs varied in quality, scoring most highly in the scope and purpose and clarity of presentation domains.

Abstract

Background: Low back pain (LBP) is highly prevalent in the general population and is responsible for increased health-care costs, pain, impairment of activity, and if chronic, is associated with a range of comorbidities.

Objectives: The purpose of this review was to identify the quantity and assess the quality of evidence-based clinical practice guidelines (CPGs) for the treatment and/or management of LBP in adults.

Methods: MEDLINE, EMBASE, CINAHL, and the Guidelines International Network were systematically searched from 2008 to 2018 to identify LBP CPGs. Eligible CPGs were assessed in duplicate using the Appraisal of Guidelines, Research and Evaluation II (AGREE II) instrument across 6 domains: scope and purpose, stakeholder involvement, rigour of development, clarity of presentation, applicability, and editorial independence.

Results: Of 181 unique search results, 22 CPGs for the treatment and/or management of LBP were eligible. Scaled domain percentages from highest to lowest were: scope and purpose (90.0%), clarity of presentation (84.0%), stakeholder involvement (54.0%), rigour of

development (51.2%), editorial independence (39.6%) and applicability (28.5%). Quality varied within and across CPGs.

Conclusions: CPGs varied in quality, with most scoring the highest in the scope and purpose and clarity of presentation domains. CPGs achieved variable and lower scores in the stakeholder involvement, rigour of development, applicability, and editorial independence domains. CPGs with higher AGREE II scores can serve as suitable evidence-based resources for clinicians involved in LBP care; CPGs with lower scores could be improved in future updates using the AGREE II instrument, among other guideline development resources, as a guide.

Abbreviations

AGREE II: Appraisal of Guidelines for Research & Evaluation II

CPG: Clinical Practice Guideline

CLBP: Chronic Low back pain

LBP: Low back pain

NSAID: Non-steroidal anti-inflammatory drug

PICO: Patients, Intervention, Comparison and Outcomes

PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses

SMRs: skeletal muscle relaxants

SSRI: selective serotonin reuptake inhibitors

TENS: transcutaneous electrical nerve stimulation

1. Background

Low back pain (LBP) is a disorder of the lumbosacral spine responsible for considerable disability (Arvin et al., 2016). A high prevalence of LBP exists in the general population, resulting in increased health care costs and missed work (Qaseem et al., 2017). A study summarizing the findings from the Global Burden of Disease reports found that low back and neck pain increased from the 12th leading cause of disability-adjusted life years to the 4th leading cause between 1990 and 2015. Disability-adjusted life years refers to the years of life lost due to premature mortality or living with disability (Hurwitz et al., 2018). Specifically, the report indicated that the prevalence of LBP lasting for more than 3 months (i.e. becoming chronic) increased by 17.3% between 2005 and 2015. Low back and neck pain have also remained the top cause for years lived with disability (Hurwitz et al., 2018). The point prevalence of LBP has been estimated to be 28.4% in Canada and 13.1% in the United States (Kent and Keating, 2005; Shmagel et al., 2016). Evidence supports exercise therapy, advice to stay active, discouragement of bed rest, the use of non-steroidal anti-inflammatory drugs (NSAIDs) and weak opioids, and spinal manipulation as effective treatment options for LBP (Koes et al., 2006).

LBP is classified in a variety of ways. One classification method is based on the following three categories: acute, subacute and chronic LBP. Acute LBP is defined as lasting less than 6 weeks, subacute LBP spans from six to twelve weeks, and chronic LBP persists for greater than 12 weeks (Brighton, 2012; Brosseau et al., 2012; Cheng et al., 2012; Goertz et al., 2012). Another classification method involves categorizing LBP as non-specific (lacking a distinct attributable cause), and specific LBP (that can be traced to a specific pathology or condition) (Arvin et al., 2016; Cheng et al., 2012; Chou et al., 2009). LBP typically resolves within 8–12 weeks, but progresses to chronic low back pain (CLBP) in 15% of patients. The prevalence of

LBP progressing to CLBP is estimated to be 5.0–10.0% which results in increased health care costs and increased risk of patients developing a range of associated comorbidities (Gore et al., 2012; Hestbaek et al., 2003; Meucci et al., 2015; Schneider et al., 2007). CLBP produces periods of pain, physical limitation, and impairment of activity and results in most of the costs associated with LBP (Gore et al., 2012).

Clinical practice guidelines (CPGs) have become an integral component of evidence-based practice assisting health care professionals' with decision-making pertinent to relevant interventions and therapies. CPGs are defined by the Institute of Medicine as "systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances" (Graham and Harrison, 2005; Woolf et al., 1999). CPG developers provide recommendations for or against interventions based on the availability and quality of evidence for their use in the medical literature. CPGs can therefore improve the quality of decisions made by clinicians, thus improving the quality and consistency of care received by patients (Woolf et al., 1999). A systematic review evaluating the relationship between CPGs and quality of care found significant improvements in care. The study also found significant improvements in health outcomes in six of the nine studies evaluated (Lugtenberg et al., 2009), further supporting the important role CPGs play in the provision of health care.

A number of studies have assessed the quality of CPGs with respect to LBP (Arnau et al., 2006; Bouwmeester et al., 2009; Doniselli et al., 2018; Lin et al., 2018; van Tulder et al., 2004); three have been published prior to 2010 and the remaining two studies evaluate only 8 and 11 CPGs. One prior study evaluated the methodological quality of LBP CPGs and concluded that the majority of those evaluated lacked adequate standards of their quality for

use (Arnau et al., 2006). A more recent systematic appraisal of LBP CPGs found that while they scored well in the domains of scope and purpose and clarity of presentation, they had variable scores in the domains of stakeholder involvement, rigour of development, applicability, and editorial independence (Doniselli et al., 2018). This presents a potential drawback of present CPGs as it is pertinent that evidence-informed guidance of high methodological quality is available to clinicians within CPGs. The issue of discrepant recommendations may be attributable to insufficient evidence or controversy regarding these treatments, in which case CPG quality should be taken into consideration by practitioners in order to ensure that patient care is concordant with recommendations made with the strongest available evidence and methodological rigour. As such, the purpose of the present systematic review is to identify the quantity of CPGs for the treatment and/or management of LBP and assess their quality using the AGREE II instrument, providing a much-needed update. It should be noted that this study evaluates the quality of evidence-based CPGs independent of the aforementioned systems of classification for LBP.

2. Methods

2.1. Approach

A systematic review was conducted to identify evidence-based CPGs for the treatment and/or management of LBP using standard methods (Higgins and Green, 2011) and Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) criteria (Moher et al., 2009). A protocol was not registered. Eligible CPGs were assessed with the widely-used and validated Appraisal of Guidelines, Research & Evaluation II (AGREE II) instrument (Brouwers et al., 2010). AGREE II consists of 23 items grouped into six domains: scope and purpose, stakeholder involvement, rigour of development, clarity and presentation,

applicability, and editorial independence. The 23 items included across the 6 domains can be found at the AGREE II developer's website: https://www.agreetrust.org/.

2.2. Eligibility Criteria

Eligibility criteria for LBP CPGs were based on the Population, Intervention, Comparison and Outcomes (PICO) framework. Eligible populations were adults aged 19 years and older with any type of LBP regardless of how it was classified by the CPG. With respect to interventions, we only included CPGs that included recommendations for the treatment and/or management of LBP. Comparisons pertained to the assessed quality of LBP CPGs using the AGREE II instrument. Outcomes were AGREE II scores, which reflect CPG content and format. The following conditions were also applied to define eligible CPGs: developed by non-profit organizations including academic institutions, government agencies, disease-specific foundations, or professional associations or societies; published in 2008 or later, which provided a decade-long window into treatment/management CPGs for LBP and at least five years since the publication of AGREE II; published in the English language; and either publicly available or orderable through our university library system. Publications in the form of consensus statements, protocols, abstracts, conference proceedings, letters or editorials; based on primary studies that evaluated LBP management or treatment; or focused on LBP curriculum, education, training, research, professional certification or performance were not eligible.

2.3. Searching and Screening

MEDLINE, EMBASE and CINAHL were searched on October 11, 2018 from 2008 to October 09, 2018 inclusive. The search strategies included indexed headings and keywords that reflect terms commonly used in the literature to refer to LBP. We also searched the

Guidelines International Network, a repository of guidelines [https://www.g-i-n.net/] using keyword searches restricted based on the eligibility criteria including “low back pain”. A sample search strategy is provided in Supplementary File 1. Following deduplication, UM and AMA screened titles and abstracts from all other sources based on the eligibility criteria. UM and AMA then screened full-text items to confirm eligibility. JYN reviewed the screened titles/abstracts and full-text items with UM and AMA, to standardize screening and discuss and resolve discrepancies between the two screeners.

2.4. Data Extraction

The following data were extracted and summarized from each eligible CPG, following the reading of the full-text and any associated supplementary documents: date of publication; country of first author; types of therapies with recommendations; classification of LBP used; and type of organization that published the CPG (i.e. academic institutions, government agencies, disease-specific foundations, or professional associations or societies). UM and AMA conducted data extraction independently and in duplicate, then they both met with JYN to review and resolve any discrepancies through discussion. While it was anticipated that most data would be available in the main CPG document itself, the website of each developer was also browsed and searched for any associated knowledge-based resources in support of implementation. This was done as these supplementary documents may have an impact on the scores of AGREE II items relating to applicability, as an example.

2.5. Data Analysis

In assessing the quality of eligible CPGs, the AGREE II instrument was applied based on the instructions provided in the user manual (Brouwers et al., 2010). To ensure consistency across appraisals using the AGREE II instrument, an initial pilot test was conducted using

three separate CPGs which were independently assessed by all three evaluators (JYN, UM, AMA). JYN has past employment experience in guideline appraisal and assessment, and trained UM and AMA to use the AGREE II instrument. Any discrepancies and inconsistencies that arose were discussed and resolved. The AGREE II tool includes 23 items in 6 domains of evaluation, which include scope and purpose, stakeholder involvement, rigour of development, clarity of presentation, applicability, and editorial independence. Each item in AGREE II is comprised of a seven-point Likert scale which ranges from strongly disagree (1) to strong agree (7) that each item is met. Using this criteria, UM and AMA independently assessed all 22 eligible CPGs, then met again with JYN to discuss and resolve any differences without unduly modifying scores assigned.

To calculate average appraisal scores, the average score of all 23 items of a single appraiser of a single CPG was taken, followed by taking the average of this value for both appraisers. To calculate average overall assessments, the average was taken of both appraisers "overall guidelines assessment" scores for each CPG. Scaled domain percentages were calculated by adding both appraisers' ratings of items within each domain, and scaling by maximum and minimum possible domain scores, before converting this into a percentage. The scaled domain percentages were calculated for inter-domain comparisons. Average appraisal scores, average overall assessments, and scaled domain percentages for each CPG were tabulated for comparison.

3. Results

3.1. Search Results

Fig. 1 Of a total of 204 search items, 181 were unique, of which 142 titles/abstracts were eliminated, resulting in 39 full-text items warranting further consideration. Of those, 17 full-

text items were not eligible for the following reasons: CPG summaries (n = 6), not published in English (n = 4), published prior to 2008 (n = 3), consensus-based CPGs (n = 2), previous version of an updated guideline (n = 1), and irretrievable (n = 1). The remaining 22 CPGs were deemed eligible and included in this review.

3.2. Clinical Practice Guideline Characteristics

Eligible CPGs were published from 2009 to 2017 in the United States (n = 9), Canada (n = 2), Netherlands (n = 2), United Kingdom (n = 2), Australia (n = 1), Belgium (n = 1), China (n = 1), Germany (n = 1), Hong Kong (n = 1), Saudi Arabia (n = 1), and South Africa (n = 1) (Al-Jassir and AlSaleh, 2013; Arvin et al., 2016; Brighton, 2012; Brosseau et al., 2012; Cheng et al., 2012; Chenot et al., 2017; Chou et al., 2009; Delitto et al., 2012; Globe et al., 2016; Goertz et al., 2012; Groff et al., 2014; Hegmann et al., 2016; Itz et al., 2016; Ju et al., 2009; Kreiner et al., 2014; Qaseem et al., 2017; Savigny et al., 2009; Snow et al., 2016; Staal et al., 2013; Toward Optimized Practice, 2011; van Wambeke et al., 2017; Zhao et al., 2016). The CPGs were funded and/or developed by professional associations or societies (n = 10), academic institutions (n = 7), disease-specific foundations (n = 3), a government agency (n = 1) and an international agency (n = 1). Therapies/interventions mentioned across these CPGs included manual therapy (n = 16), exercise programmes and/or advice to stay active (n = 15), patient education (n = 13), multidisciplinary treatment (n = 12), traction (n = 12), acupuncture (n = 11), cognitive behavioural therapy (n = 11), NSAIDs (n = 11), oral and epidural steroids (n = 11), transcutaneous electrical nerve stimulation (TENS) (n = 11), lumbar supports and orthotics (n = 10), opioids (n = 10), paracetamol (n = 10), massage therapy (n = 9), spinal fusion (n = 8), anti-depressants (n = 7), cold packs and superficial heat (n = 7), skeletal muscle relaxants (SMRs) (n = 7), laser therapy (n = 6), spinal decompression (n = 4),

vertebral disc replacement (n = 4), yoga (n = 3), and tai-chi (n = 2). The details associated with all eligible CPG characteristics are shown in Table 1.

3.3. Clinical Practice Guideline Therapy Recommendations

The most common interventions recommended in favour of use by CPGs included the following: advice to stay active/exercise (n = 13), patient education (n = 13), returning to work/regular activities (n = 12), multimodal/multidisciplinary treatment (n = 11), manipulation/mobilization (n = 10), NSAIDs (n = 10), cognitive behavioural therapy (n = 10) acupuncture (n = 7), and massage therapy (n = 6). Interventions with the most recommendations against their use across CPGs included the following: traction therapy (n = 10), therapeutic ultrasound (n = 7), TENS (n = 7), bed rest (n = 6), interferential current therapy (n = 6), selective serotonin reuptake inhibitors (SSRIs) (n = 6), medical aids, orthotics and appliances (n = 6), and laser therapy (n = 5). We provide a comprehensive chart of recommendations shown in Table 2 for the benefit of the clinician.

3.4. Average Appraisal Scores and Average Overall Assessments for Clinical Practice Guidelines

The average appraisal scores for each of the 22 CPGs ranged from 2.5 to 5.4 on the seven-point Likert scale (where 7 equals strongly agree that the item is met); seventeen CPGs achieved or exceeded an average appraisal score of 4.0, and 5 CPGs achieved or exceeded an average appraisal score of 5.0. Average overall assessments for the 22 CPGs ranged between 2.5 (lowest) and 6.0 (highest), including 19 CPGs equalling or exceeding a score of 4.0, and 8 CPGs equalling or exceeding a score of 5.0. Average appraisal scores and average overall assessments for each CPG are shown in Table 3.

3.5. Scaled Domain Percentage Quality Assessment

With regards to scaled domain percentages, score ranges were as follows: scope and purpose (55.6%–100.0%), stakeholder involvement 930.6%–83.3%), rigour of development (10.4%–82.3%), clarity of presentation (50.0%–100.0%), applicability (2.1%–54.2%), and editorial independence 90.0%–87.5%). Scaled domain percentage quality assessments are shown in Table 4.

3.6. Scope and Purpose

The overall objectives were well-defined and specified in all but one CPG (Brighton, 2012). Authors outlined the health intents, expected outcomes and target populations of the CPGs. The health questions being covered by each CPG were specifically described in all but two CPGs (Brighton, 2012; Toward Optimized Practice, 2011). The population to whom the CPG is meant to apply to was detailed clearly in all eligible CPGs.

3.7. Stakeholder Involvement

Most CPGs detailed the description of the members of the CPG development group, typically including degrees held, and institutional affiliation, in addition to some of the following: subject discipline, geographical location, and description of each member's role in the group (Al-Jassir and AlSaleh, 2013; Arvin et al., 2016; Brosseau et al., 2012; Cheng et al., 2012; Chenot et al., 2017; Delitto et al., 2012; Globe et al., 2016; Goertz et al., 2012; Groff et al., 2014; Hegmann et al., 2016; Itz et al., 2016; Kreiner et al., 2014; Qaseem et al., 2017; Savigny et al., 2009; Snow et al., 2016; Staal et al., 2013; Zhao et al., 2016). Some CPGs detailed the views and preferences of the target population (Globe et al., 2016; Goertz et al., 2012), however, most did not (Al-Jassir and AlSaleh, 2013; Arvin et al., 2016; Brighton, 2012; Brosseau et al., 2012; Cheng et al., 2012; Chenot et al., 2017; Chou et al., 2009; Delitto et al., 2012; Groff et al., 2014; Hegmann et al., 2016; Itz et al., 2016; Ju et al., 2009; Kreiner

et al., 2014; Qaseem et al., 2017; Savigny et al., 2009; Snow et al., 2016; Staal et al., 2013; Toward Optimized Practice, 2011; van Wambeke et al., 2017; Zhao et al., 2016). Target users of most CPGs were clearly defined and most described how the CPG may be used by them (Al-Jassir and AlSaleh, 2013; Arvin et al., 2016; Brighton, 2012; Brosseau et al., 2012; Cheng et al., 2012; Chenot et al., 2017; Chou et al., 2009; Delitto et al., 2012; Globe et al., 2016; Goertz et al., 2012; Groff et al., 2014; Hegmann et al., 2016; Ju et al., 2009; Kreiner et al., 2014; Qaseem et al., 2017; Savigny et al., 2009; Snow et al., 2016; Staal et al., 2013; Toward Optimized Practice, 2011; van Wambeke et al., 2017; Zhao et al., 2016).

3.8. Rigour of Development

Systematic methods were used to search for evidence in most CPGs (Arvin et al., 2016; Brosseau et al., 2012; Cheng et al., 2012; Chenot et al., 2017; Chou et al., 2009; Delitto et al., 2012; Globe et al., 2016; Goertz et al., 2012; Groff et al., 2014; Hegmann et al., 2016; Itz et al., 2016; Ju et al., 2009; Kreiner et al., 2014; Qaseem et al., 2017; Savigny et al., 2009; Snow et al., 2016; Toward Optimized Practice, 2011; van Wambeke et al., 2017; Zhao et al., 2016), where authors described a combination of the following: databases searched, time periods of search, search terms, and full search strategy. CPGs varied in their descriptions of the criteria for selecting evidence; some clearly described selection criteria (Arvin et al., 2016; Brosseau et al., 2012; Chou et al., 2009; Globe et al., 2016; Itz et al., 2016; Ju et al., 2009; Kreiner et al., 2014; Qaseem et al., 2017; Savigny et al., 2009; Snow et al., 2016) while some did not (Al-Jassir and AlSaleh, 2013; Brighton, 2012; Cheng et al., 2012; Chenot et al., 2017; Delitto et al., 2012; Goertz et al., 2012; Groff et al., 2014; Hegmann et al., 2016; Staal et al., 2013; Toward Optimized Practice, 2011; van Wambeke et al., 2017; Zhao et al., 2016). The strengths and limitations of the body of evidence were clearly described in all CPGs, with the

exception of a few (Al-Jassir and AlSaleh, 2013; Brighton, 2012; Chenot et al., 2017; Staal et al., 2013; Toward Optimized Practice, 2011; Zhao et al., 2016).

The methods for formulating recommendations varied; while most CPGs provided a fair amount of detail on how consensus was reached (Arvin et al., 2016; Brosseau et al., 2012; Cheng et al., 2012; Chenot et al., 2017; Chou et al., 2009; Globe et al., 2016; Groff et al., 2014; Hegmann et al., 2016; Itz et al., 2016; Ju et al., 2009; Kreiner et al., 2014; Qaseem et al., 2017; Savigny et al., 2009; van Wambeke et al., 2017), a few did not (Al-Jassir and AlSaleh, 2013; Brighton, 2012; Delitto et al., 2012; Goertz et al., 2012; Snow et al., 2016; Staal et al., 2013; Toward Optimized Practice, 2011; Zhao et al., 2016). All CPGs considered some health benefits, side effects, and/or risks in formulating their recommendations (Al-Jassir and AlSaleh, 2013; Arvin et al., 2016; Brighton, 2012; Brosseau et al., 2012; Cheng et al., 2012; Chenot et al., 2017; Chou et al., 2009; Delitto et al., 2012; Globe et al., 2016; Goertz et al., 2012; Groff et al., 2014; Hegmann et al., 2016; Itz et al., 2016; Ju et al., 2009; Kreiner et al., 2014; Qaseem et al., 2017; Savigny et al., 2009; Snow et al., 2016; Staal et al., 2013; Toward Optimized Practice, 2011; van Wambeke et al., 2017; Zhao et al., 2016). Nearly all CPGs provided an explicit link between recommendations and the supporting evidence, with the exception of three for which this was inconsistent (Al-Jassir and AlSaleh, 2013; Staal et al., 2013; Toward Optimized Practice, 2011). While most CPGs explicitly stated they were externally reviewed by experts prior to publication (Al-Jassir and AlSaleh, 2013; Arvin et al., 2016; Brosseau et al., 2012; Cheng et al., 2012; Chou et al., 2009; Delitto et al., 2012; Goertz et al., 2012; Groff et al., 2014; Hegmann et al., 2016; Qaseem et al., 2017; Snow et al., 2016; Staal et al., 2013; van Wambeke et al., 2017; Zhao et al., 2016), a few did not (Brighton, 2012; Chenot et al., 2017; Globe et al., 2016; Itz et al., 2016; Ju et al., 2009; Kreiner et al., 2014; Savigny et al., 2009; Toward Optimized Practice, 2011). Only four

CPGs provided both the mention of and a plan to conduct a future update (Goertz et al., 2012; Kreiner et al., 2014; Snow et al., 2016; van Wambeke et al., 2017), while the vast majority of CPGs only provided the former (Al-Jassir and AlSaleh, 2013; Arvin et al., 2016; Chou et al., 2009; Delitto et al., 2012; Globe et al., 2016; Hegmann et al., 2016; Itz et al., 2016; Qaseem et al., 2017; Toward Optimized Practice, 2011; Zhao et al., 2016).

3.9. Clarity of Presentation

Recommendations across all CPGs were specific and unambiguous except for one CPG (Brighton, 2012). All CPGs presented the different options for the management of LBP, but a few did not mention the clinical situation in which the recommendation would be appropriate (Brighton, 2012; Cheng et al., 2012; Groff et al., 2014; Snow et al., 2016). Key recommendations were generally easily identifiable in all CPGs.

3.10. Applicability

Five CPGs described facilitators and barriers to the application of recommendations (Chou et al., 2009; Goertz et al., 2012; Ju et al., 2009; Snow et al., 2016; van Wambeke et al., 2017). CPGs generally provided advice and/or tools for how recommendations could be put into practice, with the exception of six which did not provide any implementation tools (Brighton, 2012; Brosseau et al., 2012; Groff et al., 2014; Itz et al., 2016; van Wambeke et al., 2017; Zhao et al., 2016). Eight out of 22 CPGs considered potential resource implications of applying the recommendations (Al-Jassir and AlSaleh, 2013; Arvin et al., 2016; Hegmann et al., 2016; Itz et al., 2016; Ju et al., 2009; Savigny et al., 2009; Snow et al., 2016; van Wambeke et al., 2017). Most CPGs did not present monitoring and/or auditing criteria, with the exception of seven (Al-Jassir and AlSaleh, 2013; Brighton, 2012; Delitto et al., 2012; Globe et al., 2016; Goertz et al., 2012; Kreiner et al., 2014; Staal et al., 2013).

3.11. Editorial Independence

CPGs varied in their reporting of the funding source or competing interests of the members of the development panel. Of the 22 CPGs, five reported that the views of the funding body did not influence the contents of the CPG (Brosseau et al., 2012; Chou et al., 2009; Groff et al., 2014; Kreiner et al., 2014; Toward Optimized Practice, 2011); twelve declared a funding source but without identifying whether the funding source influenced the contents of the CPG (Al-Jassir and AlSaleh, 2013; Arvin et al., 2016; Chenot et al., 2017; Globe et al., 2016; Goertz et al., 2012; Hegmann et al., 2016; Itz et al., 2016; Qaseem et al., 2017; Savigny et al., 2009; Snow et al., 2016; van Wambeke et al., 2017; Zhao et al., 2016), while the remaining five did not declare a funding source (Brighton, 2012; Cheng et al., 2012; Delitto et al., 2012; Ju et al., 2009; Staal et al., 2013). No CPGs explicitly stated that no funding supported their development. CPGs also varied in their reporting of competing interests, and several CPGs did not report competing interests (Al-Jassir and AlSaleh, 2013; Brighton, 2012; Brosseau et al., 2012; Cheng et al., 2012; Delitto et al., 2012; Ju et al., 2009; Staal et al., 2013; Toward Optimized Practice, 2011; Zhao et al., 2016). Of the remaining CPGs that did detail their competing interests, ten did not specify how potential competing interests were identified or considered, or how they may have influenced the CPG development process or drafting of recommendations (Arvin et al., 2016; Chenot et al., 2017; Chou et al., 2009; Globe et al., 2016; Goertz et al., 2012; Hegmann et al., 2016; Itz et al., 2016; Savigny et al., 2009; Snow et al., 2016; van Wambeke et al., 2017).

4. Discussion

4.1. Main Findings

The purpose of this systematic review was to identify the quantity of CPGs for the treatment and/or management of LBP and assess their quality using the AGREE II instrument. Across

the 22 eligible CPGs identified, recommendations were made pertaining to various interventions, the following of which were most common: manual therapy, exercise programmes/advice to stay active, patient education, multidisciplinary treatment, traction, acupuncture, cognitive behavioural therapy, NSAIDs, oral and epidural steroids, and TENS. Quality as assessed by the 23-item AGREE II instrument varied widely across CPGs overall and by domain. The scaled domain scores from highest to lowest were as follows: scope and purpose (90.0%), clarity of presentation (84.0%), stakeholder involvement (54.0%), rigour of development (51.2%), editorial independence (39.6%), and applicability (28.5%). CPGs generally scored poorly on the editorial independence and applicability domains, while scored highly variably on the stakeholder involvement and rigour of development domains.

4.2. Comparisons to the Literature

To our knowledge, five previous studies have determined the quantity and quality of LBP CPGs (Arnau et al., 2006; Bouwmeester et al., 2009; Doniselli et al., 2018; Lin et al., 2018; van Tulder et al., 2004). Three of these studies were published prior to 2010, therefore, the present review updates the literature by assessing the credibility of LBP CPGs that have been published since this time (Arnau et al., 2006; Bouwmeester et al., 2009; van Tulder et al., 2004). The remaining two assessed a smaller number of CPGs, compared to 22 CPGs assessed in this study. The present study summarizes and assesses the quality of 22 CPGs providing recommendations for the treatment and/or management of LBP. Of these 5 aforementioned studies, one assessed CPGs published between 2001 and 2009 using AGREE II and found similar results to our findings, whereby the clarity and presentation domain scored the highest and the applicability domain scored the lowest (Bouwmeester et al., 2009). Another more recent study evaluated eight CPGs and also found similar results, identifying that the scope and purpose and clarity of presentation domains were those with the highest

scores, while the applicability and editorial independence domains scored the lowest (Doniselli et al., 2018). Further to this, similar results were found by another study evaluating the quality of CPGs relating to musculoskeletal pain including spinal, hip, knee and shoulder pain (Lin et al., 2018). Lastly, a study evaluating the quantity and quality of complementary and alternative medicine (CAM) recommendations in LBP CPGs found that CAM therapy recommendations are provided by majority of CPGs, with the domain order with respect to the CAM-specific subsections of the CPGs being similar to that of the present study (Ng and Mohiuddin, 2020). Thus, our findings corroborate with that of the existing literature, and further justify that improvements are warranted across specific AGREE II domains.

The present study revealed that several CPGs are available to support informed and shared decision-making between health care professionals and patients. While advancements in research, specific to the safety and efficacy of LBP therapies, has helped to establish an evidence-base in the medical literature, a need still exists for increased guideline development research in the context of LBP CPGs (Oliveira et al., 2018). It is worth noting that the recommendations across the CPGs included within this review were not always in agreement with one another, likely as a result of their basis of classification of LBP. For instance, CPGs pertaining to the treatment and/or management of acute or subacute LBP recommended for the use of SMRs (n = 4), whereas CPGs identifying non-specific LBP with or without radiculopathy recommend against SMRs (n = 1). Furthermore, discrepancies in recommendations also existed independent of LBP classification, but rather due to insufficient or conflicting evidence regarding a given treatment. Across pharmacological interventions, paracetamol was found to have more negative recommendations in more recently published CPGs (since 2017), when compared to older CPGs in which paracetamol is often indicated as first-line treatment. This may reflect a recent trial that suggested that

paracetamol was no more effective compared to placebo for managing LBP (Saragiotto et al., 2016). Discrepant recommendations were also visible among CAM therapy recommendations, including acupuncture and prolotherapy, thermotherapies such as cold therapy, and invasive treatments such as radiofrequency denervation.

Such aforementioned discrepancies highlight the ongoing need to improve the quality of CPG development. For example, it has been reported that major international CPGs published in recent years reflect a movement away from the medicalized treatment of LBP, but also that most health systems are not equipped to support this approach (Traeger et al., 2019). In the present study, we similarly found increased recommendations for non-pharmacological treatments such as manual therapy, exercise therapy, yoga, mindfulness, and multidisciplinary treatment across recently published CPGs, however, these same CPGs scored poorly across the applicability domain of the AGREE II instrument. Aiming to improve this domain, by improving the reporting of barriers and facilitators to treatment, and developing implementation tools, within LBP CPGs could better serve to ensure that patient care is concordant with CPG treatment recommendations. In the long term, this could help to counter system-wide issues that are detrimental to LBP patients and discordant with CPG recommendations, such as the prescription of long-term opioid drug therapy when unnecessary (Traeger et al., 2019).

CPGs are important for a number of reasons; in a study that evaluated the relationship between CPG adherence and LBP patient outcomes, it was found that increased adherence to CPGs resulted in improved physical functioning (Rutten et al., 2010). Furthermore, a systematic review evaluating the relationship between CPGs and quality of care found significant improvements in care and health outcomes across six of the nine studies evaluated

(Lugtenberg et al., 2009), suggesting that the use of evidence-based CPGs can positively influence patient health outcomes. Thus, CPG developers should focus on improving the quality of CPGs, and research should focus on addressing therapies in areas with insufficient research. With this in mind, the aforementioned, in conjunction with our review's findings, are relevant to those who will develop new or update existing CPGs for the treatment and/or management of LBP in the future. In addition to the AGREE II instrument, numerous principles, frameworks, criteria and checklists are available to guide developers in producing high-quality CPGs (Fischer et al., 2016; Gagliardi et al., 2015; Morgan et al., 2018; Schünemann et al., 2014; Shiffman et al., 2005). More recently, and of importance, include the development of internet technologies and portals which assist the CPG development process (Höhne et al., 2010; Vandvik et al., 2013).

4.3. Strengths and Limitations

One strength of this study included the use of a comprehensive systematic review to identify eligible CPGs for the treatment and/or management of LBP. Additionally, we assessed the quality of eligible CPGs using the AGREE II instrument, which has been found to be both reliable and valid, and is accepted as the gold standard for appraising CPGs (Brouwers et al., 2010). A potential limitation may be that each eligible CPG was independently assessed by two appraisers as opposed to four as recommended by the AGREE II instruction manual. To mitigate this, JYN, UM and AMA participated in a pilot test, whereby each assessor evaluated three separate CPGs independently, then met to discuss and resolve any discrepancies to achieve consensus on how to apply the instrument. Furthermore, after the appraisal of the 22 CPGs, JYN met with UM and AMA to discuss and resolve any uncertainties without unduly modifying legitimate uncertainties. Other limitations include the

fact that a review protocol was not registered, and that this review only captured CPGs published in the English language.

5. Conclusions

This review identified 22 CPGs published between 2008 and 2018 that made treatment and/or management recommendations for LBP. Following their appraisal using the AGREE II instrument, it was found that quality varied both within and across CPGs. CPGs generally scored higher in the domains of scope and purpose and clarity of presentation, while variable and lower scores were achieved in the remaining domains. The development of new CPGs or future updates should focus on improving the domains of stakeholder involvement, rigour of development, applicability, and editorial independence, based on the specifications of AGREE II, in addition to the many available tools used to improve guideline development. CPGs that achieved higher AGREE II scores and favourable overall recommendations could be used by health care professionals as the basis for informed discussion and shared-decision making surrounding their patients' safe and effective use of these LBP therapies. Given that a wide-range of therapies are available for LBP, future research should seek to compare the safety and effectiveness of the most prevalently prescribed and used LBP therapies in order to increase the efficacy of recommendations made.

Ethics Approval and Consent to Participate

This study involved a systematic review of peer-reviewed literature only; it did not require ethics approval or consent to participate.

Consent for Publication

All authors consent to this manuscript's publication.

Availability of Data and Materials

All relevant data are included in this manuscript.

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Authors' Contributions

JYN: designed and conceptualized the study, collected and analysed data, co-drafted the manuscript, and gave final approval of the version to be published.

UM: assisted with the collection and analysis of data, co-drafted the manuscript, and gave final approval of the version to be published.

AA: assisted with the collection and analysis of data, critically revised the manuscript, and gave final approval of the version to be published.

Declaration of Competing Interest

The authors declare that they have no competing interests.

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Figure Legend

Figure 1: PRISMA Diagram

Table Legend

Table 1: Characteristics of Eligible Clinical Practice Guidelines

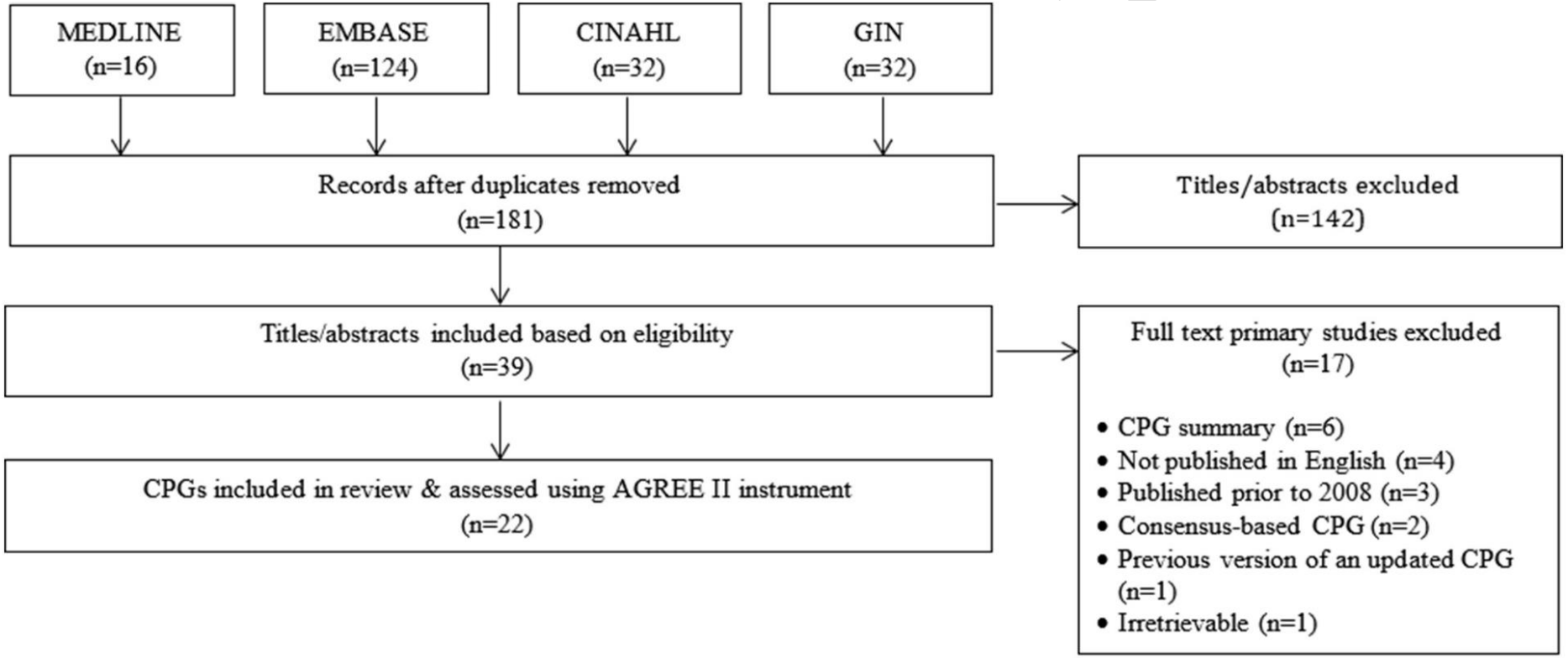
Table 2: Summary of Recommendations in Low Back Pain Clinical Practice Guidelines

Table 3: Average Appraisal Scores and Average Overall Assessments of Each Clinical Practice Guideline

Table 4: Scaled Domain Percentages for Appraisers of Each Clinical Practice Guideline

Figures

Figure 1: PRISMA Diagram



Abbreviations: CPG = clinical practice guideline, AGREE II = Appraisal of Guidelines for Research & Evaluation II

Tables

Table 1: Characteristics of Eligible Clinical Practice Guidelines

Guideline	Country (First Author)	Developer	Guideline Topic	Classification of LBP in Guideline	Therapies with Recommendations
Chenot 2017 [9]	Germany	National Care Guideline Development Group for Non-Specific Back Pain	Non-specific low back pain	Non-specific LBP	- Acupuncture - Advice to stay active - Back school - Bed rest - COX-2 inhibitors - Cryotherapy - Diathermy - Ergotherapy - Exercise programme - Flupirtine - Heat therapy - Interferential current therapy - Kinesiotaping - Laser therapy - Magnetic field therapy - Manual therapy - Massage therapy - Medical aids/orthotics - Metamizole - Multidisciplinary treatment - NSAIDs - Opioids - Paracetamol - Patient education - Percutaneous electrical nerve stimulation (PENS)

Guideline	Country (First Author)	Developer	Guideline Topic	Classification of LBP in Guideline	Therapies with Recommendations
					- Percutaneous procedures - Steroids - Surgery - TENS - Therapeutic ultrasound - Traction therapy
Qaseem 2017 [37]	United States	American College of Physicians	Non-invasive treatment for acute, subacute, and chronic low back pain	Acute, subacute and chronic LBP	- Acupuncture - Cognitive behavioural therapy - COX-2 inhibitors - Duloxetine - Electromyography biofeedback - Exercise programme - Kinesiotaping - Laser therapy - Manual therapy - Massage therapy - Mindfulness-based stress reduction - Multidisciplinary treatment - Muscle relaxants - NSAIDs - Operant therapy - Opioids - Paracetamol - Progressive relaxation - SSRIs - Steroids - Superficial heat

Guideline	Country (First Author)	Developer	Guideline Topic	Classification of LBP in Guideline	Therapies with Recommendations
					- Tai chi - TENS - Therapeutic ultrasound - Tramadol - Tricyclic antidepressants (TCAs) - Yoga
van Wambeke 2017 [50]	Belgium	Belgian Health Care Knowledge Centre	Assessment and management of low back pain and radicular pain	Non-specific LBP, radicular pain	- Advice to stay active - Antibiotics - Anticonvulsants - Cognitive behavioural therapy - Disc replacement - Exercise programme - Interferential current therapy - Manual therapy - Multidisciplinary treatment - NSAIDs - Opioids - Orthotics - Paracetamol - Patient education - PENS - Radiofrequency denervation - Return to work/activities of daily living (ADLs) - Serotonin-norepinephrine reuptake inhibitors (SNRIs)

Guideline	Country (First Author)	Developer	Guideline Topic	Classification of LBP in Guideline	Therapies with Recommendations
					- SMRs - Spinal decompression - Spinal fusion - Spinal injections - SSRIs - Steroids - TCAs - TENS - Therapeutic ultrasound - Traction therapy
Arvin 2016 [3]	United Kingdom	National Institute for Health and Care Excellence	Assessment and management of low back pain and sciatica in over 16s	LBP and sciatica	- Acupuncture - Advice to stay active - Anticonvulsants - Cognitive behavioural therapy - Disc replacement - Exercise programme - Interferential current therapy - Manual therapy - Massage therapy - Medical aids/orthotics - Multidisciplinary treatment - NSAIDs - Opioids - Paracetamol - Patient education - PENS - Radiofrequency denervation

Guideline	Country (First Author)	Developer	Guideline Topic	Classification of LBP in Guideline	Therapies with Recommendations
					- Return to work/ADLs - SNRIs - Spinal decompression - Spinal fusion - Spinal injections - SSRIs - Steroids - TCAs - TENS - Therapeutic ultrasound - Traction therapy
Globe 2016 [15]	United States	Council on Chiropractic Guidelines and Practice Parameters	Chiropractic care for low back pain	Acute, subacute and chronic LBP, recurrent/flare-up LBP	- Acupuncture - Advice to stay active - Cognitive behavioural therapy - Ergotherapy - Exercise programme - Electrical stimulation - Manual therapy - Massage therapy - Medical aids/orthotics - Multidisciplinary treatment - Patient education - Return to work/ADLs - Tai chi - Therapeutic ultrasound - Yoga
Hegmann 2016 [20]	United States	American College of Occupational and Environmental	Examination, medical history evaluation, patient examination and	Acute, subacute and chronic LBP, radiculopathy,	- Acupuncture - Adhesiolysis - Advice to stay active

Guideline	Country (First Author)	Developer	Guideline Topic	Classification of LBP in Guideline	Therapies with Recommendations
		Medicine	treatment and/or management options for and relating to low back disorders	non-specific LBP	- Anticonvulsants - Back school - Bed rest - Cognitive behavioural therapy - Colchicine - Cryotherapy - Diathermy - Discectomy - Disc replacement - Electrical stimulation - Electromyography biofeedback - Ergotherapy - Exercise programme - Heat therapy - Herbal medicines/dietary supplements - Interferential current therapy - Intradiscal electrothermal therapy (IDET) - Kinesiotaping - Magnetic field therapy - Manual therapy - Massage therapy - Medical aids/orthotics - Multidisciplinary treatment - Muscle relaxants - Myofascial release

Guideline	Country (First Author)	Developer	Guideline Topic	Classification of LBP in Guideline	Therapies with Recommendations
					- NSAIDs - Opioids - Paracetamol - Patient education - PENS - Percutaneous intradiscal radiofrequency thermocoagulation (PIRFT) - Prolotherapy - Radiofrequency denervation - Return to work/ADLs - SMRs - SNRIs - Spinal cord stimulation - Spinal decompression - Spinal fusion - SSRIs - Steroids - TCAs - TENS - TNF-alpha inhibitors - Traction therapy - Yoga
Itz 2016 [25]	Netherlands	World Institute of Pain	Invasive treatment of pain syndromes of the lumbosacral spine	(1) Uncomplicated and complicated degenerative pain syndromes (2) Non-	- Disc replacement - Epiduroscopy - IDET - Methylene blue - Radiofrequency denervation

Guideline	Country (First Author)	Developer	Guideline Topic	Classification of LBP in Guideline	Therapies with Recommendations
				degenerative pain syndromes	- Spinal cord stimulation - Spinal fusion - Steroids - Surgery
Snow 2016 [45]	United States	American Osteopathic Association	Osteopathic manipulative treatment for low back pain	Non-specific LBP	- Manual therapy
Zhao 2016 [53]	China	National Technical Committee on Acupuncture and Moxibustion of the Standardization Administration of China and the China Association of Acupuncture Moxibustion	Use of acupuncture for low back pain	Acute, subacute and chronic LBP	- Acupuncture
Groff 2014 [19]	United States	Congress of Neurological Surgeons and the Joint Section on Disorders of the Spine and Peripheral Nerves of the American Association of Neurological Surgeons and Congress of Neurological Surgeons	Fusion procedures for degenerative disease of the lumbar spine	Specific LBP (Degenerative disease of the lumbar spine)	- Spinal fusion
Kreiner 2014 [29]	United States	North American Spine Society	Diagnosis and treatment of adult isthmic	Specific LBP (Isthmic	- Spinal decompression - Spinal fusion

Guideline	Country (First Author)	Developer	Guideline Topic	Classification of LBP in Guideline	Therapies with Recommendations
			spondylolisthesis	spondylolisthesis)	
Staal 2014 [46]	Netherlands	Royal Dutch Society for Physical Therapy	Physical therapy in patients with low back pain	Non-specific LBP	- Advice to stay active - Bed rest - Exercise programme - Heat therapy - Laser therapy - Manual therapy - Massage therapy - Multidisciplinary treatment - Patient education - Return to work/ADLs - TENS - Therapeutic ultrasound - Traction therapy
Al-Jassir 2013 [1]	Saudi Arabia	Clinical Practice Guidelines Subcommittee, Orthopedic Surgery Department, King Khalid University Hospital, King Saud University	Guideline for management of persistent non-specific low back pain	Persistent/recurrent non-specific LBP (lasting between 6 weeks to 12 months)	- Acupuncture - Advice to stay active - Cognitive behavioural therapy - COX-2 inhibitors - Exercise programme - IDET - Interferential current therapy - Laser therapy - Lumbar support - Manual therapy - Multidisciplinary treatment - NSAIDs - Opioids

Guideline	Country (First Author)	Developer	Guideline Topic	Classification of LBP in Guideline	Therapies with Recommendations
					- Paracetamol - Patient education - PIRFT - Radiofrequency denervation - Return to work/ADLs - Spinal fusion - Spinal injections - SSRIs - TCAs - TENS - Therapeutic ultrasound - Traction therapy
Brighton 2012 [5]	South Africa	Department of Rheumatology, Steve Biko Academic Hospital, University of Pretoria	Management of acute low back pain in adults	Acute LBP	- Advice to stay active - Bed rest - Codeine - Cold therapy - Diathermy - Exercise programme - Heat therapy - Laser therapy - Manual therapy - Massage therapy - Multidisciplinary treatment - Medical aids/orthotics - NSAIDs - Opioids - Paracetamol - Patient education - Return to work/ADLs

Guideline	Country (First Author)	Developer	Guideline Topic	Classification of LBP in Guideline	Therapies with Recommendations
					- SMRs - Steroids - Surgery - TENS - Therapeutic ultrasound - Traction therapy - Tramadol
Brosseau 2012 [6]	Canada	Ottawa Methods Group	Therapeutic massage for low back pain	Acute, subacute and chronic LBP	- Exercise programme - Massage therapy - Patient education
Cheng 2012 [8]	Hong Kong	Guideline Development Working Group	Prevention and management of low back pain in working population in primary care	Acute, subacute and chronic LBP Non-specific LBP	- Patient education - Return to work/ADLs
Delitto 2012 [11]	United States	American Physical Therapy Association	Low back pain relating to orthopaedic Care	International Statistical Classification of Diseases and Related Health Problems (ICD) classification of LBP	- Bed rest - Exercise programme - Manual therapy - Patient education - Return to work/ADLs - Traction therapy
Goertz 2012 [16]	United States	Institute for Clinical Systems Improvement	Adult acute and subacute low back pain	Acute and subacute LBP or radiculopathy	- Acupuncture - Bed rest - Cognitive behavioural therapy - Cold therapy - Exercise programme - Heat therapy

Guideline	Country (First Author)	Developer	Guideline Topic	Classification of LBP in Guideline	Therapies with Recommendations
					- Manual therapy - NSAIDs - Opioids - Patient education - Return to work/ADLs - SMRs - Steroids - Traction therapy
Towards Optimized Practice Alberta 2011 [47]	Canada	Toward Optimized Practice Alberta	Evidence-informed primary care management of low back pain	Acute, subacute and chronic LBP, sciatica, radiculopathy Non-specific LBP	- Acupuncture - Advice to stay active - Back school - Bed rest - Cognitive behavioural therapy - Cold pack or superficial heat - Exercise programme - Lumbar support - Manual therapy - Massage therapy - Multidisciplinary treatment - NSAIDs - Opioids - Paracetamol - Patient education - Progressive relaxation - Prolotherapy - Return to work/ADLs - SMRs - Steroids

Guideline	Country (First Author)	Developer	Guideline Topic	Classification of LBP in Guideline	Therapies with Recommendations
					- TCAs - TENS - Traction therapy
Chou 2009 [10]	United States	American Pain Society	Interventional therapies, surgery, and interdisciplinary rehabilitation for low back pain	Acute, subacute and chronic LBP, radiculopathy	- Cognitive behavioural therapy - Multidisciplinary treatment - Prolotherapy - Spinal cord stimulation - Steroids - Surgery
Ju 2009 [26]	Australia	University of Adelaide	Management of acute/subacute soft tissue injuring to the low back	Acute and subacute LBP	- Acupuncture - Advice to stay active - Back school - Bed rest - Cognitive behavioural therapy - Exercise programme - Heat therapy - Interferential current therapy - Lumbar supports - Manual therapy - Multidisciplinary treatment - NSAIDs - Paracetamol - Patient education - SMRs - Steroids - Traction therapy
Savigny 2009	United Kingdom	National Collaborating	Early management of	Persistent/recurrent	- Acupuncture

Guideline	Country (First Author)	Developer	Guideline Topic	Classification of LBP in Guideline	Therapies with Recommendations
[40]		Centre for Primary Care and Royal College of General Practitioners	persistent non-specific low back pain	non-specific LBP (lasting between 6 weeks to 12 months)	- Advice to stay active - Cognitive behavioural therapy - COX-2 inhibitors - Exercise programme - IDET - Interferential current therapy - Laser therapy - Lumbar supports - Manual therapy - Multidisciplinary treatment - NSAIDs - Opioids - Paracetamol - Patient education - PIRFT - Radiofrequency denervation - Return to work/ADLs - Spinal fusion - Spinal injections - SSRIs - TCAs - TENS - Therapeutic ultrasound - Traction therapy

Table 2: Summary of Recommendations in Low Back Pain Clinical Practice Guidelines

Therapy Recommendations by Category	Guideline	Chenot 2017 [9]	Qaseem 2017** [37]	van Wambeke 2017* [50]	Arvin 2016** [3]	Globe 2016 [15]	Hegmann 2016* [20]	Itz 2016 [25]	Snow 2016* [45]	Zhao 2016 [53]	Groff 2014 [19]	Kreiner 2014* [29]	Staal 2014 [46]	Al-Jassir 2013 [1]	Brighton 2012 [5]	Brosseau 2012 [6]	Cheng 2012 [8]	Delitto 2012* [11]	Goertz 2012* [16]	TOP 2011 [47]	Chou 2009** [10]	Ju 2009* [26]	Savigny 2009 [40]
Complementary and Alternative Medicine	Acupuncture	0	+	N/A	-	+	0	N/A	N/A	+	N/A	N/A	N/A	+	N/A	N/A	N/A	N/A	+	+	N/A	0	+
	Herbal Medicines/Dietary Supplements	N/A	N/A	N/A	N/A	N/A	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Mindfulness-based Stress Reduction	N/A	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Progressive Relaxation	N/A	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	N/A	N/A	N/A
	Prolotherapy	N/A	N/A	N/A	N/A	N/A	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	-	N/A	N/A
	Tai Chi	N/A	+	N/A	N/A	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Yoga	N/A	+	N/A	N/A	+	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Therapy Recommendations by Category	Guideline	Chenot 2017 [9]	Qaseem 2017** [37]	van Wambeke 2017* [50]	Arvin 2016** [3]	Globe 2016 [15]	Hegmann 2016* [20]	Itz 2016 [25]	Snow 2016* [45]	Zhao 2016 [53]	Groff 2014 [19]	Kreiner 2014* [29]	Staal 2014 [46]	Al-Jassir 2013 [1]	Brighton 2012 [5]	Brosseau 2012 [6]	Cheng 2012 [8]	Delitto 2012* [11]	Goertz 2012* [16]	TOP 2011 [47]	Chou 2009** [10]	Ju 2009* [26]	Savigny 2009 [40]
Electrotherapies/Thermot-herapies	Cold Therapy	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	N/A	N/A	N/A	-	+	N/A	N/A	N/A
	Cryotherapy	-	N/A	N/A	N/A	N/A	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Electromyography Biofeedback	N/A	+	N/A	N/A	N/A	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Heat Therapy	N/A	+	N/A	N/A	N/A	+	N/A	N/A	N/A	N/A	N/A	+	N/A	0	N/A	N/A	N/A	+	+	N/A	+	N/A
	Interferential Current Therapy (IFC)	-	N/A	-	-	0	-	N/A	N/A	N/A	N/A	N/A	N/A	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	-
	Laser Therapy	-	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-
	Magnetic Field Therapy	-	N/A	N/A	N/A	N/A	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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	Microcurrent Stimulation/H-wave /High-Voltage Galvanic/Iontophoresis	N/A	N/A	N/A	N/A	N/A	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Percutaneous Electrical Nerve Stimulation (PENS)	-	N/A	-	-	0	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Short-wave Diathermy	-	N/A	N/A	N/A	N/A	-	N/A	N/A	N/A	N/A	N/A	-	N/A	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Therapeutic Ultrasound	-	0	-	-	0	N/A	N/A	N/A	N/A	N/A	N/A	-	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-
	Transcutaneous Electrical Nerve Stimulation (TENS)	-	0	-	-	0	0	N/A	N/A	N/A	N/A	N/A	-	-	-	N/A	N/A	N/A	N/A	0	N/A	N/A	-
Exercise Therapies	Advice to Stay Active/Exercise Therapy/Programme/ Functional Training	+	+	+	+	+	0	N/A	N/A	N/A	N/A	N/A	+	+	+	+	N/A	+	+	+	N/A	0	+
Manual Therapies	Manipulation/Mobilization	0	+	+	+	+	0	N/A	+	N/A	N/A	N/A	+	+	0	N/A	N/A	+	+	0	N/A	0	+

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	Massage Therapy	0	+	N/A	+	+	0	N/A	N/A	N/A	N/A	N/A	+	N/A	+	+	N/A	N/A	N/A	0	N/A	N/A	N/A
	Myofascial Release	N/A	N/A	N/A	N/A	N/A	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Traction Therapy	-	N/A	-	-	N/A	-	N/A	N/A	N/A	N/A	N/A	-	-	-	N/A	N/A	0	-	-	N/A	0	-
Other	Back School	0	N/A	N/A	N/A	N/A	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	N/A	0	N/A
	Bed Rest	-	N/A	N/A	N/A	N/A	0	N/A	N/A	N/A	N/A	N/A	-	N/A	0	N/A	N/A	-	-	-	N/A	-	N/A
	Ergotherapy	0	N/A	N/A	N/A	+	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Kinesiotaping	-	0	N/A	N/A	N/A	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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	Medical Aids, Orthotics & Appliances	-	N/A	-	-	0	0	N/A	N/A	N/A	N/A	N/A	N/A	-	0	N/A	N/A	N/A	N/A	-	N/A	0	-
	Patient Education	+	N/A	+	+	+	N/A	N/A	N/A	N/A	N/A	N/A	+	+	+	+	+	+	+	+	N/A	N/A	+
Pharmacological Interventions	Antibiotics	N/A	N/A	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Anticonvulsants	N/A	N/A	-	-	N/A	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Codeine	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Colchicine	N/A	N/A	N/A	N/A	N/A	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	COX-2 Inhibitors	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+

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	Duloxetine	N/A	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Flupirtine	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Metamizole	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Methylene Blue	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Serotonin-Norepinephrine Reuptake Inhibitors (SNRIs)	N/A	N/A	-	-	N/A	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Nonsteroidal Anti-Inflammatory Drugs (NSAIDs)	+	+	+	+	N/A	+	N/A	N/A	N/A	N/A	N/A	N/A	+	+	N/A	N/A	N/A	+	+	N/A	0	+
	Opioids (Strong/General)	0	+	-	-	N/A	0	N/A	N/A	N/A	N/A	N/A	N/A	+	+	N/A	N/A	N/A	+	+	N/A	N/A	+

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	Weak Opioids (General)	N/A	N/A	+	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+
	Paracetamol (Acetaminophen)	-	0	-	0	N/A	+	N/A	N/A	N/A	N/A	N/A	N/A	+	+	N/A	N/A	N/A	N/A	+	N/A	0	+
	Selective Serotonin Reuptake Inhibitors (SSRIs)	N/A	-	-	-	N/A	-	N/A	N/A	N/A	N/A	N/A	N/A	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-
	Skeletal Muscle Relaxants (SMRs)	N/A	+	-	N/A	N/A	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	N/A	N/A	N/A	+	+	N/A	0	N/A
	Systemic Corticosteroids (Oral/Epidural)	-	-	+	0	N/A	0	0	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A	N/A	N/A	+	0	0	0	N/A
	TNF-alpha Inhibitors	N/A	N/A	N/A	N/A	N/A	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Tramadol	N/A	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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	Tricyclic Antidepressants (TCAs)	N/A	-	-	-	N/A	-	N/A	N/A	N/A	N/A	N/A	N/A	+	N/A	N/A	N/A	N/A	N/A	+	N/A	N/A	+
Psychosocial/ Multimodal	Cognitive Behavioural Therapy (CBT)	N/A	+	+	+	+	0	N/A	N/A	N/A	N/A	N/A	N/A	+	N/A	N/A	N/A	N/A	+	+	+	+	+
	Multimodal Treatment Programs/Multidisciplinary Biopsychosocial Rehabilitation (MBR)	+	+	+	+	+	0	N/A	N/A	N/A	N/A	N/A	+	+	N/A	N/A	N/A	N/A	N/A	+	+	+	+
	Operant Therapy	N/A	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Return to Work/Activities of Daily Living (ADLs)	N/A	N/A	+	+	+	+	N/A	N/A	N/A	N/A	N/A	+	+	+	N/A	+	+	+	+	N/A	N/A	+
Surgical/ Invasive Treatments	Adhesiolysis	N/A	N/A	N/A	N/A	N/A	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Discectomy	N/A	N/A	N/A	N/A	N/A	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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	Disc Replacement	N/A	N/A	-	-	N/A	-	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Epiduroscopy	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Intradiscal Electrothermal Therapy (IDET)	N/A	N/A	N/A	N/A	N/A	-	0	N/A	N/A	N/A	N/A	N/A	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-
	Percutaneous Intradiscal Radiofrequency Thermocoagulation (PIRFT)	N/A	N/A	N/A	N/A	N/A	-	N/A	N/A	N/A	N/A	N/A	N/A	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-
	Percutaneous Procedures (General)	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Radiofrequency (RF) Lesion/Denervation	N/A	N/A	-	+	N/A	-	0	N/A	N/A	N/A	N/A	N/A	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-
	Spinal Cord Stimulation (SCS)	N/A	N/A	N/A	N/A	N/A	-	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A	N/A

Therapy Recommendations by Category	Guideline	Chenot 2017 [9]	Qaseem 2017** [37]	van Wambeke 2017* [50]	Arvin 2016** [3]	Globe 2016 [15]	Hegmann 2016* [20]	Itz 2016 [25]	Snow 2016* [45]	Zhao 2016 [53]	Groff 2014 [19]	Kreiner 2014* [29]	Staal 2014 [46]	Al-Jassir 2013 [1]	Brighton 2012 [5]	Brosseau 2012 [6]	Cheng 2012 [8]	Delitto 2012* [11]	Goertz 2012* [16]	TOP 2011 [47]	Chou 2009** [10]	Ju 2009* [26]	Savigny 2009 [40]
	Spinal Decompression	N/A	N/A	+	+	N/A	+	N/A	N/A	N/A	N/A	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Spinal Fusion	N/A	N/A	0	-	N/A	0	0	N/A	N/A	+	+	N/A	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+
	Spinal Injections	N/A	N/A	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-
	Surgery (General)	-	N/A	N/A	N/A	N/A	N/A	0	N/A	N/A	N/A	N/A	N/A	N/A	+	N/A	N/A	N/A	N/A	N/A	0	N/A	N/A

Legend:
* = Either average appraisal score or average overall assessment of 5.0 or higher
** = Both average appraisal score and average overall assessment of 5.0 or higher
+/green = recommendation for the therapy's use
-/red = recommendation against the therapy's use
0/yellow = recommendation unclear/uncertain/conflicting
N/A/grey = no recommendation provided

Table 3: Average Appraisal Scores and Average Overall Assessments of Each Clinical Practice Guideline

Guideline	Metric	Appraiser 1	Appraiser 2	Average	Standard Deviation
Chenot 2017 [9]	Appraisal Score	3.7	3.8	3.8	0.1
	Overall Assessment	4.0	4.0	4.0	0.0
Qaseem 2017 [37]	Appraisal Score	5.3	5.3	5.3	0.0
	Overall Assessment	6.0	5.0	5.5	0.7
van Wambeke 2017 [50]	Appraisal Score	5.0	4.6	4.8	0.3
	Overall Assessment	5.0	5.0	5.0	0.0
Arvin 2016 [3]	Appraisal Score	5.5	5.3	5.4	0.1
	Overall Assessment	6.0	6.0	6.0	0.0
Globe 2016 [15]	Appraisal Score	4.4	4.3	4.4	0.1
	Overall Assessment	4.0	5.0	4.5	0.7
Hegmann 2016 [20]	Appraisal Score	4.5	4.8	4.7	0.2
	Overall Assessment	6.0	6.0	6.0	0.0
Itz 2016 [25]	Appraisal Score	4.3	4.3	4.3	0.0
	Overall Assessment	5.0	4.0	4.5	0.7
Snow 2016 [45]	Appraisal Score	4.4	4.8	4.6	0.3
	Overall Assessment	5.0	5.0	5.0	0.0
Zhao 2016 [53]	Appraisal Score	3.5	3.7	3.6	0.1
	Overall Assessment	4.0	4.0	4.0	0.0
Groff 2014 [19]	Appraisal Score	4.5	4.3	4.4	0.1
	Overall Assessment	4.0	4.0	4.0	0.0
Kreiner 2014 [29]	Appraisal Score	5.2	5.5	5.4	0.2
	Overall Assessment	4.0	5.0	4.5	0.7
Staal 2014 [46]	Appraisal Score	3.3	3.7	3.5	0.3
	Overall Assessment	3.0	3.0	3.0	0.0
Al-Jassir 2013 [1]	Appraisal Score	4.5	4.0	4.3	0.4
	Overall Assessment	4.0	4.0	4.0	0.0
Brighton 2012 [5]	Appraisal Score	2.6	2.3	2.5	0.2
	Overall Assessment	3.0	2.0	2.5	0.7
Brosseau 2012 [6]	Appraisal Score	4.2	3.7	4.0	0.4
	Overall Assessment	5.0	4.0	4.5	0.7
Cheng 2012 [8]	Appraisal Score	3.7	4.2	4.0	0.3

	Overall Assessment	4.0	4.0	4.0	0.0
Delitto 2012 [11]	Appraisal Score	4.3	4.3	4.3	0.0
	Overall Assessment	5.0	5.0	5.0	0.0
Goertz 2012 [16]	Appraisal Score	4.9	5.0	5.0	0.1
	Overall Assessment	4.0	5.0	4.5	0.7
Towards Optimized Practice Alberta 2011 [47]	Appraisal Score	3.7	3.5	3.6	0.1
	Overall Assessment	3.0	3.0	3.0	0.0
Chou 2009 [10]	Appraisal Score	5.2	5.0	5.1	0.1
	Overall Assessment	5.0	5.0	5.0	0.0
Ju 2009 [26]	Appraisal Score	4.6	4.9	4.8	0.2
	Overall Assessment	5.0	5.0	5.0	0.0
Savigny 2009 [40]	Appraisal Score	4.5	4.5	4.5	0.0
	Overall Assessment	4.0	5.0	4.5	0.7

Appraisal scores were calculated by taking the average score of all 23 items of a single appraisal. Average appraisal scores were calculated by taking the average of the appraisal scores of both appraisers.
Overall assessments were the assessments provided by each appraiser.
Average overall assessment was the average overall assessments of both appraisers.

Table 4: Scaled Domain Percentages for Appraisers of Each Clinical Practice Guideline

Guideline	Domain score (%)					
	Scope and Purpose	Stakeholder Involvement	Rigour of Development	Clarity of Presentation	Applicability	Editorial Independence
Chenot 2017 [9]	83.3	47.2	33.3	80.6	22.9	33.3
Qaseem 2017 [37]	100.0	75.0	77.1	91.7	20.8	70.8
van Wambeke 2017 [50]	88.9	44.4	62.5	91.7	35.4	62.5
Arvin 2016 [3]	100.0	50.0	82.3	94.4	45.8	54.2
Globe 2016 [15]	77.8	77.8	57.3	52.8	29.2	45.8
Hegmann 2016 [20]	100.0	55.6	61.5	83.3	22.9	50.0
Itz 2016 [25]	94.4	33.3	60.4	88.9	10.4	41.7
Snow 2016 [45]	97.2	58.3	55.2	75.0	35.4	54.2
Zhao 2016 [53]	69.4	52.8	32.3	100.0	6.3	29.2
Groff 2014 [19]	94.4	36.1	60.4	80.6	8.3	79.2
Kreiner 2014 [29]	100.0	52.8	81.3	91.7	27.1	87.5
Staal 2014 [46]	86.1	63.9	12.5	86.1	35.4	0.0
Al-Jassir 2013 [1]	100.0	61.1	28.1	88.9	54.2	29.2
Brighton 2012 [5]	55.6	36.1	10.4	50.0	14.6	0.0
Brosseau 2012 [6]	91.7	61.1	56.3	52.8	2.1	33.3
Cheng 2012 [8]	94.4	47.2	43.8	83.3	29.2	0.0
Delitto 2012 [11]	83.3	63.9	52.1	97.2	29.2	0.0
Goertz 2012 [16]	100.0	83.3	47.9	88.9	54.2	50.0
Towards Optimized Practice Alberta 2011 [47]	80.6	30.6	21.9	94.4	27.1	41.7
Chou 2009 [10]	91.7	50.0	79.2	91.7	25.0	70.8
Ju 2009 [26]	100.0	52.8	61.5	88.9	50.0	8.3
Savigny 2009 [40]	91.7	55.6	50.0	94.4	41.7	29.2