

A systematic review of recommendations and guidelines for the management of osteoarthritis: The Chronic Osteoarthritis Management Initiative of the U.S. Bone and Joint Initiative

Amanda E. Nelson, MD, MSCR^{a,b,*}, Kelli D. Allen, PhD^c, Yvonne M. Golightly, PT, PhD^{a,d,e}, Adam P. Goode, DPT, PhD^f, Joanne M. Jordan, MD, MPH^{a,b,d,g}

^a Thurston Arthritis Research Center, University of North Carolina, Chapel Hill, NC

^b Department of Medicine, University of North Carolina, Chapel Hill, NC

^c Department of Medicine, Duke University Medical Center & Health Services Research & Development, VA Medical Center, Durham, NC

^d Department of Epidemiology, Gillings School of Global Public Health, University of North Carolina, Chapel Hill, NC

^e Injury Prevention Research Center, University of North Carolina, Chapel Hill, NC

^f Department of Community and Family Medicine, Duke University Medical Center, Durham, NC

^g Department of Orthopaedics, University of North Carolina, Chapel Hill, NC

ARTICLE INFO

Keywords:
Osteoarthritis
Management
Guidelines
Systematic review

ABSTRACT

Purpose: Although a number of osteoarthritis (OA) management guidelines exist, uptake has been suboptimal. Our aim was to review and critically evaluate existing OA management guidelines to better understand potential issues and barriers.

Methods: A systematic review of the literature in MEDLINE published from January 1, 2000 to April 1, 2013 was performed and supplemented by bibliographic reviews, following PRISMA guidelines and a written protocol. Following initial title and abstract screening, 2 authors independently reviewed full-text articles; a third settled disagreements. Two independent reviewers extracted data into a standardized form. Two authors independently assessed guideline quality using the AGREE II instrument; three generated summary recommendations based on the extracted guideline data.

Results: Overall, 16 articles were included in the final review. There was broad agreement on recommendations by the various organizations. For non-pharmacologic modalities, education/self-management, exercise, weight loss if overweight, walking aids as indicated, and thermal modalities were widely recommended. For appropriate patients, joint replacement was recommended; arthroscopy with debridement was not recommended for symptomatic knee OA. Pharmacologic modalities most recommended included acetaminophen/paracetamol (first line) and NSAIDs (topical or oral, second line). Intra-articular corticosteroids were generally recommended for hip and knee OA. Controversy remains about the use of acupuncture, knee braces, heel wedges, intra-articular hyaluronans, and glucosamine/chondroitin.

Conclusions: The relative agreement on many OA management recommendations across organizations indicates a problem with dissemination and implementation rather than a lack of quality guidelines. Future efforts should focus on optimizing implementation in primary care settings, where the majority of OA care occurs.

© 2014 Elsevier Inc. All rights reserved.

Abbreviations: OA, Osteoarthritis; AAOS, American Academy of Orthopaedic Surgeons; OARSI, Osteoarthritis Research Society International; ACR, American College of Rheumatology; NCC-CC, The National Collaborating Centre for Chronic Conditions; EULAR, European League Against Rheumatism; APTA, American Physical Therapy Association; SOFMER, French Society for Physical and Rehabilitation Therapy; ACCP, American College of Clinical Pharmacy; ACPMAB, Asian Chronic Pain Management Advisory Board; MQIC, Michigan Quality Improvement Consortium; COAMI, Chronic Osteoarthritis Management Initiative.

Support: This review was commissioned and partially funded by the U.S. Bone and Joint Initiative via the Chronic Osteoarthritis Management Initiative Work Group.

Role of funding source: This review was commissioned and partially funded by the U.S. Bone and Joint Initiative via the Chronic Osteoarthritis Management Initiative Work Group. The study sponsor had no role in study design, collection, analysis, or interpretation of data, writing the manuscript, or the decision to submit for publication.

* Corresponding author at: Thurston Arthritis Research Center, University of North Carolina at Chapel Hill, 3300 Doc J. Thurston Bldg, CB # 7280, Chapel Hill, NC 27599-7280. Tel.: +1 919 966 0553; fax: +1 919 966 1739.

E-mail address: aelnelson@med.unc.edu (A.E. Nelson).

Introduction

Arthritis, rheumatism, and back/spine problems were the leading causes of disability in the U.S. in 2005, resulting in more cases of disability than the next 8 causes combined [1]. In 2008, 13% of adults over 18 years of age had self-reported arthritis-attributable activity limitations, up from less than 9% in 2003–2005 [2]. Osteoarthritis (OA) is the most common form of arthritis, affecting more than 27 million people in the U.S. [3]. OA is one of several chronic conditions that are becoming more prevalent with the aging of the population and increasing prevalence of obesity. Data from the 2009 Behavioral Risk Factor Surveillance System indicated that the top 2 most prevalent conditions in those over 50 years of age were hypertension (36.5% for age 50–59 years, increasing to 60.7% for those over the age of 70 years) and arthritis (35% for age 50–59 years, increasing to more than 55% over the age of 70 years); the average number of conditions increased with age and was associated with a higher prevalence of activity limitations [4], highlighting the potential future burden of OA and other chronic diseases [5]. Gadermann et al. used U.S. National Comorbidity Survey Replication data to assess disease burden and comorbidities, finding that arthritis was the second most common reported disorder (prevalence 27%). More importantly, 88% of those reporting arthritis had at least one other physical or mental comorbidity (mean of 2.4 disorders) [6]. The importance of OA management as part of the care of individuals with multiple chronic conditions cannot be overlooked, given its impact on disability and functional limitation, as well as management of other chronic health conditions.

Numerous guidelines for OA management exist, but despite their many commonalities, and general agreement with these published recommendations among providers, there remains poor implementation in clinical practice [7,8]. With the goal of improving the current approach to OA management, the Chronic Osteoarthritis Management Initiative (COAMI) Work Group was convened by the U.S. Bone and Joint Initiative in May 2012. This work group includes orthopedic nurses and surgeons, rheumatologists, rehabilitation and sports medicine providers, primary care and osteopathic physicians, physical therapists, athletic trainers, and patients. COAMI issued a Call to Action in September 2012, which mentions several priority actions, including convening an OA management conference, including other partners (U.S. Preventative Services Task Force, other federal agencies, other chronic disease and professional advocacy groups, and researchers and practitioners) in ongoing efforts, exploring standardized screening tools and indicators of OA, supporting advocacy endeavors, and developing and supporting an OA-specific research agenda [9]. This systematic review is one of the recommended outcomes of the first COAMI meeting and will serve as part of the background to support these initiatives by identifying, evaluating, and summarizing existing guidelines for management of symptomatic OA at the hip, knee, or hand, with the goal of determining commonalities more directly translatable to clinical practice.

Methods

Following a protocol designed by the authors and adherent to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, a librarian-assisted literature search of the MEDLINE database was performed on April 1, 2013 using the Medical Subject Heading (MeSH) search term “osteoarthritis” with the publication type “guideline,” and subsequently with keywords “recommendation” and “management”; all searches were limited to English-language articles published since January 1, 2000 to avoid outdated or overlapping guidelines. Additionally, we searched the Agency for Healthcare Research & Quality Guidelines Clearinghouse

using the keyword “osteoarthritis,” and reviewed the bibliographies of all identified guidelines for additional references. Based on this, we performed an additional search using the keywords “Ottawa panel osteoarthritis.” Our focus was on guidelines produced by relevant organizations and specialties; we did not include articles evaluating single interventions or editorial pieces. Our team included an exercise physiologist and health services researcher (K.D.A.), 2 physical therapist/epidemiologists (Y.M.G. and A.P.G.), and two rheumatologist/epidemiologists (A.E.N. and J.M.J.).

A three-step process was utilized to screen and review articles. First, one author (A.E.N.) reviewed all titles and abstracts; inclusion criteria required a focus on OA of the hip, knee, or hand, and either pharmacologic or non-pharmacologic management. In the second step, remaining titles were reviewed by all authors when the list was further reduced by including only those articles from the last 10 years (January 1, 2003 forward), including only the most recent guideline from any one organization, and excluding articles that were summaries or commentaries on other more complete guidelines. The third step consisted of independent full-text review by two authors (A.E.N. and A.P.G.). Disagreements in this step were resolved by consensus and, if needed, a third author (Y.M.G.) reviewed the article for inclusion. Exclusion criteria at this step were as follows: not specific to OA, related to a joint site other than hand/knee/hip, or did not represent a guideline or recommendation (e.g., comments on other guidelines and guideline development without specific recommendations made, Fig. 1). After our search was completed, The American Academy of Orthopaedic Surgeons released an update to “Treatment of Osteoarthritis of the Knee” on May 18, 2013, which replaced the 2008 version during the writing of this review.

A data extraction form (Excel spreadsheet) was reviewed and edited by all authors. The extracted data included publication year, country, specialties involved, whether a systematic review was performed, the target users, and whether competing interests were discussed. Two independent reviewers then extracted a list of recommendations from each guideline (see section Acknowledgment) and the strength of recommendation was recorded; similar recommendations across guidelines were collapsed (e.g., many specific types of exercise to “low-impact aerobic exercise”) to ease reporting and interpretation. Two separate authors (A.E.N. and A.P.G.) checked the extraction tables for completeness, and one author combined the results into a final table (A.E.N., finalized June 14, 2013). At this stage, two additional articles that did not provide management recommendations, but rather recommendations for outcome measures, were excluded [10,11].

The overall quality of each included guideline was assessed using the AGREE II instrument (*Appraisal of Guidelines for Research and Evaluation*, 2nd edition; www.agreetrust.org). The validity and reliability for assessment of practice guidelines by the AGREE II has been established [12,13]. The instrument includes 23 items covering six quality domains: (1) scope and purpose, (2) stakeholder involvement, (3) rigor of development, (4) clarity of presentation, (5) applicability, and (6) editorial independence; two additional assessment items (Overall Guideline Assessment) are included for the evaluator to make an overall judgment of the practice guideline. Each item is scored on a scale of 1–7, with 1 assigned for items with no clear discussion, 7 for exceptional quality of reporting, and 2–6 for items not fully meeting the AGREE II criteria. There are no strict cutoffs designating quality using this tool, but it allows comparison between guidelines. Two authors (K.D.A. and Y.M.G.) first read the entire AGREE II user's manual and then independently assessed all included guidelines. Scoring was conducted (by A.E.N., completed June 25, 2013) according to the instrument protocol, and consisted of adding the scores of items in a domain for both reviewers and standardizing the total score out of 100%.

To ease interpretation of the recommendations, three authors (K.D.A., A.P.G., and A.E.N.; completed June 14, 2013) independently

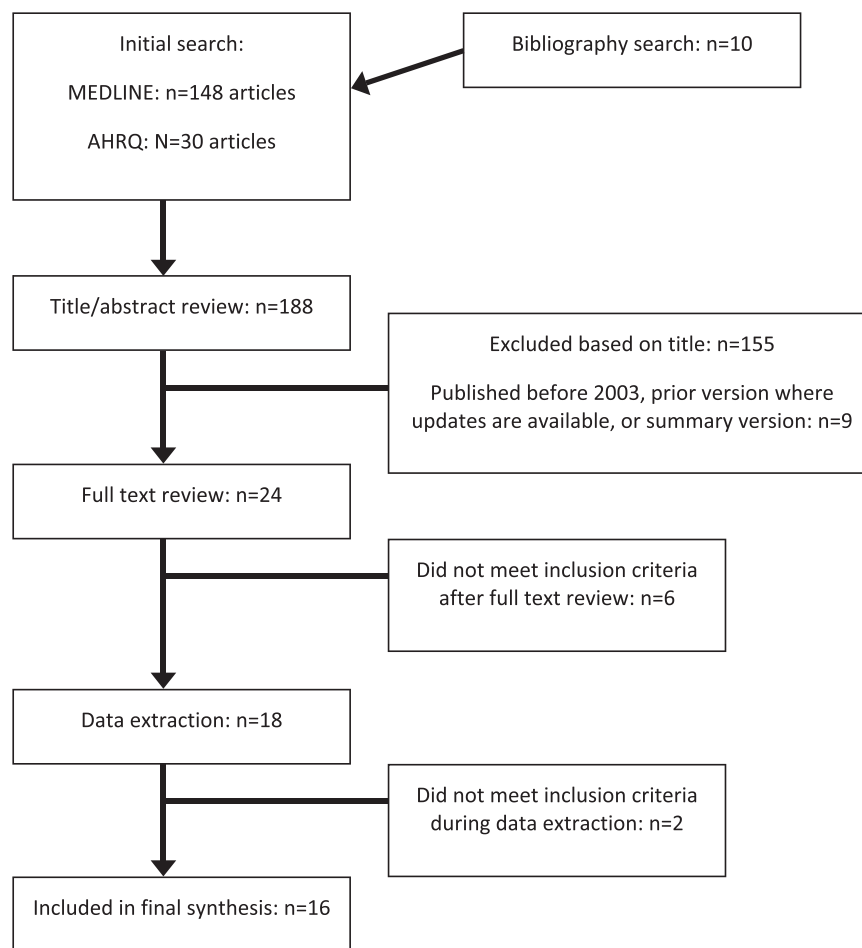


Fig. 1. Flow sheet of included studies (PRISMA).

reviewed the data extraction tables for all guidelines and generated summary recommendations as follows: R = recommended, I = inconclusive, and NR = not recommended. Where all three authors agreed (44/58 recommendations, 76%), a summary recommendation (R, I, or NR) is provided in the tables and results section; where no agreement was reached (14/58 recommendations, 24%), the summary recommendation is listed as inconclusive (I).

Results

We reviewed 188 articles and included a total of 16 articles describing guidelines for OA management (Fig. 1). Five were from the United States [14–18], one from Canada [19], eight from Europe [20–27], one from Asia [28], and one with international input from the U.S., Canada, and Europe [29]. Most recommendations were directed toward physicians and allied health professionals, and most had multidisciplinary input from general practitioners, rheumatologists, orthopedists, and physical therapists. The various grading scales used by the individual societies for their recommendations are summarized in Table 1.

AGREE II

The scaled AGREE II scores, which were derived from the two independent reviewers' scores as a percentage of the maximum possible score per the AGREE website, are shown in Fig. 2. The 6 domain scores are listed separately. The OARSi guidelines scored highest on the overall assessment (75%), followed by the AAOs, ACR, MOVE, and NCC-CC guidelines (67%). The highest domain

scores were for scope and purpose (description of overall objectives, health questions covered, and target population) and rigor of development (use of systematic methods, clear criteria for study selection, strengths and limitations of evidence described, methods of formulating recommendations described, risks and benefits considered, clear link between recommendation and supporting evidence, external review, and procedure for updates). The lowest domain scores were for applicability (discussion of facilitators and barriers to application, provides advice for practical use, consideration of resource implications, and monitoring/auditing criteria). This domain includes items about facilitators and barriers to guideline use, practical advice regarding guideline implementation, resource implications, and monitoring/auditing criteria, which were often not included in the OA guidelines. Several guidelines also did not adequately discuss issues related to editorial independence (Fig. 2).

Non-pharmacologic management

All guidelines but one (focused on pain management [16]) made recommendations for non-pharmacologic management ($n = 15$). Five main areas were identified in the non-pharmacologic recommendations: (1) education and self-management, (2) exercise and weight loss, (3) assistive devices, (4) alternative and complementary approaches, and (5) surgical interventions.

Education and self-management

Most (12/15) guidelines had moderate to strong recommendations for self-management programs and education as part of the

Table 1
Description of grades of recommendation from the individual organizations

Organization	Recommendation grading descriptions
OARSI [29]	Strength of Recommendation (SOR) based on opinions of guideline development group after taking into consideration research evidence. SOR was determined on a 0–100 mm VAS; Level of evidence (I–IV) and SOR given for each recommendation.
AAOS [18]	Graded as Strong (S, high-quality evidence), Moderate (M, moderate quality evidence), Limited (L, low-quality evidence), Inconclusive (I), or Consensus (C). NR = not recommended.
ACR [14]	Recommendations graded by expert consensus. A strong recommendation (SR) required high-quality evidence and a large gradient of difference between desirable and undesirable treatment effects. A conditional recommendation (CR) was based on absence of high-quality evidence and/or evidence of only a small gradient of difference between desirable and undesirable treatment effects. CNR = conditionally not recommended.
MOVE [20]	Recommendations graded: A (Category I evidence), B (Category II evidence or extrapolated from category I evidence), C (Category III evidence or extrapolated from category I or II evidence), or D (Category IV evidence or extrapolated from category II or III evidence).
NCC-CC [21]	Treatments were recommended (R) based on grading of evidence and formal consensus.
EULAR-hand [22]	Level of evidence graded as Ia: meta-analysis of RCTs, Ib: Randomized controlled trial (RCT), IIa: Controlled, non-randomized, IIb: quasi-experimental study, III: non-experimental/descriptive, or IV: expert committee report/opinion/clinical experience. Recommendations were graded on a VAS scale 0–100 mm (0 = not recommended at all, 100 mm = fully recommended) and an A–E ordinal scale (A = fully recommended, B = strongly recommended, C = moderately recommended, D = weakly recommended, and E = not recommended).
EULAR-hip [23]	Recommendations graded: A (Category I evidence), B (Category II evidence or extrapolated from category I evidence), C (Category III evidence or extrapolated from category I or II evidence), D (Category IV evidence or extrapolated from category II or III evidence); VAS scale for SOR used as above for EULAR-hand.
EULAR-knee [24]	Recommendations graded: A (Category I evidence), B (Category II evidence or extrapolated from category I evidence), C (Category III evidence or extrapolated from category I or II evidence), or D (Category IV evidence or extrapolated from category II or III evidence).
APTA-OS [15]	Recommendations graded: A (Strong evidence or preponderance of level I/II studies, with at least 1 level I study), B (Moderate evidence, single high-quality RCT or preponderance of level II studies), C (Weak evidence, single level II study or preponderance of level III/IV studies), including expert consensus, D (Conflicting evidence), E (Theoretical Evidence, preponderance of evidence from animal/cadaver studies, conceptual models/principles, or basic sciences), F (Expert Opinion).
Dutch [25]	Recommendations graded: 1 (One A1 study or at least two A2 studies), 2 (One A2 study or at least two B studies), 3 (One B study or at least two B studies), 4 (Expert Opinion). A1 = meta-analyses which include at least 2 RCTs quality level A2 that show consistent results. A2 = RCTs of a good methodological quality (Randomized double-blind controlled studies) with a sufficient power and consistency. B = RCTs of a moderate methodological quality with insufficient power, or non-randomized, cohort of patient–control group study involving intergroup comparisons. NR = not recommended.
Ottawa [19]	Recommendations graded A (strongly recommended), B (recommended), C+ (suggested), C (neutral), D (neutral), D+ (suggest not to use) and D– (strongly not recommended).
SOFMER [26] (Gelis)	Recommendations graded: A (Category I evidence), B (Category II evidence or extrapolated from category I evidence), C (Category III evidence or extrapolated from category I/II evidence), and D (Category IV evidence or extrapolated from category II/III evidence); validated by multidisciplinary expert reading committee.
SOFMER [27] (Mazieres)	Recommendations graded: A (Category I evidence), B (Category II evidence or extrapolated from category I evidence), C (Category III evidence or extrapolated from category I/II evidence), D (Category IV evidence or extrapolated from category II/III evidence), and validated by expert panel.
ACCP [16]	Recommendations were by expert panel consensus (no SOR given).
ACPMAB [28]	Recommendations suggested by roundtable expert discussion and consensus (no SOR given).
MQIC [17]	R = recommended based on expert consensus.
Summary	Recommendations graded: R = recommended, I = Inconclusive, NR = not recommended, based on review of guidelines independently by 3 authors of the current study.

management of OA. Regular contact to promote self-care was commonly included as a recommendation [20,21,24,27,29]. Other recommendations included instruction in joint protection, particularly for hand OA, an evaluation of ability to perform activities of daily living, psychosocial interventions, and individualization of treatment plans (Table 2).

Summary recommendations: provide or refer patients to self-management programs; provide education, regular contact to promote self-care, joint protection strategies, and individualized treatment plans to patients with OA.

Exercise and weight loss

A variety of more specific recommendations are summarized here as “low-impact aerobic exercise” which includes both land- and water-based exercises, and was recommended by 12 of 15 guidelines, generally strongly, especially at the knee and hip, with less agreement on the benefits of exercise related to hand OA (Table 3). Some groups recommended range of motion/flexibility exercises [15,17,22], while others recommended quadriceps strengthening specifically [21], or endurance/strengthening exercises [15,17–20,29]. A combination of manual therapy (which can include massage and joint mobilization/manipulation, generally provided by physical/occupational therapists, osteopaths, and chiropractors) and exercise was recommended by several groups [14,15,21,25], although manual therapy alone was generally not

recommended [14,18]. Seven guidelines (OARSI, AAOS, ACR, NCC-CC, EULAR-knee, EULAR-hip, and MQIC) recommended weight loss for overweight persons with hip or knee OA; these were generally strong recommendations (only moderate for AAOS [18], and low-quality evidence cited by EULAR at the hip [23]).

Summary recommendations: Patients should be advised to engage in low-impact aerobic exercise (land or water based), and if overweight to lose weight; consideration can be given to range of motion/flexibility exercises, exercise in combination with manual therapy, endurance/strengthening exercises, and physical/occupational therapy referral.

Assistive devices, braces, and taping

There was a general lack of agreement among guidelines in this area (Table 4). Patellar taping was recommended in the ACR [14], Dutch physiotherapy [25], EULAR [20], and the older version of the AAOS guidelines [30], but was not addressed in the AAOS 2nd edition [18]. Knee braces (including unloader braces with varus or valgus force, as indicated for lateral or medial knee OA, respectively) were recommended by OARSI [29], NCC-CC [17], and EULAR [21], but received an inconclusive rating from AAOS [18] and were not specifically addressed in other guidelines. Recommendations for medial and lateral heel wedges were inconsistent across guidelines; recommendations for their use were given by the ACR [14], OARSI [29], EULAR [24], and SOFMER [26], but they

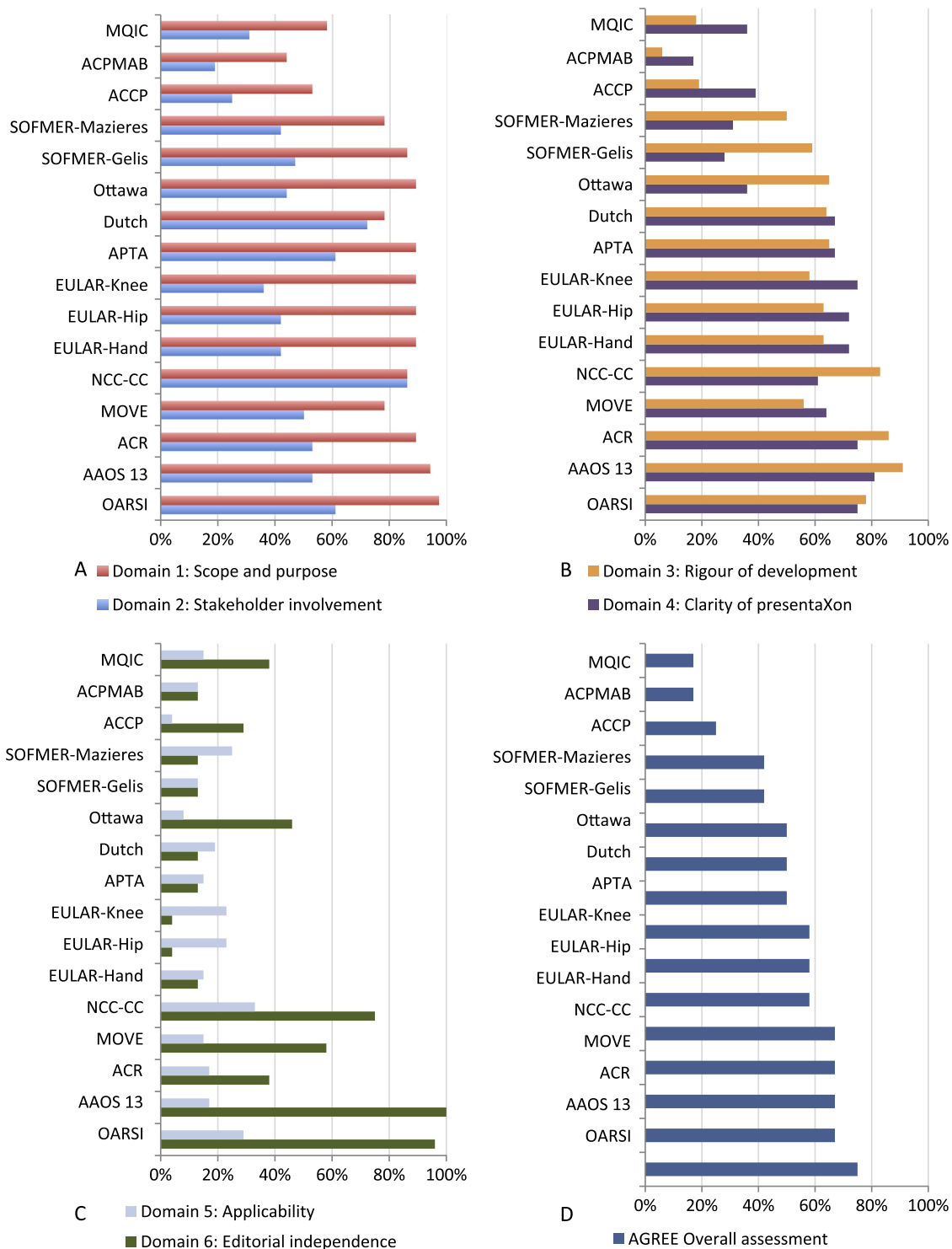


Fig. 2. Overall and domain scores for each guideline using the AGREE II Instrument. Legend: For each organization's guideline, each AGREE II domain score is shown on the x-axis as a percentage of 100, where 0 indicates the domain was not at all satisfied and 100% indicates it was fully satisfied. (www.agreetrust.org): (A) Domains 1 and 2; (B) domains 3 and 4; (C) domains 5 and 6; and (D) overall assessment.

were recommended against by the AAOS [18]. OARSI [29] and NCC-CC [21] guidelines included a recommendation for discussion of appropriate footwear and/or insoles. Walking aids (such as canes, crutches, and walkers) were generally recommended as needed for knee and hip OA [14,15,17,21,23,29]. Splints for trapeziometacarpal OA received weak recommendations from ACR [14] and EULAR [22]. Assistive devices other than walking aids were often recommended but not well-defined, although the NCC-CC specifically discussed reaching aids, elevation of chairs and beds,

and grab rails for lower extremity OA and enlarged grips and aids for opening jars for hand OA [21].

Summary recommendations: Walking aids and other assistive devices to improve activities of daily living are recommended for OA patients as needed. Based on current guidelines, there is inconclusive evidence for bracing or medial or lateral heel wedges for knee OA, and for splints for thumb base OA.

Table 2
Non-pharmacologic recommendations: Education and self-management

Organization*	Self-management and education	Regular contact to promote self-care	Joint protection	Evaluate ability to perform ADLs	Psychosocial interventions	Individualized treatment
OARSI	Ia (97)	Ia (66)				
AAOS	S					
ACR (hand)			CR	CR		
ACR (knee)	CR				CR	
ACR (hip)	CR				CR	
MOVE	A	A				D
NCC-CC	R	R		R		R
EULAR-hand			IV (59)			IV (84)
EULAR-hip	A (72)					C (92)
EULAR-knee	A	B				
APTA-OS	B (I, II)					
Dutch	2					
Ottawa						
SOFMER (Gelis)						
SOFMER (Mazieres)		C				C
ACCP						
ACPMAB	R					
MQIC	R		R			
Summary	R	R	R	R	I	R

* Grading systems described in Table 1.

Alternative and complementary modalities

Alternative and complementary therapies were also somewhat controversial (Table 5). Acupuncture, specifically for knee OA, was strongly not recommended by the AAOS [18] but was recommended by other groups [14,24,28,29]. Tai chi was recommended by the ACR [14] and the Asian consortium [28] but was not addressed in other guidelines. Thermal modalities were recommended by the ACR [14], OARSI [29], NCC-CC [21], and EULAR (for hand [22]). Transcutaneous electrical nerve stimulation (TENS) was recommended by some, primarily for patients who were not surgical candidates [14,21,24,29]. Therapeutic ultrasound was generally not supported [18,22,25].

Summary recommendations: Thermal modalities are recommended for hand, knee, and hip OA, therapeutic ultrasound is not recommended for use, and insufficient evidence currently exists to provide a general recommendation regarding acupuncture, Tai Chi, or TENS.

Surgical modalities

Six guidelines included surgical interventions (Table 6). Neither needle lavage nor arthroscopy with debridement were recommended for symptomatic knee OA by AAOS [18] or NCC-CC [21]; these modalities received limited support in older guidelines [24,29]. Limited/weak recommendations were also made for osteotomy or partial replacement for unicompartmental knee OA [18,24,29]. When discussed, joint replacement was generally recommended at the hip and knee [21,24,29].

Summary recommendations: Joint replacement is recommended for appropriate patients with knee or hip OA. Arthroscopy with debridement is not recommended for the management of symptomatic knee OA.

Pharmacologic management

Most guidelines (all but 5) also included recommendations for pharmacologic management (Table 7). Acetaminophen was consistently recommended as first-line pharmacologic management of OA, with the exception of the recent AAOS guidelines [18] where evidence was found to be inconclusive. Many guidelines

recommend topical NSAIDs as the next most appropriate agents, followed by oral NSAIDs. For patients with a high risk for gastrointestinal adverse events, gastroprotection, either in the form of a COX-2-specific medication or addition of a proton pump inhibitor or other gastroprotective agent, was commonly recommended. Other agents received some support, such as tramadol [14,17,18] and capsaicin [14,17,21,22,24,29]. Glucosamine and/or chondroitin were controversial, with positive recommendations from some organizations [22–24,29] and negative recommendations (recommended NOT to use) from others [14,15,18,21]. For refractory pain, opioids were generally recommended for hip and knee OA [14,17,21,23,24,29], but not for hand OA [14,22]. Duloxetine was recommended in the ACR guidelines [14] for refractory symptomatic knee OA but was not addressed by other groups, likely due to its relatively recent U.S. Food and Drug Administration approval. Diacerhein and avocado soybean unsaponifiables received some support [24] but were rarely discussed. The EULAR guidelines for knee OA also recommended antidepressants, sex hormones, herbal remedies, and vitamins, but little detail was given and these were not echoed in other guidelines [24].

Summary recommendations: Acetaminophen/paracetamol should be used as first-line therapy in symptomatic OA. Second-line agents should include topical agents (capsaicin and topical NSAIDs) and oral NSAIDs (with appropriate risk stratification and employment of gastroprotective strategies). For refractory symptoms, tramadol is recommended, and consideration can be given to opioids or possibly duloxetine.

Intra-articular corticosteroids were generally recommended for hip and knee OA [14,15,17,21,24,29], although this was not universal, as the AAOS recommendation was “inconclusive” [18] and EULAR recommended not using this modality for hip OA [23]. Specifically for hand OA, intra-articular corticosteroids were conditionally not recommended by the ACR [14] but were recommended by EULAR [22]. Intra-articular hyaluronic acid preparations were controversial, receiving recommendations (but of low strength) from OARSI, EULAR, and MQIC for hip and knee OA [17,23,24,29]; these agents were recommended not to be used by NCC-CC [21] and AAOS [18]. Intra-articular platelet-rich plasma or growth factor

Table 3

Non-pharmacologic recommendations: Exercise and weight loss

Organization*	Low-impact aerobic exercise	Range of motion/flexibility	Quadriceps strengthening	Supervised exercise with manual therapy	Balance	Manual therapy alone	Endurance/strengthening	Exercise after TJR	Consider PT/OT referral	Weight loss if overweight
OARSI	Ia knee; IV hip; Ib hip-water (96)						IV hip (96)		IV (89)	Ia (96)
AAOS	S			I		I	S			M
ACR (hand)										
ACR (knee)	SR			CR	NR	NR				SR
ACR (hip)	SR			CR						SR
MOVE	A (knee) C (hip)						D			
NCC-CC	R		R	R						R
EULAR-hand	IV (59)	IV (59)								
EULAR-hip	Inconclusive (72)									D (68)
EULAR-knee	A									B
APTA-OS		B (II)		B (I and IV)	C		B (II)			
Dutch	1			2				2		
Ottawa	A						A			
SOFMER (Gelis)										
SOFMER (Mazieres)	C									
ACCP										
ACPMAB										
MQJC	R	R					R		R	R
Summary	R	R	I	R	I	I	R	I	R	R

* Grading systems described in Table 1.

Table 4

Non-pharmacologic recommendations: Assistive devices

Organization*	Patellar taping	Brace with varus/valgus as indicated	Free-floating interpositional device for unicompartmental knee OA	Heel wedges (medial or lateral as indicated)	Assistive devices to improve ADLs	Walking aids as needed	Splints for trapeziometacarpal OA	Appropriate footwear/insoles
OARSI		Ia (76)		Ia (77)		IV (89–90)		I, IV (77)
AAOS		I	NR-C	NR-M				
ACR (hand)					CR		CR	
ACR (knee)	CR			CR		CR		
ACR (hip)						CR		
MOVE								
NCC-CC		R			R	R		R
EULAR-hand							IV (67)	
EULAR-hip						D (62)		
EULAR-knee	B	B		B				
APTA-OS					C	C		
Dutch	2							
Ottawa								
SOFMER				B				
(Gelis)								
SOFMER								
(Mazieres)								
ACCP								
ACPMAB								
MQJC					R	R		
Summary	I	I	I	I	R	R	I	R

* Grading systems described in Table 1.

Table 5
Non-pharmacologic recommendations: Alternative and complementary modalities

Organization ^a	Acupuncture	Tai Chi	Thermal modalities	TENS (if not surgical candidate)	Therapeutic ultrasound
OARSI	Ia (59)		Ia (64)	Ia (58)	
AAOS	NR-S			I	I
ACR (hand)			CR		
ACR (knee)	CR	CR	CR	CR	
ACR (hip)			CR		
MOVE					
NCC-CC			R	R	
EULAR-Hand			IV (77)		IV (25)
EULAR-Hip					
EULAR-knee	B			B	C
APTA-OS					
Dutch					NR (2)
Ottawa					
SOFMER (Gelis)					
SOFMER (Mazieres)					
ACCP					
ACPMAB	R	R			
MQIC					
Summary	I	I	R	I	NR

^a Grading systems described in Table 1.

injections were only considered by the AAOS and evidence was found to be inconclusive to make a recommendation [18].

Summary recommendations: Intra-articular corticosteroids are recommended for knee and hip OA; insufficient evidence currently exists to provide a general recommendation regarding intra-articular hyaluronans.

Discussion

In this systematic review, we summarize the current guidelines for OA management from several stakeholder organizations. Many of the recommendations are generally agreed upon and could be readily implemented in clinical practice for a variety of specialties providing care to OA patients. As the vast majority of OA care occurs in primary care settings, dissemination and implementation of OA management guidelines will need to be directed toward these providers for maximum impact. In a concurrent project, COAMI is reviewing outcome measures in OA, in hopes of providing a short list of relevant, valid measures to apply to the clinical management of OA patients. These two documents, in conjunction, will be used to inform clinical practice guidelines and algorithms to help streamline OA management for busy practitioners.

Although many guidelines for OA management exist with fundamentally comparable endorsements, the application of these recommendations in the clinical setting is suboptimal [7,8]. A French study evaluating self-reported physician adherence to the 2000 EULAR guidelines for knee OA management showed that 79% of physicians were aware of the guideline, and 97% or more of those agreed with the recommendations, but the percentage of physicians adhering to at least one pharmacologic and one non-pharmacologic recommendation was only 54% [31]. A Canadian study used chart review to assess adherence to recommendations based on 3 sets of guidelines; among non-pharmacologic modalities, exercise and weight loss were most often recommended (58% and 50%, respectively), while education was less often provided (29%) [32]. Pharmacologic recommendation adherence by providers was relatively high for acetaminophen (69%), followed by intra-articular corticosteroids (66%), and oral NSAIDs (51%) [32]. A more recent Canadian study assessed quality indicators of non-pharmacologic care in hip and knee OA by patient questionnaire and reported a pass rate of only 22% [33]. In a geriatric primary

care population in the U.S., Ganz et al. [34] reported a 57% overall pass rate for quality indicators assessed by patient interviews and questionnaires. These data suggest that there is not a lack of quality guidance in OA management, but rather poor uptake and utilization of the available evidence-based recommendations.

While many recommendations are agreed upon across different guidelines, some were conflicting. Acupuncture, for example, was recommended by ACR, EULAR, OARSI, and the Asian consortium, but was strongly recommended against by the AAOS, which cited “lack of efficacy” based on its review of the evidence. Glucosamine/chondroitin has long been a contentious issue in OA management, and the disagreements among guidelines are reflective of the conflicting evidence for these agents. Similarly, conflicting evidence for intra-articular hyaluronans has led to a lack of agreement among various organizations regarding use of these agents. Dissemination and implementation efforts should focus not on these more controversial recommendations, but rather on those with essentially universal agreement, such as those for education, exercise, and weight loss. Although guidelines differ in some specific recommendations regarding exercise (e.g., whether range of motion/flexibility and quadriceps strengthening exercises are specifically mentioned), there is strong agreement regarding the overall importance of physical activity for managing OA. Therefore, clinicians should emphasize and facilitate the adoption and maintenance of overall physical activity, particularly since most patients with OA are very inactive [35]. Overall guidelines for physical activity among adults [36] can serve as a basis for clinicians' recommendations, and community-based and other physical activity programs can provide more specific guidance and support for patients with OA.

A critical review of guidelines published or updated between 2001 and 2006, specifically focused on the management of knee OA, using the original AGREE instrument was published in 2007 [37]. This review identified 6 guidelines, including the EULAR 2003 guideline and AAOS 2000 guidelines mentioned here, but did not detail a systematic data extraction procedure. As in the current report, these authors also noted a general agreement among guidelines for most recommendations, and that the AGREE domain scores for scope and purpose and rigor of development tended to be higher, while other domains were not addressed as fully. In their conclusion, they state, “In order to improve applicability and to increase uptake by end users, stakeholder opinions and barriers in use need to be taken into account during guideline

Table 6
Non-pharmacologic recommendations: Surgical interventions

Organization*	Needle lavage	Arthroscopy with debridement	Arthroscopic partial meniscectomy	Osteotomy for isolated PFJ OA	Osteotomy/partial replacement for unicompartmental OA	Surgical repair of trapeziometacarpal OA	Osteotomy for hip OA	Joint replacement	Joint fusion in replacement failure
OARSI	Ib (60)	Ib (60)			Iib (75–76)			III (96)	IV (69)
AAOS	NR-M	NR-S	I		L				
ACR (hand)									
ACR (knee)									
ACR (hip)									
MOVE									
NCC-CC		NR	R					R	
EULAR-hand						III (68)			
EULAR-hip							C (60)	C (87) C	
EULAR-knee	B	C		C	C				
APTA-OS									
Dutch									
Ottawa									
SOFMER (Gelis)									
SOFMER (Mazieres)									
ACCP									
ACPMAB									
MQJC									
Summary	I	NR	I	I	I	I	I	R	I

* Grading systems described in Table 1.

development.” While still far from optimal, it does appear that the domains of the AGREE II instrument are more fully addressed in the more recent guidelines; hopefully this trend will continue and result in better-informed and more implementable guidelines in the future.

Guidelines are often updated, and OA guidelines are no exception. The AAOS guidelines were updated while we were conducting guideline assessments, with the most recent recommendations added to our review and discussed here. The OARSI guidelines are currently undergoing revision and are expected to be published in early 2014. In July 2013, after our review was completed but before the manuscript was finalized, EULAR released recommendations for the non-pharmacological core management of hip and knee osteoarthritis [38]. This updated set of recommendations includes many of the same features discussed in prior guidelines, such as assessment of activities of daily living, recommendations for individualized treatment plans including education, exercise, weight loss, and walking aids/assistive devices. Some more specific guidance is also given in several of these areas, for example for weight loss, suggestions include regular self-monitoring and monthly weights, a structured meal plan, reduced fat with guidance on portions, addressing eating behaviors, and nutrition education. The authors note a relatively poorer evidence base for hip OA, such that the efficacy of many interventions was assessed primarily for knee OA and extrapolated to hip OA; additionally, pain and physical function were most often the primary outcome, with few studies assessing other quality-of-life outcomes [38]. Hopefully, this type of guideline, which includes more specific guidance on actual implementation of the recommendations, will be more widely adopted by future guideline authors.

Despite its undeniable impact, in contrast to other chronic medical conditions such as diabetes and heart disease where screening and prevention are employed, OA is often not treated until late in the disease process. An earlier treatment strategy, or ideally a preventative one, could have a large impact on the ever-increasing burden of OA on individuals and society. Quoting from the COAMI call to action [9]: “As health care professionals, we should direct our efforts to treating OA more as the chronic disease it really is, rather than intervening once patients have significant pain or are disabled. This means asking patients about joint pain, mobility, and function before they bring it up, in whichever setting patients encounter members of their health care teams. Lifestyle changes that reduce excess weight and support physical activity are beneficial not only for the management of OA, but also can help reduce risks for diseases such as diabetes and heart disease.”

This review has several methodologic strengths but is not without limitations. We conducted a comprehensive search assisted by a librarian experienced in systematic reviews, but it was limited to one database (MEDLINE). There is a chance that our search may have missed some guidelines, however, in addition to our database search, we also conducted a hand search of the bibliographies of the included guidelines to capture others. We only searched English-language articles and so did not include any guidelines published in other languages. We anticipated challenges in summarizing recommendations across guidelines with differing descriptions of grades, and chose to generate summary recommendations. While these are based on the views of the authors, there was considerable agreement between authors (including a physician, a physical therapist, and an exercise physiologist/health services researcher) conducting this grading.

Future research should focus on dissemination and implementation of guidelines, including methods to operationalize the existing recommendations and increase uptake in target populations across specialties. While the majority of OA management occurs in primary care settings, there is also a role for assessments of joint health in subspecialty clinics such as cardiology, endocrinology,

Table 7
Pharmacologic recommendations

Organization ^a	Acetaminophen or paracetamol (< 4 g/day)	Oral NSAID	Topical NSAID	Glucosamine and/or chondroitin	Gastroprotection for high-risk patients ^b	Tramadol	Capsaicin	Opioids ^c	Duloxetine	Diacerhein	Avocado Soybean unsaponifiables	Intra-articular corticosteroids	Intra-articular hyaluronic acid
OARSI	Ia (knee) IV (hip) (92)	Ia (93)	Ia (85)	Ia (63)	Ia (93)		Ia (85)	Ia (82)				Ia knee, Ib hip (78)	Ia (64)
AAOS	I	S	S	NR-S		S		I				I	NR-S
ACR (hand)		CR ^e	CR		CR	CR	CR	CNR				CNR	
ACR (knee)	CR	CR ^e	CR	CNR		CR	CNR	SR	CR [§]			CR	
ACR (hip)	CR	CR ^e		CNR		CR		SR				CR	
MOVE													
NCC-CC	R	R	R	NR	R		R	R				R	NR
EULAR-hand	IV (87)	Ia (81)	Ia (75)	Ib (63)	Ia (81)		Ia (75)			IV (63)	IV (63)	Ib (60)	IIb (63)
EULAR-hip	A (79)	A (79)		A (34–37)	A (31–79)			A (44)		^d (28)	NR (32)	NR (41)	C (23)
EULAR-knee	A	A	A	A	A		A	B		B	B	A	B
APTA-OS		R (I)		NR (I)								R (I)	
Dutch													
Ottawa													
SOFMER													
(Gelis)													
SOFMER													
(Mazieres)													
ACCP	R	R ^e			R								
ACPMAB		R			R								
MQJC	R	R			R	R	R	R				R	R
Summary	R	R	R	I	R	R	R	R	I	I	I	R	I

^a Grading systems described in Table 1.

^b COX-2, topical over oral NSAID, or add PPI or other agent.

^c For cases refractory to other modalities.

^d Inconclusive.

^e After acetaminophen.

pulmonology, physical medicine and rehabilitation, and geriatrics, where OA can impact function, quality of life, and patients' ability to adhere to treatment recommendations for other chronic conditions. Successful dissemination and implementation efforts will require input from clinicians in each of these areas, OA patients, and administrative and policy experts who can offer perspective regarding logistical and cost-related issues and barriers.

Conclusions

There is essential agreement on many recommendations for OA management across multiple societies making such recommendations. There is not a lack of quality guidelines, but rather a deficit in dissemination and implementation of the recommendations. Future efforts should focus on optimizing implementation in primary care settings, where the majority of OA care occurs, and in other specialty clinics where many individuals are likely to have OA.

Contributions

Conception and design: A.E.N. and J.M.J.; acquisition/analysis/interpretation of data: A.E.N., K.D.A., Y.M.G., A.P.G., and J.M.J. Drafting the article: A.E.N.; critical revisions for important intellectual content: A.E.N., K.D.A., Y.M.G., A.P.G., and J.M.J. Final approval of the submitted version: A.E.N., K.D.A., Y.M.G., A.P.G., and J.M.J.

Conflict of interest

A.E.N.: Has received research grants from NIH/NIAMS and the Rheumatology Research Foundation, serves on committees for ACR and OARSI, is on the Editorial Board for *Osteoarthritis and Cartilage*, and for *Chronic OA Management*, a CME publication by Vindico Medical Education; she also receives royalties from Health Press Limited for *Fast Facts: Osteoarthritis*, 2nd Edition.

K.D.A.: Has received research grants from NIH/NIAMS and NIA, the Rheumatology Research Foundation, Department of Veterans Affairs Health Services Research and Development & Rehabilitation Research & Development, and Informed Medical Decision Making Foundation; and serves on Association of Rheumatology Health Professionals (ARHP) and OARSI committees, and the editorial boards of *Osteoarthritis and Cartilage* and *Arthritis Care and Research*, as well as *Annals of Pharmacotherapy* and is an associate editor for *Trials*.

Y.M.G.: Has received research grants from NIH/NCATS and the Arthritis Foundation, serves on committees for ACR/ARHP, and is on the Editorial Board for *Osteoarthritis and Cartilage*.

A.P.G.: Has received research awards from NIAMS and the Agency for Healthcare Research and Quality, the Foundation for Physical Therapy, and serves on committees for the ARHP.

J.M.J.: Has received research grants from NIH/NIAMS and NIEHS, the Centers for Disease Control and Prevention, Associated Schools of Public Health, and Johnson & Johnson, is on the Board of Directors for OARSI, a deputy editor of *Osteoarthritis and Cartilage*, and serves on the Communications and Marketing committee for the ACR; she is also a consultant for Eli Lilly, Samumed, Trinity Partners, and Johnson & Johnson.

None of the authors was involved in the development of any of the guidelines considered in the manuscript.

Acknowledgments

We would like to acknowledge the efforts of Adam Doré, DO, and Holly R. Thompson, BA, SPT, for performing the initial data extractions.

References

- [1] Centers for Disease Control and Prevention. Prevalence and most common causes of disability among adults—United States, 2005. *MMWR Morb Mortal Wkly Rep* 2009;58:421–6.
- [2] United States Bone and Joint Initiative. The Burden of Musculoskeletal Diseases in the United States. 2nd ed. Rosemont, IL: American Academy of Orthopaedic Surgeons; 2011.
- [3] Lawrence RC, Felson DT, Helmick CG, Arnold LM, Choi H, Deyo RA, et al. Estimates of the prevalence of arthritis and other rheumatic conditions in the United States. *Arthritis Rheum* 2008;58:26–35.
- [4] Hunter DJ, Neogi T, Hochberg MC. Quality of osteoarthritis management and the need for reform in the US. *Arthritis Care Res* 2011;63:31–8.
- [5] Pearson WS, Bhat-Schelbert K, Probst JC. Multiple chronic conditions and the aging of America: challenge for primary care physicians. *J Prim Care Community Health* 2012;3:51–6.
- [6] Gadermann AM, Alonso J, Vilagut G, Zaslavsky AM, Kessler RC. Comorbidity and disease burden in the National Comorbidity Survey Replication (NCS-R). *Depress Anxiety* 2012;29:797–806.
- [7] Hunter DJ. Quality of osteoarthritis care for community-dwelling older adults. *Clin Geriatr Med* 2010;26:401–17.
- [8] Brand CA, Ackerman IN, Bohensky MA, Bennell KL. Chronic disease management: a review of current performance across quality of care domains and opportunities for improving osteoarthritis care. *Rheum Dis Clin North Am* 2013;39:123–43.
- [9] Chronic Osteoarthritis Management Initiative (COAMI). A New Vision for Chronic Osteoarthritis Management. In: U.S. Bone and Joint Initiative Ed. 2012 at <http://www.usbjd.org/projects/files/06a.COAMICTAFinal.pdf>.
- [10] Brosseau L, Wells GA, Tugwell P, Egan M, Dubouloz C, Casimiro L, et al. Ottawa panel evidence-based clinical practice guidelines for the management of osteoarthritis in adults who are obese or overweight. *Phys Ther* 2011;91:843–61.
- [11] Brosseau L, Wells GA, Tugwell P, Egan M, Dubouloz C, Casimiro L, et al. Ottawa panel evidence-based clinical practice guidelines for therapeutic exercises and manual therapy in the management of osteoarthritis. *Phys Ther* 2005;85:907–71.
- [12] Brouwers MC, Kho ME, Browman GP, Burgers JS, Cluzeau F, Feder G, et al. Development of the AGREE II, part 1: performance, usefulness and areas for improvement. *Can Med Assoc J* 2010;182:1045–52.
- [13] Brouwers MC, Kho ME, Browman GP, Burgers JS, Cluzeau F, Feder G, et al. Development of the AGREE II, part 2: assessment of validity of items and tools to support application. *Can Med Assoc J* 2010;182:E472–8.
- [14] Hochberg MC, Altman RD, April KT, Benkhalti M, Guyatt G, McGowan J, et al. American College of Rheumatology 2012 recommendations for the use of nonpharmacologic and pharmacologic therapies in osteoarthritis of the hand, hip, and knee. *Arthritis Care Res* 2012;64:465–74.
- [15] Cibulka MT, White DM, Woehrle J, Harris-Hayes M, Enseki K, Fagerson TL, et al. Hip pain and mobility deficits—hip osteoarthritis: clinical practice guidelines linked to the international classification of functioning, disability, and health from the orthopaedic section of the American Physical Therapy Association. *J Orthop Sports Phys Ther* 2009;39:A1–25.
- [16] Herndon CM, Hutchison RW, Berdine HJ, Stacy ZA, Chen JT, Farnsworth DD, et al. Management of chronic nonmalignant pain with nonsteroidal antiinflammatory drugs. Joint opinion statement of the ambulatory care, cardiology, and pain and palliative care practice and research networks of the American College of Clinical Pharmacy. *Pharmacotherapy* 2008;28:788–805.
- [17] MQIC. Medical management of adults with osteoarthritis. In: Southfield, MI: Michigan Quality Improvement Consortium 2011:1.
- [18] American Academy of Orthopaedic Surgeons. Treatment of Osteoarthritis of the Knee. 2nd ed Rosemont, IL: American Academy of Orthopaedic Surgeons; 2013.
- [19] Loew L, Brosseau L, Wells GA, Tugwell P, Kenny GP, Reid R, et al. Ottawa panel evidence-based clinical practice guidelines for aerobic walking programs in the management of osteoarthritis. *Arch Phys Med Rehabil* 2012;93:1269–85.
- [20] Roddy E, Zhang W, Doherty M, Arden NK, Barlow J, Birrell F, et al. Evidence-based recommendations for the role of exercise in the management of osteoarthritis of the hip or knee—the MOVE consensus. *Rheumatology (Oxford)* 2005;44:67–73.
- [21] The National Collaborating Centre for Chronic Conditions. Osteoarthritis: National Clinical Guideline for Care and Management in Adults. London, UK: Royal College of Physicians; 2008 [319].
- [22] Zhang W, Doherty M, Leeb BF, Alekseeva L, Arden NK, Bijlsma JW, et al. EULAR evidence based recommendations for the management of hand osteoarthritis: report of a Task Force of the EULAR Standing Committee for International Clinical Studies Including Therapeutics (ESCISIT). *Ann Rheum Dis* 2007;66:377–88.
- [23] Zhang W, Doherty M, Arden N, Bannwarth B, Bijlsma J, Gunther KP, et al. EULAR evidence based recommendations for the management of hip osteoarthritis: report of a task force of the EULAR Standing Committee for International Clinical Studies Including Therapeutics (ESCISIT). *Ann Rheum Dis* 2005;64:669–81.
- [24] Jordan KM, Arden NK, Doherty M, Bannwarth B, Bijlsma JW, Dieppe P, et al. EULAR Recommendations 2003: an evidence based approach to the management of knee osteoarthritis: Report of a Task Force of the Standing Committee for International Clinical Studies Including Therapeutic Trials (ESCISIT). *Ann Rheum Dis* 2003;62:1145–55.
- [25] Peter WF, Jansen MJ, Hurkmans EJ, Bloo H, Dekker J, Dilling RG, et al. Physiotherapy in hip and knee osteoarthritis: development of a practice

- guideline concerning initial assessment, treatment and evaluation. *Acta Reumatol Port* 2011;36:268–81.
- [26] Gelis A, Coudeyre E, Hudry C, Pelissier J, Revel M, Rannou F. Is there an evidence-based efficacy for the use of foot orthotics in knee and hip osteoarthritis? Elaboration of French clinical practice guidelines *Joint Bone Spine* 2008;75:714–20.
- [27] Mazieres B, Thevenon A, Coudeyre E, Chevalier X, Revel M, Rannou F. Adherence to, and results of, physical therapy programs in patients with hip or knee osteoarthritis. Development of French clinical practice guidelines. *Joint Bone Spine* 2008;75:589–96.
- [28] Pongparadee C, Penserga E, Lee DJ, Chen SL, Gill RS, Hamid A, et al. Current considerations for the management of musculoskeletal pain in Asian countries: a special focus on cyclooxygenase-2 inhibitors and non-steroid anti-inflammation drugs. *Int J Rheum Dis* 2012;15:341–7.
- [29] Zhang W, Moskowitz RW, Nuki G, Abramson S, Altman RD, Arden N, et al. OARSI recommendations for the management of hip and knee osteoarthritis, part II: OARSI evidence-based, expert consensus guidelines. *Osteoarthritis Cartilage* 2008;16:137–62.
- [30] American Academy of Orthopaedic Surgeons. American Academy of Orthopaedic Surgeons Clinical Practice Guideline on the Treatment of Osteoarthritis of the Knee (Non-Arthroplasty). AAOS; 2008.
- [31] Denoel L, Mazieres B, Payen-Champenois C, Ravaud P. First line treatment of knee osteoarthritis in outpatients in France: adherence to the EULAR 2000 recommendations and factors influencing adherence. *Ann Rheum Dis* 2005;64: 70–74.
- [32] DeHaan MN, Guzman J, Bayley MT, Bell MJ. Knee osteoarthritis clinical practice guidelines—how are we doing? *J Rheumatol* 2007;34:2099–105.
- [33] Li LC, Sayre EC, Kopec JA, Esdaile JM, Bar S, Cibere J. Quality of nonpharmacological care in the community for people with knee and hip osteoarthritis. *J Rheumatol* 2011;38:2230–7.
- [34] Ganz DA, Chang JT, Roth CP, Guan M, Kamberg CJ, Niu F, et al. Quality of osteoarthritis care for community-dwelling older adults. *Arthritis Rheum* 2006;55:241–7.
- [35] Song J, Hochberg MC, Chang RW, Hootman JM, Manheim LM, Lee J, et al. Racial and ethnic differences in physical activity guidelines attainment among people at high risk of or having knee osteoarthritis. *Arthritis Care Res* 2013;65:195–202.
- [36] U.S. Department of Health and Human Services. Physical activity guidelines for Americans. In: <http://www.health.gov/paguidelines>; 2008:76.
- [37] Poitras S, Avouac J, Rossignol M, Avouac B, Cedraschi C, Nordin M, et al. A critical appraisal of guidelines for the management of knee osteoarthritis using appraisal of guidelines research and evaluation criteria. *Arthritis Res Ther* 2007;9:R126.
- [38] Fernandes L, Hagen KB, Bijlsma JW, Andreassen O, Christensen P, Conaghan PG, et al. EULAR recommendations for the non-pharmacological core management of hip and knee osteoarthritis. *Ann Rheum Dis* 2013;72:1125–35.