QUERI

Evidence Brief: Effectiveness of Models Used to Deliver Multimodal Care for Chronic Musculoskeletal Pain

January 2017

Prepared for:
Department of Veterans Affairs
Veterans Health Administration
Quality Enhancement Research Initiative
Health Services Research & Development Service
Washington, DC 20420

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PREFACE

The VA Evidence-based Synthesis Program (ESP) was established in 2007 to provide timely and accurate syntheses of targeted healthcare topics of particular importance to clinicians, managers, and policymakers as they work to improve the health and healthcare of Veterans. QUERI provides funding for four ESP Centers, and each Center has an active University affiliation. Center Directors are recognized leaders in the field of evidence synthesis with close ties to the AHRQ Evidence-based Practice Centers. The ESP is governed by a Steering Committee comprised of participants from VHA Policy, Program, and Operations Offices, VISN leadership, field-based investigators, and others as designated appropriate by QUERI/HSR&D.

The ESP Centers generate evidence syntheses on important clinical practice topics. These reports help:

- Develop clinical policies informed by evidence;
- Implement effective services to improve patient outcomes and to support VA clinical practice guidelines and performance measures; and
- Set the direction for future research to address gaps in clinical knowledge.

The ESP disseminates these reports throughout VA and in the published literature; some evidence syntheses have informed the clinical guidelines of large professional organizations.

The ESP Coordinating Center (ESP CC), located in Portland, Oregon, was created in 2009 to expand the capacity of QUERI/HSR&D and is charged with oversight of national ESP program operations, program development and evaluation, and dissemination efforts. The ESP CC establishes standard operating procedures for the production of evidence synthesis reports; facilitates a national topic nomination, prioritization, and selection process; manages the research portfolio of each Center; facilitates editorial review processes; ensures methodological consistency and quality of products; produces “rapid response evidence briefs” at the request of VHA senior leadership; collaborates with HSR&D Center for Information Dissemination and Education Resources (CIDER) to develop a national dissemination strategy for all ESP products; and interfaces with stakeholders to effectively engage the program.

Comments on this evidence report are welcome and can be sent to Nicole Floyd, ESP CC Program Manager, at Nicole.Floyd@va.gov.

Recommended citation: Peterson K, Anderson J, Bourne D, Erickson K, Mackey K, Helfand M. Evidence Brief: Effectiveness of Models Used to Deliver Multimodal Care for Chronic Musculoskeletal Pain. VA ESP Project #09-199; 2017.

This report is based on research conducted by the Evidence-based Synthesis Program (ESP) Coordinating Center located at the **Portland VA Health Care System, Portland, OR**, funded by the Department of Veterans Affairs, Veterans Health Administration, Office of Research and Development, Quality Enhancement Research Initiative. The findings and conclusions in this document are those of the author(s) who are responsible for its contents; the findings and conclusions do not necessarily represent the views of the Department of Veterans Affairs or the United States government. Therefore, no statement in this article should be construed as an official position of the Department of Veterans Affairs. No investigators have any affiliations or financial involvement (*eg*, employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties) that conflict with material presented in the report.

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EXECUTIVE SUMMARY

In Veterans, chronic pain may occur in up to 50% of those treated in primary care, and severe pain is more prevalent than in the general population. Chronic pain is a major public health challenge that is associated with serious physical and psychosocial impairment which costs the United States approximately $635 billion annually. Pain is a complex condition involving dynamic interactions between biological, psychological, and social factors unique to each individual. For this reason, pain care needs to be individually tailored, involving multiple care approaches and collaboration between primary and specialty care clinicians. Pain management guidelines, including those for the VHA, advocate for multimodal pain care. The VHA National Pain Management Strategy utilizes a stepped care model of pain management involving primary care and patient aligned care teams (PACTs), secondary consultation, and tertiary interdisciplinary pain centers. However, barriers to effective implementation of guideline-concordant care still exist, including: limitations in service accessibility; provider time constraints leading to fragmentation of the care process; complexity of treatment decisions due to variability in patients' pain characteristics and multimorbidities; variability in patient education, activation, expectations, suspicion, and mistrust; provider training and burnout; and reimbursement limitations. Thus, there is a need to identify effective models of chronic pain care with system-based interventions aiming to improve the delivery of multimodal care.

Our objectives were to determine what multimodal care delivery models relieve chronic musculoskeletal pain and minimize unintended consequences, define key elements of and the resources required for these models, and identify patients who are most likely to benefit from these models.

Background

The ESP Coordinating Center (ESP CC) is responding to a request from HSR&D for an evidence brief on the effectiveness of models used to deliver multimodal care for treating chronic musculoskeletal pain. Findings from an interim report were used to inform a November 2016 state-of-the-art (SOTA) conference and this expanded evidence brief will inform subsequent prioritization of clinical and research implementation objectives.

Methods

To identify studies, we searched MEDLINE® and CINAHL through October 2016, and other sources. We used prespecified criteria for study selection, data abstraction, and rating internal validity and strength of the evidence. See our PROSPERO protocol for our full methods.

This review found that 5 models coupling decision support —most commonly algorithm-guided treatment and/or stepped care — with proactive ongoing treatment monitoring have the best evidence from good-quality RCTs of providing clinically relevant improvement in pain intensity and pain-related function over 9 to 12 months (NNT range, 4.1 to 12.70), as well as variable improvement in other important core outcomes (Executive Summary Table). The strength of the evidence is generally low, however, as each intervention is only supported by a single study with imprecise findings. Findings from ESCAPE, SEACAP, SCAMP, and SCOPE are the most applicable to Veterans because they were studied in VAMC settings. We were unable to determine the patients who are most likely to benefit from these models due to under-reporting of key patient characteristics such as pain duration, opioid use at baseline and prevalence of common medical and mental health comorbidities. It is reasonable to consider wider implementation of one or more of these models across multiple VAMCs, with a clear plan for further evidence development to address shortcomings of previous research: (1) better characterization of patients' pain duration, opioid use at baseline, prevalence of common medical and mental health comorbidities, co-interventions, and usual care; (2) more rigorous

evaluation of model fidelity; (3) assessment of a broader range of clinically-relevant core outcomes per IMMPACT recommendations; (4) longer-term follow-up; and (5) inclusion of potentially underserved populations, such as rural settings and racial/ethnic minorities.

Executive Summary Table: Summary of Findings

Intervention major components Best evidence quality, design, follow-up duration, and sample size	**Clinically significant* improvement in: Pain Intensity or Pain-related Function (Intervention vs Control)**	**Statistically significant (P ≤ 0.05) improvement in other outcome**
Computer-based assessment; telephone-based nurse-educator. 1 fair, 12m RCT[1] of N=1066.	NR	QOL
Group multidisciplinary education sessions. 1 poor, 6m RCT[2] of N=63.	NR	QOL
ESCAPE: Stepped care with analgesics and CBT, NCM. 1 good, 9m RCT[3] of N=241.	RMDQ: RR=1.52 (95% CI 1.22 to 1.99); NNT=7.5	NR
Risk stratification, 5-hr weekly multidisciplinary sessions in rural setting. 1 poor, 18m RCT[4] of N=1905.	NR	NR
SEACAP: Collaborative care delivered by psychologist care manager. 1 good-quality, 12m RCT[5] of N=401.	RMDQ: 21.9% vs 14.0%, P=0.04 NNT=12.70 (95% CI 12.48 to 12.74)	Depression
Pharmacist-led pharmacological treatment optimization. 1 fair, 12m RCT[6] of N=325.	OMERACT-OARSI response as high improvement: 27% vs 28%; P=0.3	Depression, anxiety
STarT Back: Prognostic screening with matched pathways. 1 fair, 12m RCT[7] of N=1573.	RMDQ: 65% vs 57%; OR=1.48 (95% CI 1.02 to 2.15); NNT=10.8 (95% CI 5.8 to 206)	QOL, depression
SCAMP: Stepped care with antidepressants and self-management delivered by a NCM. 1 good, 12m RCT[8] of N=250.	BPI: 41.5% vs 17.3%; RR=2.4 (95% CI 1.6 to 3.2); NNT=4.1 (95% CI 3.0 to 6.5)	QOL, depression, anxiety
SCOPE: Telecare collaborative management; algorithm-guided analgesic optimization; 1 good, 12m RCT[9] of N=250.	BPI: 51.7% vs 27.1%; RR=1.9 (95% CI 1.4 to 2.7); NNT=4.1 (95% CI 3.0 to 6.4)	QOL, depression, sleep

*Patients with ≥ 30% reductions in pain and pain-related function unless otherwise noted
Abbreviations: m = month; RCT= randomized controlled trial; NR= not reported; QOL= quality of life; CBT = Cognitive Behavioral Therapy; NCM = nurse care managers; RMDQ = Roland-Morris Disability Questionnaire; NNT = Number Needed to Treat; OMERACT-OARSI = Outcome Measures in Rheumatology-Osteoarthritis Research Society International; OR= odds ratio; BPI = Brief Pain Inventory; RR= risk ratio; ESCAPE = Evaluation of Stepped Care for Chronic Pain; SEACAP = Study of the Effectiveness of A Collaborative Approach to Pain; STarT Back = stratified primary care management for low back pain ;SCAMP = Stepped Care for Affective Disorders and Musculoskeletal Pain; SCOPE = Stepped Care to Optimize Pain Care Effectiveness

EVIDENCE BRIEF

INTRODUCTION

PURPOSE

The ESP Coordinating Center (ESP CC) is responding to a request from HSR&D for an evidence brief on the effectiveness of models used to deliver multimodal care for treating chronic musculoskeletal pain. Findings from this evidence brief were used to inform a November 2016 state-of-the-art (SOTA) conference and subsequent clinical and research prioritization processes.

BACKGROUND

Chronic pain is typically defined as pain lasting more than a few months,[10] although many patients experience pain for years or even decades.[4,5] Chronic musculoskeletal pain is a major — and growing[11] — burden on today's Veteran population. Nearly 50% of Veterans receiving primary care endorse regular pain and have concerns about their pain.[12] Studies of Operation Enduring Freedom/Operation Iraqi Freedom/Operation New Dawn (OEF/OIF/OND) Veterans show that diseases of the musculoskeletal system are the most frequent diagnoses in cumulative reports of inpatient and outpatient encounters, even surpassing mental health conditions.[13-15] Severe pain is more common in Veterans than in the general population.[16] And this burden will grow; the prevalence of painful musculoskeletal conditions among Veterans increases each year after deployment.[11]

A nationally representative survey of the US population estimated that 31% of adults report chronic pain when defined as pain lasting for at least 6 months, and that people over the age of 50 are twice as likely to have been diagnosed with chronic pain when compared to people who are younger.[17] A 2011 report from the Institute of Medicine estimated that 100 million US adults suffer from chronic pain and that the total costs of their care due to medical treatment and lost productivity (*ie*, work days missed, number of annual hours worked, and hourly wages) are estimated at $560 to $635 billion per year, of which $261 to $300 billion are direct healthcare costs.[18]

Chronic pain is a complex condition involving dynamic interactions between biological, psychological, and social factors unique to each individual.[3] Patients often have other comorbidities such as obesity, and are at increased risk for depression, PTSD, and suicide.[19-22] Another complicating factor is that patients may have variable degrees of baseline self-management skills and may or may not be motivated or know how to address their pain outside of medication use.[23]

To address this complexity, some pain management guidelines, including those for the VHA, recommend multimodal pain care,[18,24-26] which is typically defined as the use of more than one type of therapy and can include more than one discipline when available (‘multidisciplinary’). Common modalities include self-management, complementary and integrative health, pharmacological, psychological, physical or restorative therapy, procedural treatments, etcetera. The VHA National Pain Management Strategy recommends a stepped care model of pain management that emphasizes low-intensity interventions as “first step” or “tiers,” followed by

the introduction of more intensive, multimodal, and multidisciplinary interventions as needed to maximize benefit.

Primary care providers (PCPs) are responsible for the majority of pain management.[27] However, PCPs face many system- and patient-level challenges in providing the recommended multimodal interventions.[18,27,28] In their 2011 'Blueprint for Transforming Prevention, Care, Education and Research', the Institute of Medicine's Committee on Advancing Pain Research, Care and Education found that reimbursement limitations and short primary care visits often provide inadequate time and resources for complex treatment planning and coordination of multimodal care, monitoring, and patient education and activation activities.[17] PCPs cited variability in patients' duration of pain (years to decades), their stage of disease at presentation to primary care, and the presence of mental and physical comorbidities as factors that add to the complexity of care management.[29] With other competing demands and, in some cases, uncertainty about the evidence base supporting multimodal interventions, PCPs cited "no forum to discuss challenging patients with specialists on a regular basis" as a system-level barrier.[29] PCPs also reported that chronic pain patients require more visits and non-visit work to monitor and adjust management strategies.[29] At the patient level, variable levels of patient education, activation, and expectations may present challenges to providers' attempts to promote nonpharmacological treatments and goals of improved function and quality of life. Access to multimodal interventions may also vary by clinical location and provider preference and practice patterns.[18,28] Further challenges identified by PCPs include controversies surrounding use of opioids, patient-provider relationship difficulties, and provider burn-out.[27]

A recent Patient-Centered Outcomes Research Institute (PCORI) multi-stakeholder workgroup suggested that systems interventions are needed to support PCPs and provide better tools for managing chronic pain.[28] Several strategies exist to address the challenges PCPs face in delivering more effective pain care, informed by experiences in pain management as well as chronic illness management in general. One of the most common approaches used in a variety of clinical areas is to add care coordination mechanisms to reduce the time burden on the primary provider required for organization of care and for frequent and longitudinal proactive monitoring and adjustment. Strong evidence supports short-term benefits of care management for depression, a similarly complex condition often managed in primary care.[30] Second, to enhance PCP education and improve difficult decision-making, potential decision-support mechanisms may include supporting collaboration between pain specialists and PCPs, with a pain specialist serving as a resource for PCPs,[18] risk triage, and use of stepped care algorithms. Third, developing and embedding into primary care more evidence-based patient education and activation processes[18] may improve patients' adherence and perspectives on acceptable outcomes and the patient-provider relationship. Finally, increasing access to multidisciplinary care to underserved areas, such as rural settings, and/or better integrating into primary care, would empower PCPs to refer patients for recommended multimodal care.

Completed and ongoing research is accumulating that evaluates various combinations of these strategies for improving the delivery of multimodal pain care in primary care settings. Our objectives were to determine which multimodal care delivery models relieve chronic musculoskeletal pain and minimize unintended consequences, define key elements of and the resources required for these models, and identify patients who are most likely to benefit from these models.

ELIGIBILITY CRITERIA

The ESP included studies that met the following criteria:

- ***P****opulation:* Adults with chronic musculoskeletal pain (persistent for 3 months or longer)
  - Potential effect modifiers of interest include (1) the specific location and/or type of pain; (2) patient demographics (*eg*, age, race, ethnicity, and gender); (3) patient comorbidities (including past or current alcohol or substance use disorders, mental health disorders, medical comorbidities, and those at high risk for substance use disorders)
- ***I****ntervention*: Any model with system-based mechanisms aiming to increase the uptake and organization of multimodal care (*eg*, collaborative care, care management, integrated care, telecare, peer-delivered care, informal caregiving, stepped care models, and algorithms)
- ***C****omparator*: Any
- ***O****utcomes:*
  - Effectiveness: Percentages of patients obtaining reductions in pain intensity and pain-related function from baseline of at least 30% or 50%,[31] quality of life, depression, anxiety, sleep, and opioid doses.
  - Unintended consequences: Adverse effects on patient satisfaction, provider satisfaction, time burden, sustainability
- ***T****iming:* Any study follow-up durations
- ***S****etting*: Integrated within primary care; not to include interventions occurring entirely within intensive pain rehabilitation, specialty, or tertiary care
- ***S****tudy design:* Systematic reviews, randomized controlled trials, or concurrently-controlled cohort studies

METHODS

To identify relevant articles, we searched MEDLINE® (Ovid) and CINAHL using terms for chronic pain and multimodal care through October 2016. Additional sources searched were Agency for Healthcare Research and Quality (AHRQ), Canadian Agency for Drugs and Technologies in Health (CADTH), Cochrane Database of Systematic Reviews, ECRI Institute, Health Technology Assessments (HTA), National Institute for Health and Care Excellence (NICE) Guidance and Evidence Services, National Library of Medicine, CADTH Grey Matters, Conference Papers Index, The New York Academy of Medicine's Grey Literature Report, National Institutes of Health (NIH) ClinicalTrials.gov, Clinical Trial Results, World Health Organization (WHO) International Clinical Trials Registry Platform, Research Portfolio Online Reporting Tools (RePORT), National Repository of Grey Literature (NRGL), OpenGrey, Turning Research Into Practice (TRIP), metaRegister of Controlled Trials (mRCT), Scopus, Google Scholar, Google, American Pain Society, University of Southern California Pain Center, Patient-Centered Outcomes Research Institute (PCORI), American Academy of Pain Management, VA HSR&D publications, Australian Government Department of Veterans'Affairs' Medicines Advice and Therapeutics Education Services (Veterans' MATES), American Chronic Pain Association, The Pain Community, University of New Mexico, UK's National Back Pain Association's Backcare, Pain Association Scotland, and University of New Mexico Project TeleECHO (ECHO Pain). See Appendix A in the supplemental materials for complete search strategies. Additional citations were identified from hand-searching reference lists and consultation with content experts. We limited the search to articles involving human subjects available in the English language. Study selection was based on the eligibility criteria described above. Titles and abstracts and full-text articles were reviewed by one investigator and checked by a second investigator. All disagreements were resolved by consensus.
We used predefined criteria to rate the internal validity of all studies. For controlled trials, we used the Drug Effectiveness Review Project methods.[32] For cohort studies, we used Cochrane's Risk of Bias Tool.[33-35] We abstracted data from all included studies and results for each included outcome. All data abstraction and internal validity ratings were first completed by one reviewer and then checked by another. All disagreements were resolved by consensus.

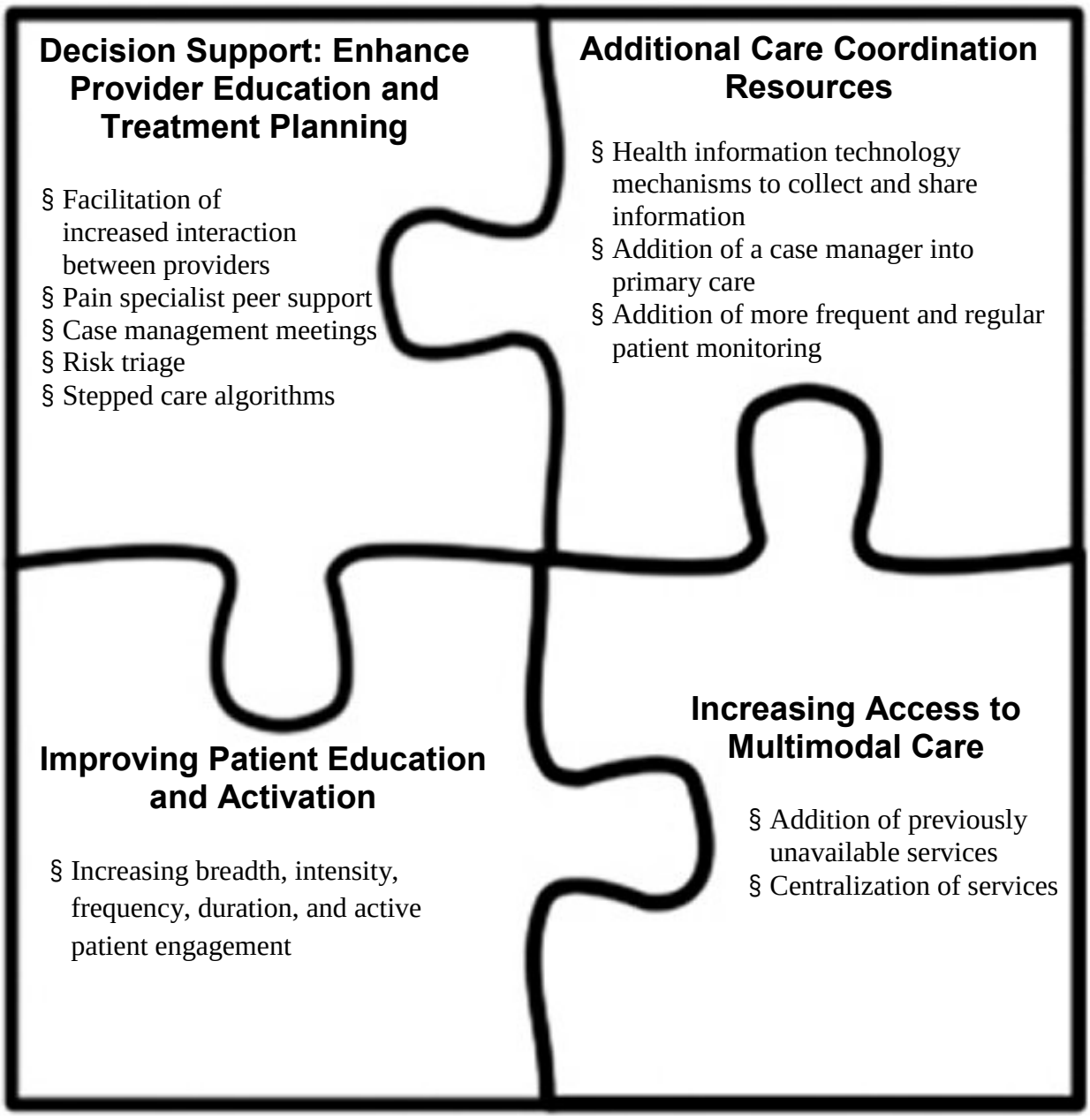
We graded the strength of the evidence based on the AHRQ Methods Guide for Comparative Effectiveness Reviews.[36] This approach incorporates 5 key domains: risk of bias (includes study design and aggregate quality), consistency, directness, precision of the evidence, and reporting biases. Ratings range from high to insufficient, reflecting our confidence that the evidence reflects the true effect. Strength of evidence ratings were first completed by one reviewer and then checked by another, and we resolved disagreements using consensus.

Models of multimodal chronic pain care differ substantially in the types of systems interventions they used to promote guideline-concordant multimodal chronic pain management in the primary care setting, and components of each intervention had varying breadth, intensity, frequency, and duration. This type of heterogeneity is often characteristic of complex multicomponent interventions and can be a challenge to constructing a framework for organizing the evidence synthesis. This is because interventions can be conceptually lumped or split by various types of characteristics and there is no agreed-upon single best approach for doing so.[37] Figure 1 illustrates how we classified the interventions into 4 categories based on the most common ways that the models attempted to change primary care processes regarding chronic pain management.

A draft version of this report was reviewed by peer reviewers as well as clinical leadership. Their comments and our responses are presented in the Supplemental Materials.

The complete description of our full methods can be found on the PROSPERO international prospective register of systematic reviews (http://www.crd.york.ac.uk/PROSPERO/; registration number CRD42016050272).

Figure 1. Four Categories of Most Common System Intervention Components



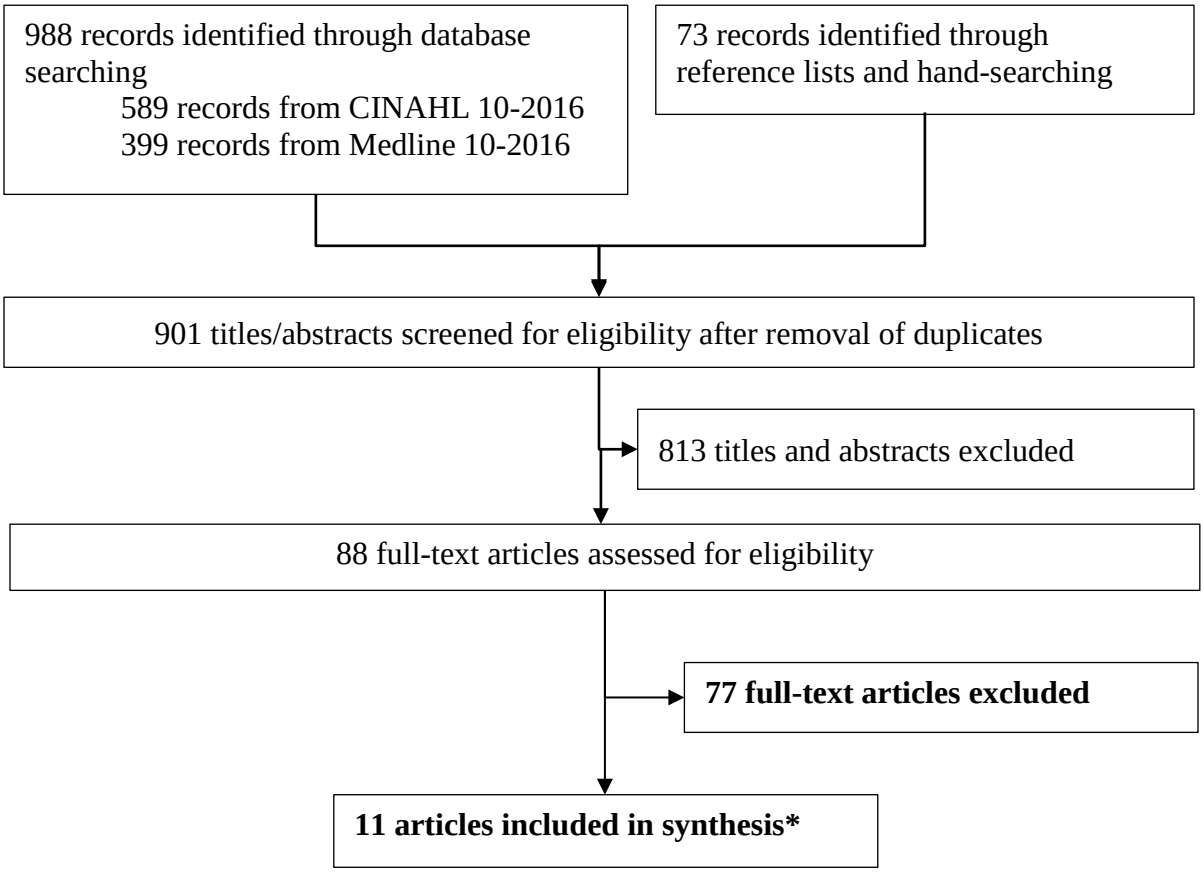
RESULTS

LITERATURE FLOW

Study Design and Quality

The literature flow diagram (Figure 2) summarizes the results of the search and study selection processes. Searches resulted in 901 potentially relevant articles. Of these, we included 8 RCTs (in 10 publications)[1-3,5-7,38-42] and 1 retrospective cohort.[4] Detailed reasons for study exclusion are provided in Appendix B in the supplemental materials.

Figure 2. Literature Flowchart

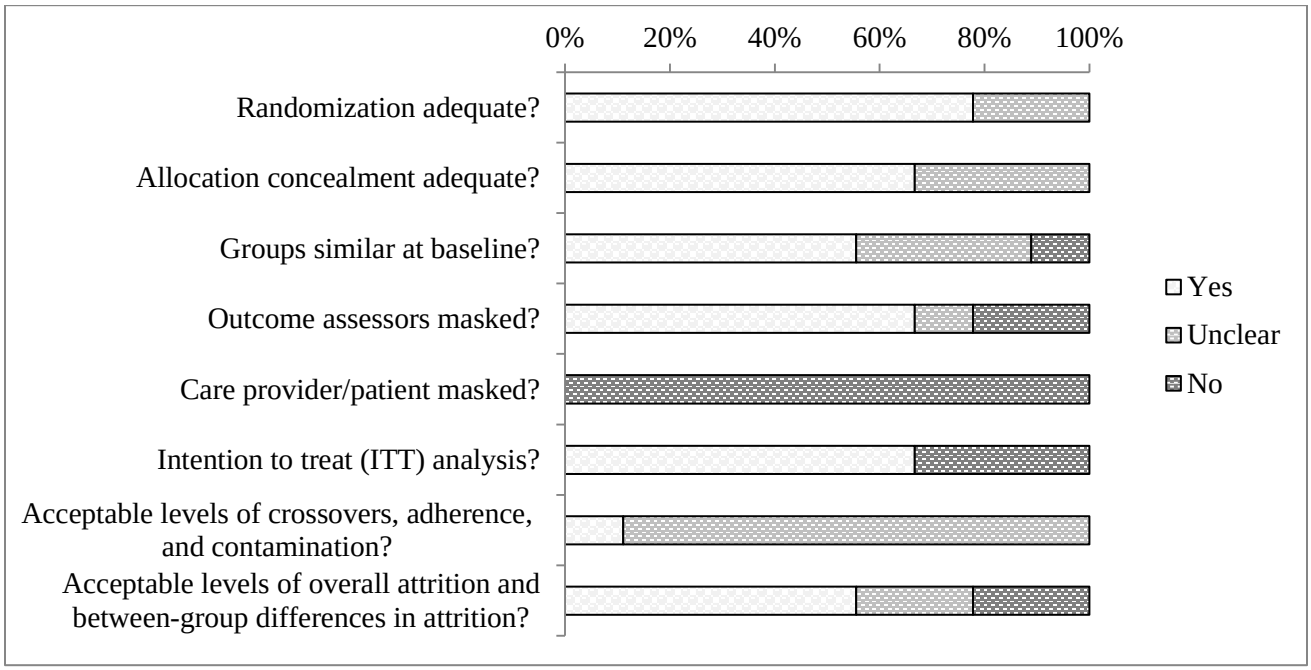


*1 secondary study included but not synthesized

Overall, most studies were fair or good quality. Three studies were rated poor.[2,4,38] Common limitations among fair-quality studies included greater than 20% attrition and baseline differences in potential prognostic factors. Poor-quality studies also had high levels of exclusions from analyses (34% to 47%). Assessment of intervention fidelity was limited to attendance at group or individual appointments or number of patient contacts. Figure 3 displays the quality indicators of the included RCTs. Despite strong methodology, the strength of the evidence is generally low as each intervention is only supported by a single study with imprecise findings (full details in Appendix C in the supplemental materials). All but one study[5] were randomized at

the patient level. Most interventions were compared to usual care, which was often minimally described as regular access to primary and specialty care.

Figure 3. Risk of Bias Assessment of Included RCTs



Setting and Subjects

We identified 9 diverse models of multimodal chronic pain care. Most studies involved multiple primary care practices in the USA[1,3,5,8,38,41] or England.[6,7] Four interventions were evaluated within either the Indianapolis (Roudebush) VAMC[3,8,41] or the Portland VAMC.[5] Two studies took place in single centers in Canada.[2,4] Table 1 gives the characteristics of the included studies (full details in Appendix C in the supplemental materials). Sample sizes were ≤ 250 patients in the majority of the studies (range, 63 to 1066). Follow-up duration was 12 months in the majority of studies (range, 6 to18 months). The proportion of male patients ranged from 31% to 92%, with higher proportions in those studies within the VA. The mean patient age ranged from 37 to 62 years old. Most studies reported baseline pain intensity which ranged from 5.1 to 7.7 on a 10-point scale. Most commonly reported mental health comorbidities were major depressive disorder, post-traumatic stress disorder, and substance use disorder, but baseline prevalence of these conditions was low in most studies (range: 1% to 24%). The exception was that one study specifically targeted patients with comorbid musculoskeletal pain and depression.[8]

Table 1. Characteristics of Included Studies*

Author Year	Sample size	Study Design	Setting	Interventions	Follow-Up (months)	Gender (% male)	Mean Age (years)	Baseline Pain Intensity**	Mental health comorbidities	Study Quality
Ahles 2001[38]	396	RCT	4 PC practices (USA)	Computer-based tailored "prescription" algorithm + nurse educator	6	39	49	NR	27% emotional distress	Poor
Ahles 2006[1]	1066	RCT	14 PC practices (USA)	Computer-based tailored "prescription" algorithm + nurse educator	12	48	48	NR	1% SUD	Fair
Angeles 2013[2]	63	RCT	Single center (Canada)	Group multidisciplinary education co-facilitated by an occupational therapist and a social worker	6	38	55	NR	19.3% possible or probable SUD	Poor
Bair 2015[3] ESCAPE	241	RCT	5 GM clinics (Indianapolis VAMC)	Stepped care with analgesics, self-management, and CBT delivered by 2 NCM	9	88	37	6.6	Mean PTSD Score[a]= 26.4 Mean Depression Score[b]= 11.2	Good
Burnham 2010[4] CAPRI	82	OBS	Single rural center (Canada)	Weekly multi-disciplinary group sessions added to analgesic optimization	18	31	47	7.7	NR	Poor
Dobscha 2009[5] SEACAP	401	RCT	5 PC clinics (Portland VAMC)	Collaborative care delivered by psychologist care manager	12	92	62	5.2	18% MDD, 16% PTSD	Good
Hay 2006[6]	216	RCT	15 practices (England)	Pharmacist-led pharmacological treatment optimization	12	36	62	6.1	NR	Fair
Hill 2011[7]	851	RCT	10 practices (England)	Physiotherapist-led stratified care using STarT Back Screening Tool	12	41	50	5.3	NR	Fair

Kroekne 2009[8] SCAMP	250	RCT	5 GM clinics (Indianapolis VAMC)	Stepped care with antidepressants and self-management delivered by a NCM	12	47	56	6.2	75% MDD Mean Anxiety score[c]= 8.9	Good
Kroenke 2014[41] SCOPE	250	RCT	5 PC clinics (Indianapolis VAMC)	Automated symptom monitoring and optimized analgesic management by NCM and PC pain specialist team	12	83	55	5.1	24% MDD, 17% PTSD	Good

*Table does not include Thielke 2015, secondary publications of already included studies; **mean score on a 10-pt scale

Abbreviations: RC = retrospective cohort; RTC = randomized controlled trial; PC= primary care; NR= not reported; SUD= substance use disorder; ESCAPE = Evaluation of Stepped Care for Chronic Pain; GM = general medicine; CBT = cognitive behavioral therapy; NCM = nurse case manager; PTSD = post-traumatic stress disorder; CAPRI = Central Alberta Pain and Rehabilitation Institute; OBS= observational; SEACAP = Study of the Effectiveness of a Collaborative Approach to Pain; MDD = major depressive disorder; SCAMP = Stepped Care for Affective Disorders and Musculoskeletal Pain; SCOPE = Stepped Care to Optimize Pain Care Effectiveness; GADS= Generalized Anxiety Disorder scale

[a] Determined using the Posttraumatic Stress Disorder Check List–17.Scores range from 0 to 68

[b] Determined using Patient Health Questionnaire–9.37 Scores range from 0 to 27,

[c] Determined using the Generalized Anxiety Disorder scale. Scores range from 0 to 21.

Overview of Multimodal Chronic Pain Care Model Components

Table 2 summarizes the intervention components utilized in the multimodal chronic pain care models. All but one model[7] involved multiple processes for improving pain care delivery. The majority of interventions included a decision-support component – most commonly algorithm-guided treatment and/or stepped-care – coupled with proactive ongoing treatment monitoring.[1-3,5,6,8,38,39,41] In 2 studies the decision support was in the form of a stratified approach by way of prognostic screening with matched treatment pathways.[4,7] One stratified model[7] focused on adults with back pain from 10 general practices within the Keele General Practice Research Partnership in England and used the validated Keele STarT Back Screening Tool, which is a 9-item inventory that queries patients about referred leg pain, comorbid pain, disability (2 items), bothersomeness, catastrophizing, fear, anxiety, and depression to categorize patients into low-, medium-, and high-risk groups.[35] The STarT Back Screening Tool is now also being evaluated in an ongoing study in 6 large primary care clinics in the integrated Group Health system in Washington State.[43] Alternatively, the stratified approach used in the Central Alberta Pain and Rehabilitation Institute (CAPRI), a single center in rural Alberta, triaged patients using an unspecified 1.5- to 2-hour assessment process to differentiate one of 4 care pathways based on the extent of their medication management, psychosocial, and/or comorbid medical illness issues (*ie*, minimal, high, complex).[4] In the majority of studies, designated case managers from various disciplines delivered the treatment monitoring component of the intervention primarily via phone contacts at various frequencies. One notable exception was in the Stepped Care to Optimize Pain Care Effectiveness (SCOPE) study in which patients in the intervention group underwent automated symptom monitoring, either by interactive voice-recorded telephone calls or by internet, which prompted live case manager follow-up on an as-needed basis.[41] Half of the models included active patient education, most of which was in the form of group education sessions. For 2 interventions, the main feature was increasing capacity for[2] and access to[4] multimodal care. The McMaster Family Health Team (MFHT) in Hamilton, Ontario sought to use existing resources to increase capacity and access to multimodal care by centralizing services via weekly 2-hour group sessions that incorporated physician, pharmacist, dietician, and physiotherapist resource persons.[2] The CAPRI represents an example of a Canadian health region administration providing funding for developing a new multidisciplinary program designed specifically to increase access to multimodal chronic pain care in a previously underserved rural setting in Lacombe, Alberta. It featured decision support via risk stratification with matched treatment pathways and weekly symptom monitoring and weekly 5-hour group multidisciplinary education and activation sessions as needed.[4]

Table 2. Overview of Chronic Pain Care Model Components

	Decision support	Increasing access to and coordination of multimodal care	Additional care coordination resources	Active patient education, activation
Ahles 2001/2006[1,38]	Algorithm-guided treatment recommendations; nurse educator support for patients with psychosocial problems.		Weekly telephone contact with nurse educator	
Angeles 2013[2]		Centralization: Multidisciplinary program developed by available providers, tailored to setting, delivered by group visits		Group sessions
Bair 2015[3,39] (ESCAPE)	Algorithm-guided stepped care with analgesics and CBT, delivered by NCM		Biweekly by NCM	
Burnham 2010[4] (CAPRI)	4 care pathways based on complexity: (1) self-management, (2) spinal block, (3) medication management, (4) multidisciplinary care	Establishment of a multidisciplinary program in a rural setting	Weekly for complex patients	Weekly 5-hr group multidisciplinary sessions for complex patients
Dobscha 2009[5] (SEACAP)	Clinician education; stepped care; expert decision support		Every 2 months by psychologist and internist team	Optional 4-session group workshop
Hay 2006[6]	Enhanced pharmacy review: pharmacist-led and algorithm-guided		Biweekly by pharmacist and nurse	3 to 6 20-minute sessions with pharmacist
Hill 2011[7]	Risk stratification using validated tool; risk-matched treatment pathways			
Kroenke 2009[8] (SCAMP)	Algorithm-guided stepped care with antidepressants and self-management		Biweekly to monthly by depression pain clinical specialist	6 30-minute sessions with NCM
Kroenke 2014[41] (SCOPE)	Algorithm-guided stepped care with analgesics		Automated monitoring via IVR or internet that would prompt nurse contacts.	

Abbreviations: NCM = nurse case manager, CBT = cognitive behavioral therapy, IVR = interactive voice response; ESCAPE = Evaluation of Stepped Care for Chronic Pain; SEACAP = Study of the Effectiveness of a Collaborative Approach to Pain; SCAMP = Stepped Care for Affective Disorders and Musculoskeletal Pain; SCOPE = Stepped Care to Optimize Pain Care Effectiveness; CAPRI = Central Alberta Pain and Rehabilitation Institute

Specific Characteristics of Multimodal Chronic Pain Care Model Components

All interventions were comprised of multiple and heterogeneous components for improving the delivery of multimodal care. Table 3 describes the specific characteristics of the model components, such as the disciplines of the care management team members, frequency and duration of care management, and whether the provider and patient education was active or passive in nature (full detail in Appendix C in supplemental materials). Among the four VA-based models[3,39, 5, 8, 41] decision support primarily involved weekly case management meetings to facilitate interaction between providers, plus either an analgesic[3,39, 41] or antidepressant[8] algorithm. Additionally, the SEACAP study from the Portland VAMC provided the most intense example of active provider education, in which providers participated in two 90-minute education sessions.[5] In the category of care coordination, VA case management teams represented nursing and mental health and pain specialties. Active symptom monitoring ranged in frequency from biweekly to every 2 months. The VA SCOPE study was notable for including a health information technology component of interactive voice response monitoring.[41] In the category of increasing access to multimodal care, mental health support was the most commonly added modality in the VA models,[1,3,4,7,8,39,41] which was primarily optional. The majority of VA models included an active patient education component (workshops, individual counseling, *etc*).

Compared to VA-based models, in the remaining models conducted in other non-VA settings,[1,38, 2,4,6,7] decision support components were less common, case management teams were more diverse – representing occupational therapy, social work, physical therapy, physiatry, pharmacy, physiotherapy, kinesiology, and dietary needs – mental health treatment was more often a required component, and patient self-management support was more often passive in nature.

Table 3. Specific Characteristics of Multimodal Chronic Pain Care Model Components

	Decision support			**Additional care coordination resources**			**Increasing access to multimodal care**	**Active patient education and activation**
	Facilitate interaction between providers	*Primary care provider education, activation*	*Pharmacotherapy algorithm*	*Active symptom monitoring frequency*	*HIT enhancement*	*Case management team*	*Mental health treatment*	*Patient self-management support*
Ahles 2001/ 2006[1,38]	NS	Passive	NS	Study arm 1: NS Study arm 2: Weekly, descending	NS	Study arm 1: PCP Study arm 2: PCP, Nurse	Study arm 1: NS Study arm 2: Required	Study arm 1: Passive Study arm 2: Both
Angeles 2013[2]	Weekly CM	NS	NS	Weekly for 8 weeks	NS	Occupational therapist, social worker	NS	Active
Bair 2015[3,39] (ESCAPE)	Weekly CM	NS	Analgesic	Biweekly	NS	Nurses	Fixed CBT	Passive
Burnham 2010[4] (CAPRI)	Int. 1: NS Int. 2: Weekly CM	NS	Int. 1: Analgesic Int. 2: NS	Study arm 1: NS Study arm 2: Weekly for 12 weeks	NS	Study arm 1: PCP Study arm 2: PCP, Physiatrist, Psychologist, Physical Therapist, Kinesiologist, Nurse, Dietician	Study arm 1: NS Study arm 2: Required, 1+ hrs psychotherapy	Study arm 1: Passive Study arm 2: Both
Dobscha 2009[5] (SEACAP)	NS	Active	NS	Every 2 months	NS	Psychologist, internist	Optional	Both
Hay 2006[6]	NS	NS	Analgesic	Biweekly	NS	Pharmacist, nurse	NS	Both
Hill 2011[7]	NS	Active	NS	NS	NS	Physiotherapist, nurse	Required, high-risk patients received "psychologically informed physiotherapy"	Passive

Kroenke 2009[8] (SCAMP)	Weekly CM	NS	Antidepressant	Biweekly to monthly	NS	Depression-pain clinical specialist	Optional	Active
Kroenke 2014[41] (SCOPE)	Weekly CM	NS	Analgesic	Automated, descending	IVR, internet	Nurse, physician pain specialist	Optional	Passive

Abbreviations: NS = none specified; CM = case management; CBT = cognitive behavioral therapy; HIT = health information technology; PCP = primary care provider; ESCAPE = Evaluation of Stepped Care for Chronic Pain; SEACAP = Study of the Effectiveness of a Collaborative Approach to Pain; SCAMP = Stepped Care for Affective Disorders and Musculoskeletal Pain; SCOPE = Stepped Care to Optimize Pain Care Effectiveness; CAPRI = Central Alberta Pain and Rehabilitation Institute

Patient Outcomes

Decision Support Coupled with Case Management

Among the 6 models that coupled decision support with case management, the proportion of patients with clinically significant improvement in pain intensity or pain-related function based on a 30% or greater reduction in scores on the RMDQ, BPI, or OMERACT-OARSI was significantly increased in ESCAPE,[3,39] SEACAP,[5] SCAMP,[8] and SCOPE[41] (NNT range, 4.1 to 12.7 in 12 months), unchanged in a model that emphasized enhanced pharmacy review and physiotherapy,[6] and unmeasured in model that emphasized rapid assessment and management via computer-based assessment.[1] In the model that emphasized rapid assessment, pain intensity and function were measured based on the SF-36.[1] Change from baseline on the bodily pain score was greater in the intervention group compared to the control at 6 months (7.6 vs 2.2; P = 0.011), but not at one year (7.8 vs 3.6; P = 0.06). Change in functional interference estimate was reduced both at 6 months (0.96 vs -0.98; P = 0.027) and one year (1.5 vs 0.65; P = 0.02). Quality of life, depression, anxiety, sleep, opioid use, and unintended consequences were variably measured. Three of the models[5,8,41] also showed improvements on at least one of the additional important outcomes of quality of life,[8,41] depression,[5,8,41] anxiety,[8] and sleep.[41]

Risk/Complexity-matched Treatment Pathways

Among the 2 models using risk stratification coupled with risk-matched treatment pathways,[4,7] only the model using the validated STarT Back screening tool for back pain resulted in greater clinically significant improvement in pain intensity or pain-related function (≥ 30% decrease in RMDQ scores) at 12 months.[7] Patients screened with STarT Back and prescribed risk-matched treatment pathways also had greater improvement in depression scores and quality of life at 12 months. However, no differences in anxiety scores, or satisfaction with care were found between intervention and control at 12 months. This evidence is limited by moderate and different levels of attrition among risk groups and has thus far only been assessed in 851 people in England who were mostly female with a mean age of 50 years and with unknown mental health comorbidities. Thus, it is unclear how applicable this evidence is to Veterans. However, as previously mentioned, the STarT Back Screening Tool is now also being evaluated in an ongoing study in 6 large primary care clinics in the integrated Group Health system in Washington State.[43]

The CAPRI's stratified approach used in a single center in rural Alberta significantly reduced pain intensity scores (rated on a 0-10 scale) compared to medication management.[4] However, this evidence is insufficient to determine true intervention effects because it was assessed in a single underpowered study (N=82) of poor quality due to lack of outcome assessor blinding, no adjustment for potential confounders, and differential loss to follow-up.

Increasing Access via Group Multidisciplinary Intervention Sessions

The McMaster Family Health Team (MFHT) in Hamilton, Ontario sought to increase access to and coordination of specialty services via their centralization in weekly group sessions.[2] After 6 months of follow-up, there was a statistically significant improvement in the SF-36 physical domain. But because this finding is supported by only a single underpowered study (N=63) with low adherence (50%), it provides insufficient evidence on which to draw conclusions about this model.

Table 4. Summary of Findings (Intervention versus Control)

Author Year	Clinically significant* improvement in pain intensity or pain-related function	QOL	Depression	Anxiety	Sleep	Opioid use	Unintended consequences/ treatment satisfaction
Decision Support Coupled with Case Management							
Ahles 2001[38]	NR	SF-36 mean: **Pain Component: 59.7 vs 46.9, P<0.005** **Role Physical: 54.8 vs 37.5, P<0.03** **Role Emotional: 81.9 vs 62.0, P<0.001** **Role Social: 79.5 vs 64.5, P<0.001**	NR	NR	NR	NR	NR
Ahles 2006[1]	NR	SF-36 mean change: **Role Emotional: 13.9 vs 3.8, P=0.046** **Vitality: 7.4 vs 3.7, P=0.048**	NR	NR	NR	NR	NR
Bair 2015[3,39] (ESCAPE)	**RMDQ: RR=1.52 (95% CI 1.22 to 1.99)** NNT=7.5	NR	NR	NR	NR	NR	NR
Dobscha 2009[5] (SEACAP)	**RMDQ: 21.9% vs 14.0%, P=0.04** NNT=12.70 (95% CI 12.48 to 12.74)	Mean change EQ-5D: -0.02 vs -0.04, P=0.17	**Mean change PHQ-9:** **-3.7 vs -1.2, P=0.003**	NR	NR	Any opioid prescribed: 65% vs 61%, P=0.56	Mean change global treatment satisfaction: -0.27 vs -0.36, P=0.44
Hay 2006[6]	OMERACT-OARSI (high improvement): 27% vs 28%; P=0.8	NR	HADS depression:† 0.01 (95% CI -0.7 to 0.7)	HADS anxiety:† -0.23 (95% CI -1.1 to 0.6)	NR	NR	Satisfaction with treatment:† -19% (95% CI -32 to -4)
Kroenke 2009[8] (SCAMP)	**BPI:** **41.5% vs 17.3%;** **RR=2.4 (95% CI 1.6 to 3.2)** NNT=4.1 (95% CI 3.0 to 6.5)	SF-36:** **General health: 11.1 (95% CI 4.2 to 18.0)** Social functioning: 6.1 (95% CI -1.3 to 13.5) **Vitality: 8.8 (95% CI 3.6 to 14.0)**	**≥50% decrease in HSCL-20 from baseline:** **RR=2.3 (95% CI 1.5 to 3.2)**	**GAD-7:**** **-2.2 (95% CI -3.5 to -0.9)**	NR	Months of opioid use over 12 months: 3.5 vs 3.0, P=0.35	NR

Author Year	Clinically significant* improvement in pain intensity or pain-related function	QOL	Depression	Anxiety	Sleep	Opioid use	Unintended consequences/ treatment satisfaction
Kroenke 2014[41] (SCOPE)	**BPI: 51.7% vs 27.1%; RR=1.9 (95% CI 1.4 to 2.7)** NNT=4.1 (95% CI 3.0 to 6.4)	SF-12:** **Physical: 2.5 (95% CI 0.0 to 5.0)** Mental: 0.2 (95% CI -2.9 to 3.3) SF-36:** Social functioning: 5.3 (95% CI -1.6 to 12.2) Vitality: 2.2 (95% CI -3.9 to 8.2)	PHQ-9:** **-1.8 (95% CI -3.4 to -0.2)**	GAD-7:** -0.7 (95% CI -1.9 to 0.5	PROMIS sleep:** **-1.0 (95% CI -2.0 to 0.0)**	Mean # of months taking opioids: 2.0 vs 1.6, P=0.27	NR
Risk/Complexity-matched Treatment Pathways							
Burnham 2010[4] (CAPRI)	NR	NR	NR	NR	NR	NR	NR
Hill 2011[7]	**RMDQ: 65% vs 57%; OR=1.48 (95% CI 1.02 to 2.15)** NNT=10.8 (95% CI 5.8 to 206	SF-12:** **Physical: -2.93 (95% CI -4.31 to -1.56)** Mental: -0.69 (95% CI -2.39 to 1.01)	**HADS depression:** 0.62 (95% CI 0.07 to 1.17)**	HADS anxiety**: 0.45 (95% CI -0.10 to 1.01)	NR	NR	Satisfaction with care (not satisfied): 27% vs 36%
Increasing Access via Group Multidisciplinary Intervention Sessions							
Angeles 2013[2]	NR	SF-36 mean change: **Physical: -15.3 vs 3.4, P=0.01** Emotional: 2.6 vs 3.7, P=.92 Social: 3.2 vs 2.7, P=0.95 Mental: 3.6 vs 3.6, P=1.0	NR	NR	NR	NR	NR

Bold indicates statistical significance.

*≥ 30% decrease from baseline; **between-group mean difference (intervention-control); †between-group mean difference (control-intervention)

Abbreviations: QOL = quality of life; RMDQ = Roland-Morris Disability Questionnaire; SF-36 = Short form-36; SF-12 = Short form-12; EQ-5D = EuroQol health-related quality of life; PHQ-9 = Patient Health Questionnaire-9; OMERACT-OARSI = Outcome measures in rheumatology-Osteoarthritis Research Society International; HADS = Hospital anxiety and depression; BPI = Brief pain inventory; HSCL-20 = Hopkins symptom checklist; GAD-7 = Generalized anxiety disorder; PROMIS = Patient-reported outcomes measurement information system; ESCAPE = Evaluation of Stepped Care for Chronic Pain; SEACAP = Study of the Effectiveness of a Collaborative Approach to Pain; SCAMP = Stepped Care for Affective Disorders and Musculoskeletal Pain; SCOPE = Stepped Care to Optimize Pain Care Effectiveness; CAPRI = Central Alberta Pain and Rehabilitation Institute

Emerging models

We identified several additional multimodal chronic pain care models that have shown promise for improving patient outcomes in single-arm before-after studies[44-49] (see Appendix D in supplemental materials for study details). The majority of these studies were small (N<65) and had short follow-up periods of 6 months or less. Most of the care models involved managed care with a multidisciplinary team. One model was unique in that it involved both group visits with a multidisciplinary team along with one-on-one visits with a primary care provider.[48] One study examined implementation of a stepped care model at a single VA center.[45] Although these pain care models have shown promise, they still need to be compared to a concurrent control group in larger samples of patients over longer-term durations to determine the true intervention effects.

We also identified several ongoing studies by recognized researchers including Matthew Bair, MD, Dan Cherkin, PhD, Jordan Karp, MD, Lynn Debar, PhD, and Erin Krebs, MD, which may fill gaps in existing research, or provide further support for various models of pain care (see Appendix D in supplemental materials for full listing of identified ongoing studies). Several ongoing studies examine models in new settings, including one national VA study examining telecare for integrated pain management. Previous studies within the VA have been limited to a single center. Another ongoing study is assessing the STarT Back Tool for risk stratification in the US healthcare system,[43] which has been previously studied in the UK.[7] Several other ongoing studies examine care models with common elements such as case management with some form of medication optimization algorithm, or collaborative care programs which increase access to specialty care. Additionally, the Nova Scotia Chronic Pain Care Collaborative Network has been implemented which provides pain and addiction specialist mentors to primary care providers. Through personal correspondence with the principal investigator, we are aware of preliminary findings available in abstract form but have not gained access to them at the time of this draft.

SUMMARY AND DISCUSSION

To our knowledge, this is the first review to focus exclusively on evaluating the effectiveness of models to improve the delivery of multimodal chronic pain care in the primary care setting. We analyzed the models based on the 4 most common ways they promoted guideline-concordant multimodal chronic pain management: decision support, additional care coordination resources, enhanced patient education and activation, and increased access to a broader range of treatments. The 9 models we identified were evaluated in mostly good-quality RCTs comprised of 3,816 individuals primarily from 5 US States. The top 5 models that provided clinically relevant improvement in pain intensity and pain-related function over 9 to 12 months (NNT range, 4.1 to 12.70), as well as variable improvement in quality of life, depression, anxiety, and sleep, coupled a decision-support component – most commonly algorithm-guided treatment and/or stepped care – with proactive ongoing treatment monitoring: ESCAPE,[3,39] SEACAP,[5] STarT Back,[7] SCAMP,[8] and SCOPE.[41] Findings from ESCAPE,[3,39] SEACAP,[5] SCAMP,[8] and SCOPE[41] have the highest applicability to Veterans because they were studied in VAMC settings. As each of the top 5 models is only supported by a single study with imprecise findings, however, current evidence leaves us with sufficient doubt about their findings to recommend further evidence development.

LIMITATIONS

This evidence base included several key limitations. First, although a larger than usual proportion of studies was conducted with Veterans, the generalizability of their findings may still be limited because they consisted of samples from single centers in Indianapolis and Portland. Second, determination of patients who are most likely to benefit from these models was limited due to under-reporting of key patient characteristics such as pain duration, opioid use at baseline, and prevalence of common medical and mental health comorbidities. Third, factors reducing our confidence that the studies' outcome estimates represent the true effects of the models are that (a) assessment of intervention fidelity was generally limited in most studies and (b) the potential confounding effects of co-interventions is largely unknown due to the limited data available on additional treatments administered outside of the study setting. Although a majority of studies reported adequate fidelity to the case management component, information was scarce about fidelity to other components, including provider training, delivery/receipt of other components, and/or enactment of skills. Only a third of studies described the level and type of co-interventions, which was typically based on patient report alone. Fourth, the comparator group was typically 'usual care,' but was generally very minimally described as regular access to primary and specialty care.[50] This is problematic because the type of usual care can vary by patient, practice, health care system, and individual providers. The inability to assess the extent to which the type of usual care used in study settings is similar to a particular target setting limits our determination of the potential added benefit of a model of care. Also, a common problem for studies of multimodal interventions is that we cannot distinguish the degree to which benefits can be attributed to the actual treatments versus the nonspecific effects of care management and/or increased monitoring because there was no attention control group.[3,5,8,39,41] Fifth, the extent to which models for improving the uptake and organization of multimodal chronic pain in primary care provide *clinically relevant* benefits[31] remains somewhat unclear. Although clinically significant improvement in pain intensity or pain-related function and quality of life outcomes were reported by 60% and 70% of the studies, respectively, only half to a small minority of studies measured other important outcomes: 50% for depression, 40% for anxiety, 10% for sleep, 30% for opioid use, and 20% for unintended consequences. Also, although the Initiative on

Methods, Measurement, and Pain Assessment in Clinical Trials (IMMPACT) recommendations on core chronic pain outcome assessment are available to guide chronic pain research, these are a decade old and new assessment instruments have subsequently emerged, including the Patient Reported Outcome Measurement Information System (PROMIS)[51]; pain intensity, interference with enjoyment in life, and interference with general activity (PEG); and Defense and Veterans Pain Rating Scale (DVPRS).[52,53] Additionally, the Pain Assessment Screening Tool and Outcomes Registry (PASTOR) was developed and is being piloted collaboratively by the VA and Department of Defense to use computer-adaptive testing and the internet to implement administration of PROMIS and DVPRS in a military health system's electronic health record system.[51] Finally, as only one study reported outcomes beyond 12 months,[4] long-term sustainability in improvement is largely unknown.

The primary limitations of our findings that related to our review methods include (1) our literature search, (2) our use of second-reviewer checking in lieu of dual independent assessment of reviewer judgements, and (3) our scope. First, although our search included multiple databases, our shortened timeframe precluded searching a more exhaustive range of sources. Also, searching for literature is a common challenge in review of complex multicomponent health care interventions because of the many dimensions and inconsistent terminology used in the studies.[37] We addressed this challenge by including a wider than usual variety of terminology in our search strategy, as well as using a wider than usual range of grey literature searching. However, there is a risk that we may have missed additional relevant studies. Second, regarding our use of second-reviewer checking, surveys of rapid evidence review end-users found that they are willing to accept certain methodological short-cuts to increase reviewer efficiencies[54] and that availability of rapid reviews increased their uptake of evidence to inform time-sensitive system-level decision-making.[55] However, there is not yet consensus on what represents best practice for rapid reviews. A scoping review of rapid reviews found that short-cut approaches vary widely across all steps of the review process and are applied inconsistently.[56] Concerns have been expressed that streamlining standard systematic review methodology may potentially increase the risk of bias of rapid reviews, leading to suggestions for future research comparing findings of standard and rapid reviews.[54,56-58] However, in contrast to the more common rapid review approach of data abstraction and quality appraisal being performed by only one reviewer – 84% to 86% based on an international survey of 40 rapid review producers – our method of using second reviewer verification was perceived to have lower risk of bias.[56] But comparison of single reviewer only, second-reviewer verification, and dual independent review methods for data abstraction and quality assessment have not yet been empirically studied. Third, regarding our scope, at the advice of our operational partners, we focused on primary care because it is responsible for the majority of pain management. However, we acknowledge this limits the applicability of the findings of our review to a broader range of specialty settings, including multidisciplinary pain clinics, rehabilitation centers, etcetera.

CLINICAL AND RESEARCH IMPLICATIONS

As a variety of care models have already proven effective in VA settings (SEACAP, SCOPE, SCAMP, ESCAPE),[3,5,8,41] it seems reasonable to consider wider implementation of one or more of these models across multiple VAMCs with a clear plan for further evidence development that addresses shortcomings of previous research through: (1) better characterization of patients' pain duration, opioid use at baseline, and prevalence of common medical and mental health comorbidities, co-interventions, and usual care; (2) more rigorous evaluation of model fidelity

across a broader range of components; (3) assessment of a broader range of clinically-relevant core outcomes per IMMPACT recommendations; (4) longer-term follow-up; and (5) inclusion of potentially underserved areas, such as rural settings and that have more racial/ethnic diversity. The STarT Back risk stratification approach that matches treatments to physical and psychosocial obstacles in back pain provided a similar extent of clinically-relevant benefit[7] to the VAMC-tested models. But as it was implemented in England, the applicability of findings from this study to a VAMC setting is unclear. However, the implementation of this strategy in the US Group Health setting is underway, with results anticipated in the near future.[43] Upon consideration of those US healthcare system findings, the VHA may also consider implementation with evidence development of the STarT Back approach as another alternative.

As a main focus of these models is to reduce the numerous known challenges to primary care providers in managing the complexities of patients with chronic pain, it is also important to understand how these models are affecting providers' experiences. As provider perspectives were largely unexplored in previous studies, we suggest future research consider assessing the 3 domains identified as important in interviews of providers at the Indianapolis VAMC: (1) patient-centered communication skills; (2) extent of shared decision-making; and (3) provider burnout.[59]

For additional related evidence review work, an updated review of the state of the science of chronic pain outcome assessment could be useful in informing the direction of future research. Also, as this is anticipated to continue to be an important clinical area in the future, with rapid evidence development expected, we suggest conducting an updated evidence review in a few years. For example, several additional multimodal chronic pain care models have already shown promise for improving patient outcomes in single-arm studies, and we also identified several ongoing studies which may fill gaps in existing research or provide further support for various models of pain care.

CONCLUSIONS

Five models coupling a decision-support component – most commonly algorithm-guided treatment and/or stepped-care – with proactive ongoing treatment monitoring have the best evidence from good-quality RCTs of providing clinically relevant improvement in pain intensity and pain-related function over 9 to 12 months, as well as variable improvement in other important core outcomes. It is reasonable to consider wider implementation of any of those models across multiple VAMCs with a clear plan for further evidence development to address shortcomings of previous research.

Acknowledgements: We would like to thank Julia Haskin, MA for editorial support and Gail Betz, MLIS for searching support.

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QUERI

Evidence Brief: Effectiveness of Models Used to Deliver Multimodal Care for Chronic Musculoskeletal Pain

Supplemental Materials

January 2017

Prepared for:
Department of Veterans Affairs
Veterans Health Administration
Quality Enhancement Research Initiative
Health Services Research & Development Service
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VA HEALTH CARE Defining EXCELLENCE in the 21st Century

TABLE OF CONTENTS

APPENDIX A: SEARCH STRATEGIES

Database: Ovid MEDLINE (October 6, 2016)

Database: Ovid MEDLINE(R) without Revisions <1996 to September Week 4 2016>
Search Strategy:
---

1 exp Disease Management/ (32626)
2 exp "Delivery of Health Care"/ (673565)
3 *primary health care/ (30397)
4 *patient care planning/ or *case management/ (10756)
5 *patient care management/ or *delivery of health care/ or *delivery of health care, integrated/ or *managed care programs/ or *disease management/ or *patient care team/ or *quality of health care/ (94114)
6 *Health Services/ut [Utilization] (3096)
7 (collaborative adj (management or care)).tw. (1278)
8 (management adj5 care).tw. (20170)
9 models, organizational/ or total quality management/ (24515)
10 organizational innovation/ (17818)
11 (outcome and process assessment).mp. (16379)
12 Program evaluation/ (45143)
13 exp Evidence-Based Medicine/ (61578)
14 (disease adj manag$).tw. (8696)
15 (multifaceted adj intervention$).tw. (680)
16 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 (858597)
17 (chronic pain or non-cancer pain or neck pain or shoulder pain or back pain or low back pain or elbow pain or hip pain or knee pain or ankle pain).tw. (54951)
18 16 and 17 (8627)
19 limit 18 to (english language and humans) (7720)
20 limit 19 to (clinical study or clinical trial, all or clinical trial or comparative study or controlled clinical trial or evaluation studies or meta analysis or multicenter study or observational study or pragmatic clinical trial or randomized controlled trial or systematic reviews) (2943)
21 self-management.ti,ab. (8734)
22 (self adj manage$).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier] (9305)
23 (stepped adj care).ti,ab. (597)
24 exp Decision Support Systems, Clinical/ (5779)
25 (integrat$ adj care).ti,ab. (2031)
26 algorithm$.ti,ab. (121876)
27 7 or 8 or 15 or 21 or 22 or 23 or 24 or 25 or 26 (158626)
28 17 and 27 (1107)
29 limit 28 to (english language and humans and (clinical study or clinical trial, all or clinical trial or comparative study or controlled clinical trial or meta analysis or multicenter study or observational study or pragmatic clinical trial or randomized controlled trial or systematic reviews)) (386)

Database: CINAHL (October 13, 2016)

Search ID#	Search Terms	Search Options	Results
S42	S22 AND S41	Limiters - English Language; Human; Publication Type: Clinical Trial, Meta Analysis, Meta Synthesis, Randomized Controlled Trial, Research, Systematic Review Search modes - Boolean/Phrase	589
S41	S38 OR S40	Search modes - Boolean/Phrase	84,542
S40	integrat* N1 care	Search modes - Boolean/Phrase	10,001
S39	S22 AND S38	Limiters - English Language; Human; Publication Type: Clinical Trial, Meta Analysis, Meta Synthesis, Randomized Controlled Trial, Research, Systematic Review Search modes - Boolean/Phrase	565
S38	S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34 OR S35 OR S36 OR S37	Search modes - Boolean/Phrase	Display
S37	(MH "Case Management")	Search modes - Boolean/Phrase	Display
S36	algorithm*	Search modes - Boolean/Phrase	33,175
S35	(MH "Decision Support Systems, Clinical")	Search modes - Boolean/Phrase	2,995
S34	stepped N1 care	Search modes - Boolean/Phrase	349
S33	(self N1 manage*)	Search modes - Boolean/Phrase	Display
S32	self-management	Search modes - Boolean/Phrase	Display
S31	(multi-component or multicomponent) N1 intervention	Search modes - Boolean/Phrase	Display
S30	(multi-component or multicomponent) N1 care	Search modes - Boolean/Phrase	Display
S29	(multi-faceted OR multifaceted) N1 intervention	Search modes - Boolean/Phrase	Display
S28	(multi-faceted OR multifaceted) N1 care	Search modes - Boolean/Phrase	Display
S27	complex N1 intervention	Search modes - Boolean/Phrase	Display
S26	multimodal N1 (care or intervention)	Search modes - Boolean/Phrase	Display
S25	multi-modal N1 (care or intervention)	Search modes - Boolean/Phrase	Display
S24	(management N5 care)	Search modes - Boolean/Phrase	Display
S23	collaborative N1 (management OR care)	Search modes - Boolean/Phrase	Display
S22	chronic pain or non-cancer pain or neck pain or shoulder pain or back pain or low back pain or elbow pain or hip pain or knee pain or ankle pain	Search modes - Boolean/Phrase	Display

S21	S1 AND S20	Limiters - English Language; Human; Publication Type: Clinical Trial, Meta Analysis, Meta Synthesis, Randomized Controlled Trial, Research, Systematic Review Search modes - Boolean/Phrase	589
S20	S17 OR S19	Search modes - Boolean/Phrase	84,542
S19	integrat* N1 care	Search modes - Boolean/Phrase	10,001
S18	S1 AND S17	Limiters - English Language; Human; Publication Type: Clinical Trial, Meta Analysis, Meta Synthesis, Randomized Controlled Trial, Research, Systematic Review Search modes - Boolean/Phrase	565
S17	S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16	Search modes - Boolean/Phrase	75,575
S16	(MH "Case Management")	Search modes - Boolean/Phrase	Display
S15	algorithm*	Search modes - Boolean/Phrase	Display
S14	(MH "Decision Support Systems, Clinical")	Search modes - Boolean/Phrase	Display
S13	stepped N1 care	Search modes - Boolean/Phrase	Display
S12	(self N1 manage*)	Search modes - Boolean/Phrase	Display
S11	self-management	Search modes - Boolean/Phrase	Display
S10	(multi-component or multicomponent) N1 intervention	Search modes - Boolean/Phrase	Display
S9	(multi-component or multicomponent) N1 care	Search modes - Boolean/Phrase	Display
S8	(multi-faceted OR multifaceted) N1 intervention	Search modes - Boolean/Phrase	525
S7	(multi-faceted OR multifaceted) N1 care	Search modes - Boolean/Phrase	Display
S6	complex N1 intervention	Search modes - Boolean/Phrase	Display
S5	multimodal N1 (care or intervention)	Search modes - Boolean/Phrase	Display
S4	multi-modal N1 (care or intervention)	Search modes - Boolean/Phrase	Display
S3	(management N5 care)	Search modes - Boolean/Phrase	Display
S2	collaborative N1 (management OR care)	Search modes - Boolean/Phrase	Display
S1	chronic pain or non-cancer pain or neck pain or shoulder pain or back pain or low back pain or elbow pain or hip pain or knee pain or ankle pain	Search modes - Boolean/Phrase	Display

Systematic Review Searching (October 20, 2016)

1. Search for current systematic reviews (limited to last 5 years) ***Search terms: Chronic pain, chronic musculoskeletal pain, musculoskeletal pain, chronic noncancer pain***	
A. Required sources:	**Evidence:**
AHRQ: evidence reports, technology assessments, U.S Preventative Services Task Force Evidence Synthesis	http://www.ahrq.gov/research/findings/evidence-based-reports/search.html Search: *Chronic pain, chronic musculoskeletal pain, musculoskeletal pain, chronic noncancer pain* Relevant results: Jeffery 2010, Multidisciplinary Pain Programs for Chronic Noncancer Pain
CADTH	https://www.cadth.ca Search: *Chronic pain, chronic musculoskeletal pain, musculoskeletal pain, chronic noncancer pain* Relevant results: Multidisciplinary Chronic Non-Cancer Pain Programs for Adults: Guidelines for Referral, Treatment Management and Program Duration Multidisciplinary Treatment Programs for Patients with Non-Malignant Pain: A Review of the Clinical Evidence, Cost-Effectiveness, and Guidelines
Cochrane Database of Systematic Reviews: Protocols & Reviews	http://www.ohsu.edu/xd/education/library/ (search through Ovid) Database: Global Health <1973 to 2016 Week 40>, EBM Reviews - Cochrane Database of Systematic Reviews <2005 to October 19, 2016> Search Strategy: --- 1 chronic musculoskeletal pain.mp. [mp=ab, ti, ot, bt, hw, id, cc, tx, kw, ct] (63) 2 chronic noncancer pain.mp. [mp=ab, ti, ot, bt, hw, id, cc, tx, kw, ct] (11) 3 Multidisciplinary Pain Program*.mp. [mp=ab, ti, ot, bt, hw, id, cc, tx, kw, ct] (1) 4 multimodal pain program*.mp. [mp=ab, ti, ot, bt, hw, id, cc, tx, kw, ct] (0) 5 multimodal pain.mp. [mp=ab, ti, ot, bt, hw, id, cc, tx, kw, ct] (11) 6 Multidisciplinary Pain.mp. [mp=ab, ti, ot, bt, hw, id, cc, tx, kw, ct] (17) ********** Relevant results: Multidisciplinary rehabilitation for fibromyalgia and musculoskeletal pain in working age adults Multidisciplinary treatment for chronic pain: a systematic review of interventions and outcomes Multidisciplinary Biopsychosocial Rehabilitation for Nonspecific Chronic Low Back Pain Multidisciplinary biopsychosocial rehabilitation for neck and shoulder pain among working age adults
ECRI Institute	https://www.ecri.org/Pages/default.aspx Relevant results: None found

HTA: Health Technology Assessments	http://www.ohsu.edu/xd/education/library/ (search through Ovid) Database: EBM Reviews - Health Technology Assessment <3rd Quarter 2016> Search Strategy: --- 1 chronic musculoskeletal pain.mp. (5) 2 chronic noncancer pain.mp. (2) 3 multimodal pain.mp. (0) 4 Multidisciplinary Pain.mp. (4) ********** Relevant results: Multidisciplinary pain programs for chronic pain: evidence from systematic reviews (Structured abstract) Ospina, M. Harstall, C. Health Technology Assessment Database. 2016 Issue 3, John Wiley & Sons, Ltd. Chichester, UK. Division: ST. AN: HTA-32003000442 Reviewed Source Original article: Ospina, M, Harstall, C. Multidisciplinary pain programs for chronic pain: evidence from systematic reviews. Edmonton: Alberta Heritage Foundation for Medical Research (AHFMR). 53p. 2003.

MEDLINE: Systematic Reviews	http://www.ohsu.edu/xd/education/library/ Database: Ovid MEDLINE(R) <1946 to October Week 2 2016>, Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations <October 19, 2016> Search Strategy: --- 1 meta-analysis.pt. (74417) 2 meta-analysis/ or systematic review/ or meta-analysis as topic/ or "meta analysis (topic)"/ or "systematic review (topic)"/ or exp technology assessment, biomedical/ (98559) 3 ((systematic* adj3 (review* or overview*)) or (methodologic* adj3 (review* or overview*))).ti,ab. (99987) 4 ((quantitative adj3 (review* or overview* or synthes*)) or (research adj3 (integrati* or overview*))).ti,ab. (7269) 5 ((integrative adj3 (review* or overview*)) or (collaborative adj3 (review* or overview*)) or (pool* adj3 analy*)).ti,ab. (16413) 6 (data synthes* or data extraction* or data abstraction*).ti,ab. (17867) 7 (handsearch* or hand search*).ti,ab. (7456) 8 (mantel haenszel or peto or der simonian or dersimonian or fixed effect* or latin square*).ti,ab. (18634) 9 (meta-analy* or metaanaly* or systematic review* or biomedical technology assessment* or bio-medical technology assessment*).mp,hw. (179119) 10 (meta regression* or metaregression*).ti,ab. (4624) 11 (meta-analy* or metaanaly* or systematic review* or biomedical technology assessment* or bio-medical technology assessment*).mp,hw. (179119) 12 (medline or cochrane or pubmed or medlars or embase or cinahl).ti,ab,hw. (134724) 13 (cochrane or (health adj2 technology assessment) or evidence report).jw. (20466) 14 (meta-analysis or systematic review).ti,ab. (136954) 15 (comparative adj3 (efficacy or effectiveness)).ti,ab. (9081) 16 (outcomes research or relative effectiveness).ti,ab. (6063) 17 ((indirect or indirect treatment or mixed-treatment) adj comparison*).ti,ab. (1367) 18 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 (298765) 19 chronic noncancer pain.mp. (496) 20 multimodal pain.mp. (332) 21 multidisciplinary pain.mp. (585) 22 chronic pain/pp [physiopathology] (1197) 23 chronic Musculoskeletal pain.mp. (791) 24 pain management.mp. (37522) 25 18 and (19 or 20 or 21 or 22 or 23) (224) ********** Relevant Results: A systematic review of the outcomes reported in multimodal pain therapy for chronic pain. [Review] Deckert, S; Kaiser, U; Kopkow, C; Trautmann, F; Sabatowski, R; Schmitt, J. Source: European Journal of Pain. 20(1):51-63, 2016 Jan. Validation and application of a core set of patient-relevant outcome domains to assess the effectiveness of multimodal pain therapy (VAPAIN): a study protocol. Kaiser, Ulrike; Kopkow, Christian; Deckert, Stefanie; Sabatowski, Rainer; Schmitt, Jochen. Is There a Need for Including Spiritual Care in Interdisciplinary Rehabilitation of Chronic Pain Patients? Investigating an Innovative Strategy. [Review] Garschagen A; Steegers MA; van Bergen AH; Jochijms JA; Skrabanja TL; Vrijhoef HJ; Smeets RJ; Vissers KC. Pain Practice. 15(7):671-87, 2015 Sep. Literature review of pain management for people with chronic pain. [Review] Takai Y; Yamamoto-Mitani N; Abe Y; Suzuki M. Japan Journal of Nursing Science: JJNS. 12(3):167-83, 2015 Jul. Efficacy of multidisciplinary pain treatment centers: a meta-analytic review. Flor H; Fydrich T; Turk DC.

	Pain. 49(2):221-30, 1992 May. [Multimodal pain therapy. Current situation]. [German] Kaiser U; Sabatowski R; Azad SC. Der Schmerz. 29(5):550-6, 2015 Oct.
NHS Evidence	http://www.evidence.nhs.uk/default.aspx Search: *Multidisciplinary chronic musculoskeletal pain, multimodal chronic musculoskeletal pain* Relevant results: Same as Cochrane Database of Systematic Reviews
NLM	https://www.nlm.nih.gov/ Search: *Multidisciplinary chronic musculoskeletal pain, multimodal chronic musculoskeletal pain* Relevant results: None found

Additional sources searched (November 1, 2016)

General Databases	
Sources:	**Evidence:**
CADTH Grey Matters	https://www.cadth.ca/resources/finding-evidence/grey-matters Search: Chronic pain, chronic musculoskeletal pain, musculoskeletal pain, chronic noncancer pain Relevant results: None
Conference Papers Index	http://library.pdx.edu/dofd/subjects Search: (all(chronic musculoskeletal pain) OR all(chronic noncancer pain) OR all(chronic pain)) AND (all(multimodal) OR all(Multidisciplinary) OR all(pain program)) Relevant results: None
Grey Literature Report	http://www.greylit.org/home Search: chronic musculoskeletal pain, multimodal, chronic pain management, collaborative pain management, Chronic pain, musculoskeletal pain Relevant results: Multidisciplinary pain programs for chronic noncancer pain. AHRQ. (already pulled)
Clinical Trials	https://www.clinicaltrials.gov/ Search: chronic pain OR musculoskeletal pain OR chronic noncancer pain | multimodal OR multidisciplinary OR collaborative | Adult, Senior | Studies that accept healthy volunteers Relevant results: Chronic Pain Care Network (NSCPCCN) Comparison of Two Multidisciplinary Rehabilitation Interventions in Patients With Chronic Low Back Pain Relational world of chronic pain patients in the course of an inpatient multimodal pain treatment focusing on psychosomatic interventions Nationwide Evaluation of Multimodal Rehabilitation in Patients With Chronic Musculoskeletal Pain

Clinical Trial Results	www.clinicaltrialresults.org/ Search: chronic musculoskeletal pain, multimodal, chronic pain management, collaborative pain management, Chronic pain, musculoskeletal pain Relevant results: None
WHO International Clinical Trials Registry Platform	http://apps.who.int/trialsearch/default.aspx Search: (chronic musculoskeletal pain OR chronic noncancer pain OR chronic pain) AND (multimodal) OR Multidisciplinary OR pain program) Relevant results: None
RePORT Research Portfolio Online Reporting Tools provides a central point of access to reports, data, and analyses of NIH research	https://projectreporter.nih.gov/reporter.cfm Search: chronic musculoskeletal pain, multimodal, chronic pain management, collaborative pain management, Chronic pain, musculoskeletal pain Relevant results: COLLABORATIVE CARE FOR CHRONIC PAIN IN PRIMARY CARE (2012) COLLABORATIVE CARE FOR CHRONIC PAIN IN PRIMARY CARE (2014) COLLABORATIVE CARE FOR CHRONIC PAIN IN PRIMARY CARE (2015) COLLABORATIVE CARE FOR CHRONIC PAIN IN PRIMARY CARE (2016)
National Repository of Grey Literature (NRGL)	http://www.nusl.cz/?lang=en Search: chronic musculoskeletal pain, multimodal, chronic pain management, collaborative pain management, Chronic pain, musculoskeletal pain Relevant results: None
OpenGrey Repository System for Information on Grey Literature in Europe	http://www.opengrey.eu/ Search: chronic musculoskeletal pain, multimodal, chronic pain management, collaborative pain management, Chronic pain, musculoskeletal pain Relevant results: Chronic low back pain Effectiveness of pain management programmes
Trip Turning Research Into Practice. Trip is a clinical search engine	https://www.tripdatabase.com/ Search: (title:chronic musculoskeletal pain)(title:management or collaborative or multimodal or multidisciplinary) Relevant results: Dawn Ernstzen, Quinette Louw, Susan Hillier. Clinical practice guidelines for the management of chronic musculoskeletal pain in primary health care: a systematic review. PROSPERO 2015:CRD42015022098 Available from http://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42015022098
metaRegister of Controlled Trials (mRCT)	http://www.isrctn.com/page/mrct Search: chronic musculoskeletal pain, multimodal, chronic pain management, collaborative pain management, Chronic pain, musculoskeletal pain Relevant results: **None**

National Institute for Health and Care Excellence (NICE Guidelines)	https://www.nice.org.uk/guidance?action=find Search: chronic musculoskeletal pain, multimodal, chronic pain management, collaborative pain management, Chronic pain, musculoskeletal pain Relevant results: **None**
Scopus (limit to conference procedings)	http://libguides.ohsu.edu/az.php?a=s Search: (all(chronic musculoskeletal pain) OR all(chronic noncancer pain) OR all(chronic pain)) AND (all(multimodal) OR all(Multidisciplinary) OR all(pain program)) Relevant results: **None**
Google Scholar	http://scholar.google.com/ Search: chronic musculoskeletal pain management, Collaborative Management of Chronic musculoskeletal Pain, related articles for Hill 2011, Kroenke 2014, multimodal Care for Chronic musculoskeletal pain, multidisciplinary pain management for Chronic musculoskeletal pain Relevant results: Update on guidelines for the treatment of chronic musculoskeletal pain Med Care. 2010 Jan;48(1):38-44. doi: 10.1097/MLR.0b013e3181bd49e2. VA healthcare costs of a collaborative intervention for chronic pain in primary care. Dickinson KC1, Sharma R, Duckart JP, Corson K, Gerrity MS, Dobscha SK. Wiedemer, N. L., Harden, P. S., Arndt, I. O. and Gallagher, R. M. (2007), The Opioid Renewal Clinic: A Primary Care, Managed Approach to Opioid Therapy in Chronic Pain Patients at Risk for Substance Abuse. Pain Medicine, 8: 573–584. doi:10.1111/j.1526-4637.2006.00254.x Von Korff M, Moore JC. Stepped Care for Back Pain: Activating Approaches for Primary Care. Ann Intern Med. 2001;134:911-917. doi: 10.7326/0003-4819-134-9_Part_2-200105011-00016 A primary care, multi-disciplinary disease management program for opioid-treated patients with chronic non-cancer pain and a high burden of psychiatric comorbidity The VHA's National Pain Management Strategy: implementing the stepped care model PH Rosenberger, EJ Philip, A Lee, RD Kerns - Fed Pract, 2011
Google	http://www.google.com/ Search: multidisciplinary pain management for Chronic musculoskeletal pain, collaborative pain management for Chronic musculoskeletal pain, systems level management of chronic musculoskeletal pain Relevant results: Veterans' Mates Therapeutic Brief- Chronic Musculoskeletal Pain: Changing the way we think about pain Towards a Multidisciplinary Team Approach in Chronic Pain Management Evaluation of a multicomponent programme for the management of musculoskeletal pain and depression in primary care: a cluster-randomised clinical trial (the DROP study)

Additional Sources Searched (November 11, 2016)

Topic Specific Sources	
Sources:	**Evidence:**
American Pain Society	http://americanpainsociety.org/education/guidelines/overview Guidelines: -March 2013- Use of Opioids for the Treatment of Chronic Pain: A statement from the American Academy of Pain Medicine (http://www.painmed.org/files/use-of-opioids-for-the-treatment-of-chronic-pain.pdf) -July 2016-Recommended Prescriber Practices from the American Academy of Pain for Methadone use to treat chronic pain -Spine Intervention Society: Appropriate Use Criteria for Fluoroscopically-Guided Diagnostic and Therapeutic Sacroiliac Interventions (spine injections) (http://1515docs.org/AUC/SI%20AUC%20Backgrounder.pdf)
PCORI	http://www.pcori.org/ Chronic Pain Management Workgroup. Stakeholder Workshop: Management of Chronic Musculoskeletal Pain http://www.pcori.org/events/2015/prioritizing-comparative-effectiveness-research-questions-systems-interventions-improve Topic Brief: http://www.pcori.org/sites/default/files/PCORI-Workshop-Topic-Brief-Musculoskeletal-Pain-060915.pdf Erin Krebs, University of Minnesota, awarded 2016: Comparative Effectiveness of Patient-Centered Strategies to Improve Pain Management and Opioid Safety for Veterans http://www.pcori.org/research-results/2016/comparative-effectiveness-patient-centered-strategies-improve-pain-management Paula Gardiner, Boston Medical Center, awarded 2013 (recruiting): Integrative Medicine Group Visits: A Patient-Centered Approach to Reducing Chronic Pain and Depression in a Disparate Urban Population http://www.pcori.org/research-results/2013/integrative-medicine-group-visits-patient-centered-approach-reducing-chronic
University of Southern California	Pain updates an medical news, but last update in 2007 (http://www.helpforpain.com/helpforpain.htm) New Medicines for Pain Treatment, last update in 2002 (http://www.helpforpain.com/helpforpain.htm)

American Academy of Pain Management (partner organizations: Arizona Center for Integrative Medicine, Integrative Health Policy Consortium, University of New Mexico, etc)	Research Abstracts (http://www.aapainmanage.org/resources/research-abstracts/) -Published research: October 2015, Exposure to High-Risk Medications is Associated with Worse Outcomes In Older Veterans with Chronic Pain Practice Guidelines (search by pain area): http://www.aapainmanage.org/resources/practice-guidelines/page/3/) -July 2015-US Dept of Health & Human Services, Low Back Pain Medical Treatment Guidelines (http://www.aapainmanage.org/resources/practice-guideline/low-back-pain-medical-treatment-guidelines-2/) -June 2015-Published in Pain Physician, Low Back Pain: Guidelines for Clinical Classification of Predominant Neuropathic, Nociceptive, or Central Sensitization Pain (http://www.aapainmanage.org/resources/practice-guideline/low-back-pain-guidelines-for-clinical-classification-of-predominant-neuropathic-nociceptive-or-central-sensitization-pain/) -February 2015- VA/DoD clinical practice guideline for the non-surgical management of hip & knee osteoarthritis (http://www.aapainmanage.org/resources/practice-guideline/vadod-clinical-practice-guideline-for-the-non-surgical-management-of-hip-knee-osteoarthritis/) Clinical Trials (search by pain area, city, state: http://www.aapainmanage.org/resources/clinical-trials/) Legislation and Regulation: http://www.aapainmanage.org/advocacy/legislation-and-regulation/
Australian Government	Australian Government on chronic pain management for Australian vets: https://www.veteransmates.net.au/topic-38-therapeutic-brief. Some of the references listed in this may be useful: -2010 National Pain Strategy: includes proposed models of care, multi-modal treatment, musculoskeletal and benefits of education on patient outcomes, etc http://www.painaustralia.org.au/the-national-pain-strategy/national-painstrategy.html - Scascighini L. et al. Multidisciplinary treatment for chronic pain: a systematic review of interventions and outcomes. Rheumatology. 2008; 47: 670-678. http://rheumatology.oxfordjournals.org/content/47/5/670.long - Veehof M. et al. Acceptance-based interventions for the treatment of chronic pain: a systematic review and meta-analysis. Pain. 2011; 152: 533-542. http://www.sciencedirect.com/science/article/pii/S0304395910006871 - Morley S, Eccleston C & Williams A. Systematic review and meta-analysis of randomized controlled trials of cognitive behaviour therapy and behaviour therapy for chronic pain in adults, excluding headache. Pain. 1999; 80: 1-13. - Mason L. et al. Topical NSAIDs for chronic musculoskeletal pain: systematic review and meta-analysis. BMC Musculoskeletal Disorders. 2004; 5: 28-36. - Gauntlett-Gilbert J. & Wilson S. Veterans and chronic pain. British Journal of Pain. May 2013. Available at: http://bjp.sagepub.com/content/7/2/79.full.pdf+html [Accessed September 2013].
American Chronic Pain Association	https://theacpa.org/ -advertises, “Vets in Pain” events Relevant results: None
The Pain Community	http://paincommunity.org/ Relevant results: None
Project TeleECHO (ECHO Pain)	-Project ECHO: bridges gap between primary and specialty care, adopted by US Army as part of a comprehensive pain management program (http://echo.unm.edu/initiatives/armed-services/)

BackCare	www.backcare.org.uk Search: multidisciplinary pain management for Chronic musculoskeletal pain, collaborative pain management for Chronic musculoskeletal pain Relevant results: None
Pain Association Scotland	http://www.painassociation.com/ Relevant results: None
VA HSR&D publications	http://www.hsrd.research.va.gov/research/default.cfm Search: chronic pain, Kroenke, musculoskeletal Relevant Results: IIR 14-070 Evaluation of a peer Coach-Led Intervention to improve Pain Symptoms (ECLIPSE) - Matthias IIR 09-058 IVR-based Cognitive Behavior Therapy for Chronic Low Back - Heapy IIR 10-128 Care Management for the Effective Use of Opioids (CAMEO) IIR 13-030 A proactive walking trial to reduce pain in Black Veterans– Diana Burgess PMI 03-195 Improving the Treatment of Chronic Pain in Primary Care RRP 12-438 Improving Pain using Peer RE-inforced Self-management Skills (IMPPRESS) TRX 04-402 Decision Support for the Management of Opioid Therapy in Chronic Pain: Jodie Trafton IIR 09-062 Musculoskeletal Spine Pain in VA: Description and Guideline Adherence

APPENDIX B: LIST OF EXCLUDED STUDIES

Exclude reasons: 1=Ineligible population, 2=Ineligible intervention, 3=Ineligible comparator, 4=Ineligible outcome, 5=Ineligible timing, 6=Ineligible study design, 7=Ineligible publication type, 8=Outdated or ineligible systematic review, 9=Protocol for eligible study

#	Citation	Exclude reason
1.	Andersen LN, Juul-Kristensen B, Sorensen TL, Herborg LG, Roessler KK, Sogaard K. Efficacy of Tailored Physical Activity or Chronic Pain Self-Management Programme on return to work for sick-listed citizens: A 3-month randomised controlled trial. *Scandinavian Journal of Public Health.* Nov 2015;43(7):694-703.	E(1)
2.	Apeldoorn AT, Ostelo RW, van Helvoirt H, et al. A randomized controlled trial on the effectiveness of a classification-based system for subacute and chronic low back pain. *Spine (03622436).* 2012;37(16):1347-1356.	E(1)
3.	Becker WC, Meghani SH, Barth KS, Wiedemer N, Gallagher RM. Characteristics and outcomes of patients discharged from the Opioid Renewal Clinic at the Philadelphia VA Medical Center. *American Journal on Addictions.* 2009;18(2):135-139.	E(4)
4.	Beneciuk JM, George SZ. Pragmatic Implementation of a Stratified Primary Care Model for Low Back Pain Management in Outpatient Physical Therapy Settings: Two-Phase, Sequential Preliminary Study. *Physical Therapy.* Aug 2015;95(8):1120-1134.	E(1)
5.	Briggs M, Closs SJ, Marczewski K, Barratt J. A feasibility study of a combined nurse/pharmacist-led chronic pain clinic in primary care. *Quality in Primary Care.* 2008;16(2):91-94.	E(6)
6.	Bronfort G, Maiers M, Evans R, Westrom K. P02.129. Individualized chiropractic and integrative care for low back pain: a randomized clinical trial. *BMC Complementary & Alternative Medicine.* 2012;12(Suppl 1):1-1.	E(1)
7.	Bültmann U, Sherson D, Olsen J, Hansen CL, Lund T, Kilsgaard J. Coordinated and tailored work rehabilitation: a randomized controlled trial with economic evaluation undertaken with workers on sick leave due to musculoskeletal disorders. *Journal of Occupational Rehabilitation.* 2009;19(1):81-93.	E(1)
8.	Carnes D, Homer KE, Miles CL, et al. Effective Delivery Styles and Content for Self-management Interventions for Chronic Musculoskeletal Pain: A Systematic Literature Review. *Clinical Journal of Pain.* 2012;28(4):344-354.	E(2)
9.	Chiauzzi E, Pujol LA, Wood M, et al. painACTION-back pain: a self-management website for people with chronic back pain. *Pain Medicine.* Jul 2010;11(7):1044-1058.	E(2)
10.	Chouinard M-C, Hudon C, Dubois M-F, et al. Case management and self-management support for frequent users with chronic disease in primary care: a pragmatic randomized controlled trial. *BMC Health Services Research.* 2013;13:49.	E(9)
11.	Courtenay M, Carey N. The impact and effectiveness of nurse-led care in the management of acute and chronic pain: a review of the literature. *Journal of Clinical Nursing.* 2008;17(15):2001-2013.	E(2)
12.	Currie SR, Hodgins DC, Crabtree A, Jacobi J, Armstrong S. Outcome from integrated pain management treatment for recovering substance abusers. *Journal of Pain.* 2003;4(2):91-100.	E(2)
13.	DasMahapatra P, Chiauzzi E, Pujol LM, Los C, Trudeau KJ. Mediators and moderators of chronic pain outcomes in an online self-management program. *Clinical Journal of Pain.* May 2015;31(5):404-413.	E(2)
14.	de Heer EW, Dekker J, van Eck van der Sluijs JF, et al. Effectiveness and cost-effectiveness of transmural collaborative care with consultation letter (TCCCL) and duloxetine for major depressive disorder (MDD) and (sub)chronic pain in collaboration with primary care: design of a randomized placebo-controlled multi-Centre trial: TCC:PAINDIP. *BMC Psychiatry.* 2013;13:147.	E(9)

#	Citation	Exclude reason
15.	de Jong CC, Ros WJ, Schrijvers G. The effects on health behavior and health outcomes of Internet-based asynchronous communication between health providers and patients with a chronic condition: a systematic review. *Journal of Medical Internet Research.* 2014;16(1):e19.	E(2)
16.	Dickinson KC, Sharma R, Duckart JP, Corson K, Gerrity MS, Dobscha SK. VA healthcare costs of a collaborative intervention for chronic pain in primary care. *Medical Care.* 2010;48(1):38-44.	E(4)
17.	Donovan MI, Evers K, Jacobs P, Mandleblatt S. When there is no benchmark: designing a primary care-based chronic pain management program from the scientific basis up. *Journal of Pain & Symptom Management.* Jul 1999;18(1):38-48.	E(7)
18.	Dorflinger L, Moore B, Goulet J, et al. A partnered approach to opioid management, guideline concordant care and the stepped care model of pain management. *JGIM: Journal of General Internal Medicine.* 2014;29:870-876.	E(6)
19.	Du S, Yuan C, Xiao X, Chu J, Qiu Y, Qian H. Self-management programs for chronic musculoskeletal pain conditions: a systematic review and meta-analysis. *Patient Education & Counseling.* Dec 2011;85(3):e299-310.	E(2)
20.	Dysvik E, Kvaløy JT, Natvig GK. The effectiveness of an improved multidisciplinary pain management programme: a 6- and 12-month follow-up study. *Journal of advanced nursing.* 2012;68(5):1061-1072.	E(2)
21.	Eaton LH, Gordon DB, Wyant S, et al. Development and implementation of a telehealth-enhanced intervention for pain and symptom management. *Contemporary Clinical Trials.* Jul 2014;38(2):213-220.	E(9)
22.	Ersek M, Turner JA, Cain KC, Kemp CA. Results of a randomized controlled trial to examine the efficacy of a chronic pain self-management group for older adults [ISRCTN11899548]. *Pain.* Aug 15 2008;138(1):29-40.	E(2)
23.	Ersek M, Turner JA, McCurry SM, Gibbons L, Kraybill BM. Efficacy of a self-management group intervention for elderly persons with chronic pain. *Clinical Journal of Pain.* May-Jun 2003;19(3):156-167.	E(2)
24.	Franek J. Self-management support interventions for persons with chronic disease: an evidence-based analysis. *Ontario Health Technology Assessment Series.* 2013;13(9):1-60.	E(2)
25.	Frank JW, Carey EP, Fagan KM, et al. Evaluation of a telementoring intervention for pain management in the Veterans Health Administration. *Pain Medicine.* Jun 2015;16(6):1090-1100.	E(4)
26.	Geraghty AWA, Stanford R, Little P, et al. Using an internet intervention to support self-management of low back pain in primary care: protocol for a randomised controlled feasibility trial (SupportBack). *BMJ Open.* 2015;5(9):e009524.	E(2)
27.	Goertz C, Salsbury S, Vining R, et al. P03.09. Development of an interprofessional model of collaborative care by doctors of chiropractic and medical doctors for older adults with low back pain. *BMC Complementary & Alternative Medicine.* 2012;12(Suppl 1):1-1.	E(4)
28.	Goertz CM, Salsbury SA, Vining RD, et al. Collaborative Care for Older Adults with low back pain by family medicine physicians and doctors of chiropractic (COCOA): study protocol for a randomized controlled trial. *Trials [Electronic Resource].* 2013;14:18.	E(9)
29.	Gustavsson C, Denison E, von Koch L. Self-management of persistent neck pain: a randomized controlled trial of a multi-component group intervention in primary health care. *European Journal of Pain.* Jul 2010;14(6):630.e631-630.e611.	E(2)
30.	Gustavsson C, Denison E, von Koch L. Self-management of persistent neck pain: two-year follow-up of a randomized controlled trial of a multicomponent group intervention in primary health care. *Spine.* Dec 1 2011;36(25):2105-2115.	E(2)
31.	Guzman J, Esmail R, Karjalainen K, Malmivaara A, Irvin E, Bombardier C. Multidisciplinary bio-psycho-social rehabilitation for chronic low back pain. *Cochrane Database of Systematic Reviews.* 2002(1):CD000963.	E(2)

#	Citation	Exclude reason
32.	Haas M, Groupp E, Muench J, et al. Chronic disease self-management program for low back pain in the elderly. *Journal of Manipulative & Physiological Therapeutics.* May 2005;28(4):228-237.	E(2)
33.	Heapy AA, Higgins DM, Cervone D, Wandner L, Fenton BT, Kerns RD. A Systematic Review of Technology-assisted Self-Management Interventions for Chronic Pain: Looking Across Treatment Modalities. *Clinical Journal of Pain.* Jun 2015;31(6):470-492.	E(2)
34.	Hentschke C, Hofmann J, Pfeifer K. A bio-psycho-social exercise program (RUCKGEWINN) for chronic low back pain in rehabilitation aftercare--study protocol for a randomised controlled trial. *BMC musculoskeletal disorders.* Nov 17 2010;11:266.	E(2)
35.	Heuts PHTG, de Bie R, Drietelaar M, et al. Self-management in osteoarthritis of hip or knee: a randomized clinical trial in a primary healthcare setting. *Journal of Rheumatology.* Mar 2005;32(3):543-549.	E(2)
36.	Hurley MV, Walsh NE, Mitchell H, Nicholas J, Patel A. Long-term outcomes and costs of an integrated rehabilitation program for chronic knee pain: a pragmatic, cluster randomized, controlled trial. *Arthritis care & research.* Feb 2012;64(2):238-247.	E(2)
37.	Hurley MV, Walsh NE, Mitchell HL, et al. Clinical effectiveness of a rehabilitation program integrating exercise, self-management, and active coping strategies for chronic knee pain: a cluster randomized trial. *Arthritis & Rheumatism.* Oct 15 2007;57(7):1211-1219.	E(2)
38.	Irvine AB, Russell H, Manocchia M, et al. Mobile-Web app to self-manage low back pain: randomized controlled trial. *Journal of Medical Internet Research.* 2015;17(1):e1.	E(1)
39.	Janke EA, Fritz M, Hopkins C, Haltzman B, Sautter JM, Ramirez ML. A randomized clinical trial of an integrated behavioral self-management intervention Simultaneously Targeting Obesity and Pain: the STOP trial. *BMC Public Health.* 2014;14:621.	E(2)
40.	Jessep SA, Walsh NE, Ratcliffe J, Hurley MV. Long-term clinical benefits and costs of an integrated rehabilitation programme compared with outpatient physiotherapy for chronic knee pain. *Physiotherapy.* Jun 2009;95(2):94-102.	E(2)
41.	Jousset N, Fanello S, Bontoux L, et al. Effects of functional restoration versus 3 hours per week physical therapy: a randomized controlled study. *Spine.* Mar 1 2004;29(5):487-493; discussion 494.	E(2)
42.	Kaapa EH, Frantsi K, Sarna S, Malmivaara A. Multidisciplinary group rehabilitation versus individual physiotherapy for chronic nonspecific low back pain: a randomized trial. *Spine.* Feb 15 2006;31(4):371-376.	E(1)
43.	Karp JF, Rollman BL, Reynolds CF, 3rd, et al. Addressing both depression and pain in late life: the methodology of the ADAPT study. *Pain Medicine.* Mar 2012;13(3):405-418.	E(9)
44.	Kawi J. Self-Management and Support in Chronic Pain Subgroups: Integrative Review. *Journal for Nurse Practitioners.* 2013;9(2):110-115.	E(2)
45.	Krebs EE, Bair MJ, Carey TS, Weinberger M. Documentation of pain care processes does not accurately reflect pain management delivered in primary care. *Journal of General Internal Medicine.* Mar 2010;25(3):194-199.	E(2)
46.	Kroenke K, Krebs E, Wu J, et al. Stepped Care to Optimize Pain care Effectiveness (SCOPE) trial study design and sample characteristics. *Contemporary Clinical Trials.* Mar 2013;34(2):270-281.	E(7)
47.	Lambeek LC, van Mechelen W, Knol DL, Loisel P, Anema JR. Randomised controlled trial of integrated care to reduce disability from chronic low back pain in working and private life. *BMJ (Clinical research ed.).* 2010;340:c1035.	E(1)
48.	Leaver AM, Refshauge KM, Maher CG, McAuley JH. Conservative interventions provide short-term relief for non-specific neck pain: a systematic review. *Journal of Physiotherapy.* 2010;56(2):73-85.	E(2)
49.	LeFort SM, Gray-Donald K, Rowat KM, Jeans ME. Randomized controlled trial of a community-based psychoeducation program for the self-management of chronic pain. *Pain.* Feb 1998;74(2-3):297-306.	E(2)
50.	Maiers MJ, Westrom KK, Legendre CG, Bronfort G. Integrative care for the management of low back pain: use of a clinical care pathway. *BMC Health Services Research.* 2010;10:298.	E(4)

#	Citation	Exclude reason
51.	May S. Self-management of chronic low back pain and osteoarthritis. *Nature Reviews Rheumatology.* Apr 2010;6(4):199-209.	E(8)
52.	Miller J, MacDermid JC, Walton DM, Richardson J. Chronic pain self-management support with pain science education and exercise (COMMENCE): study protocol for a randomized controlled trial. *Trials [Electronic Resource].* 2015;16:462.	E(2)
53.	Morasco BJ, Cavanagh R, Gritzner S, Dobscha SK. Care management practices for chronic pain in veterans prescribed high doses of opioid medications. *Family Practice.* 2013;30(6):671-678.	E(2)
54.	Nicholas MK, Asghari A, Blyth FM, et al. Self-management intervention for chronic pain in older adults: a randomised controlled trial. *Pain.* Jun 2013;154(6):824-835.	E(2)
55.	Oliveira VC, Ferreira PH, Maher CG, Pinto RZ, Refshauge KM, Ferreira ML. Effectiveness of self-management of low back pain: systematic review with meta-analysis. *Arthritis care & research.* Nov 2012;64(11):1739-1748.	E(2)
56.	Oslund S, Robinson RC, Clark TC, et al. Long-term effectiveness of a comprehensive pain management program: strengthening the case for interdisciplinary care. *Baylor University Medical Center Proceedings.* 2009;22(3):211-214.	E(2)
57.	Pombo N, Araujo P, Viana J. Knowledge discovery in clinical decision support systems for pain management: a systematic review. *Artificial Intelligence in Medicine.* Jan 2014;60(1):1-11.	E(4)
58.	Rasmussen CDN, Holtermann A, Bay H, Sogaard K, Birk Jorgensen M. A multifaceted workplace intervention for low back pain in nurses' aides: a pragmatic stepped wedge cluster randomised controlled trial. *Pain.* Sep 2015;156(9):1786-1794.	E(1)
59.	Rasmussen CDN, Holtermann A, Mortensen OS, Sogaard K, Jorgensen MB. Prevention of low back pain and its consequences among nurses' aides in elderly care: a stepped-wedge multi-faceted cluster-randomized controlled trial. *BMC Public Health.* 2013;13:1088.	E(2)
60.	Reid MC, Papaleontiou M, Ong A, Breckman R, Wethington E, Pillemer K. Self-management strategies to reduce pain and improve function among older adults in community settings: a review of the evidence. *Pain Medicine.* May-Jun 2008;9(4):409-424.	E(2)
61.	Richardson J, Loyola-Sanchez A, Sinclair S, et al. Self-management interventions for chronic disease: a systematic scoping review. *Clinical rehabilitation.* Nov 2014;28(11):1067-1077.	E(1)
62.	Riva S, Camerini A-L, Allam A, Schulz PJ. Interactive sections of an Internet-based intervention increase empowerment of chronic back pain patients: randomized controlled trial. *Journal of Medical Internet Research.* 2014;16(8):e180.	E(3)
63.	Roche-Leboucher G, Petit-Lemanac'h A, Bontoux L, et al. Multidisciplinary intensive functional restoration versus outpatient active physiotherapy in chronic low back pain: a randomized controlled trial. *Spine.* Dec 15 2011;36(26):2235-2242.	E(2)
64.	Ruehlman LS, Karoly P, Enders C. A randomized controlled evaluation of an online chronic pain self management program. *Pain.* Feb 2012;153(2):319-330.	E(2)
65.	Schulz PJ, Rubinell S, Hartung U. An internet-based approach to enhance self-managementof chronic low back pain in the italian-speaking population of Switzerland: results from a pilot study. *International Journal of Public Health.* 2007;52(5):286-294.	E(2)
66.	Semrau J, Hentschke C, Buchmann J, et al. Long-term effects of interprofessional biopsychosocial rehabilitation for adults with chronic non-specific low back pain: a multicentre, quasi-experimental study. *PLoS ONE [Electronic Resource].* 2015;10(3):e0118609.	E(1)
67.	Smeeding SJW, Bradshaw DH, Kumpfer K, Trevithick S, Stoddard GJ. Outcome evaluation of the Veterans Affairs Salt Lake City Integrative Health Clinic for chronic pain and stress-related depression, anxiety, and post-traumatic stress disorder. *Journal of Alternative & Complementary Medicine.* 2010;16(8):823-835.	E(2)

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68.	Steenstra IA, Anema JR, Bongers PM, de Vet HCW, van Mechelen W. Cost effectiveness of a multi-stage return to work program for workers on sick leave due to low back pain, design of a population based controlled trial [ISRCTN60233560]. *BMC musculoskeletal disorders.* Nov 21 2003;4:26.	E(2)
69.	Suzuki J, Matthews ML, Brick D, et al. Implementation of a collaborative care management program with buprenorphine in primary care: a comparison between opioid-dependent patients and patients with chronic pain using opioids nonmedically.[Erratum appears in J Opioid Manag. 2014 Sep-Oct;10(5):302 Note: Wasan, Ajay D [added]]. *Journal of Opioid Management.* May-Jun 2014;10(3):159-168.	E(3)
70.	Takai Y, Yamamoto-Mitani N, Abe Y, Suzuki M. Literature review of pain management for people with chronic pain. *Japan Journal of Nursing Science: JJNS.* Jul 2015;12(3):167-183.	E(2)
71.	Tierce-Haza S, Sadarangani T. Optimizing the Primary Care Management of Chronic Pain Through Telecare. *Journal of Clinical Outcomes Management.* 2014;21(11):493-495.	E(7)
72.	Unützer J, Hantke M, Powers D, et al. Care management for depression and osteoarthritis pain in older primary care patients: a pilot study. *International Journal of Geriatric Psychiatry.* 2008;23(11):1166-1171.	E(6)
73.	van Hooff ML, van der Merwe JD, O'Dowd J, et al. Daily functioning and self-management in patients with chronic low back pain after an intensive cognitive behavioral programme for pain management. *European Spine Journal.* Sep 2010;19(9):1517-1526.	E(2)
74.	Von Korff M, Moore JE, Lorig K, et al. A randomized trial of a lay person-led self-management group intervention for back pain patients in primary care. *Spine.* Dec 1 1998;23(23):2608-2615.	E(2)
75.	Walsh N, Cramp F, Palmer S, et al. Exercise and self-management for people with chronic knee, hip or lower back pain: a cluster randomised controlled trial of clinical and cost-effectiveness. Study protocol. *Physiotherapy.* Dec 2013;99(4):352-357.	E(2)
76.	Westrom KK, Maiers MJ, Evans RL, Bronfort G. Individualized chiropractic and integrative care for low back pain: the design of a randomized clinical trial using a mixed-methods approach. *Trials [Electronic Resource].* 2010;11:24.	E(2)
77.	Whitehurst DGT, Bryan S, Lewis M, Hill J, Hay EM. Exploring the cost-utility of stratified primary care management for low back pain compared with current best practice within risk-defined subgroups. *Annals of the Rheumatic Diseases.* Nov 2012;71(11):1796-1802.	E(4)

APPENDIX C: EVIDENCE TABLES

DATA ABSTRACTION OF INCLUDED PRIMARY STUDIES

Data Abstraction: Study Characteristics

Author **Year** **N** **Study Design** **Setting** **Follow-up**	**Patient Characteristics** (1) % male (2) mean age (3) % white	**Pain Characteristics** (1) Most common location (% patients) (2) Mean duration (y) (3) Pain intensity (mean score on 10-pt scale) (4) % taking opioid	**Current Comorbidities** (1) MDD (2) Anxiety (3) PTSD (4) SUD (5) Medical	**Clinically significant* improvement in: Pain Intensity or Pain-related Function** **(Intervention vs Control)**	**QOL** **Depression** **Anxiety** **Sleep** **Opioid Dose** **(Intervention vs Control)**	**Unintended Consequences** **(Intervention vs Control)**
Ahles 2001[1] 396 RCT New Hampshire and Vermont 6 months	(1) 39% male (2) 49 years (3) NR	(1) NR (2) NR (3) NR (4) NR	(1) NR (2) NR (3) NR (4) NR (5) Fair or Poor Health (28%)	NR	SF-36 Role Physical: 54.8 vs 37.5, P<0.03 SF-36 Role Emotional: 81.9 vs 62.0, P<0.001 SF-36 Role Social: 79.5 vs 64.5, P<0.001	NR
Ahles 2006[2] 1066 RCT New Hampshire, Vermont, and Maine 12 months	(1) 48% male (2) 48 years (3) 94% white	(1) NR (2) NR (3) NR (4) NR	(1) NR (2) NR (3) NR (4) 1% (5) Serious obesity (19%)	NR	SF-36 Role Emotional: 13.9 vs 3.8, P=0.046 SF-36 Vitality: 7.4 vs 3.7, P=0.048 Mean change within groups	NR
Angeles 2013[3] 63 RCT Canada 6 months	(1) 38% male (2) 55 years (3) NR	(1) NR (2) NR (3) NR (4) NR	(1) NR (2) NR (3) NR (4) Possible or probable SUD (19.3%) CAGE-AID (5) Pain due to disease process (59.7%)	NR	SF-36 Role Physical: -15.3 vs 3.4, P=0.01 SF-36 Role emotional: 2.6 vs 3.7 P=.92 SF-36 Social functioning: 3.2 vs 2.7, P=0.95 SF-36 mental component: 3.6 vs 3.6, P=1.0	NR

Author **Year** **N** **Study Design** **Setting** **Follow-up**	**Patient Characteristics** (1) % male (2) mean age (3) % white	**Pain Characteristics** (1) Most common location (% patients) (2) Mean duration (y) (3) Pain intensity (mean score on 10-pt scale) (4) % taking opioid	**Current Comorbidities** (1) MDD (2) Anxiety (3) PTSD (4) SUD (5) Medical	**Clinically significant* improvement in: Pain Intensity or Pain-related Function** **(Intervention vs Control)**	**QOL** **Depression** **Anxiety** **Sleep** **Opioid Dose** **(Intervention vs Control)**	**Unintended Consequences** **(Intervention vs Control)**
Bair 2015[4] 241 VA 9 months	(1) 88% male (2) 37 years (3) 77% white	(1) Low Back (57%) (2) NR (3) 6.6 (GCPS Severity Score) (4) 39%	(1) Mean score[a] = 11.2 (2) NR (3) Mean score[b] = 26.4 (4) NR (5) No. of Medical Diseases, mean= 0.94	RMDQ: RR=1.52 (95% CI 1.22 to 1.99) NNT=7.5	PHQ-9 (Depression): 11.1/27 vs 11.3/27	NR
Burnham 2010[5] 82 Retrospective Cohort Canada 18 months	(1) 31% male (2) 47 years (3) NR	(1) NR (2) 8.2y (3) 7.7 (4) NR	(1) NR (2) NR (3) NR (4) NR (5) NR	NR	NR	NR
Dobscha 2009[6] 401 RCT VA 12 months	(1) 92% male (2) 62 years (3) 89% white	(1) 67% back, 65% neck or joint (2) NR (3) 5.2 (4) 43%	(1) 18% (2) 13% (PRIME-MD) (3) 16% (4) 16% (5) 4.9 (RxRisk-V medical morbidity score, range 0 to 45)	RMDQ: 21.9% vs 14.0%, P=0.04 NNT=12.70 (95% CI 12.48 to 12.74)	Mean change in EQ-5D: -0.02 (95% CI -0.05 to 0.01) vs -0.04 (95% CI -0.05 to -0.02), p=0.17 Mean change in PHQ-9: -3.7 (95%CI -4.9 to -0.24) vs -1.2 (95% CI -4.9 to -2.4), p=0.003 Any opioid prescribed: 65% vs 61%, p=0.56	Mean change global treatment satisfaction: -0.27 (95% CI -0.41 to -0.12) vs -0.36 (95% CI -0.51 to -0.22), p=0.44
Hay 2006[7] 216 RCT England 12 months	(1) 36% male (2) 62 years (3) NR	(1) 100% knee (2) NR (3) 6.1 (4) NR	(1) NR (2) NR (3) NR (4) NR (5) NR	OMERACT-OARSI response as high improvement: 27% vs 28%; P=0.8	Difference in change in HADS depression (control-intervention): 0.01 (95% CI -0.7 to 0.7) Difference in change in HADS anxiety (control-intervention): -0.23 (95% CI -1.1 to 0.6)	Satisfaction with treatment (control-intervention): -19% (95% CI -32 to -4)

Author **Year** **N** **Study Design** **Setting** **Follow-up**	**Patient Characteristics** (1) % male (2) mean age (3) % white	**Pain Characteristics** (1) Most common location (% patients) (2) Mean duration (y) (3) Pain intensity (mean score on 10-pt scale) (4) % taking opioid	**Current Comorbidities** (1) MDD (2) Anxiety (3) PTSD (4) SUD (5) Medical	**Clinically significant* improvement in: Pain Intensity or Pain-related Function** **(Intervention vs Control)**	**QOL** **Depression** **Anxiety** **Sleep** **Opioid Dose** **(Intervention vs Control)**	**Unintended Consequences** **(Intervention vs Control)**
Hill 2011[8] 851 RCT England 12 months	(1) 41% male (2) 50 years (3) NR	(1) 100% low back (2) NR (3) 5.3 (do not give scale range) (4) NR	(1) NR (2) NR (3) NR (4) NR (5) NR	RMDQ: 65% vs 57%; OR=1.48 (95% CI 1.02 to 2.15) NNT=10.8 (95% CI 5.8 to 206)	Difference in mean change SF-12: Physical: -2.93 (95% CI -4.31 to -1.56) Mental: -0.69 (95% CI -2.39 to 1.01) Difference in mean change HADS: Depression: 0.62 (95% CI 0.07 to 1.17) Anxiety: 0.45 (95% CI -0.10 to 1.01)	Satisfaction with care (intervention vs control): not satisfied: 27% vs 36%
Kroenke 2009[9] 250 RCT VA 12 months	(1) 47% male (2) 56 years (3) 60% white	(1) 60% back, 40% hip or knee (2) 9y (3) 6.2 (BPI) (4) 45%	(1) 75% (2) Mean score: 8.9/21 (GAD-7) (3) NR (4) NR (5) 2.7 (mean # medical illnesses),	BPI: 41.5% vs 17.3%; RR=2.4 (95% CI 1.6 to 3.2) NNT=4.1 (95% CI 3.0 to 6.5)	SF-36 between group mean difference: Social functioning: 6.1 (95% CI -1.3 to 13.5) Vitality: 8.8 (95% CI 3.6 to 14.0) 50% or greater decrease in HSCL-20 from baseline: RR=2.3 (95% CI 1.5 to 3.2) GAD-7 between group mean difference: -2.2 (95% CI -3.5 to -0.9) Mean months of opioid use within 12 month period: 3.5 vs 3.0, p=0.35	NR

Author Year N Study Design Setting Follow-up	**Patient Characteristics** (1) % male (2) mean age (3) % white	**Pain Characteristics** (1) Most common location (% patients) (2) Mean duration (y) (3) Pain intensity (mean score on 10-pt scale) (4) % taking opioid	**Current Comorbidities** (1) MDD (2) Anxiety (3) PTSD (4) SUD (5) Medical	**Clinically significant* improvement in: Pain Intensity or Pain-related Function (Intervention vs Control)**	**QOL Depression Anxiety Sleep Opioid Dose (Intervention vs Control)**	**Unintended Consequences (Intervention vs Control)**
Kroenke 2014[10] 250 RCT VA 12 months	(1) 83% male (2) 55 years (3) 77% white	(1) NR (2) NR (3) 5.1 (BPI) (4) 34%	(1) 24% (2) 5.9 (GAD-7) (3) 17% (4) NR (5) 2.1 (mean # comorbid medical disease)	BPI: 51.7% vs 27.1%; RR=1.9 (95% CI 1.4 to 2.7) NNT=4.1 (95% CI 3.0 to 6.4)	SF-12 between group difference: Physical: 2.5 (0.0 to 5.0) Mental: 0.2 (-2.9 to 3.3) SF-36 between group difference: Social functioning: 5.3 (-1.6 to 12.2) Vitality: 2.2 (-3.9 to 8.2) PHQ-9 between group difference: -1.8 (-3.4 to -0.2) GAD-7 between group difference: -0.7 (-1.9 to 0.5) PROMIS sleep between group difference: -1.0 (-2.0 to 0.0) Mean # of months taking opioids: 2.0 vs 1.6, p=0.27	

Abbreviations: NR= not reported; y= years; MDD= major depressive disorder; SUD= substance use disorder; RMDQ= Roland Morris Disability Questionnaire; NNT= number needed to treat; SF-12= 12 item short form survey; HADS= Hospital Anxiety and Depression Scale; GAD-7= Generalized Anxiety Disorder scale-7; BPI= Brief Pain Inventory; SF-36= 36 item short form survey; HSCL-20= 20 item Hopkins Symptom Checklist; PROMIS= Patient Reported Outcomes Measurement Information System

[a] Determined using the Posttraumatic Stress Disorder Check List–17.Scores range from 0 to 68

[b] Determined using Patient Health Questionnaire–9.37 Scores range from 0 to 27,

[c] Determined using the Generalized Anxiety Disorder scale. Scores range from 0 to 21.

Data Abstraction: Intervention Characteristics

	Ahles 2001/ 2006[1,2]	Angeles 2013[3]	Bair 2015[4]	Burnham 2010[5]	Dobscha 2009[6]	Hay 2006[7]	Hill 2011[8]	Kroenke 2009[9]	Kroenke 2014[10]
Main components	Self-management Dartmouth COOP Clinical Improvement System (DCCIS) "computer-based algorithm" and a telephone-based, nurse educator intervention	Small group sessions covering education about chronic pain management, medication management, and physical activation techniques	Stepped care with analgesics, self-management and CBT delivered by 2 NCM	Multi-disciplinary approach: initial assessment, medication assessment, and supervised medication management or full multi-disciplinary program management	Collaborative approach: "Assistance with Pain Treatment" (APT) – clinician education, efficient delivery of necessary support to optimize guideline-concordant care and activate patients	Enhanced pharmacy review: pharmacy management in accordance with an algorithm	Stratified care model: Prognostic screening with STarT Back Screening Tool, matched treatment pathways	Stepped care with antidepressant and self-management delivered by a nurse case manager (NCM)	Automated symptom monitoring (ASM) and optimized analgesic management by NCM and MD pain specialist team
Case management team	Primary care clinician and nurse educator	Occupational therapist and social worker	2 nurse case managers (NCM)	Family physician, physiatrist, psychologist, physical therapist, kinesiologist, nurse, and dietician	Full-time psychologist care manager and internist	Community pharmacist; study nurse	Physio-therapist	NCM and MD depression specialist	NCM and MD pain specialist
Case management team training		Yes		Some had prior experience	Limited			Yes	Yes

	Ahles 2001/ 2006[1,2]	Angeles 2013[3]	Bair 2015[4]	Burnham 2010[5]	Dobscha 2009[6]	Hay 2006[7]	Hill 2011[8]	Kroenke 2009[9]	Kroenke 2014[10]
Patient contact with case management team	1-5 telephone calls over 1 week to 3 months	Weekly 2-hour group sessions for 8 weeks	Biweekly telephone for a total of 12	Low Risk Group: Initial assessment and ongoing care by primary care clinician High Risk Group: weekly 5-hour group sessions and one-on-one meetings with other CAPRI staff	Every 2 months after initial assessment	3 to 6 20-minute sessions with pharmacist	Initial assessment; follow-up physiotherapy	≥ 13 scheduled contacts (in-person and telephone)	1 in-person meeting and at 1 and 3 months; all others ASM-prompted
Case management meetings	Nurse-educator provided rapid feedback to PCP regarding patient treatment plan	Discussions with clinicians about pain management, education, self-management. During specific sessions, clinicians were involved as resource persons.	Weekly between physician investigators, supervising psychologist					Weekly	Weekly

	Ahles 2001/ 2006[1,2]	Angeles 2013[3]	Bair 2015[4]	Burnham 2010[5]	Dobscha 2009[6]	Hay 2006[7]	Hill 2011[8]	Kroenke 2009[9]	Kroenke 2014[10]
Stepped care protocol	Algorithmic rapid problem assessment and feedback to patients and practitioners, nurse educator intervention		Algorithmic analgesic optimization, then CBT	In some cases, patients were moved to more intensive treatment groups	Possible elements: APT internist consultation, individual mental health or SUD treatment consultation, additional care manager telephone contacts, or referral to the specialty pain clinic, orthopedics, or neurosurgery for evaluation for a procedural approach	Analgesic optimization algorithm			
Physician education, activation	Physicians sent patient flow sheet with information about patients "prescription" letter based on DCCIS questionnaire				2 90-minute sessions; ongoing feedback and recommend-dations from case management team		Single clinic session, physiotherapy (physical) sessions; physiotherapy (physical and psychological) sessions	Antidepressant optimization algorithm	Analgesic optimization algorithm

	Ahles 2001/ 2006[1,2]	Angeles 2013[3]	Bair 2015[4]	Burnham 2010[5]	Dobscha 2009[6]	Hay 2006[7]	Hill 2011[8]	Kroenke 2009[9]	Kroenke 2014[10]
Patient self-management support, activation, education	Based on responses to DCCIS questionnaire, patients were mailed a "prescription" letter referring them to specific pages of self-care educational information	Small group sessions	Patients provided menu of strategies using standardized protocol	Low Risk Group: ongoing care by primary care clinician High Risk Group: developed comprehensive problem and goal list, treatment plan, and weekly group education	Mailed written educational materials and encouraged to attend 4-session group workshop	3 to 6 20-minute sessions with pharmacist	Educational video and book	6 30-minute sessions with NCM using standard protocol	Written guide of self-management and other pain-related web-based and local resources
Psychological treatments	Weekly, individual nurse education sessions delivered by phone		6 biweekly, individual CBT sessions delivered by phone; referral to mental health practitioner as needed	Low Risk Group: N/A High Risk Group: weekly 1-hour psychotherapy session			High risk patients receive "psychologically informed physiotherapy"		
Health information technology									Telehealth modality via interactive voice response (IVR) or internet

	Ahles 2001/ 2006[1,2]	Angeles 2013[3]	Bair 2015[4]	Burnham 2010[5]	Dobscha 2009[6]	Hay 2006[7]	Hill 2011[8]	Kroenke 2009[9]	Kroenke 2014[10]
Ongoing monitoring	Weekly phone contacts unless patients reported a significant (less than level 3) improvement in pain	Weekly group sessions, post-intervention interview, 6-month follow-up assessment	Biweekly phone contacts; 12 during trial	Low Risk Group: primary care physician management until the pain is deemed satisfactorily controlled and stable High Risk Group: weekly group sessions and one-on-one	Every 2 months after initial assessment			≥ 13 scheduled contacts (in-person and telephone)	Automated using 15-item measure; weekly for first month, biweekly for months 2 and 3, monthly for months 4 to 12
Processes for ensuring treatment fidelity			Training, observation, audiotaping, feedback					Training, observation of first 5 subjects, weekly case management conferences, completion of a checklist for each session	
Role of PCP		Session topic suggestions		Low Risk Group: medication/ pain management High Risk Group: weekly group sessions and one-on-one meetings					Partnership per Three-Component Model

	Ahles 2001/ 2006[1,2]	Angeles 2013[3]	Bair 2015[4]	Burnham 2010[5]	Dobscha 2009[6]	Hay 2006[7]	Hill 2011[8]	Kroenke 2009[9]	Kroenke 2014[10]
Role of pharmacist			Overseeing dispensing			Monitor patients and optimize analgesics			
Incorporation of patients' goals/ preferences	Nurse educator established patient preferences for types of pain management strategies			Low Risk Group: No High Risk Group: Yes		Analgesic algorithm took into account patient preferences		Selection of self-management strategies	Choice of phone or internet for automated monitoring
Coordination of specialty care				Yes, team members included multiple specialties					
Patient stratification-guided care				Yes, complexity was a factor in determining treatment group					Assessment of opioid-prescribing risk

QUALITY ASSESSMENT OF INCLUDED PRIMARY STUDIES

Quality Assessment of RCTs

Author Year Country	Randomization adequate?	Allocation concealment adequate?	Groups similar at baseline?	Outcome assessors masked?	Care provider/ patient masked?	Intention-to-treat (ITT) analysis?	Acceptable levels of crossovers, adherence, and contamination?	Acceptable levels of overall attrition (≤ 20%) and between-group differences in attrition (≤ 10%)?	Quality rating (Good, Fair, Poor)
Ahles 2001[1] USA	Unclear; Insufficient detail to determine	Unclear; Insufficient detail to determine	No; More women (69% vs 53%) in the intervention group. More patients with emotional distress (33% vs 20%) and fair to poor health (35% vs 20%) in control group.	No; Patients acted as outcome assessors	No	No; Only patients who completed the follow-up questionnaire were analyzed	Unclear; Crossover: NR Adherence: NR Contamination: NR	No; 47% of patients failed to respond to the final questionnaire	Poor

Author Year Country	Randomization adequate?	Allocation concealment adequate?	Groups similar at baseline?	Outcome assessors masked?	Care provider/ patient masked?	Intention-to-treat (ITT) analysis?	Acceptable levels of crossovers, adherence, and contamination?	Acceptable levels of overall attrition (≤ 20%) and between-group differences in attrition (≤ 10%)?	Quality rating (Good, Fair, Poor)
Ahles 2006[2] USA	Unclear; random numbers printed on the baseline assessment forms, followed by computer-based assignment	Unclear; random numbers printed on the baseline assessment forms, followed by computer-based assignment	Unclear; More serious obesity (17% vs 10%) in the usual care group of cohort 1. More patients with SUD and pain for ≤3 yrs distress in the control group and intervention group, respectively, of cohort 2.	No; Patients acted as outcome assessors	No	No; Only patients who completed the follow-up questionnaire were analyzed	Unclear; Crossover: NR Adherence: NR Contamination: NR	Yes; Cohort 1: Attrition was 12%-16% Unclear; Cohort 2: Attrition was 23%- 29%	Fair

Author Year Country	Randomization adequate?	Allocation concealment adequate?	Groups similar at baseline?	Outcome assessors masked?	Care provider/ patient masked?	Intention-to-treat (ITT) analysis?	Acceptable levels of crossovers, adherence, and contamination?	Acceptable levels of overall attrition (≤ 20%) and between-group differences in attrition (≤ 10%)?	Quality rating (Good, Fair, Poor)
Angeles 2013[3] Canada	Yes	Unclear Insufficient detail to determine	Unclear; Mean age not given, more patients in early intervention group unemployed before pain onset and on government compensation after pain onset	Unclear; Unclear who acted as outcome assessors	No	No	Yes; Crossover: 2 subjects crossed over Adherence: Patients included in the analysis attended 6 or more of the 8 sessions Contamination: NR	No; In the early intervention group 34% dropped out, and in the late intervention group 35% dropped out	Poor
Bair 2015[4] USA	Yes; Computer generated	Yes; Concealed opaque envelopes	Yes	Yes; Research assistants blinded to treatment group	No	Yes	Unclear; Crossovers: NR Adherence: mean 9.2/12 sessions Contamination: NR	Yes; 95% at 9 months usual care, 89% at 9 months intervention	Good
Dobscha 2009[6] USA	Yes; SAS generated randomization	Yes; Independent statistician	Yes	Yes; Research assistant blinded	No	Yes	Unclear; Crossover: NR Adherence: 40-98% Contamination: NR	Yes	Good

Author Year Country	Randomization adequate?	Allocation concealment adequate?	Groups similar at baseline?	Outcome assessors masked?	Care provider/ patient masked?	Intention-to-treat (ITT) analysis?	Acceptable levels of crossovers, adherence, and contamination?	Acceptable levels of overall attrition (≤ 20%) and between-group differences in attrition (≤ 10%)?	Quality rating (Good, Fair, Poor)
Hay 2006[7] England	Yes; Computer generated	Yes; Sealed opaque envelope. Assessed treatment concealment and found it to be effective - 4% revealed.	Unclear; Less obese in physiotherapy group than in control (26% vs 41%)	Yes; Study nurses and researchers blinded	No	Unclear; Stated ITT analysis but not all analyzed that were randomized	Unclear; Crossovers: NR Adherence: 96% in pharmacy arm attended 3 or more sessions Contamination: some differences in co-interventions among groups	Yes; 83.3% control, 91.7% pharm, 89% phys at 12 months	Fair
Hill 2011[8] England	Yes; Computer generated	Yes; Remote randomization unit	Yes; Differential rate of "routine and manual occupations" in high-risk group (57% vs 73%)	Yes	No	Yes	Unclear; Crossovers: NR Adherence: 93% initial attendance Contamination: NR	Unclear; 77% intervention, 74% control at 12 months. Differential follow-up in high-risk groups at 12 months (82% vs 71%)	Fair

Author Year Country	Randomization adequate?	Allocation concealment adequate?	Groups similar at baseline?	Outcome assessors masked?	Care provider/ patient masked?	Intention-to-treat (ITT) analysis?	Acceptable levels of crossovers, adherence, and contamination?	Acceptable levels of overall attrition (≤ 20%) and between-group differences in attrition (≤ 10%)?	Quality rating (Good, Fair, Poor)
Kroenke 2009[9] USA	Yes; Computer generated	Yes; Concealed opaque envelopes	Yes; More patients in intervention group taking anti-depressants	Yes; Research assistants blinded to treatment group	No	Yes	Unclear; Crossovers: NR Adherence: mean 2.5/5 in-person contacts, mean 11.5/8 telephone contacts Contamination: Yes, describe patient-reported co-interventions	Yes; 83% at 12 months intervention, 81% at 12 months usual care	Good
Kroenke 2014[10] USA	Yes; Computer generated	Yes; Computer-generated list with varying block sizes, carried out by an independent project manager that wasn't involved with assessment	Yes	Yes; Research assistants blinded to treatment group	No	Yes; Only 1 excluded from primary analysis	Unclear; Crossovers: NR Adherence: Unclear - mean 12.7 nurse telephone contacts and mean 13.5 ASM contacts Contamination: reported on co-interventions	Yes; 97% at 12 months usual care, 94% at 12 months intervention	Good

Abbreviations: NR= not reported; SUD= substance use disorder; ITT= intention to treat; pharm= pharmacy; phys= physiotherapy; ASM= automated symptom monitoring

Quality Assessment of Observational Studies

Author Year	Risk of selection bias? (Yes, No, Unclear)	Risk of performance bias? (Yes, No, Unclear)	Risk of detection bias? (Yes, No, Unclear)	Risk of bias due to confounding (Yes, No, Unclear)	Risk of attrition bias? (Yes, No, Unclear)	Risk of reporting bias? (Yes, No, Unclear)	Overall risk of bias (High, Medium, low)
Burnham 2010[5]	Unclear;	Unclear;	Unclear;	Unclear;	Unclear;	No	Poor
Canada	Unclear how patients were accepted as referrals	No description of co-interventions or intervention fidelity	Outcome assessors not blinded, pain intensity quantified not using standardized scale	Groups different at baseline in education level and depression; no adjustment for confounders	Low but differential overall loss to follow-up (0% med management vs 13% multi management)		

STRENGTH OF EVIDENCE FOR INCLUDED STUDIES

Strength of Evidence for Improvement in Pain Intensity and Pain-related Function

SOE Grade	Study, Design (N)	Study Limitations*	Consistency	Precision**	Findings
Low	Ahles 2001,[1] 2006,[2] RCT (1066)	Medium	Unknown	Precise†	No significant difference in changes in bodily pain scores (SF-36).
Insufficient	Angeles 2013,[3] RCT (63)	High	Unknown	Imprecise†	Improved bodily pain score (SF-36): mean difference 13.1, P<0.05
Low	Bair 2015,[4] RCT (241)	Low	Unknown	Imprecise	Improved pain scores with intervention: RMDQ: 44% vs 32%; RR=1.52 (95% CI 1.22 to 1.99)
Insufficient	Burnham 2010,[5] Cohort (82)	High	Unknown	Imprecise†	No significant difference in pain improvement between supervised medication management and full program.
Low	Dobscha 2009,[6] RCT (401)	Low	Unknown	Imprecise	Improved pain scores with intervention: RMDQ: 21.9% vs 14.0%, P=0.04
Low	Hay 2006,[7] RCT (216)	Medium	Unknown	Imprecise	No significant difference in changes in OMERACT-OARSI (high improvement).
Low	Hill 2011,[8] RCT (851)	Medium	Unknown	Imprecise	Improved pain scores with intervention: RMDQ: 65% vs 57%; OR=1.48 (95% CI 1.02 to 2.15)
Moderate	Kroenke 2009,[9] RCT (250)	Low	Unknown	Precise	Improved pain scores with intervention: BPI: 41.5% vs 17.3%; RR=2.4 (95% CI 1.6 to 3.2)
Moderate	Kroenke 2014,[10] RCT (250)	Low	Unknown	Precise	Improved pain scores with intervention: BPI: 51.7% vs 27.1%; RR=1.9 (95% CI 1.4 to 2.7)

*High, medium, low based on study quality
**OIS for ≥ 30% improvement in pain intensity/ related function outcome
†Precision based on other reported pain outcome when primary outcome not reported
Abbreviations: SF-36= 36 item short form survey; RMDQ=Roland-Morris Disability Questionnaire; RR= relative risk;; OMERACT-OARSI=Outcome measures in rheumatology-Osteoarthritis Research Society International; BPI=Brief pain inventory

APPENDIX D: EMERGING MODELS

SINGLE-ARM BEFORE-AFTER STUDIES

Author, Year	N	Setting	Intervention	Follow-Up	Findings
Briggs, 2008[11]	65	England	Managed care with nurse and pharmacist	6 months	Improved pain score (0-10 scale) : 8 vs 6.3, p<0.001
Chelminski, 2005[12]	63	University Medical Center, US	Case management with PCP, pharmacists, and psychiatrist: structured clinical assessments, monthly follow-up, pain contracts, medication titration, and psychiatric consultation	3 months	Improved pain score (0-10 scale): 6.5 vs 5.5, p=0.003
Dorflinger, 2014[13]	NR	VA	Collaborative care with multidisciplinary team including PCPs, specialists, support	12 month cohorts	No difference in pain severity rating
Gardiner, 2014[14]	65	Boston Medical Center	Integrative medical group visit care model: clinician facilitated group visits, self-care, one-on-one meetings with PCP	8 weeks	Improved pain score: mean reduction in score=0.7, p=0.005
Unutzer, 2008[15]	14	University Medical Center, US	Care management with nurse and PCP	6 months	Improved pain score (0-10 scale): 5.67 vs 4.18, p=0.021
Wiedemer, 2007[16]	335	VA	Opioid Renewal Clinic: Managed Care with PCP, pharmacists, multi-specialty pain team	18 months	Improved opioid use behaviors.

Abbreviations: PCP=Primary care provider

PENDING FINDINGS

Principal Investigator(s); Setting	Intervention	Study Design	Status	Information Resources (NCT or other registry #; citation(s) for published protocols; links to project websites)
Enric Aragones, MD, PhD; primary care centers in Tarragona, Spain	Care management, optimized antidepressant treatment and psychoeducational group	RCT	Recruiting participants	NCT02605278 Aragonès E, López-Cortacans G, Caballero A, et al. Evaluation of a multicomponent programme for the management of musculoskeletal pain and depression in primary care: a cluster-randomised clinical trial (the DROP study). *BMC psychiatry*. 2016;16(1):1.
Matthew Bair, MD, MS; Indianapolis VA	CAre Management for the Effective use of Opioids (CAMEO): Algorithm-based co-analgesic treatment or self-management	RCT	Analysis phase; no published data.	VA HSR&D Project #IIR 10-128 http://www.hsrd.research.va.gov/research/abstracts.cfm?Project_ID=2141700805
Dan Cherkin, PhD; primary care clinics in WA state	STarT Back Tool risk stratification	RCT	Recruiting participants.	NCT02286141 Cherkin D, Balderson B, Brewer G, et al. Evaluation of a risk-stratification strategy to improve primary care for low back pain: the MATCH cluster randomized trial protocol. *BMC Musculoskeletal Disorders*. 2016;17(1):361.
Maud-Christine Chouinard, PhD, Catherine Hudon, PhD; primary care practices in Quebec, Canada	Nurse case management and self-management support in primary care	RCT	Completed. Qualitative experiences and baseline characteristics published. No studies on pain outcomes published. Author contacted.	NCT01719991 Chouinard M-C, Hudon C, Dubois M-F, et al. Case management and self-management support for frequent users with chronic disease in primary care: a pragmatic randomized controlled trial. *BMC Health Services Research.* 2013;13:49.
Lynn DeBar, PhD; Kaiser Permanente GA, HI, and Northwest regions	Pain Program for Active Coping and Training (PPACT): Collaborative care with multidisciplinary team to integrate psychosocial services into primary care	RCT	Ongoing. Project end date: 02/28/2018	https://projectreporter.nih.gov/project_info_description.cfm?aid=9348731&icde=31747148
Eric de Heer; primary care practices in Netherlands	Collaborative care with care-manager, psychiatrist and physiotherapist with or without duloxetine	RCT	Abstract of preliminary results published. Full results to be published early 2017.	NTR1089 de Heer E, de Wilde-Timmerman L, Dekker J, et al. Efficacy of Collaborative Care versus antidepressant treatment in chronic pain and major depression: a multi-center proof of concept study. *Journal of Psychosomatic Research*. 2016;85:60-61.

Principal Investigator(s); Setting	Intervention	Study Design	Status	Information Resources (NCT or other registry #; citation(s) for published protocols; links to project websites)
Linda Eaton; rural community health providers in WA, WY, AK, MT, ID	Telehealth-enhanced symptom management with community health care providers and case managers	RCT	Currently in analysis phase; no published data.	Eaton LH, Gordon DB, Wyant S, et al. Development and implementation of a telehealth-enhanced intervention for pain and symptom management. *Contemporary clinical trials*. Jul 2014;38(2):213-220.
Christine Goertz, DC, PhD; community-based centers in IA, IL	Collaborative care between primary care and chiropractic care	RCT	Results to be published early 2017.	NCT01312233 Goertz CM, Salsbury SA, Vining RD, et al. Collaborative Care for Older Adults with low back pain by family medicine physicians and doctors of chiropractic (COCOA): study protocol for a randomized controlled trial. Trials [Electronic Resource]. 2013;14:18.
Jordan F. Karp, MD; University of Pittsburgh primary care	Stepped care with venlafaxine, supportive management, and problem-solving therapy	RCT	Phase I data published. Full evaluation of stepped care model to be published early 2017.	NCT01124188 Karp JF, Rollman BL, Reynolds CF, 3rd, et al. Addressing both depression and pain in late life: the methodology of the ADAPT study. *Pain Medicine*. Mar 2012;13(3):405-418.
Erin Krebs, MD, MPH; VA National	Telecare collaborative management or integrated pain team management	Controlled trial	Contract pending.	https://wwwcf.nlm.nih.gov/hsr_project/view_hsrproj_record.cfm?NLMUNIQUE_ID=20164146
Peter MacDougal, PhD, MD, FRCPC; primary care in Nova Scotia	Nova Scotia Chronic Pain Care Collaborative Care Network: Chronic pain and addiction specialists serving as mentors to primary care providers.	RandomizedSingle group assignment	Completed. Posters and abstracts published. In contact with author to receive publications.	NCT00909493

APPENDIX E: PEER REVIEW

Comment #	Reviewer #	Comment	*Author Response*
Are the objectives, scope, and methods for this review clearly described?			
1	1	Yes	*None*
2	2	Yes	*None*
3	3	Yes	*None*
4	4	Yes	*None*
Is there any indication of bias in our synthesis of the evidence?			
9	1	No	*None*
10	2	No	*None*
11	3	No	*None*
12	4	No	*None*
Are there any published or unpublished studies that we may have overlooked?			
13	1	Yes - It is possible that some relevant studies were missed. For example, the following article comes to mind. Why was this missed in the search, and if it was located, why was it excluded? Lamb SE1, Hansen Z, Lall R, Castelnuovo E, Withers EJ, Nichols V, Potter R, Underwood MR; Back Skills Training Trial investigators. Group cognitive behavioural treatment for low-back pain in primary care: a randomised controlled trial and cost-effectiveness analysis. Lancet. 2010 Mar 13;375(9718):916-23. doi: 10.1016/S0140-6736(09)62164-4. Epub 2010 Feb 25.	Yes, our search missed this study because its indexing lacked terms for health care delivery or management. Upon review, we excluded this study because it focused only on CBT and lacked any system-level strategies for improving multimodal care delivery overall.
14	2	No	*None*
15	3	No	*None*
16	4	No	*None*
Additional suggestions or comments can be provided below. If applicable, please indicate the page and line numbers from the draft report.			

17	1	I am a little concerned that the search was largely limited to Medline and CINAHL. What about PsychINFO, CENTRAL and EMBASE?	We always search MEDLINE because of its broad subject coverage. For subject-specific databases, we additionally specifically chose CINAHL because of this review's focus on models of care involving collaboration, management, and integration with nursing and allied health professions. Although we recognize that pain is a complex condition often involving dynamic interactions with behavioral and mental health factors, we did not search PsycINFO because we did not anticipate the additional psychological-focused sources to add key literature not already identified through MEDLINE and CINAHL. Likewise, because of the overlap between MEDLINE, CENTRAL and EMBASE, we judged there to be a low risk of missing key unique literature through exclusion of CENTRAL and EMBASE that we would not find through extensive searching of reference lists, asking our Operational Partners, peer reviewers and other experts, and searching other sources.
18	1	Although I appreciate the focus on examining care delivered in primary care settings, this focus may be unnecessarily limited, since a large historical literature has focused on examination of the effectiveness of multidisciplinary pain clinics or centers, and these reports may have at lesat some relevance in the context of the current review.	Added to Discussion: *"At the advice of our Operational Partners, we focused on primary care because it is responsible for the majority of pain management. However, we acknowledge this limits the applicability of the findings of our review to a broader range of specialty settings, including multidisciplinary pain clinics, rehabilitation centers, etc."*
19	1	All acronyms should be defined (e.g., NR, on page 3 in the Executive Summary)	Added acronyms
20	1	A very recent published paper could be cited: Nahin RL, Severe Pain in Veterans: The Impact of Age and Sex, and Comparisons to the General Population, Journal of Pain (2016), doi: 10.1016/j.jpain.2016.10.021.	Thank you. Added to Background: "*Prevalence of severe pain is more common in veterans than in the general population.*[22]"
21	1	Multimodal pain care can include non-opioid pharmacological approaches	Agreed, we already have "pharmacological" treatment in our Background list of potential multimodal pain care options.
22	1	I'm not sure about some assertions, such as the statement that most participants in the studies cited were older. Also, the IOM estimate of 116 million persons with chronic pain was revised to 100 million.	Removed "older" from list of complicating factors listed in the Background. Revised IOM estimate as suggested.
23	2	Please make sure that you define all abbreviations and acronyms in the tables. Some are missing. Also, please review the References list as there are some duplicates..	Added definitions of abbreviations and acronyms and removed duplicate references.

24	3	Page 24, lines 18-24. Regards to primary care clinicians experience with multimodal models of chronic pain management, there is some VA data about these programs, likely through process improvement processes. I am uncertain about the accessibility of such data or the quality. Potential references for this data are Ilene Robeck, Nancy Wiedemer, and Stephen Mudra.	Thank you for these suggestions. We are aware of Dr. Wiedemer's work in improving opioid use through her Opioid Renewal Clinic. We included findings from her 2007 single-arm study in Appendix D. *Wiedemer NL, Harden PS, Arndt IO, Gallagher RM. The opioid renewal clinic: a primary care, managed approach to opioid therapy in chronic pain patients at risk for substance abuse. Pain Medicine. 2007;8(7):573-584* . Contact with Drs. Robeck and Mudra did not result in identification of any additional data.
25	4	1. Executive summary (page 2) -- define or include some parenthetical information to clarify "small-study."	Changed to "…a single study with imprecise findings. We previously used "small" to describe when findings were imprecise due to an insufficiently powered evidence base. To assess precision of remission rates, we used an online calculator to determine the sample size needed for 80% power with a 5% two-tailed significance level (https://www.stat.ubc.ca/~rollin/stats/ssize/b2.html)
26	4	2. Background (page 4): The IOM report was revised; from 116 million to 100 million estimate	Revised.
27	4	3. Background (page 4): Should read 31% (not 31 percent)	Changed as suggested.
28	4	4. Methods (page 7): It might help this reader/reviewer to define "grey literature."	We removed the term grey literature and instead listed all the sources.
29	4	5. Study design and quality (page 9): Clarification of what "moderate levels of attrition" means would help. "Small study" is mentioned again.	Changed sentence on page 9 to: *"Common limitations among fair-quality studies included greater than 20% attrition…"* On page 10, changed sentence to: "…a single study with imprecise findings."
30	4	6. Risk of bias...(page 10): What is considered an acceptable level of attrition?	We generally consider attrition of ≤ 20% as acceptable. This is consistent with RCTs' typical approach of calculating power to reasonably expect 20% attrition. Added these thresholds to Quality Assessment table.
31	4	7. The Roudebush VAMC is mentioned several times. Could include Indianapolis in parenthesis or simply refer as Indianapolis VAMC to be consistent with mention of Portland VAMC.	Changed to Indianapolis VAMC
32	4	8. Table 1: in Bair, ESCAPE study: Mean (SD) depressive and PTSD symptoms were listed in Table 2	Added
33	4	9. Key multimodal chronic pain care model processes (page 13): The sentence "All but two models included components to multiple states of the process" required me to read a few times. Hoping it could be clarified some.	Changed to: "*All but two models[2,7] involved multiple processes for improving pain care delivery*"
34	4	10. Model components...(page 15): I'm not clear on the meaning of "fixed" in 57% of the models.	Changed to 'required'.

35	4	11. Table 3 (page 16): What dose "fixed CBT" mean?	Changed to 'required' vs optional/as-needed.
36	4	12. Table 3 (page 16): int 1 and int 2 are not intuitive. Either spell out or consider other term(s), e.g. study arm 1, study arm	Changed as suggested.
37	4	13. Patient outcomes (page 18): The phrase "statistically significantly increased in…" is awkward. Could simply say: statistically significant.	Changed to *"…was significantly increased…"*
38	4	14. Table 4 (page 19): For the Kroenke (SCAMP) trial what are the units for amount of opioid use during the intervention (3.5 vs 3.0)?	Added unit, which was mean number of months within 12 month period.
39	4	15. Summary and Discussion (Page 22): provide some parenthetical information that specifies what is meant by "small study."	We used "small" to describe when findings were imprecise due to an insufficiently powered evidence base. To assess precision of remission rates, we used an online calculator to determine the sample size needed for 80% power with a 5% two-tailed significance level (https://www.stat.ubc.ca/~rollin/stats/ssize/b2.html)
40	4	16. Should consider including Indianapolis in parentheses when referring to Roudebush VAMC or simply refer as Indianapolis VAMC.	Changed to "Indianapolis VAMC"
41	4	17. References: #3 and #20 are repeats	Deleted duplicate #20
42	4	18. Grey literature searching?	Changed title of search results table in Supplemental materials to "Additional sources searched"
43	4	19. Appendix C: Depression and PTSD symptoms (mean and SD) are reported in Table 2 of ESCAPE	Added.
44	4	20. Appendix C: Anxiety symptoms are reported in Table 4 of SCAMP	Added
45	4	21. Appendix C: What are the units for "amount of opioid use" in SCAMP?	Added unit, which was mean number of months within 12 month period.
46	4	22. Curious why the Hill 2011 trial is rated as fair? With such a large trial across UK practices, I might expect a little greater attrition than single-site trials.	Yes, at 24%, its attrition was higher than in other 12 months studies (range, 3% to 19%); even than in another multicenter study of 15 sites in England (16%) . But it is a minor flaw that is not likely to cause major bias – which is reflected by the fair quality rating.
47	5	Page 8, line 7: need a "." After management	Added
48	5	Page 26, line 14-15: "PROMIS: Your might consider this reference: Cook, Karon F., et al. "Leveraging PROMIS measures to build and pilot the DoD's Pain Assessment Screening Tool and Registry (PASTOR)." QUALITY OF LIFE RESEARCH. Vol. 24. VAN GODEWIJCKSTRAAT 30, 3311 GZ DORDRECHT, NETHERLANDS: SPRINGER, 2015.	Added

49	5	Page 26, line 17-18: DVPRS: Consider these references: Buckenmaier, Chester C., et al. "Preliminary validation of the Defense and Veterans Pain Rating Scale (DVPRS) in a military population." Pain Medicine 14.1 (2013): 110-123. Polomano, Rosemary C., et al. "Psychometric Testing of the Defense and Veterans Pain Rating Scale (DVPRS): A New Pain Scale for Military Population." Pain Medicine (2016): pnw105.	Added
50	5	Page 26, line 56-59 Since you mention PROMIS, PEG, and the DVPRS, would it also be prudent to recommend utilization of these new standards for capturing information on the impact of pain on other key functional domains? These tools were developed with an understanding of the value of collecting information consistently using established functional domains. Because of computer adaptive testing and the modern Internet, collection of information on a wide range of pain related functional domains is feasible. PASTOR, which leverages both PROMIS and the DVPRS, can be completed in less than 20 minutes and provides information on pain intensity (DVPRS) and depression, anxiety, anger, physical function, social function, pain interference, sleep disturbance, and fatigue (PROMIS). Recognizing the PASTOR effort that was developed collaboratively by the VA and DoD seems prudent.	Added: “Additionally, the Pain Assessment Screening Tool and Outcomes Registry (PASTOR) was developed and is being piloted collaboratively by the VA and Department of Defense to use computer adaptive testing and the internet to implement administration of PROMIS and DVPRS in a military health system’s electronic health record system.”

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