Pain Medicine

Pain Medicine 2014; 00: 00–00
Wiley Periodicals, Inc.

The Complexity Model: A Novel Approach to Improve Chronic Pain Care

John F. Peppin, DO, FACP,* Martin D. Cheatle, PhD,† Kenneth L. Kirsh, PhD,‡ and Bill H. McCarberg, MD§

*••, Mallinckrodt Pharmaceuticals, Hazelwood, Missouri; †Department of Psychiatry, Perelman School of Medicine, University of Pennsylvania, Philadelphia, Pennsylvania; ‡••, Millennium Research Institute, Lexington, Kentucky; §••, Neighborhood Healthcare, Escondido, California, USA

Reprint requests to: Martin D. Cheatle, PhD, Center for Studies of Addiction, Perelman School of Medicine, University of Pennsylvania, 3535 Market Street, 4th Floor, Philadelphia, PA 19104, USA. Tel: 215-746-7365; Fax: 610-988-4952; E-mail: cheatle@mail.med.upenn.edu.

Disclosures and conflicts of interest: JP: nothing to declare that relates to the topic of this article. MC: nothing to declare that relates to the topic of this article. KK: nothing to declare that relates to the topic of this article BM: Advisor: Pfizer, Pricara, Sucampo, InsysTherapeutics, QRxPharma, TevaPharma, Neurogesx, Salix.

Abstract

Objective. More than 25% of the US population experiences chronic pain; yet few physicians specialize in the field of pain medicine. This article will review a theoretical model of care that stratifies treatment and patients by level and type of complexity and promotes communication between specialist and primary care providers.

Discussion. The undertreatment of pain was recently brought to national attention to encourage both clinicians and patients to advocate for improved pain care. The specialty of pain medicine and models of care, challenges of managing pain in a primary care setting, and the reliance on an opioid-focused approach are reviewed. An evolved model of pain care based on the complexity of pain and emphasizing a dynamic collaboration between the primary care provider and the pain specialist is discussed.

Conclusions. From the perspective of the busy clinician, the treatment of chronic pain can be overwhelming. The scarcity of trained pain practitioners and the burgeoning number of patients with chronic pain necessitate a new approach that values the complex nature of chronic pain and offers a practical blueprint to meet these challenges.

Key Words. Chronic Pain; Pain Medicine

Introduction

The specialty of pain medicine represents a relatively new field that is only a few decades old. At the inception of this specialty, the need to effectively treat those patients with chronic pain was great and remains imperative. It has been recently estimated that 100 million people in the United States suffer from chronic and undertreated pain [1]. The economic cost of chronic pain is also staggering. The recent Institute of Medicine (IOM) report "Relieving Pain in America: A Blueprint for Transforming Prevention, Care, Education, and Research" estimated the annual cost of chronic pain in the United States to be $560 to over $600 billion including health care costs ($261–300 billion) and lost productivity ($297–336 billion) [2]. Ferrell has described the status of chronic pain treatment as "the moral outrage of unrelieved pain" [3]. Likewise, the IOM report on pain emphasized that effective pain management is a "moral imperative" and added that pain should be considered a disease with distinct pathology and there is a need for interdisciplinary treatment approaches [2].

There is a clear need to provide care to this growing patient population, but there is a scarcity of trained physicians or health care professionals (HCPs) with the knowledge base to manage all these patients [4,5]. Due to this shortage of specialty trained HCPs, primary care physicians (PCPs) have by default filled a "surrogate" role as pain physician [6]. The movement of increasing the involvement of PCPs in the treatment of chronic

pain was born out of necessity but is not a new concept. Gallagher in 1999 [7] strongly advocated for a reorganization of how the health care system manages pain and outlined a model in which pain medicine physicians collaborate with PCPs and provide ongoing "consultative support." More recently, Gallagher challenged us to view chronic pain as a public health problem that requires a population-based approach that depends on PCPs being skilled in pain management and pain care delivered within the medical home model [8]. Unfortunately, for the most part, the focus has been on educating PCPs on the appropriate and safe use of opioids [9]. However, chronic pain is a dynamic, multidimensional phenomenon that requires the PCP and pain physicians to work collaboratively and utilize an arsenal of interventions not just one approach (pharmacotherapy, injections, etc) to promote and maintain improvement.

A new approach is necessary to effectively and efficiently assess and stratify patients by need: complicated cases requiring the expertise of a pain medicine specialist; less complex cases that can be managed by the PCP with pain specialist support; and cases easily managed by PCPs. As most PCPs do not feel confident in their ability to treat these complex pain patients, a successful treatment model will facilitate improved communication, cooperation, and a team approach to this patient population [10,11].

This article will review the current approach to the treatment of patients with chronic pain and outline an approach to pain care termed "the Complexity Model," which emphasizes patient stratification and facilitates an ongoing collaboration between the pain specialist and the PCP. The proposed theoretical stratification tool is designed to guide patient selection, triage, and treatment. Development of this tool was based on prevailing literature and consensus of the authors who have extensive expertise in the field of pain medicine. This is similar to the process utilized in the development of the Opioid Risk Tool [12] which was initially based on expert opinion of risk factors for opioid misuse and later validated. The intent of this article is not to present a detailed model of care but to highlight the deficiency of the current approach to managing chronic pain. The goal of this model is to raise awareness of the complex nature of chronic pain, promote a more comprehensive evaluation of these patients, and improve the efficiency of managing patients with chronic pain in the PCP setting. Further research will be required to validate and refine this model and stratification tool.

Pain Medicine and Models of Pain Care

The early "pain community" was concerned with educating physicians and other HCPs about the importance of treating pain, both acute and chronic and at end of life. Pain medicine has evolved into a specialty with multiple journals, professional organizations, and a specialized body of knowledge.

Pain specialists come from a variety of backgrounds, the majority being from anesthesiology but also include physical medicine and rehabilitation, internal medicine, neurology, and psychiatry. Pain fellowships have become increasingly more focused on acquiring technical skills in interventions and pharmacotherapy. While interventions are quite useful for rendering a differential diagnosis or alleviating an acute pain episode, outcome studies on patients with chronic noncancer pain reveal minimal long-term efficacy from the majority of treatments provided in pain medicine [13].

There are several models for pain care that includes unimodality approaches such as interventional pain medicine and multimodal (pain management and pharmacotherapy), multidisciplinary, and interdisciplinary care. Multidisciplinary care consists of care provided by several disciplines and typically is not coordinated nor having shared treatment goals. Interdisciplinary pain care relies upon a team of health care providers that possess unique skills and knowledge that compliment each other. Team members are collaborators, and treatment decisions and goals are consensus based [14]. While there is evidence of the effectiveness of the interdisciplinary pain care model, the number of such clinics has been on the decline in the United States [15].

Managing Chronic Pain in the Primary Care Setting

Complicating the ability of patients to receive appropriate pain care is the mismatch of the potential number of patients suffering from chronic pain (100 million) and the number of board-certified physicians. The majority of pain patients are cared for by PCPs, who often lack the training, time, or resources to effectively and efficiently assess and manage these complex cases. Few PCPs feel comfortable in treating pain or prescribing opioids [10,11]. The majority of chronic pain patients, even the most complicated cases, rarely see a pain specialist or have an evaluation at an interdisciplinary pain center. Lack of access is one factor limiting referral to pain specialists, and also, the complicated nature of pain can be overwhelming even for the well-trained specialist.

A promising recent development in improving pain care is the Accountable Care Act of 2010 emphasis on encouraging the establishment of patient-centered medical homes (PCMHs). The model of PCMHs is to develop a multidisciplinary team led by a PCP to prevent the emergence of predictable health problems, intervene early when problems arise, and actively track and manage patient symptomology. A model of managing patients with pain and substance use disorder within a PCMH has been described in the literature [16].

Complexity

Medicine, in its' current paradigm, approaches a problem linearly. Ockham of Orange developed a theory of

how data and observations could be taken into account with a single overriding theory, which has been labeled "Ockham's Razor" [17]. For example, a patient has pneumonia, diabetes, and heart disease, and all are assessed and treated as separate entities. Most medical professionals may be unfamiliar or uncomfortable in attempting to incorporate a number of different symptoms, disease states, medications, etc, into a single, complex multimodal approach. The traditional method is to examine each individual problem by itself and apply the linear approach by rendering a diagnosis followed by a specific treatment plan, thus adhering to the principles of Ockham's Razor. This linear approach may be suitable in treating an acute process such as a diseased appendix, but the medical community has been less than effective when managing complex chronic diseases, especially chronic pain.

A nonlinear model has many advantages when dealing with a chronic disease. Unfortunately, changing paradigms in science and medicine can be a herculean task [18]. Linearity is often central in the training of HCPs and has utility in a number of scenarios encountered in medical practice but is much less useful in more complicated chronic cases. We are challenged to incorporate this more traditional "linear" approach into a more "nonlinear" or Complexity Model. Complexity can be defined as "a system in which large networks of components with no central control and simple rules of operation give rise to complex collective behavior, sophisticated information processing, and adaptation via learning or evolution" (p. 23) [19]. It is that "behavior" that we are treating in the chronic pain patient. The construct of complexity clearly relates to chronic disease as Johnson states, "... the most lethal diseases have managed to tap into the heart of what makes a Complex system so difficult to predict, manage and control—thereby outsmarting the body's sophisticated, but ultimately limited, defense mechanisms" (p. 177) [20].

Pain Medicine as a Specialty

The vast majority of pain fellowships have been administered under anesthesia departments, and the primary focus has been on interventions. While this is suitable for making a differential diagnosis and relieving an acute pain episode, it is less effective in managing the complex chronic pain patient. For all practical purposes, chronic pain should be considered a chronic disease [2,21].

While PCPs are trained in the chronic disease management model, which requires collection of complex histories and performance of physical examinations to generate a diagnosis and treatment plan, most fellowship-trained pain physicians do not acquire these skills. Pain fellowships are 1 year in duration with ACGME requirements to master multiple interventions [22]. It is inconceivable that a pain fellow could acquire the knowledge and skills to manage the complexities of the chronic pain patient.

Fishman et al. [23] asserted that the field of pain medicine was fragmented and practiced as a subspecialty of a number of medical disciplines and that there was a need for specialized training in pain medicine. Subsequently, a 2009 position paper from the American Academy of Pain Medicine (AAPM) [24] strongly recommended that pain medicine be established as a primary medical specialty which would support a multidisciplinary approach.

Ideally, there would be a distinct 3- to 4-year pain residency organized through an integrated pain department that would include training in the history, physical examination, diagnosis, and treatment of acute and chronic pain. Fellowships could be offered for additional focused specialization (interventions, addiction, etc). Realistically, at the minimum, the current fellowship structure should be extended to a 2-year fellowship to incorporate these needed skills.

The Opioid-Focused Model

Opioids have, for millennia, provided relief from suffering for patients with pain of cancer origin and noncancer origin. Opioids have become increasingly a focus both in the media and in published articles on the treatment of pain. A brief keyword search in PubMed helps to reinforce this assertion (see Table 1). This emphasis on opioid therapy has resulted for a number of reasons, including the unidimensional, linear approach to chronic pain (and medicine in general), the focus of the pharmaceutical industry, and the use of the opioid model from end-of-life and cancer populations being transposed to those with pain of noncancer origin. With all the other potential pharmacologic and nonpharmacologic interventions available to treat pain, the overemphasis on opioids has led to an increase in opioid prescribing and presents distinct medical, societal, and psychosocial problems.

Opioids can be effective in relieving chronic pain but should not be the default standard for all chronic pain patients especially due to time constraints or pressure

Table 1 Brief keyword search of PubMed looking for numbers of articles on pain

Keywords	Articles
"opioids"	88,692
"opioids" + "pain"	26,728
"narcotics" + "pain"	19,735
"NSAIDs" + "pain"	15,163
"anti-inflammatory" + "pain"	13,209
"steroids" + "pain"	11,336
"antidepressants" + "pain"	4,392
"benzodiazepines" + "pain"	2,355
"muscle relaxants" + "pain"	815
"TCAs" + "pain"	94

from the patient to obtain immediate relief. Some patients respond well to opioid therapy, whereas others do not, and in a subgroup of patients, the risks outweigh any potential benefits. Only a comprehensive evaluation can determine the most appropriate therapeutic approach for an individual patient and help mitigate the risk of opioid misuse, abuse, and addiction.

A New Model of Chronic Pain Treatment Stratification

Multiple problems and issues can affect a patient's pain level and their ability to function effectively with their pain. These include motivational, educational, psychiatric and behavioral, social, and medical variables. A comprehensive biopsychosocial approach to evaluation and treatment decision making seems intuitive in dealing with a complex pain patient but is often not utilized. The IOM report on pain noted "We believe pain arises in the nervous system but represents a complex and evolving interplay of biological, behavioral, environmental, and societal factors . . ." [2]

The focused approach is one of physician convenience and training and not one of proper treatment and evaluation. Barriers to the biopsychosocial approach will still continue, for example, reimbursement for the increased time involved, training physicians in the traditional biomedical philosophy, patient's resistance to a more expansive evaluation which includes psychosocial assessments, etc. However, the biopsychosocial approach has been demonstrated to be clinically and economically efficacious for a variety of pain conditions [25–28].

The Complexity Model requires a comprehensive pain evaluation that includes assessing the various factors that can influence the manifestation and maintenance of chronic pain. Based on this evaluation, patients then can be stratified into levels of care (PCP, PCP plus specialty care, etc).

Factors Affecting Chronic Pain

Medical Comorbidities

Patients with chronic pain often present with various medical comorbidites. In a study from the Netherlands on patients with hip and knee osteoarthritis, 98.6% suffered from one or more coexistent diseases, and of this group, 84.4% suffered from one or more moderate or severe coexistent diseases with cardiac disease being the most prevalent [29]. Similar results have been found in patients with chronic low back pain [30]. Much of the literature on comorbidities suggests a strong negative correlation between comorbidities and insomnia, pain, and other symptoms. Although this is intuitive, there has been little written in the literature about the evaluation, diagnosis, or quantification of comorbidities in patients with chronic pain. Treatment decisions need to factor in medical comorbidities such as activating physical therapy in a patient with cardiac disease or use of opioids in a patient with obstructive sleep apnea.

Psychiatric Comorbidities

It is not uncommon for patients with chronic pain to present with multiple psychiatric comorbidities particularly depression and anxiety. There is compelling neuroscientific and clinical evidence regarding the strong relationship between the pain experience and mood states and the effect of stress on central nervous system dysregulation [31,32]. In a large sample (N = 5,877) obtained from the National Comorbidity Survey, the association between chronic pain and common mood and anxiety disorders was assessed and compared with the general population. The prevalence of depression was 20.2% in the chronic pain group vs 9.3% in the general population; any anxiety disorder in the pain group was 35.1% vs 18.1% in the general population, and the prevalence Posttraumatic stress disorder was 10.7% vs 3.3% [33]. Psychosocial factors can alter the pain experience and determine outcomes in patients with pain and therefore should be assessed and treated [34].

Risk for Medication Abuse and Diversion

While the majority of pain patients do not abuse, misuse, or are at risk for iatrogenic addiction when prescribed opioids, a subgroup of this population will have difficulty in managing their medications. Given the rising prevalence of prescription opioid abuse and opioid-related overdoses, it is imperative that providers caring for these patients, and who may prescribe opioids, screen and monitor for signs of misuse, abuse, evolving addiction, and diversion [35–41]. As recommended by several expert consensus groups, appropriate opioid prescribing, risk assessment, and monitoring should include the use of validated screening tools developed from the research on aberrant drug-related behaviors suggestive of opioid misuse or abuse, and urine drug monitoring [42–44]. Based on the initial risk assessment, patients can be classified into low-, moderate-, and high-risk groups for misusing/abusing opioids [45]. Patients considered to be at low risk can be managed in primary care with less intense monitoring (i.e., less frequent office visits) and more moderate dosing of opioids. Patients at moderate risk will require closer surveillance, more limited access to opioids initially, and possible cotreatment with other specialists (such as behavioral health practitioners, addiction medicine practitioners). Some PCPs will feel comfortable with managing moderate-risk patients alone, but reaching out to other professionals should be an option at this stage for those who have little interest or confidence in managing this level of complexity. Patients judged to be at high risk should be referred to a specialty pain management program or if actively abusing medications to a chemical dependency program.

Number of Chronic Pain Problems/Triggers

Most chronic pain patients, both in Europe and the United States, have more than one pain complaint at their initial evaluation [46,47]. Intuitively, the greater the number of pain complaints, the more difficult it will be to

evaluate and treat a patient. Further, if a patient presents for the "focused" evaluation for back pain, yet they also have migraines, chronic generalized myofascial pain syndrome, and knee pain, it seems unlikely that a single intervention (spinal surgery, injection) will be successful.

Number of Past Surgeries

There has been a growing literature on the relationship between chronic pain states and past surgeries. Pain after thoracic surgery has been reported as high as 25–60% [48]. Chronic chest wall pain in patients who have had mastectomies is increasingly recognized as a common and problematic complication of these surgeries [49]. Approximately 14% of patients undergoing laparoscopic herniorrhaphy will experience chronic pain [50]. There is even a postsurgery fatigue syndrome that is becoming better recognized [51]. A study from Germany found that "pain-associated surgeries" were a negative predictor of treatment outcomes [52]. This data can be easily obtained when taking a patient history.

Tobacco Usage

Tobacco use has a strong relationship with chronic pain, but the true nature of this relationship is poorly understood. Interestingly, it appears that nicotinic receptors have a role to play in analgesia [53]. Some congeners of nicotine have activities, in animal models, that equal morphine [54]. Further, lung cancer patients who continue to smoke have higher levels of pain than those who do not [55]. Other studies have shown that smokers in a chronic pain clinic have elevated pain and increased pain interference with function [56]. In this study, there was also a correlation with the amount smoked. Lastly, there is evidence that patients that are nicotine dependent have a higher risk for abusing prescribed opioids [57].

Head Trauma History

Traumatic brain injury (TBI) is currently underdiagnosed [58]. Mild TBI may predispose patients to increased substance abuse [59]. Those with head trauma tend to have higher premorbid rates of abuse and addiction which may be the mechanism of the trauma in many cases [60,61]. Additionally, TBI is a risk factor for subsequent depression and other psychiatric disabilities [62]. As far as the risk for the development of chronic pain states, traumatic migraine or headache are well described [63]. However, other pain states have not been systematically examined. In one review, 23 studies were analyzed [64]. Although many of the studies reviewed had limitations, the authors concluded, "Chronic pain is a common complication of TBI and contributes to morbidity and potentially poor recovery after brain injury." At least empirically, there seems to be an association with head trauma and pain states other than headache. This seems to be true even for minor brain injuries. As TBI can also affect cognition and emotion, this is an important factor to determine, evaluate, and treat if necessary.

Body Mass Index

Data suggest that bariatric surgery can moderately reduce lower back pain [65]. Further, there is a fairly strong correlation between musculoskeletal pain and obesity [66]. Obesity may also be a contributor to osteoarthritis, not only through excessive joint loading but also through the induction of an inflammatory component [67]. In a study from the Netherlands on patients with osteoarthritis of the hip or knee, 52% had a body mass index (BMI) between 25 and 30 [68]. The current data seems to suggest that increased weight is not associated with significantly increased chronic pain, generally, except perhaps in elderly populations where obesity is highly correlated with chronic pain [68,69]. However, elevated BMI is correlated with other disease states that must be diagnosed and treated in the chronic pain patients (e.g., sleep apnea). Again, stressing the importance of the complexity of chronic pain, the author stated, "Calculation of the BMI should become a routine part of the screening evaluation for chronic pain patients, with additional screening for disability and psychological distress in patients with elevated BMIs." [69] It is critical that BMI be included in the evaluation of these patients and that weight loss (through diet and exercise) be emphasized. Additionally, BMI needs to be evaluated on a regular basis and needs to be addressed, especially in the setting of chronic opioid therapy due to increased risk of obstructive sleep apnea and respiratory depression.

Sleep Disorders

The majority of patients with chronic pain report problems with sleep disruption. There is also literature that sleep disturbance can exacerbate clinical pain [70,71], and pain can clearly cause sleep disruption. The hypothesized mechanisms of the bidirectional association between pain and sleep have included that sleep deprivation causes a reduction in pain thresholds [72] and evidence that sleep deprivation leads to an increase in inflammatory cyctokines [73].

Sleep disorders must be evaluated, diagnosed, and treated. Further, a low threshold should be taken and patients sent for evaluation with a sleep specialist when sleep apnea is suspected especially if the patient is prescribed opioids. Without restful and consistent sleep, treatment outcomes will be compromised.

Goal Setting

Appropriate and realistic goal setting is a critical component in developing a patients' treatment plan. Unrealistic goals may never be met and yield frustration and hopelessness in patients which will translate into poor adherence to prescribed therapies and treatment failure. Patients who accept that they will always have some degree of pain and limitations and establish a goal of symptom management tend to have improved mood and functionality. Much of the work on goals and pain management has been published in occupational and

physical medicine and rehabilitation literature. In one study, goal setting was defined as an individual's motivation to return to work. This was the single most predictive factor in a patient being able to return to work [74]. Appropriate goal setting adds to the complexities of evaluation and treatment and needs to be taken into consideration.

Education Level and Employment Status

In a study examining arm, shoulder, and neck pain, women and those with the lowest educational levels had the highest pain scores [75]. Educational level was correlated with knee pain in a study in general practice patients over the age of 35 years [76]. In a 14-year prospective study of patients in Norway, gender, age, sleep quality, and educational level remained significant variables in the number of pain sites [77]. In a study of patients treated surgically for neuromas, employment status and number of surgeries were negatively correlated with neuroma surgical outcomes [78]. While we cannot change the educational or socioeconomic status of patients, we can be cognizant that these factors might affect treatment outcome.

Pharmacotherapy Regimen

Polypharmacy is the rule rather than the exception in the treatment of all chronic illnesses, chronic pain being no exception [79]. Medication errors can occur if a thorough medication history is not taken [80].

Polypharmacy can contribute to other symptoms, which will complicate treatment. For example, insomnia is associated with polypharmacy [81]. Which medications have worked in the past, which are inhibiting improvement, which are placing the patient at risk, and which need to be changed or doses increased are all questions that must be answered. Patients who are on opioids and have benzodiazepines added to their treatment regimen might have an increased risk of sudden death [82]. Addition of multiple CNS depressants, such as diphenhydramine, tricyclic antidepressants, or benzodiazepines may also exacerbate sleep apnea. The addition of opioids to this mix could be fatal. A rational approach to pharmacotherapy in the chronic pain patient that targets sleep, mood, and pain can be efficacious but first requires a comprehensive, not a focused, evaluation.

Coping and Social Support

There is persuasive literature that psychological factors including pain coping skills and social support can affect pain and functionality [83,84]. In one study, long-term disability was assessed in 78 patients with rheumatoid arthritis. Passive pain coping and low levels of social support predicted functional disability [85]. Dunbar and Katz evaluated 20 chronic pain patients with a history of substance abuse of prescribed opioids. They discovered that those patients that did not abuse opioid therapy were more likely to be active members of Alcoholics Anonymous and to have a stable support system as compared with those patients that abused their prescribed opioids [86]. Assessing and, when necessary, bolstering coping skills and social support can improve long-term outcomes from pain care and mitigate problematic medication use.

Physical Conditioning

It has been found that aerobic exercise reduces pain levels significantly even after only 2 minutes of exercise [86]. This effect is maintained up to 32 minutes of exercise and is maintained 30 minutes postexercise. Additionally, in both obese and nonobese patients, acute resistance exercise improved the sense of positive well-being and the short form-36 psychological scales [87]. Further, there is evidence that regular exercise improves fatigue, depression, and quality of life in patients with multiple sclerosis [88]. Lack of exercise is an increased risk for potential treatment failure and increased pain.

Each of the above criteria for the model has been arbitrarily and intuitively given numerical weight. Each will then be applied to an individual patient and a score obtained. The total scores have been divided into four categories: very low, low, moderate, and high complexity.

Table 2 consolidates the above information into a scoring form. This will allow for quick summation of the complexity score and a ranking, which will help with further treatment and follow-up schedules.

"Complexity" Model for Chronic Pain Treatment

Some of the above categories may overlap. For example, poor sleep patterns and obstructive sleep apnea are related to each other as well as to depression and BMI. All of these factors are related to pain. As there are multiple interactions, it is difficult to parse and separate. This is why the notion of symptom clusters may be a more useful paradigm. This new model must of necessity start with a complete patient history and physical. This is critical as it is the baseline evaluation that determines treatment selection and level of monitoring. Patients and their environment are not static but dynamic, and their complexity will change over time, but the initial evaluation gives the PCP or pain medicine specialist a starting point for a particular patient's background, risks, and potentials for successful treatments. The history should establish the type of pain and the most consistent diagnosis for each pain problem, and the physical examination helps to support that diagnosis (i.e., index of suspicion). Other problems, uncovered by the history and physical examination, should be evaluated as well. Good documentation is critical with the objective to: 1) establish working diagnoses; 2) outline a clear treatment approach; 3) determine the patient's goals; 4) summarize the patient's pain problems, comorbidities, support system; 5) clearly communicate with the patient's PCP; and 6) provide appropriate documentation for reimbursement. Documentation is often stressed as part of safe opioid prescribing practices. Documentation should tell

Table 2 Proposed Complexity Model complexity stratification

Medical Comorbidities
0: No comorbidities
1: Mild chronic disease, such as hypertension
2: Moderate disease (e.g., heart disease, chronic mild to moderate COPD)
3: Chronic disease, such as diabetes, rheumatoid arthritis, chronic kidney disease
4: Severe disease: postbypass surgery, poorly controlled diabetes, more severe COPD, etc, cancer, malnutrition
5: Very severe disease (e.g., end-stage renal and/or liver disease, severe or end-stage cancer, endstage COPD or heart disease)
Psychiatric Comorbidities
0: None
1: Adjustment disorder
2: Major depression without anxiety features
3: Major depression with anxiety features or comorbidity
4: Severe psychiatric disease: schizophrenia, bipolar disorder, borderline personality
Number of Past Surgeries
0: 0 Surgeries
1: 1 Surgery
2: 2–4 Surgeries
3: 5 or More surgeries
Tobacco Use
0: None
1: Smoker
2: Heavy smoker (>1 ppd)
Head Trauma/LOC/Closed Head Injuries
0: 0 Injuries
1: 1 Injury
2: 2 or More injuries
Weight
0: Normal BMI
1: +10% above BMI
2: >30 BMI
Sleep Comorbidities
0: None
1: Mild insomnia
2: Moderate insomnia >1 year
3: Severe insomnia >2 years
4: Sleep apnea, obstructive or central treated
5: Untreated sleep apnea or intolerant to treatment
Scheduled Medication Diversion and Abuse Risk (ORT score)
0: Low risk (0–3)
1: Medium risk (4–7)
2: High risk (8+)

Table 2 Continued

Addiction and Substance Dependency Risk
0: None
1: Catastrophizing, chemical coping traits
2: Past history of addiction
3: Active addiction problem
Level of Conditioning
0: Exercises regularly
1: Exercises intermittently
2: Does not exercise
Number of Chronic Pain Problems
0: Single pain complaint
1: Main pain complaint plus one other pain complaint other than headaches or myofascial pains
2: Main pain complaint plus more than one other pain complaint other than headaches or myofascial pains
3: Main pain complaint plus transformed and chronic migraines/chronic headaches
4: Main pain complaint plus fibromyalgia or multiple chronic myofascial pain syndromes, and headaches or other pain complaint
5: Main pain complaint, plus fibromyalgia, migraines, multiple other pain complaints
Goals
0: Clear and achievable goals
1: Clear but unachievable goals
2: Unrealistic goals

Education Level	Employment Status
0: College or higher	0: Working, retired, or full-time student
1: Finished high school, not further	1: Not working
2: Did not enter or finish high school	2: Disability/claim pending

BMI = body mass index; ORT = Opioid Risk Tool.

the patient's story and remind the HCP of the patient's original presentation and established treatment goals and success in achieving these goals. A systematic approach to gathering history concerning potential comorbidities is essential.

As pain patients often times experience co-occurring mood disorders and can engage in poor pain coping skills such as catastrophizing, a clinical psychologist with expertise in chronic pain can be an essential and invaluable resource. Likewise, pain patients tend to fear movement or exercise (kinesiophobia) which can lead to further deconditioning and more pain. Physical therapy assessment and cotreatment can be helpful in restoring patient's mobility, endurance, and self-efficacy all leading to improved pain, mood, and functionality.

The pain medicine specialist should be a true consultant. Each patient of sufficient complexity would be referred, and each patient should have a PCP. The pain medicine specialist should require that any patient seen without a PCP obtain one as a necessary component in their treatment program. The Complexity Model can only work for managing the most involved cases when there is close cooperation and communication with the PCP. The patient needs to be stratified into the various complexity categories, have comorbidities assessed, and an initial treatment regimen defined. This can be done by the PCP or pain medicine specialist depending on the confidence levels of all involved clinicians. The PCP can then implement and monitor the treatment regimen, with continued input from the pain medicine specialist as needed and defined by the complexity category. Patient's complexity will change as they age and have the potential of developing other more serious comorbidities. This might necessitate a re-evaluation by the pain specialist.

Once the patient has had the initial evaluation, diagnoses have been rendered, and a treatment plan outlined, the patient may be monitored by the PCP, especially if the patients is in the very low or low-complexity stratification groups. The high and some moderate complexity patients may require more frequent follow-up visits; however, even in these groups, once the comorbidities are diagnosed and treated and the pain controlled, the

PCP may be able to monitor and manage the treatment regimen. This could even be done in conjunction with audio/video teleconference follow-up visits especially in rural states [90].

Treatment could be a combination of pharmacological therapies, interventions (injections, radio frequently ablation, spinal cord stimulation), physical therapy, cognitive behavioral therapy, and/or integrative/complimentary therapies. The pharmacologic therapies should be broad and include "adjuvants" such as antiepileptics, muscle relaxants, SNRIs, SSRIs, TCAs, and other medications. Opioids are one option and should be used within the confines of the risks and complexity stratifications described. There should never be a "cookie cutter" approach to the chronic pain patient but rather an attempt to use all the potential modalities and therapies available in a logical approach and based on, when available, consensus-based guidelines.

As there are so many facets involved in managing and coordinating the care of these patients, a "case manager" should be involved to oversee each individual patients' treatment plan and ensure that consultations, referrals, past medical records, and testing were obtained and completed. This could be accomplished in the setting of a "Preauthorization" department and may be funded in part by private insurance companies as a form of cost-containment strategy [91]. In addition, there needs to be oversight of the process, which could occur using a psychologist, pharmacist, or other HCP. This coordinator could be housed either in the offices of the PCP or the pain medicine specialist. They would review each patient's medications, treatments, physicians, and co-morbidities. Follow-up visits would be noted and patients held accountable for keeping those appointments.

Necessary Systemic Changes

There are multiple barriers to the implementation of this model. These include 1) achieving appropriate reimbursement for these types of evaluations; 2) recognition and financial support for multidisciplinary and interdisciplinary approaches; 3) appropriate training of pain medicine specialists in the "complexity" model; and 4) design and implementation of research to validate and refine this approach and determine which components are effective and which are not effective.

The time required for these types of evaluations can be lengthy depending on the complexity of the presenting patient and expertise of the clinician involved. This must be reimbursed appropriately. Our current reimbursement system is procedure and intervention focused. It does not reward the intellectual effort required for 90 minutes spent performing the type of thorough evaluation required. If the objective is to improve pain management outcomes and reduce the economic burden of poorly managed pain, the current reimbursement system for cognitive medicine needs to change [2]. In addition, interdisciplinary pain programs have been disappearing, and only a few such programs continue to operate [15,92]. One reason for this reduction is not the paucity of evidence supporting efficacy and cost savings [93,94] but the lack of financial support from third-party payers.

Conclusions

Over the last several decades, there has been an evolution in primary care to shift from a linear approach to disease management compartmentalizing medicine based on organ systems and /or procedures to a nonlinear model based on complex science theories [95]. In the field of pain medicine, there has also been recognition that pain is a complex phenomenon that requires a collaborative effort of PCPS and specialists. Gallagher [8] introduced the "Pain Medicine and Primary Care Community Rehabilitation Model" which emphasizes an integrated, interdisciplinary, patient-centered team care approach based on the biopsychosocial model embedded in the PCP practice site and supported by pain medicine specialty clinics. Collaborative care models, which stress an integration of care between the PCP, the patient, and the specialist, have been developed to address effectively managing pain with opioids while minimizing risk [96,97]. The Complexity Model, like previous calls for reform in pain care [2,7,8,23], requires that all pertinent issues are identified, patients stratified, and that treatment is personalized to the needs of an individual patient and their specific medical and psychological comorbidities. The pain medicine specialist working collaboratively with the PCP would evaluate and stratify the patient and send back treatment and monitoring recommendations based on that stratification. The Complexity Model is unique in that it stratifies patients based on psychological and physical comorbidities.

For any of these proposed models to function appropriately, there needs to be "oversight." That is follow-up to ensure that testing and referrals are scheduled and completed, old records are obtained for review, pharmacotherapy regimen is adhered to, and treatment goals are achieved or revised. Further, the patient must begin to accept more responsibility for their treatment and improvement. A group-based "pain school" typically lead by a psychologist could be developed that would include information on pain, diet, weight loss, exercise, improving pain coping skills, and smoking cessation. This "school" would be cost- and time-effective. Patients would be encouraged to attend, and accountability for attendance and progress would function similar to that seen in Alcoholics Anonymous and Weight Watchers.

Concerns that this approach is too time-consuming and is poorly reimbursed or that pain medicine specialists have not been trained in this type of evaluation may be valid in the current system. However, if we are to meet the challenges set forth in the AAPM 2009 position paper or the more recent IOM report, we must advocate for changing the current approach to training pain specialists,

reimbursement, and how we evaluate and treat chronic pain patients. From a practical perspective, a thorough evaluation at the first visit saves time at subsequent visits. Medication interactions, interfering treatments, or redundant treatments and tests could be reduced, and the patient's comorbidities would be addressed leading to improved pain care and outcomes and health care cost savings.

In the current atmosphere of "health care reform," there should be a great concern among pain medicine physicians as there is some speculation that reimbursement will be dependent on outcomes and patient satisfaction. The multidisciplinary approach to chronic pain is the most efficient and efficacious, and we must work to protect this critical asset for our patients. A piecemeal approach will be ineffective and costly to the patient, society, and eventually to the practitioner.

Future research must include measuring the various comorbidities in a large cohort of patients with pain and developing a more refined stratification model and subsequently testing this model against meaningful outcome measures (pain, function, mood, return to work, etc). Adoption of any new model of pain care also requires demonstration of economic viability.

Summary

Chronic pain is prevalent and continues to grow, and there is a lack of pain specialists with an attendant consequence of undertreating pain leading to more suffering. Most pain care is delivered by PCPs who typically do not have the time and resources or possess the requisite skills to manage these complicated cases.

Opioids have been a focus of pain care but are not the answer for most patients and can lead to additional personal and societal problems. Treatment must be at the very least multidisciplinary, directed by a well-trained practitioner, and based upon the patient's stratification into levels of complexity. A comprehensive biopsychosocial evaluation and treatment regimen will be more efficacious than symptoms management by an array of HCPs.

The Complexity Model evaluates and treats all of the domains that constitute the chronic pain experience. The success of the model depends on each patient having a PCP and the pain physician serving as a true consultant.

The future of pain medicine as a specialty will require a change from the current linear model of care to an interdisciplinary and coordinated model.

Acknowledgment

MDC would like to acknowledge the support from Grant 1R01DA032776-01 from the National Institute on Drug Abuse, National Institutes of Health in the writing of this manuscript.

References

1 Tsang A, Von Korff M, Lee S, et al. Common chronic pain conditions in developed and developing countries: Gender and age differences and comorbidity with depression-anxiety disorders. J Pain 2008;9(10):883–91.

2 Institute of Medicine (IOM). Relieving Pain in America: A Blueprint for Transforming Prevention, Care, Education, and Research. Washington, DC: The National Academies Press; 2011.

3 Ferrell BR. The role of ethics committees in responding to the moral outrage of unrelieved pain. Bioethics Forum 1997;13(3):11–6.

4 Gureje O, Von Korff M, Simon GE, Gater R. Persistent pain and well-being: A World Health Organization study in primary care. JAMA 1998;280(2):147–51.

5 Breuer B, Pappagallo M, Tai JY, Portenoy RK. US Board certified pain physicians practices: Uniformity and census data of their locations. J Pain 2007;8(3):244–50.

6 Cole BE. Resources for education on pain and its management: A practitioner's compendium. Curr Pain Headache Rep 2009;13(2):110–9.

7 Gallagher RM. Primary care and pain medicine. A community solution to the public health problem of chronic pain. Med Clin North Am 1999;83(3):555–83.

8 Gallagher RM. Pain medicine and primary care: The evolution of a population-based approach to chronic pain as a public health problem. In: Deer T, Leong M, Buvanendran A, et al., eds. Comprehensive Treatment of Chronic Pain by Medical, Interventional, and Integrative Approaches. The American Academy of Pain Medicine Textbook on Pain Management. New York: Springer; 2013:1003–11.

9 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 Med 2007;8(7):573–84.

10 Upshur CC, Luckmann RS, Savageau JA. Primary care provider concerns about management of chronic pain in community clinic populations. J Gen Intern Med 2006;21(6):652–5.

11 O'Rorke JE, Chen I, Genao I, Panda M, Cykert S. Physicians' comfort in caring for patients with chronic nonmalignant pain. Am J Med Sci 2007;333(2):93–100.

12 Webster LR, Webster RM. Predicting aberrant behaviors in opioid-treated patients: Preliminary validation of the Opioid Risk Tool. Pain Med 2005;6(6): 432–42.

13 Jamison R. Nonspecific treatment effects in pain medicine. IASP Pain Clinical Updates 2011;XIX(2): 1–7.

14 Turk DC, Paice JA, Cowan P, et al. Interdisciplinary pain management, 2010. Available at: http://www.americanpainsociety.org/uploads/pdfs/2010InterdisciplinaryWhitePaper-FINAL.pdf (accessed November, 2014).

15 Schatman ME. Interdisciplinary chronic pain management: International perspectives. IASP Pain Clinical Updates 2012;XX(7):1–5.

16 Cheatle MD, Klocek J, McLellan AT. Managing pain in high-risk patients within a patient-centered medical home. Transl Behav Med 2012;2:47–56.

17 Ockham W. Philosophical Writings A Selection, Revised edition. Indianapolis, IN: Hackett Pub Co; 1990.

18 Kuhn T. Structures of Scientific Revolution. Chicago, IL: University of Chicago Press; 1970.

19 Melanie M. Complexity, a Guided Tour. New York: Oxford University Press; 2009.

20 Johnson NF. Simple Complexity: A Clear Guide to Complexity Theory. Oxford, England: Oneworld Publications; 2007.

21 Tracey I, Bushnell MC. How neuroimaging studies have challenged us to rethink: Is chronic pain a disease? J Pain 2009;10(11):1113–20.

22 ACGME. Program requirements for graduate medical education in pain medicine, 2014. Available at: https://www.acgme.org/acgmeweb/Portals/0/PFAssets/ProgramRequirements/530_pain_medicine_07012014_1-YR.pdf (accessed November 2014).

23 Fishman SM, Gallagher RM, Carr DB, Sullivan LW. The case for pain medicine. Pain Med 2004;5(3): 281–6.

24 Dubois MY, Gallagher RM, Lippe PM. Pain medicine position paper. Pain Med 2009;10(6):972–1000.

25 Lamb SE, Hansen Z, Lall R, et al. Group cognitive behavioral treatment for low-back pain in primary care: A randomized controlled trial and cost-effectiveness analysis. Lancet 2010;375(9718):916–23.

26 Linton SJ. A 5-year follow-up evaluation of the health and economic consequences of an early cognitive behavioral intervention for back pain: A randomized, controlled trial. Spine 2006;31(8):853–8.

27 Thieme K, Flor H, Turk D. Psychological pain treatment in fibromyalgia syndrome: Efficacy of operant behavioral and cognitive behavioral treatments. Arthritis Res Ther 2006;8(4):R121.

28 Turner JA, Manci L, Aaron LA. Short- and long-term efficacy of brief cognitive-behavioral therapy for patients with chronic tempromandibular disorder pain: A randomized, controlled trial. Pain 2006; 121(3):181–94.

29 van Dijk GM, Veenhof C, Schellevis F, et al. Comorbidity, limitations in activities and pain in patients with osteoarthritis of the hip or knee. BMC Musculoskelet Disord 2008;9:95. doi: 10.1186/1471-2474-9-95. Available at: http://www.biomedcentral.com/1471-2474/9/95 (accessed December 2013).

30 Ritzwoller DP, Crounse L, Shetterly S, Rublee D. The association of comorbidities, utilization and costs for patients identified with low back pain. BMC Musculoskelet Disord 2006;7:72. doi: 10.1186/1471-124747-7-72. Available at: http://www.biomedcentral.com/1471-2474/7/72 (accessed December 2013).

31 Rome H, Rome J. Limbically augmented pain syndrome (LAPS): Kindling, corticolimbic sensitization, and the convergence of affective and sensory symptoms in chronic pain disorders. Pain Med 2000;1:7–23.

32 Chapman CR, Tuckett RP, Song CW. Pain and stress in a systems perspective: Reciprocal neural, endocrine, and immune interactions. J Pain 2008; 9(2):122–45.

33 McWilliams LA, Cox BJ, Enns MW. Mood and anxiety disorders associated with chronic pain: An examination in a nationally representative sample. Pain 2003;106(1–2):127–33.

34 Rahman A, Reed E, Underwood M, Shipley ME, Omar RZ. Factors affecting self-efficacy and pain intensity in patients with chronic musculoskeletal pain seen in a specialist rheumatology pain clinic. Rheumatology (Oxford) 2008;47(12):1803–8.

35 Substance Abuse and Mental Health Services Administration. *Results from the 2009 National Survey on Drug Use and Health: Volume I. Summary of National Findings* (Office of Applied Studies, NSDUH Series H-38A, HHS Publication No. SMA 10-4856Findings). Rockville, MD; 2010.

36 Johnston LD, O'Malley PM, Bachman J, Schulenberg JE. Monitoring the future national results on adolescent drug use: Overview of key findings, 2010. Ann Arbor MI. Institute for Social Research, The University of Michigan. 2011. Available at: http://radar.boisestate.edu/radar/pdfs/mtf-overview2010.pdf (accessed December 2013).

37 Substance Abuse and Mental Health Services Administration, Center for Behavioral Health Statistics and Quality. *Drug Abuse Warning Network, 2008: National Estimates of Drug-Related Emergency Department Visits*. HHS Publication No. SMA 11–4618. Rockville, MD; 2011.

38 Warner M, Chen LH, Makuc DM. Increase in fatal poisonings involving opioid analgesics in the United States, 1999–2006. NCHS Data Brief 2009;22(September):1–8.

39 Paulozzi LJ, Budnitz DS, Xi Y. Increasing deaths from opioid analgesics in the United States. Pharmacoepidemiol Drug Saf 2006;15(6):618–27.

40 Paulozzi LJ, Ryan GW. Opioid analgesics and rates of fatal drug poisoning in the United States. Am J Prev Med 2006;31(6):506–11.

41 Bohnert AS, Valenstein M, Bair MJ, et al. Association between opioid prescribing patterns and opioid overdose-related deaths. JAMA 2011;305(13):1315–21.

42 Chou R, Fanciullo GJ, Fine PG, et al. Clinical guidelines for the use of chronic opioid therapy in chronic noncancer pain. J Pain 2009;10(2):113–30.

43 Passik S, Kirsh K. Screening for opioid abuse potential. Clin Updates IASP 2008;26(7):1–4.

44 Peppin JF, Passik SD, Couto JE, et al. Recommendations for urine drug monitoring as a component of opioid therapy in the treatment of chronic pain. Pain Med 2012;13(7):886–96.

45 Gourlay DL, Heit HA, Almahrezi A. Universal precautions in pain medicine: A rational approach to the treatment of chronic pain. Pain Med 2005;6(suppl 2):107–12.

46 AAPM Facts and Figures on Pain. American Academy of Pain Medicine. Available at: http://www.painmed.org/patientcenter/facts_on_pain.aspx#incidence (accessed November 2014).

47 Chrubasik S, Junck H, Zappe HA, Stutzke O. A survey on pain complaints and health care utilization in a German population sample. Eur J Anaesthesiol 1998;15(4):397–408.

48 Wildgaard K, Ravn J, Kehlet H. Chronic post-thoracotomy pain: A critical review of pathogenic mechanisms and strategies for prevention. Eur J Cardiothorac Surg 2009;36(1):170–80.

49 Couceiro TCM, Menezes TC, Valênca MM. Post-masectomy pain syndrome. The magnitude of the problem. Rev Bras Anesthesiol 2009;59(3):358–65.

50 Dickinson KJ, Thomas M, Fawole AS, Lyndon PJ, White CM. Predicting chronic post-operative pain following laparoscopic inguinal hernia repair. Hernia 2008;12(6):597–601.

51 Zargar-Shostari K, Hill AG. Postoperative fatigue: A review. World J Surg 2009;33(4):738–45.

52 Schulte E, Hermann K, Berghöfer A, et al. Referral practices in patients suffering from non-malignant chronic pain. Eur J Pain 2010;14(3):308e1–10.

53 Picciotto MR, Caldarone BJ, Sarah L, King SL, Zachariou V. Nicotinic receptors in the brain: Links between molecular biology and behavior. Neuropsychopharmacology 2000;22(5):451–65.

54 Donnelly-Roberts DL, Puttfarcken PS, Kuntzweiler TA, et al. ABT-594 [(R)-5-(2-azetidinylmethoxy)-2-chloropyridine]: A novel, orally effective analgesic acting via neuronal nicotinic acetylcholine receptors. I. In vitro characterization. J Pharmacol Exp Ther 1998;285(2):777–86.

55 Weingarten TN, Moeschler SM, Ptaszynski AE, et al. As assessment of the association between smoking status, pain intensity, and functional interference in patients with chronic pain. Pain Physician 2008; 11(5):643–53.

56 Daniel M, Keefe FJ, Lyna P, et al. Persistent smoking after a diagnosis of lung cancer is associated with higher reported pain levels. J Pain 2009;10(3):323–8.

57 Friedman R, Li V, Mehrotra D. Treating pain patients at risk" evaluation of a screening tool in opioid treated pain patients with and without addiction. Pain Med 2003;4(2):182–5.

58 National Institute of Health (NIH). Rehabilitation of persons with traumatic brain injury. NIH Consens Statement 1998;16(1):1–41.

59 Bjork JM, Grans SJ. Does traumatic brain injury increase risk for substance abuse? J Neurotrauma 2009;26(7):1077–82.

60 Graham DP, Cardon AL. An update on substance use and treatment following traumatic brain injury. Ann NY Acad Sci 2008;1141(October):148–62.

61 Corrigan JD, Bogner J, Holloman C. Lifetime history of traumatic brain injury among persons with substance use disorders. Brain Inj 2012;26(2):139–50.

62 Hibbard MR, Uysal S, Kepler K, Bodgany J, Silver J. Axis I psychopathology in individuals with traumatic brain injury. J Head Trauma Rehabil 1998;13(4):24–39.

63 Packard RC. Chronic post-traumatic headache: Associations with mild traumatic brain injury, concussion, and post-concussive disorder. Curr Pain Headache Rep 2008;12(1):67–73.

64 Nampiaparampil DE. Prevalence of chronic pain after traumatic brain injury. JAMA 2008;300(6):711–9.

65 Khoueir P, Black MH, Crookes PF, et al. Prospective assessment of axial back pain symptoms before and after bariatric weight reduction surgery. Spine J 2009;9(6):454–63.

66 Chan G, Chen CT. Musculoskeletal effects of obesity. Curr Opin Pediatr 2009;21(1):65–70.

67 Lübbeke A, Duc S, Garavaglia G, Finckh A, Hoffmeyer P. BMI and severity of clinical and radiographic signs of hip osteoarthritis. Obesity (Silver Springs) 2009;17(7):1414–9.

68 Marcus DA. Obesity and the impact of chronic pain. Clin J Pain 2004;20(3):186–91.

69 McCarthy LY, Bigal ME, Katz M, Derby C, Lipton RB. Chronic pain and obesity in elderly people: Results from the Einstein aging study. J Am Geriatr Soc 2009;57(1):115–9.

70 Vitiello MV, Rybarczyk B, Von Korff M, Stepanski EJ. Cognitive behavioral therapy for insomnia improves sleep and decreases pain in older adults with co-morbid insomnia and osteoarthritis. J Clin Sleep Med 2009;5:355–62.

71 Quartana PJ, Wickwire EM, Klick B, Grace E, Smith MT. Naturalistic changes in insomnia symptoms and pain in temporomandibular joint disorder: A cross-lagged panel analysis. Pain 2010;149:325–31.

72 Okifujo A, Hare BD. Do sleep disorders contribute to pain sensitivity? Curr Rheumatol Rep 2011;13(6):528–34.

73 Heffner KL, France CR, Trost Z, Ng HM, Pigeon WR. Chronic low back pain, sleep disturbance, and interleukin-6. Clin J Pain 2011;27(1):35–41.

74 Tan V, Cheatle MD, Mackin S, Moberg PJ, Esterhai JL. Goal setting as a predictor of return to work in a population of chronic musculoskeletal pain patients. Int J Neurosci 1997;92(3–4):161–70.

75 Huisstede BM, Wijnhover HA, Bierma-Zeinstra SM, et al. Prevalence and characteristics of complaints of the arm, neck, and/or shoulder (CANS) in the open population. Clin J Pain 2008;24(3):253–9.

76 Belo JN, Berger MY, Koes BW, Bierma-Zeinstra SM. Prognostic factors in adults with knee pain in general practice. Arthritis Rheum 2009;61(2):143–51.

77 Kamaleri Y, Natvig B, Ihlebaek CM, Benth JS, Bruusgaard D. Change in the number of musculoskeletal pain sites: A 14-year prospective study. Pain 2009;141(1–2):25–30.

78 Stokvis A, Henk Coert J, van Neck JW. Insufficient pain relief after surgical neuroma treatment: Prognostic factors and central sensitization. J Plast Reconstr Aesthet Surg 2009;63(9):1538–43.

79 Gallagher RM. Pain science and rational polypharmacy: An historical perspective. Am J Phys Med Rehabil 2005;84(suppl 3):S1–3.

80 Fitzgerald RJ. Medication errors: The importance of an accurate drug history. Br J Clin Pharmacol 2009; 67(6):671–5.

81 McCrae CS. Late-life comorbid insomnia: Diagnosis and treatment. Am J Manag Care 2009;15(suppl): S14–23.

82 Johnson EM, Porucznik CA, Anderson JW, Rolfs RT. State-level strategies for reducing prescription drug overdose deaths: Utah's prescription safety program. Pain Med 2011;12(suppl 2):S66–72.

83 Linton SJ. A review of psychological risk factors in back and neck pain. Spine 2000;25(9):1148–56.

84 Turk DC, Okofuji A. Psychological factors in chronic pain: Evolution and revolution. J Consult Clin Psychol 2002;70(3):678–90.

85 Evers AW, Kraaimaat FW, Geenen R, Jacobs JW, Bijlsma JW. Pain coping and social support as predictors of long-term functional disability and pain in early rheumatoid arthritis. Behav Res Ther 2003; 41(11):1295–310.

86 Dunbar S, Katz NP. Chronic opioid therapy for nonmalignant pain in patients with a history of substance abuse: Report of 20 cases. J Pain Symptom Manage 1996;11(3):163–71.

87 Hoffman MD, Shepanski MA, Mackenzie SP, Clifford PS. Experimentally induced pain perception is acutely reduced by aerobic exercise in people with chronic low back pain. J Rehabil Res Dev 2005; 42(2):183–90.

88 Levinger I, Goodman C, Hare DL, et al. Psychological responses to acute resistance exercise in men and women who are obese. J Strength Cond Res 2009;23(5):1548–52.

89 Stroud NM, Minahan CL. The impact of regular physical activity on fatigue, depression and quality of life in persons with multiple sclerosis. Health Qual Life Outcomes 2009;7:68–77.

90 Terry K. The promise of telemedicine: Providing curbside consults for chronic care, acute care, and pain. J Fam Pract 2011;60(suppl 9): S58–62.

91 Peppin JF, Wright P, Kirsh KL. Exploring the economic impact of a pre-evaluation unit in a multidisciplinary clinic (Poster #0170). PAINWeek 2011, Las Vegas, NV. Sep. 7–10, 2011.

92 Noe C, Williams CF. The benefits of interdisciplinary pain management. J Fam Pract 2012;61(suppl 4): S12–6.

93 Turk DC. Clinical effectiveness and cost-effectiveness of treatments for patients with chronic pain. Clin J Pain 2002;18(6):355–65.

94 Gatchel RJ, Okifuji A. Evidence-based scientific data documenting the treatment and cost-effectiveness of comprehensive pain programs for chronic non-malignant pain. J Pain 2006;7(11):779–93.

95 Sturmberg JP, Martin CM, Katerndahl DA. Systems and complexity thinking in the general practice literature: An integrative, historical narrative review. Ann Fam Med 2014;12(1):66–74.

96 Kroenke K, Krebs E, Wu J, et al. Stepped Care to Optimize Pain care Effectiveness (SCOPE) trial study design and sample characteristics. Contemp Clin Trials 2013;34(2):270–81.

97 Cahana A, Dansie EJ, Theodore BR, Wilson HD, Turk DC. Redesigning delivery of opioids to optimize pain management, improve outcomes, and contain costs. Pain Med 2013;14(1):36–42.