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Psychological Interventions for the Treatment of Chronic Pain in Adults

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Abstract

The high prevalence and societal burden of chronic pain, its undertreatment, and disparities in its management have contributed to the acknowledgment of chronic pain as a serious public-health concern. The concurrent opioid epidemic, and increasing concern about overreliance on opioid therapy despite evidence of limited benefit and serious harms, has heightened attention to this problem. The biopsychosocial model has emerged as the primary conceptual framework for understanding the complex experience of chronic pain and for informing models of care. The prominence of psychological processes as risk and resilience factors in this model has prompted extensive study of psychological treatments designed to alter processes that underlie or significantly contribute to pain, distress, or disability among adults with chronic pain. Cognitive-behavioral therapy is acknowledged to have strong evidence of effectiveness; other psychological approaches, including acceptance and commitment therapy, mindfulness, biofeedback, hypnosis, and emotional-awareness and expression therapy, have also garnered varying degrees of evidence across multiple pain conditions. Mechanistic studies have identified multiple pathways by which these treatments may reduce the intensity and impact of pain. Despite the growing evidence for and appreciation of these approaches, several barriers limit their uptake at the level of organizations, providers, and patients. Innovative methods for delivering psychological interventions and other research, practice, and policy initiatives hold promise for overcoming these barriers. Additional scientific knowledge and practice gaps remain to be addressed to optimize the reach and effectiveness of these interventions, including tailoring to address individual differences, concurrently addressing co-occurring disorders, and incorporating other optimization strategies.

Keywords
psychological interventions, chronic pain, adults

Psychological approaches for managing chronic pain are widely recognized as significant components of an integrated, evidence-based, patient-centered, multimodal, and interdisciplinary care plan. However, a significant gap exists between the evidence for the effectiveness of several psychological interventions and their routine availability and use in clinical care. This article is intended to address that gap by providing a comprehensive examination of these approaches in the context of foundational principles of chronic pain and chronic-pain management and articulating future directions for research and innovations in practice.

The review begins by offering a definition and a brief overview of theories of chronic pain that inform the science and contemporary models of chronic-pain management. The biopsychosocial perspective is employed to highlight the multidimensional nature of chronic pain and to explicate psychological and social or contextual factors thought to contribute to the development, maintenance, and exacerbation of the pain experience. Gaps in scientific knowledge and practice are also discussed.

The overview is followed by a more detailed consideration of the theoretical and empirical foundations of psychological treatments for chronic pain. Specific categories of psychological treatments will be described,

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followed by a narrative review of the empirical evidence supporting their efficacy and effectiveness, whether delivered alone or in the context of multimodal and interdisciplinary care. Later, general and specific mechanisms hypothesized to underlie the efficacy or effectiveness of these approaches, models for integrating psychological interventions into multimodal, patient-centered pain care, and evidence supporting these models will be discussed. A critical review of that evidence follows, where key components of successful integrated-care models and the value added by psychological treatments are highlighted.

Other important issues that may affect the effectiveness of psychological treatments for chronic pain are described, including overlapping pain conditions, high rates of observed medical and mental health comorbidities and health-risk behaviors, and individual differences and disparities. Important assessment and measurement issues, including phenotyping and outcome measurement, biomarkers, modifiers and mediators of effects, and advances in the use of technology-assisted assessments are also addressed. In addition, observed barriers to timely and equitable access to psychological treatments for chronic pain will be discussed, highlighting patient, provider, and organizational or systemic barriers.

Conclusions articulate important gaps in scientific knowledge and practice relating to the optimization of patient-centered outcomes and innovative study designs and methods. The article ends by offering a path forward for advancing the science and practice of psychological treatment for chronic pain. Although there is growing evidence of the efficacy of psychological treatments for acute pain (e.g., perioperative pain, pain associated with fractures and other injuries, dental pain, and pain associated with ambulatory medical and dental procedures), cancer-related pain, and pain at the end of life, this article is focused on psychological treatments for chronic pain not associated with cancer or malignant disease. Likewise, this article focuses on adults experiencing chronic pain, although there is a large and growing literature on pain in infants, children, and adolescents (Fisher et al., 2014) as well as older adults (Reid et al., 2015). Finally, the article is focused on psychological treatments, defined as those primarily informed by psychological theory and commonly practiced by psychologists. Though many other pain-management approaches rely on psychological theory or integrate components of psychological interventions, these will not be discussed.

Background and Context

Pain is ubiquitous to the human condition, and although it most often successfully resolves with little or no specific intervention, pain can persist over an extended time frame, if not a lifetime. For some people, it can be associated with significant negative impacts on physical and emotional functioning, well-being, and overall quality of life. Mounting evidence documents the high prevalence of persistent or chronic pain, its costs on sufferers and on society, and individual differences and disparities in the experience and management of pain. In 2011, the U.S. Institute of Medicine (now called the National Academies of Sciences, Engineering, and Medicine) published a seminal report titled *Relieving Pain Care in America: A Blueprint for Transforming Prevention, Care, Education, and Research*, which labeled chronic pain as a significant public-health concern whose resolution would require a comprehensive approach (Institute of Medicine, 2011).

In 2018, the U.S. Centers for Disease Control and Prevention (CDC) published its first *Morbidity and Mortality Weekly Report* on pain. The CDC documented that approximately 50 million adult Americans, or 20.4% of the U.S. adult population, reported chronic pain, defined as the presence of pain on most days or every day during the past 6 months (Dahlhamer et al., 2018). Perhaps even more striking was the report's estimate that 19.6 million, or 8%, of adult Americans experience “high-impact chronic pain,” defined as pain that has limited one's life or work activities on most days or every day during the past 6 months. A major epidemiological study of the global burden of disease provides further evidence of the prevalence and disabling nature of chronic pain (Rice et al., 2016). Estimates of years lived with disabling conditions paint an even starker picture: Chronic low-back pain ranks first, followed by major depressive disorder (Rice et al., 2016). Chronic pain is a primary reason people seek medical care, and the total annual costs of such care are believed to be between $560 billion and $635 billion—more than twice the amount spent on heart disease and cancer combined (Institute of Medicine, 2011).

Following a principal recommendation in the Institute of Medicine report, in March 2016, the U.S. Department of Health and Human Services published its National Pain Strategy (NPS), in which it specified recommendations for addressing this public-health challenge across the domains of population research, prevention and care, disparities, service delivery and payment, professional education and training, and public education and communication (Interagency Pain Research Coordinating Committee [IPRCC], 2016). Findings and recommendations addressed key gaps in scientific knowledge and clinical practice across each domain.

The NPS asserted that (a) pain is a condition for which biological, psychological, and social factors are simultaneously relevant—thus it requires an integrated, evidence-based, multimodal, and interdisciplinary plan of care; (b) an adaptive self-management approach to chronic pain can improve patients' quality of life and is therefore an important component of pain prevention and management; and (c) people with chronic pain need safe and effective treatment options that take into account individual differences in susceptibility to pain and preferences for and responses to treatment. Despite evidence attesting to the complexity of pain and the need for an integrated and multimodal approach to optimize its management, the NPS acknowledges, care for chronic pain is frequently limited to that delivered by a single provider and use of analgesic medication, especially opioids. In fact, concurrent with its recognition of pain as a public-health problem, the CDC began sounding the alarm about an overreliance on prescription opioids (despite a lack of evidence for their effectiveness and growing evidence demonstrating risk of significant harms; Martell et al., 2007), including a rapid escalation in deaths associated with unintended overdoses (CDC, 2011).

Consistent with the recommendations in the NPS, the CDC published a guideline for prescribing opioids for chronic pain (Dowell et al., 2016), which specified that "nonpharmacologic therapy and non-opioid pharmacologic therapy are preferred for chronic pain" (p. 1633). Similar guidelines have been promulgated by the American College of Physicians (Qaseem et al., 2017) and other groups. Together, these guidelines provide a useful framework for the focus of this article—namely, the psychological treatment of chronic pain.

Defining Chronic Pain

The International Association for the Study of Pain (IASP) is globally acknowledged to be the world leader in the study of pain. After more than 40 years, the IASP updated its 1979 definition of pain as an "unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage" (quoted in Volinn et al., 1991, p. 739). Despite long-standing efforts to define pain in objective terms, such as recent efforts by the National Institutes of Health (NIH) to identify "pain signatures" in the brain and other biomarkers, the revised definition (Raja et al., 2020) emphasizes that pain is a personal experience influenced to varying degrees by biological, psychological, and social factors. It is always unpleasant. Finally, and perhaps most notably, although the experience of pain can be linked to an injury or aversive stimulus, the definition does not tie the experience of pain to a stimulus such as structural pathology or tissue damage. The IASP specifically noted that pain and nociception are different phenomena and that pain cannot be inferred from activity in sensory neurons. Finally, the IASP reinforced the idea that persons' reports of pain should be accepted and respected.

According to the IASP, chronic pain is ongoing or recurrent pain that lasts beyond the usual course of acute illness or injury or for more than 3 to 6 months and adversely affects an individual's well-being. The CDC, using questions from the National Health Interview Survey, defined chronic pain as pain that is present on most or every day during the past 6 months (Dahlhamer et al., 2018). In 2019, in collaboration with the World Health Organization (WHO), an IASP working group addressed the important question of whether chronic pain is a symptom or a disease (Treede et al., 2019). The working group recognized that when chronic pain is present, it can be a leading complaint requiring specialized care. They suggested that in conditions such as fibromyalgia or nonspecific low-back pain, chronic pain may be conceived as a disease. Otherwise, chronic pain is commonly viewed as a symptom of an underlying condition.

Existing research using sensitive biological markers has failed to identify specific structural tissue damage in a large percentage of individuals reporting fibromyalgia and chronic low-back pain, two commonly reported painful conditions (Jarvik et al., 2001). Support for the efficacy of powerful biological agents (e.g., opioids) in the management of back pain, the most commonly endorsed site of pain, is similarly limited (Martell et al., 2007). Thus, attempts to uncover an explanatory biological mechanism for the experience of many chronic-pain conditions or apply unimodal medical approaches (e.g., analgesics or medical interventions, including injections or surgery) for the management of chronic pain commonly fail to accrue substantial benefits. Indeed, patients' experiences speak to the negative effects of chronic pain on physical and emotional functioning and overall well-being, as well as social relationships, work functioning, maintenance of other important social roles, and financial stability, among other challenges. It is also common for people with chronic pain to report frustrations with health care systems and public and private health insurance systems, which are often unsympathetic to or unsuccessful in adequately addressing their complaints. Thus, the experience of chronic pain is marked by significant burden in multiple domains.

Patient narratives underscore these burdens. The Institute of Medicine report documented the voices of people with pain, patient advocates, and providers of pain care to explicate common experiences of living with and treating chronic pain, including frustration with the current culture of pain management. For example, the following quote is from a person with chronic pain: “Appointment after appointment, test after test, nothing to really confirm [the diagnosis]. . . . Having pain that I did not understand, as a physical therapist, fearing some dreadful disease, was hard enough. . . . So, in addition to pain, I had anxiety and depression” (Institute of Medicine, 2011, p. 113). And this quote is from a clinical pharmacy specialist: “We cannot successfully treat the complexity of pain without treating the whole patient. Insurance companies will pay for useless, expensive procedures and surgeries but won’t pay for simple cognitive-behavioral therapy and physical rehab therapy” (Institute of Medicine, 2011, p. 129).

Narratives such as these draw attention to the high coprevalence of chronic pain and mental health and substance-use disorders (Gatchel, 2004). Particularly common is major depressive disorder, which may be present in as many as 50% of persons seeking pain-management services (Bair et al., 2003; S. M. Banks & Kerns, 1996). Mental health problems are associated with greater pain intensity and disability (Bair et al., 2003; Katon & Ciechanowski, 2002). Particularly concerning is evidence that opioid therapy is disproportionately prescribed for persons with chronic pain and mental health and substance-use disorders (Seal et al., 2012). It is also concerning that mental health problems may interfere with engagement and sustained participation in pain interventions (Kerns & Haythornthwaite, 1988). Conversely, chronic pain is known to undermine the effectiveness of treatments for common mental health and substance-use disorders (Bair et al., 2003). These data call for all mental health providers, including psychologists, and almost regardless of the specific focus of their practice, to assess patients for chronic pain and to address the management of chronic pain in their practice (Darnall et al., 2016; Edmond et al., 2019; Wandner et al., 2019).

Contemporary Perspectives on Chronic Pain

The modern era of pain and pain management emerged from empirical evidence linking behavior and health that expanded rapidly in the 1960s and 1970s. The pioneering work of Melzack and Wall continues to be recognized as perhaps the most substantial breakthrough in a series of conceptual and empirical advances in the understanding of pain. Their gate-control theory of pain described pain as a centrally mediated perceptual experience (Melzack & Wall, 1965). According to the theory, the experience of pain is a function of both ascending pain signals from the periphery and cognitive-evaluative and emotional-motivational factors regulated in the brain. In 2001, Melzack’s pain-neuromatrix model more clearly and succinctly conceptualized pain as a multidimensional experience involving structural pathology and peripheral pain signals (i.e., nociception); the experience of pain, per se; and other affective, cognitive, and behavioral dimensions produced by patterns of interacting nerve impulses in the central nervous system generated by a variety of inputs from multiple sources (Melzack, 2001). Consistent with Melzack’s model of pain, the biopsychosocial model espoused by Engel (1978) highlights the interrelatedness of biological, psychological, and social factors in the context of health and illness, including pain and its management (Gatchel et al., 2007). Today, and as emphasized in the IASP’s definition of pain, the biopsychosocial model is widely recognized as the principal model that informs the study of pain, the clinical practice of pain management, and the education of health care professionals and the public. As an integrative-systems model, it integrates the multidimensionality, individual variability, and complexities of the full pain experience. A schematic of the biopsychosocial model is presented in Figure 1.

With widespread acceptance of the biopsychosocial model of pain has come an explicit acknowledgment that treatments targeting a reduction in pain intensity without addressing declines in functioning and emotional distress are insufficient. Increasingly, patients and experts in the field have advocated for integrated, evidence-based, patient-centered, multimodal, and interdisciplinary models of pain care that target the entirety of the multidimensional experience of chronic pain (Institute of Medicine, 2011). Conceptualizing chronic pain as a biopsychosocial phenomenon rather than a purely medical one requires a major paradigm shift in the way providers assess, conceptualize, and treat pain. This shift in how chronic pain is treated should emphasize the shared development of personalized care plans that support patient education and empowerment and incorporate actionable strategies that target personally valued and specific behavioral goals and patient-centered outcomes. Consistent with a biopsychosocial model, these goals may appropriately target biological factors (e.g., through identification and treatment of underlying disease, pathology, or tissue damage as warranted), with simultaneous efforts to reduce both the intensity and severity of pain, optimize functioning and productivity, and reduce suffering and emotional distress.

Several interrelated issues have emerged as key considerations in research, clinical practice, and education related to pain and pain management. Central to these considerations is the importance of focusing on the person with chronic pain as opposed to the pain itself. In its first publication, for example, the Initiative on Methods, Measurement, and Pain Assessment in Clinical

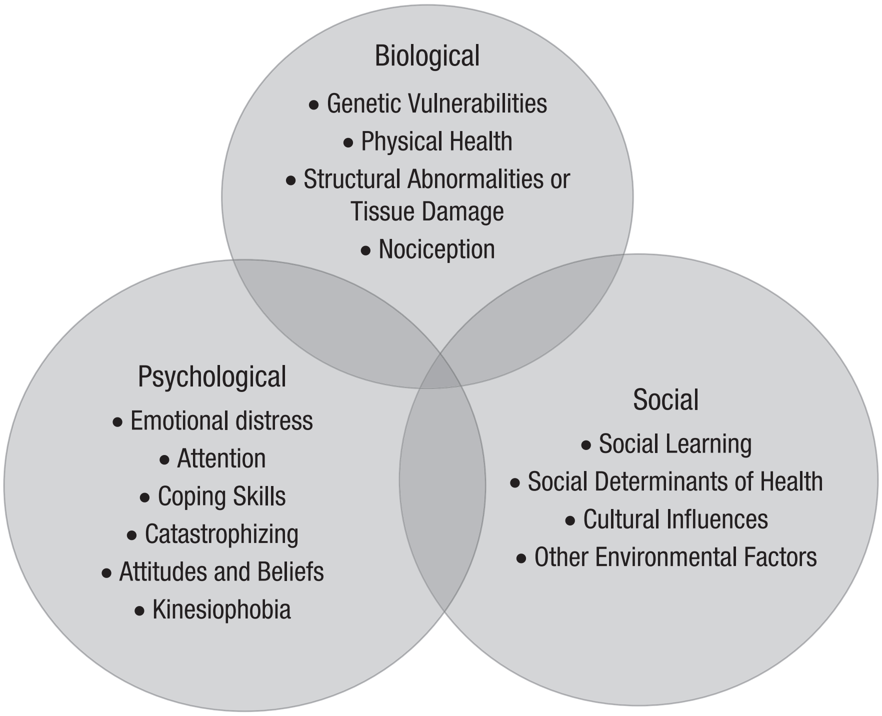

Fig. 1. Biopsychosocial model of chronic pain (based on the work of Engel, 1978).

Trials (IMMPACT), a public–private partnership convened to develop consensus reviews and recommendations for improving the design, execution, and interpretation of clinical trials of treatments for pain, came to a similar conclusion (Turk et al., 2003). The group recommended six core outcome domains for chronic-pain clinical trials: (a) pain, (b) physical functioning, (c) emotional functioning, (d) ratings of improvement and satisfaction with treatment, (e) symptoms and adverse events, and (f) disposition. Building on these recommendations, IMMPACT subsequently recommended specific standardized measures for each domain, including the measure of pain interference from the West Haven–Yale Multidimensional Pain Inventory (Dworkin et al., 2005). Fifteen years later, measures of pain interference—that is, the degree to which pain limits individuals' physical, mental, and social activities—have begun to replace measures of pain intensity or severity as the prespecified primary outcome measure in clinical pain trials (Kroenke et al., 2019), and personally meaningful and behavioral goals to reduce pain interference are increasingly specified in clinical pain care (Heapy et al., 2018).

A second consideration is how chronic pain varies in the context of multiple co-occurring medical and mental health conditions (Goulet et al., 2016; Higgins et al., 2014; Hooten, 2016; Knaster et al., 2012; Martucci et al., 2014; Morasco et al., 2011; Otis et al., 2003). Third, individuals rarely have a single, isolated chronic-pain condition, which has relevance both for quality of life and for treatment. Substantial overlap can occur between seemingly distinct pain conditions affecting disparate body parts (Aaron & Buchwald, 2003; Aaron et al., 2000; Koroschetz et al., 2011; Maixner et al., 2016; Ramond-Roquin et al., 2015). This phenomenon is increasingly common with advancing age and among women; 75% of older adults endorse multiples sites of pain (Patel et al., 2013), and these overlapping pain problems can create substantial difficulties in managing pain. Chronic overlapping pain conditions appear to be strongly related to shared risk factors (Maixner et al., 2016)—that is, an individual's phenotype and genotype may place them at risk not just for a specific chronic-pain condition but for a number of seemingly distinct (though related) pain problems. Finally, multiple psychosocial factors, such as negative affect, play crucial roles in shaping the burden and cost of many chronic-pain conditions (Edwards et al., 2011; Edwards, Dworkin, Sullivan, et al., 2016; Ramond-Roquin et al., 2015; Turk et al., 2016).

These perspectives on chronic pain have led to the identification of a range of factors that appear to be strongly and reliably associated with important patient-centered outcomes, and they have informed ongoing efforts, including the development and evaluation of psychological treatments, to help manage pain and mitigate its negative effects on physical and emotional functioning and overall quality of life. Those factors and treatments will be discussed in detail below.

Mechanisms Underlying Maladjustment to Chronic Pain

Research has investigated a wide range of mechanisms that might explain why some individuals fare better than others when confronted with chronic pain. What follows is a description of the research on factors that precipitate maladjustment or promote adaptation to pain through their influence on health behaviors, how people process pain, central nervous system processing, and sleep.

Health behaviors

Pain-related negative affect and negative cognitions seem to reduce the likelihood of exercise and other health-promoting behaviors among persons with chronic pain, which may contribute to their impact on long-term outcomes such as functional disability. In samples of obese patients with knee osteoarthritis, for example, catastrophizing was associated with poorer weight management, more frequent binge eating, reduced physical capacity, and reduced quality of life (Somers et al., 2009). Depressive symptoms have been associated with reduced physical activity and exercise (Ekkekakis & Murri, 2017; Newitt et al., 2015), and in prospective studies of patients with acute low-back pain, those with high levels of negative affect and catastrophizing were most likely to rely on bed rest and to reject exercise, which can lead to physical deconditioning over time (Bousema et al., 2007; Verbunt et al., 2008). By contrast, protective factors such as social support have been associated with greater engagement in physical activity and exercise (Stevens et al., 2020; Stewart & Yuen, 2011).

Features of pain-related catastrophizing have been shown to correlate not only with reduced engagement in exercise (Castaneda et al., 1998) but also with the use of potentially ineffective medications (Neame & Hammond, 2005) and a reduced likelihood of attending scheduled treatment visits (Litt & Porto, 2013; Shelby et al., 2012). Recent studies have also highlighted catastrophizing as a predictor of medication side effects and discontinuation of pharmacologic treatment (Toth et al., 2014). Likewise, depression is strongly associated with reduced medication compliance and increased indices of misuse, particularly misuse of opioid medications (Garland, Trostheim, et al., 2019; Häuser et al., 2018; Just et al., 2018; Webster, 2017). Depressive symptoms and major depression are further associated with increased smoking rates, and smoking appears to be a risk factor for adverse pain outcomes (e.g., the development of widespread, persistent pain; Bendayan et al., 2018; Bica et al., 2017). These are plausible pathways by which psychosocial distress could enhance disease, amplify pain, and promote mortality.

Information-processing biases

Edwards and colleagues have previously described the role of psychosocial processes in the onset and maintenance of chronic pain via certain pathways (e.g., information-processing biases, central nervous system; Edwards, Dworkin, Sullivan, et al., 2016). In particular, high levels of depression, distress, and catastrophizing and low levels of acceptance, mindfulness, and self-efficacy in managing pain may lead to cognitive and attentional biases that prompt individuals to intensely and selectively attend to pain-related stimuli (Crombez et al., 2013; Quartana et al., 2009; Schoth et al., 2012; Van Damme et al., 2004). People who catastrophize experience more difficulty controlling pain-related thoughts relative to people who do not; they also tend to hyperfocus on their pain sensations, and their ability to cognitively and physically engage in tasks is more compromised by the anticipation of pain (Quartana et al., 2009). Likewise, among people with painful rheumatic disease, those with clinical depression have been shown to demonstrate a recall bias for disability- and pain-related words (Denton et al., 2005), as well as a tendency to ruminate about the meaning of pain-related words (Sitges et al., 2007). Taken together, these studies suggest that psychosocial factors (e.g., high levels of distress and catastrophizing and low levels of self-efficacy and acceptance) are implicated in the risk for negative long-term pain outcomes.

Central nervous system pathways

Edwards and colleagues further identified central nervous system pathways as prominent in the onset and maintenance of chronic pain (Edwards, Dworkin, Sullivan, et al., 2016). They noted that advancements with respect to brain imaging have increased exponentially. Results from these imaging studies suggest that individuals with chronic pain evidence unique alterations in both brain structure and function (Moayedi et al., 2018; Mouraux & Iannetti, 2018; Peyron & Fauchon, 2019; Pfannmoller & Lotze, 2019). Functional magnetic resonance imaging (fMRI), positron emission tomography, and electroencephalography are examples of technologies commonly used to study the neural bases of pain. There is now a vast body of research that has compared patients with a variety of persistent pain conditions to pain-free controls and identified alterations in structure, function, neurochemistry, and connectivity in a number of cortical regions that are considered important for the perception of pain. These include the primary and secondary somatosensory cortices, insular and anterior cingulate cortices, prefrontal cortices, and many subcortical areas such as the periaqueductal gray, amygdala, and cerebellum (Cunningham et al., 2019; Martucci & Mackey, 2018; Peyron & Fauchon, 2019; van der Miesen et al., 2019).

Although a complete description of the role of cognition and emotion in shaping the brain's processing of sensory information is outside the scope of this review, many of the psychosocial factors mentioned previously have been shown to modulate the perception of pain and the neural consequences of chronic pain. For example, catastrophizing is associated with disrupted function and connectivity of the default mode network, a set of interconnected brain regions that are generally active when an individual is not focused on a specific task or the external environment, such as during daydreaming, self-reflection, or mind-wandering (Baliki et al., 2014; Hubbard et al., 2014; J. Kim et al., 2019; Lee et al., 2018). Recent findings have suggested that psychosocial and behavioral interventions that target cognitive processes such as catastrophizing can reverse functional and structural brain changes related to chronic pain within several months (Cunningham et al., 2019; Lazaridou et al., 2017; Seminowicz et al., 2011, 2013; Sevinc et al., 2018; Zeidan & Vago, 2016). Collectively, these findings suggest that interventions targeting catastrophizing and negative affect may produce long-lasting, adaptive shifts in the way the brain processes pain.

Sleep

Sleep disturbances are common among patients with chronic pain (Haack et al., 2020; Nijs et al., 2018; Whibley et al., 2019), and pain and sleep problems appear to have a reciprocal interaction. Both acute and chronic pain disrupt sleep, and difficulty falling or staying asleep, poor subjective sleep quality, short sleep duration, and disrupted sleep architecture are all highly prevalent among persons with pain (Finan et al., 2013; Haack et al., 2020). Experimental and clinical data indicate that sleep deprivation lowers the pain threshold, reduces the cognitive capacity to cope with pain, and increases pain intensity, which exacerbates poor sleep (Haack et al., 2020). Sleep disturbance can aggravate pain and inflammatory processes, reduce endogenous pain inhibition, increase emotional distress, and reduce well-being (Geenen et al., 2018; Haack et al., 2007; Sivertsen et al., 2015). Hence, poor sleep may contribute to increased pain, creating a vicious cycle.

The relationship between chronic pain and sleep appears to be influenced by a range of factors. In particular, psychological factors such as mental health problems (e.g., depression, anxiety) are associated with poor sleep (Finan et al., 2013; Vincent et al., 2015). Catastrophizing, as well, has been associated with reduced sleep quality (Othman et al., 2019). Reviews of the biopsychosocial model of pain have generally highlighted interrelationships between sleep and psychological factors such as distress, and some reviews have suggested that sleep disruption is a critical pathway by which negative affective processes affect long-term pain outcomes (Buenaver et al., 2012; Edwards et al., 2006, 2011; Finan et al., 2013). In support of this hypothesis, numerous studies have now shown that cognitive-behavioral therapy (CBT) improves sleep in patients with chronic pain (especially those with comorbid insomnia) and that this improvement in sleep is associated with reductions in pain and distress, improvements in pain-related disability, and enhanced quality of life (Castel et al., 2012; Daly-Eichenhardt et al., 2016; Finan et al., 2014; Ho et al., 2019; Kiropoulos et al., 2016; Menting et al., 2018; Mundt et al., 2016; Murray et al., 2019; Salwen et al., 2017; Smith et al., 2015; Tang et al., 2018).

Psychological Treatments for Chronic Pain

Psychological factors have been acknowledged as salient in the pain experience. Though our understanding of these factors and their relative contributions is still evolving, extant research points to the critical role they play in the onset, maintenance, and exacerbation of chronic pain. With this recognition has come a movement to harness psychological interventions to address the many facets of biopsychosocial functioning that are demonstrably affected by chronic pain, including the intensity of pain itself, physical functioning, emotional and social well-being, productivity, and even self-esteem. Some of these interventions focus on nonspecific psychological constructs such as interpersonal validation. Others target pain itself via the acquisition of self-regulatory skills that can help individuals recognize and counteract dysfunctional beliefs, patterns, and stressors that amplify pain. Still others aim to disentangle the tight connection between physical pain and emotional suffering, whereas others focus on underlying processes, such as trauma or emotional avoidance, that are thought to maintain pain via neural pathways in the brain. All aim to attenuate some subset of psychological risk factors or to augment psychological protective factors.

This next section reviews the most commonly deployed psychological interventions utilized in the treatment of chronic pain. Where possible, underlying theories and mechanisms are discussed, a description of the intervention is provided, and a review of the evidence for each modality is provided, including a description of the outcomes each is thought to affect. See Table 1 for a summary of the listed interventions. Although the list of interventions and therapies is not exhaustive, those included are the most widely accepted within the pain-care community.

Supportive psychotherapy

Perhaps the earliest psychological intervention and the least studied in relation to pain, supportive psychotherapy is nondirective talk therapy. The goal of supportive psychotherapy is to offer people a safe environment where they can process distress and receive validation. It is unlike other psychological interventions for chronic pain in that it involves no established protocol and no specific skills, strategies, or techniques uniquely adapted for the treatment of chronic pain. Rather, the focus of supportive psychotherapy is on the practitioner's unconditional acceptance and empathic understanding of the person with pain. Nonspecific factors such as the therapeutic alliance, validation, and positive regard are hypothesized to account for observed improvements.

Because supportive psychotherapy is not specific to pain and has not been systematically deployed in the field, data on its effectiveness for pain are limited. Moreover, because it is not standardized, it is hard to draw conclusions about its usefulness in treating chronic pain. As a nonspecific intervention, supportive psychotherapy has been shown to benefit individuals with a variety of conditions, including depression and anxiety (Barrowclough et al., 2001; Cuijpers et al., 2012). In the case of pain, supportive psychotherapy has not garnered targeted scientific attention. However, some data about its effectiveness can be gleaned from large clinical trials of more standardized treatments (e.g., CBT for chronic pain [CBT-CP], biofeedback) that have included it as a comparator. For example, one trial examining the effectiveness of CBT-CP for the treatment of vulvodynia included a supportive-psychotherapy condition to control for time and nonspecific mechanisms that are present in most therapies (e.g., therapist attention, validation). Women in the study were randomly assigned to either the CBT-CP or the supportive-psychotherapy condition. Both groups evidenced reductions in pain severity and improvements in sexual functioning and mood (Masheb et al., 2009). Notably, improvements in pain were more pronounced in the CBT-CP group, whereas improvements in mood were more pronounced in the supportive-psychotherapy group. Women reported that CBT-CP was more credible for treating their pain—meaning they would be more likely to utilize that treatment than supportive psychotherapy. Another large meta-analysis examining psychological interventions for treating chronic back pain included supportive-psychotherapy interventions alongside self-regulatory interventions such as biofeedback and CBT-CP. Findings suggested that supportive psychotherapy improved chronic back pain but was outperformed by self-regulatory interventions that had a more explicit focus on pain (Hoffman et al., 2007).

The consensus seems to be that there is a benefit to engaging in supportive psychotherapy for individuals with pain, particularly with respect to emotional functioning, but interventions targeting pain specifically are perceived as more credible and are likely to yield greater benefits in terms of pain outcomes.

Self-regulatory therapies

In the 1970s and 1980s, proponents of behaviorism (Brady, 1981) and cognitive social learning theory (Bandura, 1977) cited a growing body of research on the efficacy of behavior therapy and behavior modification for preventing, managing, and treating disease and physiological dysfunction. Schwartz's articulation of a psychobiological model of self-regulation (and dysregulation), with its roots firmly in systems theory, was influential in advancing both the science and practice of behavioral medicine and pain management (Schwartz, 1979). Schwartz's model highlighted five core components of self-regulation: (a) environmental demands; (b) central nervous system information processing; (c) feedback from peripheral organs; (d) negative (internal) feedback; and (e) biofeedback. Schwartz emphasized the central role of the brain as a "health care system" designed to promote automatic self-regulation in the face of environmental challenges. Consistent with other systems perspectives, Schwartz further suggested that dysregulation could occur at any level of the system and interventions designed to promote self-regulation affect all stages or components of the regulatory system. Sustained emotional and physiological unrest is hypothesized to contribute to the development and exacerbation of chronic pain, just as chronic pain can contribute to negative alterations in emotional, psychological, and physical well-being. Therefore, self-regulatory approaches are hypothesized to increase individuals' sense of personal control over emotional and physiological states commonly believed to be uncontrollable and to dampen physiological arousal that increases pain.

Table 1. Contemporary Psychological Treatments for Chronic Pain

Treatment	Strategy	Proposed mechanisms	Painful conditions	Outcomes
Supportive psychotherapy	Nondirective; emphasizes unconditional acceptance and empathic understanding	Therapist attention, validation, positive regard	Vulvodynia, back pain	Moderate improvements in mood and emotional functioning
Relaxation training	Uses breathing, relaxation of muscle groups, and visual imagery to counteract the body's stress response	Regulation of the stress response, self-efficacy in pain management	Headache	Reductions in frequency of headache; improvements in ability to manage pain; reductions in use of analgesics
Biofeedback	Uses biofeedback equipment to monitor physiological processes (e.g., heart rate, sweating) affected by stress and pain; teaches strategies for down-regulating the physiological response, which can improve pain	Regulation of the stress response, self-efficacy	Fibromyalgia, headache, back pain	Small to moderate improvements in pain intensity, depression, physical functioning, and muscle tension
Hypnosis	Entails hypnotic suggestions, made by a clinician, for immediate and long-term pain reduction; also incorporates relaxation training	Dampens neural activity responsible for pain and its transmission	Back pain, fibromyalgia, temporomandibular disorders, arthritis, mixed pain conditions	Small to moderate improvements in pain intensity, physical functioning, and mood
Operant-behavioral therapy	Eliminates maladaptive behaviors consistent with the "sick" role; replaces them with healthier "well" behaviors	Positive reinforcement for "well" behaviors; time-contingent pain medication and tapering; role playing and modeling	Mixed or undefined pain conditions; fibromyalgia, chronic low-back pain	Small to large reductions in pain intensity, interference from pain, and depressive-symptom severity; return to work; improvements in physical functioning and medication use
Cognitive-behavioral therapy	Identifies and alters maladaptive thoughts about pain that precipitate distress and unhelpful behaviors (e.g., isolation, withdrawal, being sedentary); promotes the development of helpful behavioral coping strategies (e.g., relaxation)	Self-efficacy (confidence) in coping with pain, reduction in maladaptive cognitions, improved sleep	Musculoskeletal pain, neuropathic pain, headache	Small to moderate improvements in pain, functional disability, and mood
Acceptance and commitment therapy	Encourages acceptance of chronic pain and focuses on strategies for identifying and reinforcing behaviors consistent with valued social roles and desired behavioral goals	Psychological flexibility, acceptance	Broadly applied to chronic pain	Small to medium effects on mood and physical functioning
Mindfulness-based interventions[a]	Emphasizes the importance of nonjudgment; aims to disentangle physical pain from emotional suffering via increased awareness of the body, the breath, and activity	Psychological flexibility	Broadly applied to chronic pain	Improvements in emotional well-being; reductions in pain-related distress; pain outcomes vary by condition
Emotional-awareness and expression therapy	Highlights the interconnectivity of brain regions responsible for processing physical pain and emotions; encourages confrontation of avoided emotions or stimuli to dampen the connection between emotions and pain	Exposure, dampened neural activation of physical pain–emotion circuits	Fibromyalgia; preliminary evidence to date for most other pain conditions	Small to moderate effects on pain, functioning, and emotional distress
Psychologically Informed Physical Therapy	Integrates physical therapy and cognitive-behavioral therapy for chronic pain	Exposure, self-efficacy	Knee pain, low-back pain	Small effects on functioning

[a] There is wide variability in the application of mindfulness-based interventions, which makes clear conclusions about mechanisms and outcomes difficult to articulate.

Self-regulatory therapies (SRTs) teach individuals to self-monitor physical and psychological cues and to employ the use of self-management strategies when those cues signal trouble. SRTs that have been widely applied to pain include relaxation training, biofeedback, and hypnosis. When encountering stress, be it conflict, task demands, physical or emotional threat, or pain itself, the body's fight-or-flight system is activated. At such times, the sympathetic nervous system shifts into overdrive. Muscles tense, blood flows to the extremities, heart rate quickens, and breathing becomes shallow to allow the body to mobilize the resources needed to neutralize or escape from threats. This activation in response to real or perceived threats can worsen pain for those who have painful conditions—especially conditions that are activated by stress.

Relaxation training. Relaxation training interventions are perhaps the oldest and most widely used of the SRTs. Relaxation training is a broad term that encapsulates various strategies that target the purposeful activation of the parasympathetic nervous system. In so doing, these strategies down-regulate the stress response and the sympathetic nervous system. As the former response diminishes, the heart slows down; breathing deepens, muscles relax, the body regains its ability to repair strained tissue, and pain decreases. Deep breathing, progressive muscle relaxation, and visual imagery are all examples of relaxation strategies that were at one time used as stand-alone pain-management strategies or embedded into biofeedback and other self-regulatory interventions. Older reviews demonstrated that relaxation has some utility in reducing the severity and frequency of headaches (Turner & Chapman, 1982). At least one recent review of chronic nonmalignant pain suggests that when used as a stand-alone intervention, relaxation is not associated with improvements in pain intensity (Jeffrey et al., 2016) but may be associated with an improved ability to manage pain and decreased use of analgesics (Jeffrey et al., 2016; Turk et al., 2008). Although relaxation training can be deployed independently, it is typically delivered as one of many pain self-management strategies in the context of other psychological interventions or multidisciplinary treatment programs for chronic pain.

Biofeedback. *Bio* refers to the body, and *feedback* refers to information fed back to the individual. In biofeedback, special instruments are used to detect physiological stress cues (e.g., muscle tension, brain waves, heart rate, galvanic skin response [sweat-gland activity]), and information about these cues is brought to the individual's attention to prompt the use of strategies that can regulate them. For example, most people use instruments such as thermometers as a matter of course in their daily lives. When their temperature is elevated, they might regulate it by taking medication, using a cold compress, or taking a cool shower. In the case of pain, physiological stress cues prompt the use of strategies acknowledged to down-regulate the stress response while simultaneously up-regulating the relaxation response—strategies such as deep breathing, progressive muscle relaxation, visual imagery, and distraction. With time and training, patients learn to detect the physiological cues without the instruments and to regulate them accordingly.

During a typical biofeedback training session, clinicians apply biofeedback equipment. Some instruments, such as the thermistor, which measures temperature and blood flow, and the photoplethysmography, which measures heart rate variability, are applied to the finger. Other instruments, such as the pneumograph, are placed around the trunk to measure breathing rate and rhythm. The electrodermograph measures galvanic skin response (sweating) and is placed on the palm. Perhaps the most common biofeedback instrument for use in the treatment of chronic pain is the electromyograph, which measures muscle tension; it can be placed anywhere tension is observable but is most frequently applied to the head. The electroencephalograph (EEG), which is attached to the scalp and measures brain waves, is the most complicated of all biofeedback instruments and is therefore used relatively infrequently. Once the EEG is applied, the therapist guides the individual through a series of mental activities (e.g., relaxation, mindfulness, self-hypnosis) that affect the physiological processes it measures. Through this process, the individual learns that psychological processes can influence and, in fact, regulate physiological responses that may precipitate, exacerbate, or maintain pain.

Biofeedback can be delivered on its own or in conjunction with other interventions. Most frequently, it is delivered by a mental health professional, but almost any practitioner can be trained to deliver it if they have the right equipment. Because biofeedback integrates biological or physiological elements with psychological ones, it may be more palatable to people who are sensitive to assertions that pain is "all in their head" and, because of its emphasis on the physiological, may be preferentially referred by practitioners whose perspectives on pain align closely with the medical model of disease. It may be most appropriate for people with painful conditions (e.g., musculoskeletal pain, headache, fibromyalgia) who are particularly sensitive to increases in stress.

Biofeedback is effective for a variety of painful conditions, though the evidence supporting its use is perhaps most widely chronicled with respect to back pain (Sielski et al., 2017). Indeed, one large, recent meta-analysis revealed a small to moderate uncontrolled effect on pain intensity that was stable over long-term follow-up and effects on pain and muscle tension that were comparable to those of active control treatments (Sielski et al., 2017). Findings in this meta-analysis suggested that biofeedback also successfully produced small to medium long-term effects on depression, disability, muscle tension, and cognitive coping. As the length and frequency of biofeedback sessions increased, greater improvements in pain-related disability were observed.

Though effective, biofeedback requires specially trained personnel and the requisite equipment to do it; this equipment can be pricey, and trained clinicians are often in short supply. Accordingly, biofeedback can be difficult to access.

Hypnosis. No discussion of SRTs for chronic pain would be complete without including hypnosis, also called hypnotic analgesia. Though acknowledged to treat pain since the 1800s, hypnosis was formally adapted for use with chronic pain and subjected to rigorous evaluation only over the past 20 years. There is great variation in the delivery, active components, and, indeed, the very definition of hypnosis. This variation may contribute to its limited uptake in the broader field of nonpharmacologic interventions for chronic pain (M. P. Jensen & Patterson, 2014).

The difficulty arriving at a universal definition of hypnosis has likely been fueled by early disagreements regarding the theoretical models explaining it. Some researchers have proposed neodissociation and dissociation-control models, which specify that hypnosis results in a shift in cognitive processes whereby effortful evaluation and responding marked by higher-level executive functioning are replaced by automatic behavioral responses. Put more simply, hypnosis precipitates a state in which information is processed and behavior regulated without input from higher-level cognitive processing (e.g., criticism, judgment, unhelpful cognitive evaluation) that can exacerbate pain (M. P. Jensen & Patterson, 2014). Still others have suggested that sociocognitive theory best explains the effectiveness of hypnosis. From a sociocognitive perspective, hypnosis acts on expectancy, motivation, demand characteristics, environmental context clues, and role enactment (M. P. Jensen & Patterson, 2014).

So, what is hypnosis? In their seminal piece on hypnosis for chronic pain, Jensen and Patterson argued for the definition of hypnosis provided by Kihlstrom: “a social interaction in which one person, designated the subject, responds to suggestions offered by another person, designated the hypnotist, for experiences involving alterations in perception, memory, and voluntary action” (Kihlstrom, 1985, p. 385; quoted in M. P. Jensen & Patterson, 2014). Hypnosis for chronic pain is led by a trained clinician; the length of a given session may vary depending on the individual’s progress or preference. It involves a series of hypnotic suggestions for immediate and long-term pain reduction as well as training on self-regulatory skills to address pain, including relaxation, focused attention, and visual imagery.

Recent reviews and meta-analyses suggest that responses to hypnosis are highly variable from person to person. Individuals who do respond may experience improvements in domains beyond pain (e.g., mood, relaxation, energy; M. P. Jensen & Patterson, 2014). Some research suggests that people who do not evidence lasting improvements in pain intensity may report high levels of satisfaction with hypnosis, in part because they endorse temporary reductions in pain (M. P. Jensen et al., 2007) and improvements in other domains. Relative to no treatment, hypnosis is associated with greater improvements in pain intensity, duration, and frequency and physical disability among individuals suffering from a variety of chronically painful conditions, including back pain, fibromyalgia, temporomandibular disorders, and arthritis (Elkins et al., 2007; M. P. Jensen & Patterson, 2014). The magnitude of these effects varies somewhat by condition and, as noted above, across individuals. There is limited research comparing hypnosis for chronic pain to other psychological interventions for pain (e.g., CBT, biofeedback, acceptance- and mindfulness-based interventions), but the limited studies out there suggest its effectiveness is similar to that of biofeedback (M. P. Jensen, 2009) and that it may outperform SRTs in non-headache-pain sufferers (Adachi et al., 2014). In still other studies, hypnosis shows promise for pain management when combined with strategies such as cognitive therapy. Indeed, in one small investigation, combining hypnosis with a cognitive intervention for pain resulted in additive improvements over either individually (M. P. Jensen et al., 2011).

Extant research into the mechanisms underlying hypnosis lends some support for two prevailing theoretical models. Specifically, neurophysiological investigations reveal that many of the brain structures known to contribute to pain processing (e.g., thalamus, insular cortex, anterior cingulate cortex, primary and secondary sensory cortices, prefrontal cortex) respond to hypnosis (M. P. Jensen & Patterson, 2014). Brain studies further suggest that hypnotic suggestions can target specific structures in the brain and can dampen the neural activity responsible for the transmission of pain in the brain. Such findings lend support for the neodissociation and dissociation-control theories of hypnosis. However, findings from other studies support the sociocognitive model (M. P. Jensen & Patterson, 2014). Support for both models suggests that a more integrative model might be more appropriate.

Operant-behavioral interventions

Originally described by Fordyce in the 1960s, operant-conditioning models of chronic pain rely heavily on learning theory. Fordyce argued that in contrast to the prevailing view of pain as a subjective, internal experience, pain manifests in behaviors that are observable to others and hence subject to external contingencies in the same manner as any other behavior (Fordyce, 1976). According to this model, maladaptive pain behaviors consistent with the "sick" role (e.g., complaints of pain, withdrawal from normal activities, grimacing) may be reinforced by positive consequences (e.g., care from loved ones, analgesic highs, disability compensation) or the avoidance of unwanted outcomes (e.g., work, participation in undesired activities). Operant-behavioral interventions seek to sever these unhealthy conditioned associations and replace them with healthier behaviors that encourage individuals to abandon the "sick" role for a "well" one.

Operant-behavioral interventions first identify the maladaptive contingencies that reinforce pain behaviors; they then promote more adaptive behaviors that are desired (e.g., self-management behaviors such as exercise, participation in activities or chores). Therapeutic interventions are founded on core principles of contingency management and simultaneously target (a) elimination of the positive consequences and avoidant reinforcements that follow pain behaviors and (b) social reinforcement of desired behaviors. Early tests of operant-behavioral interventions were conducted in intensive residential treatment programs in which professional staff delivered positive reinforcements (most commonly praise) for adaptive "well" behaviors while ignoring pain behaviors. These programs emphasized engagement in goal-directed behavioral therapies, including structured exercise programs and other social activities led by psychologists and physical, occupational, and vocational therapists.

A key component of these programs was their structured approach to tapering opioids and other sedating medications. Active medications were compounded into a "pain cocktail" that was delivered by nursing staff on a time-contingent, not pain-contingent, basis. Patients were informed that over time, the active ingredients in the cocktail would be decreased and eventually eliminated, although they would not know when those changes occurred. In this manner, virtually all patients who completed the programs were successfully withdrawn from analgesic and other sedating medications by the end of treatment. In addition to dramatic reductions in medication use, proponents of these programs touted improvements in overall functioning, especially return to work (Fordyce, 1976). Early results encouraged the proliferation of similar programs across the United States and around the world in the 1980s and 1990s. Less intensive outpatient treatment approaches modeled after Fordyce's model also proliferated. With the emergence of CBT (described below), proponents of interdisciplinary pain-treatment programs, including Fordyce himself, eventually encouraged broadening the programs to incorporate cognitive appraisal, cognitive restructuring, and training on adaptive coping skills. Today, although few residential pain-treatment programs remain because of payment and reimbursement challenges (Murphy et al., 2013; Townsend et al., 2008), a focus on promoting adaptive "well" behaviors through the systematic application of operant-conditioning principles (specifically, contingency management) and systematic reductions in pain-contingent use of risky analgesics (especially opioids) remain cornerstones of most psychological and behavioral approaches to chronic-pain management.

Cognitive-behavioral therapy

In 1983, Turk published his seminal book describing a cognitive-behavioral perspective on pain management, launching a further revolution in the clinical application of social-learning models of pain (Turk et al., 1983). He and other proponents of the cognitive-behavioral perspective emphasized a primary role of cognition, particularly appraisals, as determinants of how individuals—primarily people with pain—define health, illness, and disease. That perspective draws heavily on the stress, appraisal, and coping model of Lazarus and his colleagues (Lazarus, 1984), which explicitly attends to individual differences in biological, emotional, and behavioral responses to similar environmental events, such as acute pain. The model proposes that psychological stress manifests when a person's cognitive appraisal of an interaction with the environment taxes or exceeds the person's resources to cope with it and endangers the person's well-being.

Drawing heavily on this model, CBT-CP first gained traction in the 1980s. CBT-CP is less concerned with the biological or structural determinants of pain and more focused on validating the experience of pain and its concomitant challenges. Central to CBT-CP is the understanding that psychological factors can contribute to the exacerbation and maintenance of physical pain. Though related, the experience of pain can be disentangled from the emotional distress, disability, and social difficulties it precipitates, which means that improvements in those outcomes can occur without changes in pain itself.

CBT-CP seeks to cognitively reconceptualize pain such that common appraisals of helplessness, fear, and hopelessness are replaced by a sense that pain is a problem to be solved. Thus, CBT-CP encourages self-control and self-efficacy among persons with pain by challenging entrenched perceptions about pain and its impact on functioning (e.g., fears about engaging in physical activity). Both the gate-control theory of pain and the neuromatrix model also inform CBT-CP (Melzack, 2001; Melzack & Wall, 1965); each emphasizes the important roles that thought and emotion play in the experience of chronic pain.

CBT-CP has evolved somewhat since its inception: Whereas earlier iterations predominantly focused on reconceptualizing the experience of pain, more recent ones embrace a more didactic, skill-acquisition approach. Despite this evolution, CBT-CP has remained true to its early roots, which advocated for an inherently flexible style that allows for tailoring and attempts to identify current personal strengths, weaknesses, and preferences. Traditionally delivered in person by a specially trained psychologist, nurse, or other health or mental health professional over the course of six to 12 sessions, CBT-CP incorporates goal-setting and problem-solving principles to support uptake of adaptive coping skills, accomplishment of behavioral goals, and adoption of pleasant activities.

The cognitive, or thought-centered, strategies emphasized in CBT-CP promote the use of behavioral coping strategies. Many people with pain may engage in unhelpful thought patterns—that is, they may catastrophize about their pain or hold tightly to beliefs about their pain that are not entirely true. For example, they may believe that they are helpless when it comes to pain, that pain has ruined their life, or that movement will only make things worse. This type of thinking tends to perpetuate behavioral patterns that support their assumptions. Because thoughts are often precursors to action, the belief that one is helpless to improve pain or functioning may interfere with the uptake of self-management skills that could improve one's quality of life. Specifically, the belief that activity will exacerbate pain is apt to prompt sedentary behavior, which contributes to deconditioning, greater pain, and functional limitations. Such thoughts may also trigger feelings of anxiety that can increase muscle tension and exacerbate pain. To address this, CBT-CP employs cognitive strategies to challenge individuals' erroneous perceptions about the need to restrict activity and behavioral strategies to promote safe movement. Accordingly, CBT-CP works to identify maladaptive thought processes and teaches strategies to reframe or correct these thoughts to facilitate more adaptive, active self-management.

Furthermore, CBT-CP promotes the acquisition of specific coping skills for pain and their integration into daily life. When used regularly, these skills can (a) help people to maintain a consistent level of activity, (b) reduce the frequency and intensity of pain flares, and (c) improve people's confidence in their ability to manage pain, particularly when pain is severe. Pain coping skills include self-regulatory strategies such as relaxation training (e.g., deep breathing, guided imagery, progressive muscle relaxation). Given that stress and pain can activate physiological processes that increase muscle tension and further exacerbate underlying pain, regular practice of relaxation strategies can prevent increases in pain or immediately reduce pain when it escalates. Because people with pain often get caught in vicious overactivity/underactivity cycles wherein the pressure to complete tasks results in overexertion, elevated pain, and the subsequent need for prolonged periods of rest (for hours or days), CBT-CP teaches time-based pacing. This strategy encourages individuals to adopt an activity/rest cycle based on how long they exert themselves rather than how much of a task they accomplish. This strategy, when used properly, ensures that people with pain can maintain a consistent level of activity and allows most to get more done with less pain. Because sleep is known to exacerbate pain and is often disrupted among people with pain, CBT-CP also incorporates evidence-based sleep strategies.

Among the psychological approaches to chronic pain, CBT-CP has emerged as the gold standard in self-management. It has been widely studied and found to be largely effective across various pain conditions and populations (Ehde et al., 2014; Williams et al., 2012). Compared with standard care, CBT-CP yields greater improvements with respect to pain intensity, physical functioning, catastrophizing, and mood. Many randomized controlled trials (RCTs) have investigated the use of CBT-CP for pain. Several comprehensive meta-analyses of trials comparing CBT-CP with other active interventions based on cognitive-behavioral principles have revealed that CBT-CP prompts significant improvements in pain, physical functioning, mood, coping, and social functioning (Eccleston et al., 2009; Hoffman et al., 2007; Williams et al., 2012). Indeed, a 2012 Cochrane review of psychological interventions for chronic pain (excluding headache) that examined 35 trials revealed a small to moderate advantage for CBT-CP compared with active controls on measures of disability and catastrophizing, but not on pain or mood, and a small to moderate advantage compared with treatment as usual on measures of pain, disability, catastrophizing, and mood

(Williams et al., 2012). Thus, findings from these meta-analyses have largely supported CBT-CP as an effective treatment for chronic pain. Indeed, compared with more traditional medical approaches, CBT-CP emerges as not only more clinically effective but also more cost-effective (Gatchel & Okifuji, 2006; Turk & Burwinkle, 2005). CBT-CP has also been successfully tailored for specific types of pain (e.g., back pain, fibromyalgia; Williams et al., 2012) and populations (e.g., children, adults with low literacy, patients with neurological conditions; Ehde et al., 2014).

Although traditionally delivered in face-to-face settings, CBT-CP has been successfully adapted for delivery in a variety of formats (e.g., Web-based, telephone-based, interactive voice response) to improve access; in terms of outcomes, these adapted formats are comparable to traditional ones (Heapy et al., 2015). Given the high volume and quality of research supporting the effectiveness of CBT-CP for pain self-management, the NPS emphasizes the inclusion of these programs as standard components of sound pain care and advocates for both public and private insurers to cover them.

Acceptance- and mindfulness-based approaches

Informed by both Skinnerian operant behaviorism and core principles of cognitive social learning theory, Hayes proposed a "third-generation" cognitive-behavioral approach termed acceptance and commitment therapy (ACT) as an alternative to operant-behavioral interventions and CBT-CP (Hayes, 2004). Hayes proposed a novel theoretical model, termed *relational frame theory*, predicated on the idea that human language and cognition are learned and therefore modifiable through the application of operant-behavioral principles (Hayes et al., 2001). At its most fundamental level, Hayes's approach is the antithesis of virtually all other pain-management approaches, which emphasize pain as "bad" and seek to reduce its intensity. By contrast, acceptance- and mindfulness-based approaches encourage the acceptance of pain and focus on identifying and reinforcing behaviors consistent with valued social roles and desired behavioral goals.

At their core, these approaches move away from CBT-CP's emphasis on logic and the role of "helpful" thinking as a precursor to optimal physical functioning and emotional well-being. Instead, acceptance- and mindfulness-based approaches normalize suffering as an inherent part of the human condition and acknowledge that psychological suffering is highly correlated with physical pain. They encourage persons with pain to pursue valued activities by accepting, rather than challenging, pain and associated thoughts or emotions.

Often referred to as contextual cognitive-behavioral interventions, these approaches resist labeling cognitions, emotions, or behaviors as adaptive or maladaptive. Instead, these approaches consider the context in which cognitions, emotions, and behaviors occur and their functional implications. Unlike CBT-CP, which prioritizes cognitive processes (e.g., analyzing, judging) as the primary determinants of behaviors or coping strategies, acceptance- and mindfulness-based approaches suggest that coping behaviors are the product of thoughts *and* other sensory input. Adherents of acceptance- and mindfulness-based approaches believe that by emphasizing cognitive processes, CBT-CP actually limits the range of available adaptive coping strategies. Instead, acceptance- and mindfulness-based approaches promote the development of psychological flexibility, which involves embracing the present moment and using the totality of sensory input to inform changes to or maintenance of behaviors that are consistent with values.

Unlike CBT-CP, which encourages individuals to change "unhelpful" thought patterns, acceptance- and mindfulness-based approaches emphasize cognitive defusion as a critical strategy to reduce suffering. Essentially, cognitive defusion is used to help people distance themselves from their thoughts. Often, people overidentify with the content of their thoughts, which can maintain or exacerbate suffering. For example, someone experiencing pain might think, "This pain will never end." If such thoughts are accepted as true, they can precipitate significant distress. Rather than change those thoughts, cognitive defusion encourages people to notice them without attaching to them. Through that process, suffering can be reduced.

Under the CBT model, cognitions precede emotions; thus, what someone thinks about something determines how they feel about it, and by changing a thought, they can change how they feel. Acceptance- and mindfulness-based approaches acknowledge that thoughts and emotions are related, but targeted intervention can occur at the level of emotions as well as thoughts. In these approaches, acceptance is a companion skill to defusion, and it deals directly with challenging emotions. Strategies for acceptance may include engaging, or continuing to participate in valued activities even when one experiences challenging emotions, and refraining, or resisting urges to avoid unwanted emotions, particularly if doing so will limit one's progress toward valued activities. In the context of pain, acceptance might involve acknowledging negative emotions that occur when one participates in a valued activity—for example, frustration in response to increased pain while playing with grandchildren—but resisting the urge to disengage from that activity. Instead, a person might observe and accept the experience of frustration without judgment or notice and let go of the thoughts contributing to the frustration.

Another critical skill for acceptance and mindfulness is being present, or noticing the present moment rather than fixating on past or future events. Being present may also involve describing present events rather than analyzing or judging them. For example, a person experiencing pain might be encouraged to notice its location in the body and describe what it feels like rather than judging it as unpleasant or predicting how it will affect them. Self-as-observer, another acceptance and mindfulness strategy, involves differentiating between an awareness of the present that is internally manufactured via the language or thoughts one uses to process it and the present as it actually is.

By encouraging psychological flexibility, acceptance- and mindfulness-based strategies are thought to promote individuals' adherence to personally valued activities. They also inform individuals' selection of, changes to, and maintenance of behaviors that support movement in valued directions. In so doing, acceptance- and mindfulness-based approaches embrace behavioral strategies such as skill acquisition and goal-setting that are heralded by other psychologically minded interventions, including CBT-CP. Hearkening back to the example cited above, for a grandparent who feels frustrated by pain while pursuing valued activities with grandchildren, committed action might involve developing self-management strategies that allow for easier engagement or, consistent with behavioral interventions, altering the activity or behavior to allow for more comfortable interaction.

There is substantial evidence supporting the use of acceptance- and mindfulness-based interventions to treat a variety of problems, and most studies have suggested that the interventions are comparable to other established interventions (McCracken & Vowles, 2014). Concerning chronic pain, specifically, the emerging literature suggests that acceptance- and mindfulness-based interventions are preferable to treatment as usual. A 2016 meta-analysis of 25 RCTs using waitlist, treatment-as-usual, and education control conditions reveals small to medium posttreatment effects on functioning and mood following acceptance- and mindfulness-based interventions, as well as small to large effects on pain, disability, and pain interference at long-term follow-up (Veehof et al., 2016). The same study also demonstrates that acceptance- and mindfulness-based treatments are comparable to CBT-CP.

It is important to note that acceptance- and mindfulness-based interventions are often discussed in tandem because many of the principles discussed above are relevant for both. However, there are two distinct, widely investigated interventions that have grown out of this tradition. The first, acceptance and commitment therapy for chronic pain (ACT-CP), considered a second-generation CBT therapy, emphasizes defusion and acceptance of pain and associated thoughts and emotions while simultaneously promoting engagement in meaningful and valued activities. Like CBT-CP, ACT-CP is a manual-based treatment that can be delivered in individual or group settings. ACT-CP encourages individuals to (a) recognize the self as distinct from struggles; (b) be willing to experience struggles as they are, without superimposing a narrative; and (c) identify values and commit to moving toward those values regardless of struggles in the present moment (McCracken, 2015). Sessions focus on building core skills in cognitive defusion, mindfulness, commitment to action, and acceptance as a means to develop greater psychological flexibility. Research on ACT specifically has suggested that, relative to no treatment, ACT improves physical functioning and emotional well-being (Hughes et al., 2017; McCracken & Vowles, 2014) but does not lessen the intensity of pain. In at least one review, ACT produced medium to large effects on measures (e.g., acceptance, psychological flexibility) thought to underlie changes in clinical outcomes (Hughes et al., 2017). In controlled studies, ACT has performed similarly to CBT-CP (Hughes et al., 2017; Veehof et al., 2011).

By contrast, mindfulness-based stress reduction (MBSR), one of the more widely researched mindfulness interventions, emphasizes the importance of nonjudgment and aims to disentangle the experience of physical pain from emotional suffering via increased awareness of the body, the breath, and activity. It is a manual-based, 10-week intervention, usually delivered in group settings, wherein participants attend weekly 2-hr sessions and one 8-hr retreat. Proponents believe that exercises in which persons with pain are encouraged to nonjudgmentally observe their pain are akin to exposure and may promote greater tolerance. Indeed, they are taught to observe not just their pain but also the emotions and cognitions that arise in response to it. They learn to emotionally and cognitively distance themselves from the pain, which leaves greater room to respond intentionally rather than in instinctual ways that may be maladaptive (e.g., by withdrawing or pushing through). Large meta-analytic studies of MBSR have revealed improvements in emotional well-being and psychological distress among persons with chronic conditions, including pain. Other studies have reported short-term improvements in pain intensity and physical functioning among people with low-back pain (Anheyer et al., 2017). One review suggested that outcomes following MBSR may be due to nonspecific factors (e.g., expectations) and may vary significantly by painful condition (Chiesa & Serretti, 2011). At present, few studies of MBSR for pain have included active control conditions; this precludes conclusions about its effect relative to other psychological interventions. Other mindfulness-based interventions have demonstrated consistent long-term reductions in pain intensity relative to active control treatments (Reiner et al., 2013). Overall, there is greater variation in the effectiveness of MBSR and mindfulness-based interventions than in that of ACT and CBT-CP (Rosenzweig et al., 2010).

Barriers to acceptance- and mindfulness-based interventions are similar to those observed for CBT-CP (e.g., time, transportation, need for specially trained therapists). As more recent treatments, the former have been investigated less in nontraditional formats (e.g., telehealth, Web-based interventions) meant to address barriers to care. In one recent trial, an 8-week acceptance- and mindfulness-based intervention delivered via teleconferencing was found noninferior (i.e., not meaningfully less effective) to traditional in-person care in its effects on functional disability, mental and physical quality of life, depression, activity, and sleep quality immediately following treatment. Participants in the teleconferencing condition were, however, much more likely than those in the face-to-face condition to drop out of the intervention (Herbert et al., 2017). Given the importance of in vivo experiential activities in MBSR and mindfulness-based interventions, it is not surprising that these may not be as adaptable for less traditional formats.

Emotional-awareness and expression therapy

As psychological interventions for chronic pain such as supportive psychotherapy, biofeedback, CBT-CP, and acceptance- and mindfulness-based interventions have garnered support for their effectiveness across a variety of painful conditions and populations, they have become more mainstream and acceptable to patients and providers alike. Efforts are currently under way to investigate which interventions work best and for whom. Emotional-awareness and expression therapy (EAET) is a more recent therapeutic intervention that seeks to address this question. At its core, EAET targets the hypothesized connection between physical and emotional pain first postulated by Sarno (1998).

Psychological processes such as mood, appraisals, and thoughts are critical contributors to pain. However, some researchers have argued that psychosocial and emotional processes may be particularly salient for many people with chronic pain (Lumley & Schubiner, 2019a, 2019b). Indeed, the literature seems to support this assertion; early-life traumas, posttraumatic stress disorders (PTSDs), and life stress have demonstrated strong associations with many chronic painful disorders (Seng et al., 2006). Notably, research has suggested that certain patients, including those classified as interpersonally distressed and those with comorbid trauma, may evidence suboptimal responses to evidence-based psychological interventions for pain (Turk, 2005). Perhaps this is because existing psychological interventions for pain do not directly target disrupted emotional or relational processes. Because emotional and physical pain share overlapping neurobiological substrates, disrupted emotional or relational processes may maintain or exacerbate the physical experience of pain (MacDonald & Leary, 2005).

The suggestion by some in the field that targeting trauma and disrupted emotional functioning may reduce physical pain and improve physical functioning has met with some skepticism. For the most part, skeptics have raised concerns that such endeavors might have the unintended effect of exacerbating trauma, emotional distress, or physical pain itself (Lumley & Schubiner, 2019a, 2019b). Citing relevant literature suggesting that individuals with chronic pain have experienced widespread stigma, including claims that their pain is “all in their head,” many believe that patients will be reluctant to engage in a treatment that targets emotion. Despite this skepticism, EAET, a manual-based, eight-session intervention emphasizing connections among dysfunctional emotional processes (stemming from past traumas or emotionally stressful circumstances) and pain, has garnered early support.

Those who engage in the treatment learn, in lay terms, about the neuroscience of pain (specifically, the role that neural pathways play in generating and maintaining pain and the interconnectivity of brain regions responsible for physical pain and emotional processing). They also learn that early-life experiences, trauma, stress, and interpersonal conflicts can contribute to the onset and maintenance of pain, particularly when these experiences prompt avoidance of emotionally charged reminders (e.g., persons, places, situations). The therapy is designed to assist individuals as they identify the avoided emotional stimuli (relational conflicts, traumas), express emotions, and approach conflict via experiential activities. EAET draws from several evidence-based modalities, including psychological pain interventions, exposure strategies for developing awareness and expression of emotions and fears, written emotional disclosure, assertiveness training, psychodynamic strategies for challenging defenses, and rescripting therapies in which patients rewrite pain narratives with an emphasis on strength and empowerment.

A series of observational and pilot interventions testing various iterations of what finally became EAET (Burger et al., 2016; Lumley et al., 2008) suggested improvements in terms of pain, disability, quality of life, and trauma symptoms and mixed results in terms of sleep, mood, and fatigue. More recently, a series of RCTs testing EAET with different patient groups, in different settings and formats, and over different durations (Hsu et al., 2010; Lumley & Schubiner, 2019a; Slavin-Spenny et al., 2013; Thakur et al., 2017; Ziadni et al., 2018) revealed improvements in pain and disease symptoms but mixed effects on physical functioning and emotional distress. The most notable of these was an NIH-funded trial comparing the effects of the eight-session EAET protocol, CBT-CP, and an educational intervention in a large sample of people (mostly women) with fibromyalgia (Lumley et al., 2017). The findings revealed that EAET was superior to education and had small to moderate effects on almost all outcomes. EAET was superior to CBT-CP with respect to improvements in widespread pain, reductions in fibromyalgia symptoms, and the percentage of participants achieving a 50% pain reduction. In fact, 22.5% of those enrolled in EAET evidenced at least a 50% reduction in pain; in the CBT-CP condition, only 8% reached that threshold. Though EAET is a relatively new intervention, early evidence suggests that it is safe and effective and may be comparable to other treatments for chronic pain—particularly CBT-CP. More research is necessary to determine its overall impact and its potential as a mainstream psychological intervention for chronic pain.

Nonpsychological treatments with a psychological basis

The practice of augmenting nonpsychological modalities with psychologically informed treatments is not particularly novel. Intensive multidisciplinary pain programs, which may include physical therapy, medication management, exercise, chiropractic, or self-management programs such as biofeedback, CBT-CP, or acceptance- and mindfulness-based approaches, have existed for decades and are largely more effective than any single modality. However, these multidisciplinary programs do not typically integrate the treatments they entail. Instead, each intervention is delivered in isolation. More recently, there has been a move to integrate those interventions and to incorporate psychological principles into nonpsychological approaches such as physical therapy and exercise. A 2018 review of psychological interventions delivered by physiotherapists in combination with physical therapy identified 34 studies examining a wide variety of chronic painful conditions (e.g., low-back pain, mixed musculoskeletal conditions, osteoarthritis, neck pain) and psychological approaches (e.g., CBT-CP, acceptance- and mindfulness-based approaches, relaxation, hypnosis, coping-skills training; Silva Guerrero et al., 2018). Compared with physical therapy alone or treatment as usual, the combined interventions yielded small improvements in pain intensity, disability, self-efficacy, fear of movement, and catastrophizing. However, the quality of the evidence varied considerably across outcomes; findings were most robust for pain intensity and catastrophizing.

Psychologically informed physical therapy is a specific modality incorporating CBT techniques into traditional physical therapy (Archer et al., 2018), in which individuals simultaneously receive physical therapy and training on pain-related coping skills. For example, a provider who observes a patient pushing too hard to complete an exercise might coach them to pace their activity or set more reasonable goals. Alternatively, a provider who notices a patient engaging in unhelpful or catastrophic thinking (e.g., “I can’t do this” or “This is going to hurt”) might take this opportunity to educate the patient about the unhelpful sequelae of that kind of thinking (e.g., frustration, refusal to participate), which may ultimately translate to greater pain or disability. Next, the provider might help the individual learn to reframe their thinking in ways that prompt healthy engagement in the exercise (e.g., by confronting fears of pain, acknowledging that the exercise might be difficult but will likely make them stronger, or creating a plan to pace the activity to minimize discomfort). Participants thus receive in vivo coaching on the use of CBT-CP-based skills for pain self-management, which can address barriers to engaging in exercises and therefore optimize outcomes. A recent review of RCTs of psychologically informed physical therapy revealed short-term improvements in functioning among people with knee pain and low-back pain; results for neck pain were inconclusive (Archer et al., 2018). Altogether, findings suggest that physical therapy informed by CBT-CP and by acceptance- and mindfulness-based approaches may hold promise; however, further evaluation is warranted (Coronado et al., 2020).

Mechanisms Underlying Psychological Interventions for Chronic Pain

In this section, we present a summary of research examining whether improvements in patients’ outcomes attributed to psychological interventions are reliably associated with the mechanisms hypothesized to underlie adjustment to chronic pain.

Psychosocial Risk and Resilience Factors

Essentially all behavioral and nonpharmacologic treatments commonly used for chronic pain appear to produce some of their benefits by reducing negative affect, decreasing catastrophizing, enhancing self-efficacy, and generally improving key psychosocial-process variables (Burns et al., 2015b; Edwards, Dworkin, Sullivan, et al., 2016). Overall, evidence from a variety of interventional studies suggests that the theory informing the techniques that underlie a particular treatment may be less important than whether those techniques impact key factors that prompt changes in cognition, emotion, and behavior (Burns et al., 2015a, 2015b; Burns, Glenn, et al., 2003; Burns, Kubilus, et al., 2003). Treatment-related improvements in cognitive-content variables, such as pain catastrophizing, appear to be influential across modalities of intervention and pain-related outcomes (Thorn et al., 2011). For example, a recent large, pragmatic trial comparing CBT-CP with MBSR for chronic pain reported that although the two interventions had somewhat different targets of treatment (i.e., the latter focused on enhancing mindfulness and the former on reducing catastrophizing and negative thinking), they had similar or identical effects on the hypothesized psychological mediators of treatment outcomes, as well as on pain intensity (Cherkin et al., 2016; Turner et al., 2016). Both CBT and MBSR increased self-efficacy, acceptance, and mindfulness and decreased catastrophizing and pain intensity.

It is important to note that although not all process studies have fully met the standards of a rigorous test of mechanism (e.g., showing that the putative mechanism changes before the outcome and that early changes in the mechanism correlate with later changes in the outcome), some have. For example, seven studies of catastrophizing used sophisticated modeling to demonstrate that psychological interventions for pain produced adaptive improvements in psychosocial-process variables such as catastrophizing, and changes in catastrophizing and related factors (e.g., self-efficacy) that occurred earlier in the treatment course were associated with longer-term changes in outcomes such as pain severity and disability (Burns et al., 2012; Burns, Glenn, et al., 2003; Burns, Kubilus, et al., 2003; Johannsen et al., 2018; Lazaridou et al., 2017; Levy et al., 2014; Trompetter et al., 2015; Turner et al., 2007).

Exposure

Many psychological interventions for chronic pain also explicitly or implicitly target behavioral avoidance, which has been reliably linked to poorer pain outcomes. For example, exposure has been used to reduce pain-related fear by promoting gradual increases in activities (e.g., walking, stretching) that individuals might otherwise avoid because of a real or perceived fear of increased pain or injury (van Vliet et al., 2018; Vlaeyen & Crombez, 2019). Graded exposure treatments, in which individuals with chronic pain gradually engage in steadily more intense levels of activity, are embedded in many psychological interventions for chronic pain (particularly CBT-CP and acceptance- and mindfulness-based interventions) and have demonstrated a long history of successful improvement of patient functioning and quality of life, particularly in patients with back pain (Leeuw et al., 2008; Vlaeyen et al., 2002). Although avoidance can be adaptive in the short term in the context of acute injuries, it paradoxically may have detrimental long-term effects. Exposure-based treatments reduce avoidance behaviors and promote the pursuit of individually valued life goals in the face of persistent pain, which produces an array of adaptive outcomes (Cunningham et al., 2019).

Placebo and nonspecific factors

Placebos are inert pills, devices, or procedures used to control for various nonspecific aspects of treatments in RCTs. In drug trials, for example, placebos may be pills that look exactly like the medication being studied but have no active ingredients that would cause a physiological effect. Placebo responses in RCTs and in clinical care include placebo effects—salubrious clinical outcomes stemming from patients' participation in rituals, symbols, or behaviors associated with medical treatment—as well as spontaneous improvement and regression to the mean.

Although much of the literature on placebos and much innovation in the design and delivery of placebo interventions have involved pharmacologic treatments, some studies have included carefully designed control conditions for RCTs of behavioral treatments. Such control interventions are generally matched for the form, timing, and professional expertise involved in the treatment of interest. Still, they omit the elements of active treatment that are presumed to be critical in conferring benefits. For example, in a study of CBT for insomnia, participants received CBT, progressive muscle-relaxation training, or a desensitization-oriented behavioral treatment used to control for the nonspecific effects of CBT (Edinger et al., 2001). The treatments were matched on factors such as the number and length of sessions, the expertise of the interventionist, and the assignment of between-session at-home practice. There were no differences in participants' ratings of treatment credibility and expected helpfulness at the start of treatment, no differences in their compliance or session attendance during treatment, and no differences in their ratings of the interventionists' warmth or competence following treatment. Thus, significantly greater improvements in sleep observed in the CBT group appeared to be attributable to the specific content of the CBT intervention rather than nonspecific effects. Other studies have employed similar carefully designed control conditions, such as psychoeducational conditions in trials of MBSR (Wong et al., 2018), a supportive education-focused control condition in ACT (Dindo et al., 2019), and several disease-education control conditions in trials of CBT-CP (Davis et al., 2015; Kashikar-Zuck et al., 2012; Lazaridou et al., 2017; Palermo et al., 2016; Thorn et al., 2018; Wong et al., 2018).

The patient–clinician relationship (which contributes strongly to patient expectations) is also critical in understanding placebo effects (Blasini et al., 2018; Chen et al., 2019). Here the focus is not on a single factor but rather an amalgam of explicit behaviors (e.g., attention, warmth, focused touch, validation, empathic witnessing) and oblique or nonconscious cues (e.g., vocal, facial, eye, and bodily expressiveness; nonfocused touch; proximity relations; embodied treatment; Kaptchuk & Miller, 2018). Several large RCTs in chronic pain demonstrate that clinical encounters can significantly enhance placebo effects (Fuentes et al., 2014; Kelley et al., 2009). In these studies, methods that enhanced the therapeutic alliance between patients and practitioners (e.g., practitioners' use of warm interaction styles, active listening, empathic understanding, or physical contact) increased patient-reported benefits from treatment, even (or, in some cases, especially) placebo treatment. An emergent theory broadly extends the patient–clinician-relationship model with neuroimaging and behavioral evidence establishing that placebo effects can be evoked with exposure to nonconscious placebo cues in a matter of milliseconds (Ingvar, 2015; K. B. Jensen et al., 2012; K. B. Jensen, Kaptchuk, et al., 2015; K. B. Jensen, Kirsch, et al., 2015).

Given that chronic pain often involves the nonconscious amplification of aberrant symptoms (Woolf, 2011), some researchers have hypothesized a phenomenon referred to as *predictive coding*, which specifies that patients' immersion in therapeutic encounters furnishes a barrage of synergizing nonconscious and conscious signals that subtly alter neurological sensory processes (Ongaro & Kaptchuk, 2019). Essentially, the nervous system has to process an enormous stream of varying signals from its sensory organs. The perception of sensation, including pain, is essentially a process of prediction based on an integration of sensory input, experience, expectancies, and contextual cues. The brain is constantly updating its hypotheses about incoming input; mismatches between predicted input and actual input result in prediction errors, which prompt the system to revise its hypotheses. From this perspective, the experience of recovery or improvement is not the direct consequence of improved health but rather involves inferences that certain interoceptive events are signs that this improvement is taking place. Thus, placebo effects may partly involve the processing of therapeutic contextual elements (e.g., a caring, competent expert assuring or implying that treatment will improve a patient's symptoms), resulting in updated predictions, with consequent beneficial effects on symptom-related neurobiology (Ongaro & Kaptchuk, 2019).

These placebo studies have suggested that improvements relative to pretreatment baselines are the function of both nonspecific factors and active treatments such as CBT, ACT, and mindfulness-based interventions. On average, however, the latter appear to produce larger and longer-lasting benefits. For example, in a study that compared Internet-delivered CBT with Internet-delivered education for children with chronic pain and their parents (Palermo et al., 2016), both treatments resulted in reductions in daily activity limitations, but the CBT group showed significantly ($p < .05$) larger reductions than the education group 6 months later. Collectively, the findings from this study and others suggest that both nonspecific placebo-related factors and specific treatment-targeted mechanisms (e.g., reductions in catastrophizing, increases in mindfulness) play important roles in shaping the benefits of psychological interventions for chronic pain.

Special Populations: Implications for the Psychological Treatment of Chronic Pain

Though psychological factors and interventions have been widely studied in pain, there remain disparities in pain, its outcomes, and its management. As the biopsychosocial model makes apparent, the study of chronic pain necessarily demands the identification of individual differences. Two people with seemingly identical injuries will not report the same degree of pain, will not be identically affected by the pain, and will not manage the pain in the same way. The sources of this variation are enormous in number, but the field has identified some factors that appear to be consistently influential. In particular, sex and gender and sociocultural factors may convey differential risk for pain, suboptimal treatment, and poorer pain outcomes. These differences and disparities may necessitate efforts to tailor psychological interventions to be sensitive to these factors.

Sex and gender

Sex and gender are important factors in the perception and experience of pain (Bartley & Fillingim, 2013). For decades, considerable evidence has suggested that pain is more prevalent among women relative to men (Bartley & Fillingim, 2013); women are also more likely to experience recurrent pain, severe pain (both acute and chronic), more frequent pain, and longer-lasting pain in the context of numerous conditions. Furthermore, musculoskeletal pain, inflammatory arthritis, gastrointestinal pain, neuropathic pain, orofacial pain, and headache are all more prevalent among women than men (Bartley & Fillingim, 2013).

The sex differences observed in the pain experience appear to have roots in several biological, psychological, and sociocultural processes. Regarding biological processes, there is consistent evidence suggesting that hormones influence sex differences in clinical pain conditions. First, some studies have demonstrated that painful conditions such as migraine and temporomandibular disorders are similarly prevalent among prepubescent males and females and that female-predominant sex differences in prevalence emerge after puberty (Greenspan et al., 2007). In addition, symptom severity across several painful conditions, including temporomandibular disorders, irritable bowel syndrome, chronic endometriosis, headache, and fibromyalgia, vary across the menstrual cycle, lending additional support for the role of hormones (Greenspan et al., 2007). Additionally, laboratory-based quantitative-sensory-testing studies have shown that women demonstrate greater sensitivity and reduced tolerance to multiple modalities of experimental pain compared with men (Bartley & Fillingim, 2013).

Psychosocial mechanisms also contribute to sex differences in the pain experience. Gender roles, for example, are associated with responses to pain. Men often adopt a traditionally masculine gender norm of increased pain tolerance, whereas women tend to adopt norms centered around accepting pain as a normal part of life (Myers et al., 2003). Laboratory studies have associated men's endorsement of masculinity with higher pain thresholds, greater pain tolerance, and lower pain ratings (Robinson et al., 2001). Sex differences in perceptions and reports of pain are also accounted for by several psychological factors, including coping, catastrophizing, and affective distress. For example, compared with men, women endorse more frequent catastrophizing, and this higher frequency of catastrophizing mediates sex differences in pain-related outcomes, clinical pain, and experimental pain (Edwards et al., 2004; Keefe et al., 2000; Meints et al., 2017). In addition, certain mental health conditions, such as depression, are more prevalent among women than men, and their co-occurrence in the setting of pain is thought to portend poorer pain outcomes (Keogh et al., 2006).

Social factors may likewise influence men and women differently. In particular, women are more likely to report that relational demands (e.g., caring for others) are a persistent barrier to optimal pain self-management (Ziadni et al., 2018). These relational factors may also explain why women more readily use medication to treat acute pain flares (Darnall & Stacey, 2012); the pressure to care for others may overwhelm efforts to care for the self in these instances. Women are more likely than men to evidence ill-defined pain conditions (e.g., fibromyalgia) and are more likely to report feeling stigmatized in health care interactions, which may stem from providers' overreliance on medical explanations for pain (Hoffmann & Tarzian, 2001) or differences in how women communicate about their pain (Werner & Malterud, 2003); for example, women are more likely than men to cite emotional distress when reporting pain, which may cause their reports to be discounted (Hoffmann & Tarzian, 2001).

Given the observed differences between men and women with respect to the pain experience, preliminary evidence suggesting sex differences in responses to nonpharmacologic treatments for chronic pain are not surprising. Women are less likely than their male counterparts to fear exercise-based interventions (Bränström & Fahlström, 2008), and it appears that although they respond similarly to behavioral interventions immediately after treatment, they may not sustain said gains over the long term (Keogh et al., 2005; Murphy et al., 2016).

Sociocultural factors

In addition to sex and gender, race and ethnicity play critically important roles in the development and experience of pain and should always be considered in assessments of psychosocial factors related to pain (Meints et al., 2019). For example, compared with non-Hispanic White individuals, Black individuals are more sensitive to and less tolerant of experimental pain and report greater disability, suffering, and psychological symptoms in response to clinical pain (Green et al., 2003; Hampton et al., 2015; H. J. Kim et al., 2017). Likewise, compared with non-Hispanic White people, people who identify as Hispanic endorse more severe clinical pain and demonstrate more sensitivity to and less tolerance for experimental pain (Hollingshead et al., 2016). Although much research examining racial and ethnic differences in pain in the United States has focused on Black, Hispanic, and non-Hispanic White groups, some studies have assessed pain in other racial or ethnic groups; for example, two studies have shown that individuals who identify as Asian demonstrate a lower pain tolerance, a lower pain threshold, and greater sensitivity to pain compared with people who are White (Ostrom et al., 2017; Rowell et al., 2011).

In addition to racial and ethnic differences in the experience of pain, research has revealed considerable racial and ethnic disparities in medical treatment for pain. According to a review by Anderson and colleagues, such disparities in treatment are present across an array of medical settings (Anderson et al., 2009). Compared with White patients, patients of color are more likely to have their pain underestimated by providers, are less likely to receive comprehensive diagnostic workups for pain, are less likely to receive opioids as part of their pain-management regimen, and receive less aggressive pain treatment (Meints et al., 2019). Some of the recent literature on ethnic variation in pain has aimed not only to quantify these differences but also to determine possible underlying mechanisms and contributing factors.

One hypothesis relates to sociocultural factors that cause chronic stress among many marginalized racial groups. In addition to the socioeconomic strain often observed among people of color in the United States, Black individuals are frequently exposed to racism in day-to-day life (K. H. Banks et al., 2006; Mays et al., 2007; Shavers & Shavers, 2006). Chronic socioeconomic strain and racism lead to high levels of sympathetic-nervous-system activation and physiological exhaustion, which can make individuals more sensitive to painful stimuli. Perceived bias and discrimination may also be related to the experience of pain among people of color more generally. In one survey, about half of Hispanics and 70% of Black individuals in the United States reported discrimination or unfair treatment as a result of their race or ethnicity (Pew Research Center, 2016). Discrimination is associated with increased psychological distress, which is, in turn, associated with the development of chronic pain (Brown et al., 2018). Perceived discrimination has been linked to increased bodily pain among Black and Chinese Americans (Burgess et al., 2009; Dugan et al., 2017) and to increased pain intensity among Black women with osteoarthritis (Taylor et al., 2018). Indeed, perceived discrimination was shown to be among the strongest predictors of back pain among people who identified as Black in a national sample (Edwards, 2008).

Racial and ethnic disparities in pain care may be driven in part by false beliefs about people of color (Meints et al., 2019). In a primary-care setting, Black and Hispanic patients were monitored more closely for potential drug abuse than White patients were (Becker et al., 2011), which suggests that providers believed non-White patients were more likely to misuse and abuse opioid prescriptions. Hoffman and colleagues also found that nearly half of a sample of medical students endorsed false beliefs about biological differences between Black and White individuals, and those who did so reported lower pain ratings for Black patients compared with White patients (Hoffman et al., 2016). A recent meta-analysis of studies using the implicit association task (IAT), a test of unconscious bias in attitudes and beliefs, revealed that of the dozens of studies that have used the IAT to evaluate provider bias in relation to health disparities, over 80% found evidence for biases in favor of Whites or against people of color across levels of training and disciplines (Maina et al., 2018).

Another potential contributor to disparities involves possible group differences in communication quality, which is central to pain management. Research has indicated that good patient–provider communication (e.g., effective questioning, expression of empathy and concern, shared decision making) is beneficial for patients' adherence to treatment recommendations (Zolnierek & Dimatteo, 2009), engagement in self-management (Henry & Matthias, 2018), and satisfaction with care (Ruberton et al., 2016). Language barriers, cultural differences in communication styles, and health literacy may affect patient–provider communication. For example, Spanish-speaking Hispanic patients reported difficulties describing their pain experience to non-Spanish-speaking providers and in understanding the clinical recommendations made by those providers (Cohen et al., 2007). Moreover, compared with English-speaking patients, Spanish-speaking patients in emergency rooms were less likely to understand their diagnosis or treatment plan, less likely to be satisfied with their care and the patient–provider relationship, and less likely to return when necessary (Carrasquillo et al., 1999; Crane, 1997).

Collectively, numerous patient-, provider-, and system-level factors appear to contribute to disparities in pain perception, pain reporting, pain treatment, and long-term pain outcomes. Deepening our understanding of these factors and developing methods to reduce disparities by more effectively assessing and managing pain in at-risk groups is an important part of the NPS (Worley, 2016). Consideration of how these factors might affect the uptake or outcomes of psychological interventions for chronic pain is critical. Though these issues are understudied, some encouraging findings have recently emerged—for example, Thorn and colleagues developed and implemented a successful and effective CBT intervention for a largely rural sample of low-socioeconomic-status, Black chronic-pain patients with limited health literacy (Thorn et al., 2018). Such programs, involving tailored interventions designed to maximally benefit at-risk groups, will likely represent the wave of the future in personalized, empirically supported pain care.

Emerging Models of Integrated Pain Care: Where Do Psychological Therapies Fit Best?

The NPS highlights significant inadequacies and gaps in current approaches to chronic-pain care, which are often limited to medication or invasive medical procedures delivered by lone providers. Furthermore, it highlights the lacking evidence for meaningful benefits and the significant risk of harm associated with these modalities (IPRCC, 2016). Consistent with the biopsychosocial framework for understanding chronic pain, the strategy recommends integrated, evidence-based, patient-centered, multimodal, and interdisciplinary treatment as the standard of chronic-pain care. The NPS defines integrated pain care as "the systematic coordination of medical, psychological and social aspects of health care and includes primary care, mental health care, and when needed, specialist services" (IPRCC, 2016, p. 11). To achieve this standard, the NPS recommends (a) more quality research on the effectiveness of pain interventions, integrated care, models of care delivery, and reimbursement innovations; (b) more effective methods to disseminate research findings and incentives to incorporate them into clinical practice; and (c) innovations in models of payment and reimbursement that support a population-based approach, including support for integrated, patient-centered, interdisciplinary teams (IPRCC, 2016).

The NPS recommendations are consistent with experts' long-held perspectives on optimal care for persons with chronic pain. By the 1950s, for example, Bonica, often considered the father of modern pain management, argued that the complexity of chronic pain required an integrated, multimodal, and interdisciplinary approach (Bonica, 1990). Building on this belief, Fordyce developed a behaviorally based, residential treatment program that applied core principles espoused by Bonica for the most complex, treatment-refractory, and at-risk population of people with chronic pain (Fordyce, 1976). Intensive pain-rehabilitation programs modeled after Fordyce's approach rapidly emerged in the 1970s. Such programs typically involve colocated interdisciplinary teams of physicians, nurses, physical therapists, psychologists, and other health professionals. Common components are optimization of medications for managing pain and co-occurring conditions and an emphasis on behavioral activation and improved self-management of pain through structured exercise and psychological interventions such as CBT. Although some programs are residential, many are conducted on an entirely outpatient basis. The effectiveness (and even cost-effectiveness) of integrated programs continues to be supported by data (Flor et al., 1992; Guzman et al., 2001; Hoffman et al., 2007; Turk et al., 1992). Ultimately, however, it is important to acknowledge that these programs are resource-intensive and often available only for the most treatment-refractory and at-risk patients. Therefore, the viability of these programs for the larger population of persons with chronic pain remains questionable.

In this context, integrated models of pain care that are more consistent with a population-health perspective and feasible for delivery in primary-care settings have been proposed. The ideal model of care is one that incorporates evidence-based approaches that can be reasonably applied to prevent the transition from acute to chronic pain, prevent escalating disability and emotional distress among persons with ongoing chronic pain, or improve outcomes for those already experiencing negative effects of chronic pain on physical and emotional functioning, including people with high-impact chronic pain. Several models have been articulated, and empirical evidence that will allow for their evaluation is rapidly emerging.

Two examples highlight the potential effectiveness of less intensive integrated approaches. Dobscha and colleagues (Dobscha et al., 2009) tested a biopsychosocially informed collaborative-care model targeting veterans with chronic musculoskeletal pain in a Veterans Health Administration (VHA) primary-care setting. That model incorporated clinician education, patient assessment, behavioral activation, symptom monitoring, feedback and recommendations for clinicians, and facilitated access to specialty pain care as indicated. Key features of this approach are the integration of pharmacotherapy, physical therapy, and psychological treatment with explicit attention to healthy lifestyle factors and mental health comorbidities, all in the service of promoting adaptive pain self-management as a pathway to improve patient-centered outcomes, including pain-related disability, pain intensity, and depressive-symptom severity. In another study conducted in part in the VHA as well as a university-affiliated medical center, Kroenke and colleagues (Kroenke et al., 2009) tested a more explicit example of an approach designed to target co-occurring chronic musculoskeletal pain and depressive disorder. Their integrated approach included optimized pharmacologic management of depressive disorder and a cognitive-behaviorally informed intervention for pain self-management. Relative to a usual-care condition, this integrated approach resulted in clinically meaningful improvements in depressive-symptom severity and modest improvements on pain-relevant outcomes.

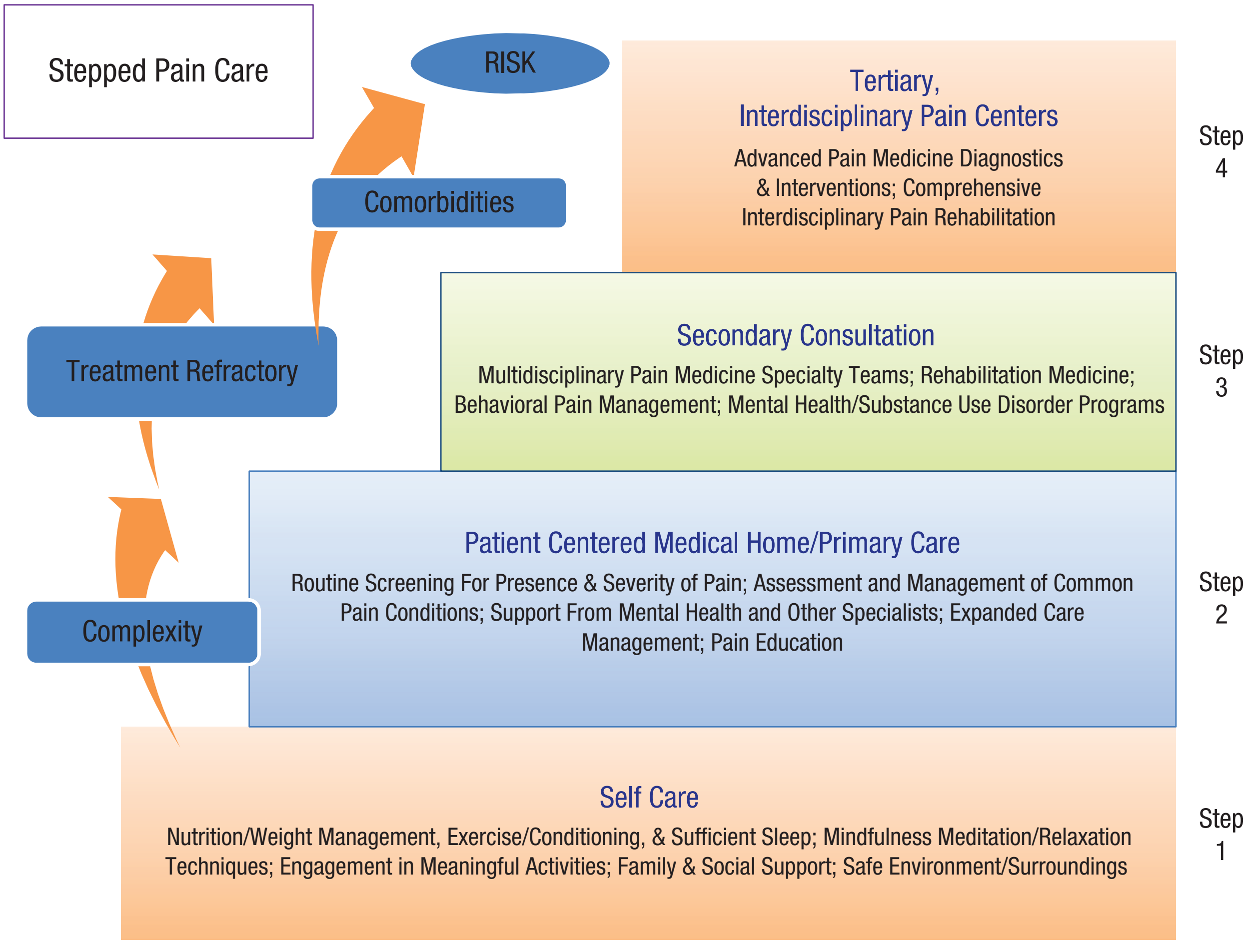

Fig. 2. Veterans Health Administration Stepped Care Model of Pain Management. From *VHA Pain Management*, U.S. Department of Veterans Affairs (2020; https://www.va.gov/painmanagement/providers/index.asp). In the public domain.

Three models of pain-care delivery have drawn attention in the field: stepped care, stratified care, and matched care (Linton et al., 2018). The stepped-care model of pain management has garnered strong interest as a population-based and empirically supported model and was described as a promising model of integrated care in the Institute of Medicine report (2011). In general, the model encourages a conservative approach to pain management with escalating, algorithmic, and evidence-based engagement of more intensive approaches when pain remains poorly managed and in the context of increasing complexity, comorbidities, and risk. In 2009, the VHA adopted the stepped-care model as its standard of pain care (Kerns et al., 2011); soon afterward, the U.S. Department of Defense (DOD) followed suit. Under the VHA's and DOD's version of the stepped-care model, the assessment and management of most common pain conditions takes place in the primary-care setting and incorporates interdisciplinary care, often including teams of mental health specialists and, increasingly, interdisciplinary pain teams. If effective pain management is not achieved within the primary-care setting, patients receive timely and equitable access to specialty care, including pain-medicine specialists, rehabilitation specialists, advanced mental health and substance-use-disorder care, pain-relevant psychological treatment, and other complementary and integrative health approaches. This model also proposes access, when indicated, to tertiary pain care, defined as advanced pain-medicine diagnostics and interventions (e.g., implantable devices, experimental medications) and interdisciplinary pain-rehabilitation programs that incorporate psychological treatment. Findings supporting the feasibility and effectiveness of the model have begun to emerge, including reductions in patients' reliance on opioid therapy and increased access to multimodal care (Dorflinger et al., 2014; Moore et al., 2016). A schematic of the stepped-care model for pain management is presented in Figure 2 (Department of Veterans Affairs, 2020).

The stratified- and matched-care models are based on concepts related to precision pain management.

These models incorporate the assumption that specific characteristics of patients can be used to prescribe specific treatments to optimize patient outcomes. Early investigations of these models have concentrated on psychological factors already identified as conferring risk for negative outcomes, including disability, among persons with pain.

Stratified-care models identify patients as low, medium, or high risk and direct them to different levels of treatment on that basis. One study that yielded particularly promising results used a risk-stratification tool, the STarT Back Screening Tool, to (a) identify patients with back pain who endorsed statements consistent with fear avoidance and pain catastrophizing and (b) direct those patients to psychologically informed physical therapy at varying levels of intensity. This risk-stratification approach resulted in improved outcomes and reduced health care costs (Foster et al., 2014).

Matched-care models use patient phenotypes (e.g., high pain catastrophizing, fear avoidance, deleterious pain-relevant communication within the family) to direct patients to specific interventions or tailor treatments to address specific risk profiles. Emerging evidence provides some support for the incremental effectiveness of patient–treatment matching (Åsenlöf et al., 2009; Linton et al., 2016; Sennehed et al., 2018). However, one study designed to test the potential benefit of tailoring CBT-CP on the basis of patients' preferences for learning specific pain coping skills produced largely equivocal results (Kerns et al., 2014).

In a recently published rapid review of the empirical literature, Peterson and colleagues (2018) attempted to identify and define key elements of primary-care-based models of multimodal chronic-pain care that provide clinically relevant benefits. Models of care were operationalized as "any model with system-based mechanisms aiming to increase the uptake and organization of multimodal care" (Peterson et al., 2018, p. 71); the authors identified nine such models in the literature. Most had been evaluated via a single, generally fair- to good-quality RCT. The authors concluded that multimodal models of chronic-pain care that coupled decision support for providers (to enhance their education and treatment planning) with proactive treatment monitoring consistently provided clinically relevant improvements in pain and function. Other components of effective models were algorithmic stepped care for optimizing outcomes, additional care-coordination resources, patient education, and explicit interventions to promote patient activation. These results encourage further investigation of emerging models of care that incorporate these key components.

The above models all suggest a critical role for psychology alongside other evidence-based modalities to treat chronic pain. However, because pain-management practices are seemingly being redefined in light of identified risks with respect to opioids, it is critical to elaborate how psychological interventions may factor into opioid policy changes, opioid tapering, and the treatment of opioid-use disorder (OUD). The perspectives of primary-care and pain-management specialists have factored heavily into shaping psychology's role in this shift.

Long-term opioid therapy (LTOT), a dominant treatment modality for chronic pain—especially high-impact chronic pain—over the past 3 decades, is now known to be of questionable benefit (Krebs et al., 2018; Martell et al., 2007) and has been causally linked in a dose-dependent fashion to serious harms, including declining functional status, hypogonadism, immunosuppression (Edelman et al., 2019), overdose, and OUD (Chou et al., 2015). Given the generally unfavorable risk/benefit profile of LTOT, consensus guidelines promote (a) avoiding the initiation of LTOT in favor of nonpharmacologic or nonopioid pharmacologic treatment; (b) continually reassessing the benefits and risks of opioids for people already on LTOT; and, when those benefits no longer outweigh the risks, (c) reducing or discontinuing opioid therapy while boosting pain self-management strategies and nonopioid pain care (Dowell et al., 2016; VA & DOD, 2017). If OUD develops in the course of LTOT, guidelines strongly recommend referral for evidence-based treatment of OUD and discontinuation of opioids.

Health systems' efforts to follow these guidelines and mitigate the impact of the opioid crisis have included a move toward interdisciplinary, integrated care in which psychological interventions play an important role. Avoiding the initiation of LTOT among persons with incident chronic pain implies a paradigm shift away from pharmacologically focused treatment—which, whether it involves opioids or nonopioids, shows a consistent pattern of modest efficacy and appreciable harm—to an approach founded on self-management and nonpharmacologic interventions. In the latter scenario, long-term medications are used sparingly or avoided altogether. For this shift to occur, barriers to psychological and other nonpharmacologic treatments need to be systematically addressed. Consistent with the NPS and Institute of Medicine report, this overhaul requires changes in the education of the public and professionals, in reimbursement structures, and in patient care and access to pain management (Institute of Medicine, 2011).

Regarding the role for psychological therapies in opioid tapering, research is limited to date (Frank et al., 2017). A systematic review of studies on the effectiveness of strategies to reduce or discontinue LTOT identified six studies, with 238 total participants, that have assessed the effectiveness of behavioral interventions (Frank et al., 2017). Only three of the studies were rated as good quality, and none of those three studies—which were all small trials—had adequate statistical power to detect clinically meaningful differences in opioid-dose reductions. One trial compared a 4-month interactive-voice-response intervention with usual care among patients with chronic pain (N = 51); patients were not required to commit to tapering to enroll in the study. Compared with usual care, the intervention reduced patients' mean opioid dose significantly at 4-month (p = .04) and 8-month (p = .004) follow-up (Naylor et al., 2010). Another trial compared an 8-week group intervention that was based on mindful meditation and CBT and did not explicitly encourage dose reduction with usual care among patients on LTOT (N = 35). The mean change in participants' daily opioid dose (measured as a morphine-equivalent dose) from baseline to 26 weeks was −10.1 mg in the intervention group compared with −0.2 mg in the control group (p = .8; Zgierska et al., 2016). The third trial compared a 22-week opioid-tapering intervention, which consisted of motivational interviewing and education on pain self-management delivered by a physician assistant, with usual care (N = 35); opioid-dose reduction was the primary outcome. At 22 weeks, participants' mean opioid dose had decreased by 43% in the intervention condition compared with 19% in the usual-care condition (p = .07; Sullivan et al., 2017).

Given the move away from risky pharmacologic and interventional (e.g., surgical) strategies, coupled with increasing recognition of the effectiveness of psychological interventions for the treatment of pain, the latter should be expected to grow, though the feasibility of that growth will largely depend on dismantling barriers discussed in the next section. Furthermore, including medication-related outcomes (e.g., tapering, cessation) as a core outcome domain when investigating the pragmatic effectiveness of psychological interventions for chronic pain will be critical as the field moves forward.

Barriers to Timely and Equitable Access to Psychological Treatments

As articulated in the NPS and echoed by expert commentators (Becker et al., 2018), despite abundant evidence for the efficacy and effectiveness of psychological treatments for chronic noncancer pain, their uptake in real-world settings lags. This gap in translation is the function of a complex interplay of barriers at the patient, provider, and organizational or systems levels; the discussion below separates these levels for ease of discussion, but that separation does not imply that any acts in isolation.

Patients may not recognize the potential benefits of psychological treatments for chronic noncancer pain and, therefore, may either actively or passively decline to pursue such treatments (Becker et al., 2017). More specifically, they may misunderstand the treatments' rationale, mechanism of action, or components and therefore doubt their relevance. This barrier is in itself multilayered, likely reflecting factors such as a deficit in the broader cultural understanding of the biopsychosocial model (often reinforced by providers whose understanding is lagging); stigma toward treatments that deal with emotional, psychological, or mental health; and a bias toward treatments that require less active participation. Patients have also reported provider-level barriers (e.g., failure of providers to recommend these treatments) as well as organizational and systems-level barriers, including cost and availability (Becker et al., 2017). Finding adequate time to participate in psychological treatments for chronic pain has likewise been cited by patients as a significant barrier.

Like patients, providers—especially nonpsychologists—may misunderstand psychological treatments' rationale, mechanism of action, or components and therefore doubt their relevance or benefit. They may pass these doubts on to patients either subconsciously or consciously and may discourage their patients' participation either actively or passively (e.g., by failing to recommend these treatments). Both patient- and provider-level barriers may be ameliorated through implementation strategies such as education and marketing. Although a complete discussion of such strategies is beyond the scope of this review, the successful marketing of psychological treatments is similar to that of any product or service. Potential benefits should be made tangible and personal to the consumer, and the treatments themselves should be appealing, engaging, and effective.

Organizational or system-level barriers to timely and equitable access to psychological treatments for chronic pain include lack of insurance coverage and provider scarcity. Such barriers are increasingly being addressed through innovative delivery platforms and interventions. For example, individual, in-person CBT-CP is not covered by most insurance plans, including Medicare and Medicaid, which makes it functionally inaccessible to the large majority of U.S. patients with chronic pain. However, group-based CBT-CP and ACT modalities with demonstrated effectiveness (Cherkin et al., 2016; Wetherell et al., 2011) have a lower per-patient delivery cost, which allows providers to charge less and thereby increase access. Provider scarcity, especially in rural or other underserved areas, is a significant challenge to equitable access to psychological pain treatments. However, Web-, virtual video-, and telephone-based interventions allow for remote patient–provider interactions. A novel CBT-CP intervention using asynchronous, personalized telephone feedback was found not inferior to traditional CBT-CP in improving pain-related functional interference and increasing patients' activity levels (Heapy et al., 2017), a promising finding for increased access to psychological treatments for chronic pain.

Future Directions

Psychological interventions for chronic pain date back at least to the 1950s. Many are derived from established therapeutic models and founded on sound scientific theories (e.g., learning theory, relational frame theory). Others are newer and draw from several other evidence-based disciplines or target specific patient populations. Findings suggest that most psychological interventions for chronic pain demonstrate some level of effectiveness on measures of pain intensity, physical functioning, mood, self-efficacy in managing pain, and catastrophic thinking. Recently, the VHA convened experts from around the United States to review the evidence for nonpharmacologic approaches for the management of chronic pain, including psychological interventions. The purpose of this meeting was to inform clinical policy decisions for the VHA and identify state-of-the-art approaches. After much deliberation, the experts concluded that the evidence was strongest and most robust for CBT-CP and acceptance- and mindfulness-based interventions (Becker et al., 2018). Biofeedback, hypnosis, and stand-alone relaxation or meditation interventions were also determined to have reasonable evidence (Becker et al., 2018), though these had not been studied as widely across diverse pain conditions.

In addition to summarizing the state of the science with respect to psychological interventions, the conference participants identified significant gaps in clinical practice and research that must be addressed to move the field forward and to address the barriers to uptake of these interventions. The following section highlights many of those gaps and some additional ones, including the need to (a) conduct pragmatic and implementation trials of established psychological interventions (e.g., CBT-CP, acceptance- and mindfulness-based interventions) to test for real-world effectiveness and uptake, (b) address comorbidities and multiple overlapping pain conditions in patients with chronic pain, (c) optimize the effectiveness of established interventions, (d) study the effectiveness of newer interventions (e.g., EAET) and established modalities (e.g., biofeedback) in diverse pain conditions and as a function of sex and race, (e) examine the use of mobile-health technologies to expand access to psychological interventions for pain, and (f) expand and standardize outcomes.

Conducting pragmatic and implementation trials

Given that CBT-CP and acceptance- and mindfulness-based interventions generally (a) yield small to moderate effects on pain, functioning, and mood; (b) seem to be comparable to other pharmacologic and nonpharmacologic interventions in terms of their effectiveness and cost; and (c) fall into the category of self-regulatory strategies identified by the NPS to reduce overreliance on potentially risky medications or invasive and potentially harmful interventions, the focus of future research on these modalities should shift from their basic effectiveness to their broader implementation and dissemination (Becker et al., 2018). Specifically, examining how to make these treatments readily available to the public, given barriers identified in the current health care infrastructure, is warranted. These barriers include limited access or reimbursement, high levels of patient burden (e.g., time, travel), stigma associated with engaging in psychologically based treatments, and providers' limited knowledge of or fluidity in referring patients to these modalities (Becker et al., 2018). Trials seeking to address these barriers will simultaneously need to evaluate the real-world effectiveness of these interventions—asking, essentially, whether these modalities elicit favorable outcomes when implemented in pragmatic settings, outside of the tightly controlled walls of academia.

A recent joint initiative among the Department of Veterans Affairs (VA), DOD, and NIH is endeavoring to do just this. The Pain Management Collaboratory, as it is called, was initiated in 2017. This initiative has funded a coordinating center and 11 pragmatic trials of nonpharmacologic approaches to pain management. Several of these trials are testing the pragmatic effectiveness of CBT-CP and mindfulness-based approaches, whereas others are evaluating the best ways to integrate psychological interventions with other modalities and testing optimal strategies for disseminating psychological approaches for pain in existing service lines (Kerns et al., 2019).

Addressing comorbidities

Given the preponderance of comorbid pain conditions and other health or mental health challenges among individuals with pain, future research should incorporate targeted efforts to tailor existing psychological interventions to meet the needs of people with complex presentations.

Mental health problems such as depression, anxiety, and trauma are not uncommon among pain sufferers and can present challenges for the successful management of pain. Despite commonly held beliefs among people with chronic-pain and health care providers that effective treatment of chronic pain will satisfactorily address mental health symptoms, empirical support for such claims remains equivocal. There is a growing consensus that currently available treatment approaches targeting pain management alone are insufficient for addressing mental health symptoms. There is some evidence that integrated approaches explicitly targeting chronic pain and co-occurring mental health concerns may hold promise. For example, in a sample of individuals with co-occurring chronic musculoskeletal pain and major depressive disorder, combining optimized pharmacologic treatment for major depression with a cognitive-behavioral intervention for pain resulted in clinically meaningful reductions in depressive-symptom severity and moderate reductions in pain intensity and pain-related disability (Kroenke et al., 2009). Preliminary evidence has also supported the efficacy of an integrated psychological approach combining CBT-CP and cognitive-processing therapy for PTSD among veterans with pain (Otis et al., 2003). Currently, however, there is no widely accepted or tested integrated treatment to address co-occurring pain and PTSD.

Problems related to substance use and addiction, such as smoking, are harder to address among individuals with chronically painful conditions. At least one randomized pilot study integrating CBT-CP with a standard smoking-cessation treatment yielded higher quit rates, along with improvements in pain intensity, self-efficacy, and pain-related anxiety, relative to the standard treatment alone (Hooten et al., 2014). In some cases, chronic pain begets problems such as medication overuse or OUD. Preliminary evidence has suggested that a cognitive-behavioral approach may yield improvements in both chronic pain and co-occurring OUD (Barry et al., 2019). A pilot study delivered in a substance-use-disorder treatment program combined principles of CBT and acceptance-based approaches to pain management with content related to avoiding the use of substances to cope with pain (Ilgen et al., 2016); findings were promising.

Finally, pain is associated with many other physical health conditions (e.g., HIV infection, hepatitis C, diabetes) and is acknowledged to complicate and maintain difficulties with weight (Janke et al., 2007) and sleep (Finan et al., 2013). Efforts to address pain alongside the challenges of other chronic conditions have sparked interest. Indeed, a pilot trial of CBT-CP tailored for people with HIV supported the intervention's feasibility and acceptability among participants and demonstrated preliminary efficacy (Merlin et al., 2018). Though relatively recent, efforts to integrate treatments to address comorbidities have shown some promise and will continue to be important.

Optimizing the effectiveness of established interventions

As highlighted above, psychological interventions are generally beneficial for the treatment of pain, but there is large variation in responses to treatment, given the heterogeneity of patients in any given trial. In light of that variation, future research might shift from effectiveness trials to trials that can identify what works and for whom.

Limitations have been identified for even the most effective interventions. For example, a series of investigations into CBT-CP across a range of conditions revealed limited effectiveness for patients suffering from high levels of interpersonal distress, and other studies have suggested that individuals with greater psychiatric distress, poorer baseline coping, and greater baseline catastrophizing are less likely to respond to treatment (Litt & Porto, 2013; Turk, 2005). Findings such as these lend support for the development of psychosocial taxonomies to guide treatment selection and the use of optimized trial designs, in which patients randomly assigned to treatment conditions (e.g., CBT-CP) could be randomly reassigned to alternative conditions later (e.g., EAET), on the basis of certain decision rules (e.g., failure to demonstrate improvements in the initial condition after a given time frame).

Optimized trial designs may also help answer questions about who can benefit most from which intervention. Still other designs allow for the identification and refinement of optimal treatment components and dosing (Collins et al., 2007). In an effort to optimize patient engagement, *preference trials* are also growing in popularity, and these are relevant for psychological interventions for pain. In these trials, patients initially state their preferences for treatment modalities (e.g., CBT-CP or mindfulness) and are randomly assigned their preferred treatment or something else. In at least one CBT-CP preference trial, participants identified the pain-related coping skills they were most interested in learning and were then randomly assigned to an intervention focused on learning those skills or an alternative set of skills. No differences were identified across treatment groups (Kerns et al., 2014).

One of the great puzzles in pain research and management, and a source of significant frustration in clinical trials as well as clinical practice, is that patients with the same condition often respond completely differently to a given treatment (Attal et al., 2011; Dworkin et al., 2012, 2014). Such findings suggest that within a diagnostic category, multiple pain mechanisms and modifying factors may be active to varying degrees in different patients, leading to marked within-subjects variation in treatment effects and a need for personalized or precision pain medicine (Attal, 2019; Edwards, Dworkin, Turk, et al., 2016; Rodriguez Vicente et al., 2018). Interestingly, although a great deal is known about the predictors of persistent pain and disability, less is known about the phenotypes that predict responses to pain treatment. Addressing this gap is the central goal of pain phenotyping.

A phenotype is the ensemble of observable characteristics displayed by an organism; generally, pain phenotyping focuses on patients' self-reported characteristics and symptoms (e.g., pain qualities, psychosocial functioning), which may distinguish subgroups with differential responses to treatment (Fillingim et al., 2014). Most of the phenotypic characteristics that have been studied as predictors of treatment outcomes are also characteristics that contribute to the risk for developing, or exacerbating, chronic pain (Edwards, Dworkin, Sullivan, et al., 2016; Edwards, Dworkin, Turk, et al., 2016). For example, patients with higher levels of negative affect, catastrophizing, and emotional distress appear to benefit less from oral opioid treatment for chronic pain, to experience greater negative side effects, and to be at greater risk for opioid misuse (Wasan et al., 2015). Instead, patients reporting high levels of catastrophizing and negative emotions appear to benefit most from nonpharmacologic treatments such as CBT-CP (Schutze et al., 2018)—a finding that highlights the potential benefits of phenotyping on the basis of cognitive and emotional processes (i.e., patient treatment could theoretically be optimized by taking into account levels of distress, depression, catastrophizing, and other affective factors). However, other studies have suggested that persons with high levels of interpersonal distress may not benefit at all from CBT-CP across a variety of painful conditions (Turk & Burwinkle, 2005). Collectively, these findings suggest that the use of phenotyping in several domains related to pain (e.g., psychosocial functioning, pain qualities, neuropathic pain symptoms, sensory processing) has great potential to advance the long-term goal of tailored or personalized chronic-pain treatment (Gewandter et al., 2019).

As in other areas of medicine, such as oncology and cardiology, there is considerable interest in and growing research on the use of functional and physiological measurements, particularly MRI, as diagnostic, prognostic, and predictive biomarkers. Many biomarkers appear to hold promise in the area of analgesic-drug development. To date, however, the use of biomarkers in the context of psychological treatments for chronic pain has been quite limited. One promising application is the work of Wachholtz, who has pioneered an approach involving the integration of psychophysiological assessment and personalized feedback to enhance the psychological treatment of individuals with chronic pain and OUD (Wachholtz et al., 2015).

Psychological interventions for chronic pain and the measurement of pain-related and psychosocial functioning can also be enhanced or optimized using technology-assisted assessment strategies. Although patients' self-reported assessments are critical (consistent with the definition of pain as a self-reported experience) for guiding clinical care, facilitating monitoring over time, and assessing responses to treatments, they have some limitations, including their requirements for burdensome patient assessments, their proneness to recall biases, and their susceptibility to the influence of current sensory and emotional states (Turk et al., 2016). Indeed, multiple investigations have demonstrated substantial differences in estimates of daily physical activity assessed with self-reports and with objective methods (van Weering et al., 2007, 2009, 2011). Moreover, self-reports usually measure experience and behavior at a single point in time or assess an averaged experience over a recalled period of time. However, it is well known that pain can vary considerably over time, depending on a range of factors, including activity, mood, and environmental factors that can affect physical function. The ability to continuously and objectively monitor clinically relevant outcomes, such as physical functioning and activity, over time would improve our understanding of the dynamics and influence of pain in daily life. It could shed critical real-time insight into the ability of psychological interventions to affect pain, functioning, distress, and sleep. These possibilities have led to excitement about the potential of accelerometers to contribute to the assessment and treatment, including psychological treatment, of pain.

Accelerometers are small, often wrist-worn, devices that objectively measure the duration, frequency, and intensity of physical activity over several days or weeks. That movement-tracking technology, known as actigraphy, is useful for capturing the amount of physical activity in people with various painful conditions. Actigraphy can be particularly useful in characterizing daily patterns of physical activity (McLoughlin et al., 2011). Actigraphy has been used successfully to characterize changes in activity duration and intensity within a single day or across days and to discriminate between patterns of activity on weekdays and weekends. The identification of variability can be used to design therapeutic physical-activity regimens, as in recent studies of interventions designed to increase activity levels in patients with chronic pain (Greenberg et al., 2019; Jackson et al., 2019). Actigraphy should not be viewed as a replacement for patients' self-reports of physical activity, which reflect perceptions that likely influence patients' willingness to engage in physical activity and how patients view their capabilities and disability status. This technology can, however, complement self-report measures and provide a more refined understanding of the relationships among symptoms, perceptions, mood, environmental factors, and objectively measured physical activity. It may also be used to prompt momentary psychologically based interventions in response to real-time assessments.

Establishing effectiveness of interventions in diverse populations

The relative effectiveness of newer interventions such as EAET and established interventions such as biofeedback for diverse pain populations remains an important avenue for continued examination. In addition, given the aforementioned variations in experiences of pain and its management that have been well documented as a function of race and gender, efforts to establish the effectiveness of all psychological interventions for different groups remain an important target. Future investigations should endeavor to oversample from vulnerable populations to allow conclusions to be drawn. Where discrepancies in effectiveness are identified, efforts to tailor interventions to meet the unique needs of these populations will be critical.

Expanding the use of mobile-health technology

Mobile-health technology (e.g., smartphone applications, interactive voice response, text messaging) has received increasing attention as a means of monitoring patients and optimizing psychological interventions for chronic pain (Mariano et al., 2019; Scott et al., 2018; Sundararaman et al., 2017). One recent multicenter trial compared outcomes among 213 patients with painful end-stage knee osteoarthritis who received either app-delivered information on day-to-day postoperative care or standard "treatment as usual" postoperative care after a total knee replacement (Timmers et al., 2019). Outcomes were measured using self-reported online questionnaires for 4 weeks after discharge. Results indicated that a month after surgery, the group who received app-delivered education had lower levels of health care utilization and less pain at rest, during activity, and at night. In addition, the patients educated through the app showed significant improvements in physical functioning, quality of life, and self-reported ability to perform physical-therapy exercises and daily self-care activities (Timmers et al., 2019). Such findings highlight the broad potential benefits of app-delivered treatments for pain in a variety of settings.

A 2019 systematic review and meta-analysis of nearly 20 RCTs noted that e-health and mobile-health applications (e.g., Internet-delivered pain self-management or CBT-CP treatment programs) have a significant beneficial effect (at least in time frames of 3 months or less) on pain intensity, physical function, and psychosocial function in patients with chronic pain (Moman et al., 2019). These findings are encouraging, though much work remains to be done.

Relatively few mobile-health trials have utilized robust randomized controlled methodologies, and long-term follow-up data are scarce; it will be critical to address these shortcomings in future trials. Specific concerns pertaining to the use of mobile-health technologies also require ongoing attention (Sundararaman et al., 2017). Access to the mobile technology (e.g., smartphones, tablets, computers) necessary to participate in these interventions is a significant concern. For those who can leverage technology, security, privacy, and confidentiality issues are also at the forefront. Protecting personal health information and data emerges as a particularly challenging concern in mobile-health interventions, especially because encryption tools are challenging to implement on personal devices. Other concerns include the need for technical support and the barriers faced by individuals who have visual difficulties, poor literacy, or language barriers and may not be in a position to maximally benefit from mobile-health technology. Despite these difficulties, however, this area offers a great deal of promise as one component of a personalized, multimodal, multidisciplinary pain-management approach.

Expanding and standardizing outcomes

It is important to identify outcomes of interest that have traditionally not been included in trials of psychological interventions for chronic pain. Efforts to address these gaps will do much to move the field forward. Although most trials have examined pain intensity, physical functioning, pain coping, mood, disability, or quality of life, few have systematically examined the effect of psychological interventions for pain on outcomes such as health care utilization, medication use, and lost workdays. One recent meta-analysis pooled findings from

14 studies examining psychological therapies for chronic pain (Pike et al., 2016). The quality of the research allowed the authors to conclude with confidence that psychological interventions largely reduced health care use. However, findings for medication use and lost workdays were inconclusive because these outcomes were not reliably measured by enough studies.

Amid the opioid crisis, with its roots in the overprescription of opioids, and the increasing understanding of the unfavorable risk-to-benefit ratio of opioids for chronic pain (Chou et al., 2015), there is growing interest in psychological therapies' role in reducing opioid use, or *opioid-sparing effects*. Opioid-sparing effects include averting initiation of opioids, preventing short-term use from transitioning to long-term use, or reducing or discontinuing current use.

Regarding the question of whether psychological therapies have demonstrated opioid-sparing effects, the data are limited. Recent prominent guidelines have recommended avoiding the initiation of opioid therapy for chronic pain in favor of nonpharmacologic or nonopioid treatments (Dowell et al., 2016; VA & DOD, 2017). Should these guidelines be followed, psychological therapies could be described as having an opioid-sparing effect if they became part of the standard menu of treatments offered to patients in place of opioids or as a means of tapering off opioids.

A recent systematic review and meta-analysis examined how a variety of psychological (described as "mind-body") therapies, including meditation, hypnosis, relaxation, guided imagery, therapeutic suggestion, and CBT, affected pain and opioid use among patients who were prescribed opioids for a variety of pain conditions (Garland, Brintz, et al., 2019). Although 60 studies were included in the review, only eight could be included in the meta-analysis on opioid-related effects, the results of which demonstrated that, overall, psychological therapies had a significant, small association with opioid use (Cohen's $d = -0.26$; 95% confidence interval [CI] = [−0.44, −0.08]; $p = .01$). These findings underscore the importance of future efforts to include opioid initiation, use, and dosing in trials of psychological interventions for chronic pain.

Finally, no discussion of outcomes would be complete without mention of current efforts to standardize measurement. The IMMPACT work groups specified necessary outcome domains but did not advocate for the use of certain measures over others, though they did identify those with the most robust validity (Dworkin et al., 2005). The use of varied measurements, even validated ones, can make it hard to draw comparisons across trials or draw robust conclusions about effectiveness. Against that background, the NIH, DOD, and VA Pain Management Collaboratory has brought together national experts to select validated measures and to make recommendations for the harmonization of measurements across trials (Kerns et al., 2019).

Summary

Embracing the biopsychosocial model of pain and its management, psychological interventions for chronic pain have emerged as critical components of effective multidisciplinary pain care. Indeed, the NPS strongly encourages the widespread dissemination of psychological interventions to improve functioning and quality of life among individuals with chronic pain while simultaneously reducing practitioners' overreliance on strategies (e.g., opioids, surgical interventions) that may convey more risk than benefit. Despite overwhelming evidence for the effectiveness of psychological interventions in the management of chronic pain, gaps in knowledge and barriers to uptake remain. In particular, efforts to optimize the effectiveness of such interventions, to educate persons with pain and their providers about their utility, to broaden their reach, and to tailor them for unique populations remain important avenues for continued research.

Transparency

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