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Acute Pain Medicine in the United States: A Status Report

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Abstract

Background—Consensus indicates that a comprehensive, multimodal, holistic approach is foundational to the practice of acute pain medicine (APM), but lack of uniform, evidence-based clinical pathways leads to undesirable variability throughout U. S. healthcare systems. Acute pain studies are inconsistently synthesized to guide educational programs. Advanced practice techniques involving regional anesthesia assume the presence of a physician-led, multidisciplinary acute pain service, which is often unavailable or inconsistently applied. This heterogeneity of

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educational and organizational standards may result in unnecessary patient pain and escalation of healthcare costs.

Methods—A multidisciplinary panel was nominated through the Acute Pain Medicine Shared Interest Group (APMSIG) of the American Academy of Pain Medicine (AAPM). The panel met in Chicago, Illinois, in July 2014, to identify gaps and set priorities in APM research and education.

Results—The panel identified 3 areas of critical need: 1) an open-source acute pain data registry and clinical support tool to inform clinical decision making and resource allocation and to enhance research efforts; 2) a strong professional APM identity as an accredited subspecialty; and 3) educational goals targeted toward third-party payers, hospital administrators, and other key stakeholders to convey the importance of APM.

Conclusion—This report is the first step in a 3-year initiative aimed at creating conditions and incentives for the optimal provision of APM services to facilitate and enhance the quality of patient recovery after surgery, illness, or trauma. The ultimate goal is to reduce the conversion of acute pain to the debilitating disease of chronic pain.

Keywords

Acute Pain; Delivery of Healthcare; Medical Informatics; Anesthesiology; Research; Education

Introduction: Acute Pain (Re-) Enters the Limelight

The insight that the experience of pain is not simply a sensation but an experience more akin to hunger or nausea was a seminal event that inaugurated modern pain research (1-2). Unraveling this observation gave rise to the research discipline of psychophysics research and coincided with, in Beecher's words, “a common tide of interest at that time in the pain problem (1).” Similarly, the current upsurge of professional and regulatory interest in pain control can be seen as an offshoot of broader societal trends to empower patients and to address their wants (3), needs, and rights (4). These trends have relevance to the area of acute pain medicine (APM).

The practice of APM involves the practice of medicine at multiple levels of inpatient healthcare, rehabilitation, and recovery of the patient at home. Specialists in APM diagnose variants of and conditions related to acute pain, offer medical, interventional, and complementary and integrative medicine (CIM) therapies, and provide for primary and secondary prevention of acute pain where feasible, all via direct patient-physician relationships.

The historical foundations of modern scientific pain research relied largely upon observations in acute pain (5); however, in recent decades much of the focus of pain medicine has been on chronic and cancer pain (6). This emphasis owes much to John Bonica, whose work treating World War II veterans with chronic pain and psychological comorbidity convinced him of the value of a multidisciplinary approach. Exceptions are the first U.S. federal clinical practice guideline, published in 1992, which focused on the topic of acute pain (7), and the first guideline in acute pain from the American Society of Anesthesiologists (ASA) in 1995 (8). Even so, the intellectual center of much 21st century

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pain research and practice has shifted away from acute pain, concurrent with greater attention to chronic pain processes such as sensitization and psychological comorbidity. Indeed, no chapter in the historical memoir published by the International Association for the Study of Pain (IASP), which surveyed scientific and clinical progress during that organization's first 30 years, was devoted to acute pain (9).

The practice of APM is once again gaining attention as megatrends converge (10-11). First, as the U.S. healthcare system strives to provide cost-effective, high-quality care while also improving access, any means to reduce complications, facilitate recovery, and shorten stays after surgery, trauma, or illness are being evaluated. Acute pain control subsequent to the approximately 70 million U.S. surgical procedures each year is “low-hanging fruit” for cost savings, and many countries publish guidelines or evidence syntheses addressing postsurgical pain control (12-14). Acute pain control is also an essential component of current clinical pathways and enhanced recovery protocols after surgery (15-16). Second, ever-improving multimodal regimens have brought everyday acute pain control to a level of effectiveness previously seen only in intensive research protocols (15). Unfortunately, unimodal reliance on systemic opioids for aggressive pain control is fraught with serious and sometimes fatal side effects (17-18), mandating the need for progress in delivering effective opioid-sparing analgesia. Third, clinicians and neuroscientists alike recognize that the transition from acute to chronic pain may begin within minutes of injury, making the distinction between the two an artificial one (19-23). Population-based data suggest that better control of acute pain may, for some patients, reduce the risk that pain from an operation or acute medical illness (e.g., herpes zoster) will become chronic (24). Finally, the rewards for improving patients’ experience with care – including increased patient satisfaction scores and decreased total long-term healthcare costs – align with efforts to control acute pain effectively.

To this last point, it should be added that aside from any physiological benefit from improved pain control, there is a moral imperative to do our best to avert patients’ needless suffering from pain (4). In no population is this more true in recent years than for members of the armed forces for whom pain control after injury may start almost immediately, even in the theater of combat (25), requiring capabilities far beyond those available to Bonica.

To sustain scientific progress, a number of advances are necessary within the APM medical environment. Current inpatient practice environments often demand simultaneous leadership in systems-level practices that ensure delivery of safe and effective acute pain care at the patient-population level. For example, it is no longer sufficient to simply perform a nerve block or place an indwelling catheter: APM teams must consider how these interventions affect patient safety, rehabilitation, and disposition; the training of healthcare providers in multiple disciplines; the logistics of supply chain management and financing; and optimal healthcare delivery.

Although acute pain management occurs in a variety of patient care settings (e.g., pre-hospital, emergency-department, and perioperative environments), the historical emphasis has been in the perioperative environment where acute pain management has logically fallen under the auspices of anesthesiology (26) and regional anesthesiology, specifically (27-31).

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This aligns with the recently-approved decision to make regional anesthesiology and the specialty of APM a distinct subspecialty fellowship of anesthesiology to be accredited through the Accreditation Council for Graduate Medical Education (ACGME).

Concurrent with the development of new training opportunities in APM, significant expansion is needed in scientific research on the mechanisms, pathophysiology, epidemiology, prevention, treatment, and continuous quality improvement of acute pain. Already, new evidence challenges many long-held beliefs about acute pain. First, acute pain is a continuum, ranging from a symptom to a disease process, a nidus for a host of chronic conditions, similar to the model of progression of inflammation to sepsis (32). Second, effective management may not involve opioids principally or exclusively; nonopioids may instead offer important analgesic effects (33). Third, ongoing studies suggest that one-third of patients have trajectories of progressively worsening pain intensity postoperatively, despite clinicians' widespread impressions that a steady decline in postoperative pain intensity over time is the norm (34). Finally, purportedly safe delivery of acute pain care, improperly accomplished, can substantially increase patient morbidity and mortality (35-36). This rapidly growing body of literature points to a focus beyond regional anesthesia to include these additional considerations to maximize the effectiveness and safety of the practice of APM.

Finally, the practice of APM must embrace a multimodal, holistic, comprehensive, and multidisciplinary approach to the care of the patient experiencing acute pain, recognizing that no single remedy is likely to offer a global solution (37). Ultimately, APM physicians may serve as a resource for, and a referrer to, a multitude of other practice environments, including family practice, nursing, pharmacy, integrative medicine, physical therapy, and more (37).

Background of Acute Pain Medicine Shared Interest Group and Creation of the APMSIG Panel

In 2012, leaders within American Academy of Pain Medicine (AAPM) began a discussion centered on the emerging medical practice of acute pain, how it was distinct from but related to chronic pain, and how AAPM could best facilitate this emerging subspecialty of pain medicine. It was recognized that the practice of APM was rapidly evolving but suffered from a leadership vacuum with little coordination among multiple lines of effort.

In 2002, the Fellowship Directors Group (at first called the Directors of Regional Anesthesia Fellowship Training) first met at the annual meeting of the American Society of Regional Anesthesia and Pain Medicine (ASRA). More recently, the informal group has met twice a year, at the annual meetings of ASRA and ASA. In 2009, a consensus of group members agreed that APM should be added to the fellowship title, formerly called Regional Anesthesia Fellowships. As the number of training programs in the field increased, a smaller subcommittee addressed establishing ACGME accreditation of the fellowship. Also in 2009, in another important development, the AAPM journal *Pain Medicine* established the Acute and Perioperative Pain section for scholarly efforts focused on the field of APM (37). Of note was a general recognition among pain specialists that chronic pain usually evolves from

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an acute episode. Moreover, the disease process of pain is a continuum that is influenced by pre-existing patient factors, environmental factors, and acute and chronic components. Although AAPM historically has focused on the most physically and socially debilitating portion of this continuum, i.e., chronic pain, increasing attention is warranted for effective acute pain management, particularly as it may attenuate or prevent progression to chronic pain.

Therefore, the AAPM leadership recommended creating the Acute Pain Medicine Shared Interest Group (APMSIG), which received endorsement from the AAPM Board of Directors and met for the first time during the 2013 AAPM annual meeting. The APMSIG vision statement is highlighted in Box 1 (37).

The APMSIG charged the panel with the following tasks:

1. Examine the practice of APM based on the current state of science, identify knowledge gaps, and establish priorities for APM research and education for the next 3 years.
2. Ensure that actions and goals are aligned with priorities established in the Institute of Medicine (IOM) report on pain (to include the forthcoming U.S. Department of Health and Human Service's National Pain Strategy document) and the Army Pain Management Task Force document (11, 25, 38).
3. Establish goals and objectives for the specialty.

Acute Pain Medicine (SIG) Panel Meeting

The next step would be a comprehensive evaluation by the APMSIG Panel of the specialty today along with recommendations for goals in acute pain education and research. To this end, the APMSIG Panel met in Chicago, Illinois, over July 11-13, 2014. Members represented a variety of backgrounds, including anesthesiology, emergency medicine, psychiatry, and nursing with specialties in chronic pain, addiction medicine, public health administration, regional anesthesia, and research. Additional input was sought from contributors and thought leaders from IASP, the American Pain Society (APS), ASRA, and ASA. The panel discussed short-term working definitions for acute pain and APM as a starting framework to enable further discussions. Discussions followed on prioritization of research, education, and policy principles, first in breakout sessions of the Research Group and the Education Group (Appendix), followed by review by the entire panel for consensus. The outcomes of this meeting include this consensus-based report for publication as a starting point for defining and codifying the specialty of APM and to lay the foundation for developing practice guidelines and standards. Notably, this report is not intended to represent a formal systematic review of acute pain diagnostic or therapeutic interventions, as such projects warrant dedicated initiatives.

The panel affirmed a conviction that the practice of APM is at the core of compassionate and effective medical care of patients, is a practice allied with but distinct from chronic pain care, and is an essential service within any modern healthcare system.

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Working Definitions of Acute Pain and Acute Pain Medicine

Two definitions are germane to this discussion: One is the definition of acute pain, and the other is the definition of APM. The definition of acute pain has many national and international versions. The Gale Encyclopedia of Medicine and Segen's Medical Dictionary emphasize that acute pain is usually temporary and results from a specific adverse chemical, thermal, or mechanical stimulus, such as a surgery, injury, illness, or infection (39-40). As a common reference point, the panel reviewed the widely accepted definition of pain published in 1994 by the IASP and the standardized pain taxonomy established by the Army Pain Management Task Force and published by the Army Surgeon General in 2010 (25, 41). Together, these resources define pain as an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage, a subjective experience that can be acute or chronic.

Taking the experiential component of pain as a given, the panel considered the impact of the difference between nociception and pain as well as the perception of acute pain during different states of consciousness, in particular as a result of a surgical procedure. A subsequent ontological discussion led to agreement that a comprehensive taxonomy of pain lay outside the scope of the current meeting and deserved a separate initiative; thus, the panel took IASP terminology as a base and further reached consensus that the experience of acute pain encompasses the following important characteristics:

1. Has an inciting event
2. Is of sudden onset
3. Is time limited
4. Has potential to develop into a pathologic condition

The panel reached consensus on a working definition of acute pain, which is highlighted in Box 2. The progression of acute pain to chronic pain, termed chronification, was recognized by the experts to be an important potential consequence but not one that is essential to the definition of acute pain, as chronification does not always occur, and further scientific investigation is needed in this area.

A satisfactory definition of APM as a discipline has been elusive due to various modes of current practice along with an explosion of knowledge in the clinical and basic science arenas. An earlier AAPM definition of pain medicine encompasses the prevention, evaluation, diagnosis, treatment, and rehabilitation of painful disorders and notes that such disorders may arise from “a discrete cause, such as postoperative pain or pain associated with a malignancy, or may be a disorder in which pain constitutes the primary problem, such as neuropathic pain or headache (10).” By consensus, the panel observed that APM is not restricted to operating room practice and the discipline of APM assumes a diverse and multidisciplinary team of providers.

The panel formed a working definition of APM, highlighted in Box 3. At present, the panel acknowledged that a definition of APM remains in flux, and finalizing it is a key future goal

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as the subspecialty evolves. A pressing need to synthesize a comprehensive ontology related to acute pain became evident, to be addressed at future meetings.

State of APM Evidence

Measurement of Acute Pain

Recent scientific clinical guidelines, research, and reviews call for multidimensional evaluations of acute pain in the context of a biopsychosocial framework to examine the impact of acute pain on global health and well-being and to gauge the effectiveness of pain treatments (12, 42-47). Concerns over the high incidence of pain chronification associated with poorly controlled acute pain have placed greater emphasis on the need for more comprehensive pain assessments beyond pain intensity (19, 48-49). The relatively new pay-for-performance reimbursement structure based on Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) patient satisfaction scores for pain is driving major efforts by healthcare organizations to improve pain control (50-51). Consequently, more robust quality improvement programs are focusing on relevant multivariable pain-related patient-reported outcomes (PROs). Examples of reliable and valid PRO scales and instruments to measure many pain-related outcomes and domains are listed in the Table (44, 52-73). The revised APS Patient Outcomes Questionnaire (APS-POQ-R) is an example of a multidimensional PRO instrument to facilitate pain data collection to measure the quality of pain care (58). Based on the impactful sentinel event alert from The Joint Commission (TJC), healthcare organizations are also urged to track serious opioid-related adverse events as part of standard quality improvement programs (74).

Dimensions of Pain Measurement

Advances in understanding the multidimensional aspects of pain broaden the possibilities for selecting diverse PROs for primary endpoints for clinical pain trials (75) and for monitoring routine clinical care (54-55). While regular assessments and reassessments of pain intensity remain a requirement by the TJC, reliance on pain intensity alone poses significant issues. First, inherent risks to patient safety can occur when aggressive opioid management is used to treat the pain intensity score with inadequate assessment, especially in opioid naïve and medically compromised patients, with protocols that stipulate titration to a specific number. Second, differences exist in the subjective nature and interpretation of pain rating scales by both patients and healthcare providers. Third, pain ratings with movement or activity are equally if not more important than ratings at rest, but these are not often routinely obtained and documented (76). Lastly, unidimensional pain ratings fail to capture the impact of pain on aspects of health and well-being critical to evaluating overall patient improvement and recovery and the effectiveness of treatment plans (54-55).

Multidimensional pain measurement strategies offer significant advantages by measuring domains of importance such as functionality; pain interference; perceptions of pain relief; quality and character of pain; psychological experiences (e.g., anxiety, depression); social roles, functioning, and interactions; sleep; and satisfaction with pain care (44, 55, 77-80). Concepts such as pain catastrophizing and fear avoidance, primarily studied in the context of chronic pain (81), are now incorporated into studies of acute pain (82-84). A systematic

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review and meta-analysis of 29 studies, involving the use of 14 instruments to measure anxiety and pain catastrophizing, demonstrated a statistically significant association between those variables and the development of postsurgical pain syndromes (82). Pain-related fear and disability, often viewed as more relevant to chronic pain, also have implications for those experiencing acute pain as revealed by another meta-analysis (83). In addition, a measure of patient global impression of change or improvement from pain therapies is commonly employed in pain research and is recommended in the 2008 IMMPACT Report addressing the clinical importance of treatment outcomes in clinical trials (85).

Biomarkers of Acute Pain

Over the past decade, a number of biomarkers of acute pain have been discovered. Some of the more straightforward biomarkers include unidimensional consideration of physiologic variables such as heart rate and respiratory rate, although advanced processing of these variables (e.g., heart rate variability) permits evaluations of sympathetic outflow (86-88). Further processing of these physiologic variables may also permit evaluation of relative balancing of nociceptive and anti-nociceptive activity while under anesthesia, thus allowing the anticipation and optimization of postoperative acute pain management based upon intraoperative events (89).

Another category of biomarkers includes “-omic” markers. Work on genetic biomarkers has gradually moved from the identification and characterization of single-gene polymorphisms, such as *OPRM1* and *COMT*, to simultaneous consideration of large numbers of genes via gene chips across ever-increasing numbers of patient cohorts (90-91). Research on genetic biomarkers has steadily progressed from the T1 bench-type of translational research toward the T4 stage, whereby various genetic biomarkers for pain sensitivity and analgesic efficacy have been studied in the clinical environment. The frontier of genomic insights into acute pain has grown to include consideration of proteonomic and metabolomic sources of observed patient variance (92-93). Already, metabolomic studies of acute pain have identified both novel mechanisms of nociceptive signal transmission and central sensitization, as well as multiple targets for pharmaceutical development (94). The mapping of cytokine biomarkers to different phenotypes and severities of acute pain offers an exciting opportunity to associate peripheral injuries with central sensitization and has already provided numerous targets for therapeutic intervention for this vexing conundrum (95-98).

Functional neuroimaging of the brain and spinal cord offers one of the most objective measures yet of acute pain (99-100). These approaches combine functional magnetic resonance imaging (fMRI) data with machine learning algorithms trained upon patients at rest or experiencing varying levels of experimentally-induced nociception. The result is a classification method with which fMRI data can be used to accurately predict whether a patient was experiencing acute pain at the time of imaging. Notably, such progress has spurred provocative discussion on the comparison of patient-reported ratings of acute pain intensity with objective measurements of acute pain obtained via neuroimaging. Neuroimaging biomarkers may offer the opportunity to parse nociceptive from psychosocial aspects of acute pain across the domains of diagnosis and treatment.

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Analogous Models

A recurrent theme of this panel's discussion was the clinical distinction between “minor” acute pain and “major” or “high-impact” acute pain. Although there were difficulties in quantifying these descriptions, most participants shared their clinical observations of these 2 broad phenotypes. This discussion led to comparisons with modern models of the progression of inflammation to sepsis (101). In this model, acute pain is analogous to expected signs and symptoms of inflammation following tissue trauma. However, in certain patients, given a sufficient degree of injury or inflammation or both, the typical, expected, and physiologic response transforms into pathophysiologic phenomena that can become self-perpetuating to no apparent benefit. Also similar to sepsis, mounting evidence suggests that primary and secondary prevention strategies may disrupt this progression from physiologic response to pathophysiologic disease. In an additional parallel, patients either return to baseline within several days of insult or the acute process transforms into a smoldering chronic disease state for months to years. While much research on progression is needed, the panel concurred that this framework offered a platform for exploring acute pain as an entity in greater detail.

Differentiation Between Acute and Chronic Pain

The differentiation between acute and chronic pain is made from clinical and mechanistic standpoints. Unlike acute pain, chronic pain is usually not time limited, producing pathophysiologic organ-system changes with no useful purpose. Notably, the distinction between acute and chronic pain may be probabilistic rather than deterministic in those scenarios in which the pain trajectory represents a continuum of evolving experiences.

Nonetheless, descriptive categories are often used to differentiate acute pain (e.g., postsurgical, post trauma, obstetric, burn, post-procedural) from chronic pain (e.g., neuropathic, cancer, noncancer, nociceptive)(102). Also, temporal relations between acute and chronic pain are often used, with 3 to 6 months duration as a common cutoff point. However, such descriptive tools do not provide a comprehensive or easily deduced classification of acute or chronic pain. Instead, understanding the mechanisms underlying pain subtype across the dimensions of time, experience, pathophysiology, and outcomes is likely the more appropriate approach.

Regarding acute pain, scientific literature describes the activation of peripheral nociceptors transmitting pain signals centrally following activation by an array of mediators (e.g., pressure, heat, inflammatory cytokines and chemokines) (22). Of note, each etiology of acute pain maintains a unique fingerprint of such activation and in normal situations resolves with healing. Regarding chronic pain, the activation of such nociceptors continues, leading to permanent neuroplastic changes within the central nervous system, subsequently promoting chronification. Again, numerous mechanisms have been elucidated regarding chronification including involvement of the N-methyl D-aspartate (NMDA) receptor, cyclooxygenase 2 (COX-2) system, microglia, and endocannabinoid system (22). Thus, individualized treatment regimens that focus on immediate pain but also block the transition from acute to chronic pain are essential.

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Although acute pain and chronic pain have notable differences, they also have numerous similarities. For instance, both conditions share risk factors, such as genetic predisposition, psychosocial predispositions (e.g., anxiety, catastrophizing), and pain thresholds (103). Furthermore, both pain types require the treatment goals of minimizing pain, optimizing function, and addressing psychological factors (102).

Thus, while recognizing similarities and differences, 4 essential questions remain:

- Which patients will experience severe acute pain?
- How do we identify optimal individualized treatment regimens?
- Which patients will develop chronic pain after injury or surgery, and which prevention strategies should be utilized?
- Which patients will seek long-term opioid therapy after injury or surgery, and which prevention strategies should be utilized?

Transition from Acute to Chronic Pain

Nearly all cases of chronic pain begin as acute pain. Many models suggest that prolonged exposure to acute pain leads to structural changes within the central nervous system that transform this condition into a chronic pain syndrome (104-107). Depending upon the type of surgery, as many as 50% to 70% of patients may experience surgical-site pain at least 6 months after surgery, with approximately 10% rating their pain as severe in intensity (108-109). Established risk factors for the transition of acute to chronic pain in the surgical setting include younger age, female gender, catastrophizing, low socioeconomic status, preoperative pain, impaired diffuse noxious inhibitory control, type and duration of surgery, injury to specific nerves, severity of acute pain, and, possibly, prior exposure to radiation therapy and chemotherapy (21, 110). Notably, the focus of research to date has been on acute-to-chronic pain transitions in the perioperative setting; investigations on the acute-to-chronic transition in non-operative patients have lagged.

The association between acute pain severity and the risk of chronic pain deserves special attention. It is important to note the paucity of evidence demonstrating within-subject effects of intervening on acute pain to definitively reduce the incidence of chronic pain. Thus, it remains unclear whether the association of acute pain intensity with chronic pain incidence is predicated upon high nociceptive loads, poor analgesic effectiveness, high pain sensitivity, poor coping, all of the above, or perhaps none of the above. Further, given the importance of timing in such transitions, it remains unclear whether there are certain temporal or even spatial thresholds of acute pain that increase the probability of developing chronic pain. It also remains possible, if unlikely, that observations of acute and chronic pain are conditionally independent of one another. Parsing the independent effects of the above factors is difficult in experimental -- let alone clinical -- settings, given that the observed state of a patient in pain reflects the interaction of the above factors. It is even unclear whether this represents multiple facets of a single disease (e.g., chest pain and arm numbness from a ST segment elevation myocardial infarction [STEMI]) or separate disease states with distinct mechanisms that present with a similar set of symptoms (e.g.,

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gastroesophageal reflux disease (GERD) and STEMI both produce chest discomfort yet have radically distinct mechanisms).

A limited number of studies have identified predictors for the development of chronic postsurgical pain (CPSP) syndromes, strongly boosting the rationale for advocating for more comprehensive perioperative assessment of pain and related outcomes and aggressive pain prevention management (82, 111-114). It is estimated that 10% to 50% of patients undergoing common procedures such as thoracotomy, breast surgery, inguinal hernia repair, leg amputation, and coronary artery bypass experience chronic pain following surgery (108). Interestingly, a more extensive body of evidence for CPSP exists for patients having surgery for cancer (115). A number of studies have uncovered high rates of CPSP among patients having general surgery, joint replacements, and prostatectomies (116-119). Simanski et al. conducted a follow-up evaluation (mean 29 months post-surgery; N=911) and found that CPSP, defined by pain intensity ≥ 3 of 10, was experienced by 83 patients (14.8%)(116). When analyzed by surgical discipline, 28% were general surgery patients, 15% vascular, and 57% trauma/orthopedic, and CPSP was observed in patients having major or minor procedures. Chronic pain prevalence was as high as 44% following total knee replacement and 27% following total hip replacement (117). Overall, estimates of chronic pain prevalence range from 10% to 34% following total knee arthroplasty and from 7% to 23% following total hip arthroplasty (118). A relatively smaller proportion of patients, about 14% at 3 months and 1% at 6 months, experience CPSP after prostatectomy (119).

Perioperative opioid use

The vast majority of surgical patients experience acute pain and receive prescription opioids. In 1980, Porter and Jick published a widely cited letter to the editor in the *New England Journal of Medicine*, reporting on a survey of their hospitalized patients in which addiction was rare following prescription opioid use (4/11,000)(120). Thus, a generation of doctors has believed that the magnitude of opioid-use disorders following postoperative prescription opioid use is small. However, Wasan et al. and Ballantyne et al. conducted more recent reviews of the literature and concluded that the evidence for the earlier assertion was weak and that the real rates following surgery might be as high as 10% (121-122). This is particularly important, as prescription opioid abuse is a national crisis (123), costing in excess of $50 billion dollars per year (124), and prescription opioid overdose is now the leading cause of unintentional overdose deaths in the United States (125). Appropriate medical exposure is partly responsible: 35%-80% of people addicted to prescription opioids report that they were first exposed to opioids for the legitimate treatment of pain, including postsurgical pain (126-129). While we are gaining greater insight into the predictive factors of long-term postoperative use (130-131), much research is needed to further characterize these factors and develop effective interventions to reduce this huge societal problem.

Transitional Care

The transition from hospital to home or other settings is currently a period of discontinuity of care, during which there may be no designated healthcare provider with primary pain care responsibilities. This is more pertinent than ever, with growing pressures to discharge patients earlier, even after complex surgeries. Pain remains under-assessed and undertreated

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among medical and surgical inpatients (132). Even with high-quality in-hospital pain management, the patient may be abruptly switched from an individualized parenteral or regional analgesic regimen to a standard oral regimen, then discharged with a non-individualized oral analgesic prescription. Subsequent plans to manage pain and medication side effects and for office follow-ups are frequently inadequate. Such suboptimal care can result in increased pain and stress, sleep disruption, diminished quality of life, decreased patient satisfaction, loss of trust in physicians and the healthcare system, an increase in emergency department visits, and other adverse outcomes. For example, a recent study of 5,339 patients who underwent spine surgery at the Duke University Medical Center between 2010 and 2011 found that pain-related issues were primary drivers of postoperative emergency department visits: 643 patients accounted for 1,005 emergency department visits within 90 days of surgery (133). A review of 204 chief complaints revealed that 112 (55%) were related to uncontrolled pain or pain medication side effects.

Considerations prior to discharge should include anticipating dynamic analgesic requirements due to increasing physical activity, including participation in physical and other rehabilitative therapies; predicting changing analgesic needs due to type of injury or surgery; degree of opioid tolerance (134); availability and affordability of prescribed medications; type and expertise of caregivers; and comorbid medical and psychiatric disorders. With regard to the latter, poor acute pain management is associated with depression and anxiety (132). In patients with current or past substance-use disorders, uncontrolled pain can lead to self-medication with alcohol and illicit drugs and is associated with decreased retention in opioid maintenance treatment programs (135-136). For patients with opioid-use disorders on opioid agonist maintenance therapy, expert management to bridge these patients back to methadone or buprenorphine is essential.

Multimodal Prevention and Treatment

As with other diseases, such as diabetes or heart disease, in which weight and diet are managed by specialists with focused knowledge and training to avoid full manifestations, APM requires dedicated providers with the knowledge and training to avoid pain chronification. An acute pain service that is multidisciplinary and practices multimodal analgesia is generally accepted as best for achieving effective acute pain care (32). Multimodal analgesia typically refers to the use of 2 or more analgesic medications that work through different mechanisms, additively or synergistically, thereby reducing the dose and side effects of any one pain medication (12). An additional benefit of multimodal analgesia is a reduction in opioid use with its associated side effects and potential for mortality (137). With the establishment of acute pain services in most major hospitals and the development of anesthesiologists who subspecialize in APM, the definition of multimodal analgesia has expanded significantly beyond medications to include analgesic techniques such as regional anesthesia (16, 138). It is likely that this definition will expand even further as APM matures to include non-pharmacologic approaches to pain such as acupuncture, transcutaneous electrical nerve stimulation (TENS), relaxation techniques (mindfulness), massage, and biofeedback. This approach will necessarily require a specialized team of physicians, nurses, and support staff. The subspecialty of APM is

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designed to lead this team of professionals with the goal of superior acute pain management for patients.

Adequacy of Guidelines

Stemming from the synthesis of the above models, guidelines that address acute pain management include those updated in 2012 by the ASA, intended for the perioperative setting (12). Laudable for raising awareness, the recommendations to embrace multimodal analgesia and -- where possible -- regional anesthesia are otherwise nonspecific. Additionally, ASRA has put forth multiple guidelines addressing fellowships in regional anesthesiology and APM (139-140). While useful, they point to the continuing lack of a comprehensive acute pain strategy that matches patient-specific factors to specific acute-injury patterns to guide choices of evidence-based precision acute pain techniques.

The effort put forth by the Australian and New Zealand Anaesthetists and Faculty of Pain Medicine in *Acute Pain Management: Scientific Evidence* comes closest to achieving a comprehensive acute pain strategy (13). This broad text details everything from proper evaluations for acute pain to pharmacologic, interventional, and alternative treatments for its management. It provides an excellent review of the current literature but, as above, lacks a patient- and injury-specific approach that is vital to acute pain management. This lack combined with the lack of uniformity in the grading methods used by various societies have led to a void in quality systematic reviews.

Systematic Acute Pain Medicine and Healthcare Outcomes

Major gaps exist in our understanding of the implications of APM teams for cost-effectiveness of care, measurable improvements in functional status, PROs, and objective measures of patient perspectives on healthcare delivery via HCAHPS. Rectifying such gaps relies on improving our understanding of optimal methods to implement practice changes at the systems level. This requires a T4 approach to research, which, in turn, requires a unique set of experimental designs centered on implementation practices. Without such work, we run the risk that substantial improvements in acute pain practices will be inefficiently and incompletely disseminated to broader at-risk communities in disadvantaged environments.

To date, there has been little work on the cost-effectiveness of APM teams. Prior research has been mostly limited to patient-controlled analgesia delivery, and even those improvements were concluded to be cost-effective (141-142). Prototype workflows involving ambulatory total joint arthroplasty demonstrated this was feasible for select patients and could offer a substantial cost savings given projected total joint arthroplasty volumes in next few decades (143-145). Current hospital insurance systems often preclude longer-term investment in improving patient functional status, despite the fact that such longer-term investments may offer substantial decreases in total healthcare costs (146). Overall, an approach that simultaneously considers short- and long-term implications of acute pain care decisions is superior to the current model, which emphasizes only short-term effects that are more easily visible with historical accounting tools.

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Acute pain services traditionally have focused on decreasing pain intensity ratings, which is problematic for 2 reasons. First, at a systems level, such an isolated focus can be dangerous to entire populations of hospital patients. For example, bringing a patient's pain intensity rating to zero may not be possible, and its pursuit may increase morbidity and mortality. Second, the past few years have brought increased recognition that the role of the pain service is to decrease pain *while facilitating functional recovery*. Tools such as the Defense and Veterans Pain Rating Scale (DVPRS) offer a more holistic approach to evaluating a patient's pain level within the context of other dimensions of well-being such as mood and sleep (Figures 1 & 2)(56-57). The panel supports initiatives that include a battery of PROs such that pain intensity and analgesic utilization can be examined in a broad context of patient-focused measures. Notably, such panels must be administered within a realistic framework so that such evaluations do not overburden other simultaneous healthcare processes.

The IOM pain report called for population-level prevention and management strategies (11). Specifically, the IOM report identified a need for more consistent data on pain, and for data to be collected regularly using standardized measures to identify patient characteristics and longitudinal trends for treatment response. The report appeared to underscore the need and value for a large-scale patient registry system.

A patient registry is defined as “an organized system that uses observational study methods to collect uniform data (clinical and other) to evaluate specified outcomes for a population defined by a particular disease, condition, or exposure, and that serves a predetermined scientific, clinical, or policy purpose(s)” (147). A benefit of registries is that they typically provide ‘real world’ data on heterogeneous patients, thus allowing for improved disease and patient phenotyping, treatment practices, and patient outcomes (148). A comprehensive acute pain registry would minimize exclusions and, therefore, results have greater generalizability, particularly among a patient population with multiple comorbidities, and would ultimately facilitate precision medicine -- tailoring of interventions to the individual patient-- thereby optimizing outcomes. Integration of an effective and efficient registry into patient care would inform clinical decision making, facilitate assessment of individual treatment response, and allow for broad assessment of treatment safety and effectiveness across thousands of patients (11), thereby improving health care across diseases.

In the United States, hospitals are strongly incentivized to participate in the HCAHPS program that queries patients about their experience during hospitalization and contains multiple questions about pain management. Recent data suggest that national HCAHPS scores pertaining to pain management have improved in recent years, while other single-year data suggest that patients living in different parts of the country experience regional differences in their experience with inpatient pain management (149-150). By tying reimbursement to HCAHPS performance, many hospital systems have begun exploring ways to improve the patient experience, including pain management. Such emphasis should spur additional work to identify optimal ways of measuring and improving the systematic delivery of safe, advanced acute pain care.

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APMSIG Recommendations

Making Acute Pain Data Operational

The primary recommendation from the APMSIG Panel regarding research priorities addressed the need for an open-source acute pain data registry and clinical support tool. To this end, the panel considered making clinical data operational in 3 domains: capture, analysis, and utilization.

Modern electronic medical record systems (EMR) capture a wealth of data. As previously described, pain assessments, which are commonly used in clinical settings, may offer only partial perspectives on a patient's acute pain experience. Further, such clinical assessments often fail to fully capture the contextual basis of the assessment. While research assessment tools offer more structured evaluations of pain intensity and context, these tools often require high levels of training, time, and even money, which preclude widespread clinical adoption.

Novel, hybrid systems such as the Stanford-developed and implemented Collaborative Health Outcomes Information Registry (CHOIR) (151) and the U.S. Department of Defense's complementary pain registry, the Pain Assessment Screening Tool and Outcomes Registry (PASTOR) (47, 57), have successfully overcome such limitations by leveraging Computer Adaptive Testing (CAT) strategies to enable in-depth pain evaluations while enhancing clinical efficiency. Both registry systems use item banks capturing a wide range of physical, psychological, and social functioning domains that were developed by the Patient Reported Outcomes Measurement Information System (PROMIS) through the National Institutes of Health (NIH) (Table)(52-53). The PROMIS collects PRO data and also serves as an important clinical tool to inform providers of the psychosocial impacts of pain that are often overlooked with current pain measurement tools. The APMSIG Panel supports the expansion of NIH PROMIS item banks and domains into the acute pain setting to more fully capture information on pain intensity within the context of patient factors, disease and procedural burden, activity, treatment, and outcomes.

Next, it is necessary to consider analytic approaches to an ever-growing collection of EMR data involving pain. By panel estimate, analyses of multi-center EMR data on acute pain observations may span tens of millions of events within the next several years. Such methodologies may permit the simultaneous consideration of a substantially larger number of variables than is currently possible with existing datasets. These data may also allow research teams to better separate variance components stemming from patient vs. healthcare delivery systems. This last item is critical to enabling widespread clinical utilization of this growing, yet currently disconnected, set of acute pain data.

Acute Pain Medicine Subspecialty Recognition

In May 2013 during the semi-annual ASRA meeting, the Fellowship Directors Group voted unanimously to actively explore the process of accrediting this fellowship as a subspecialty of anesthesiology through the ACGME. A small subcommittee compiled this request, with support from ASRA AAPM, ASA, and other organizations, and submitted it to the ACGME on December 5, 2013. In the fall of 2014, the ACGME Board of Directors approved regional

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anesthesiology and APM to become the next accredited subspecialty fellowship training program within anesthesiology.

Accreditation is expected to fill a critical gap. While a growing body of evidence supports multimodal APM and regional anesthesiology in the hospital setting, anesthesiologists have cited insufficient training as a reason for not incorporating these practices (152-155). After completing their core residency in anesthesiology, few trainees have gained sufficient clinical experience and training to provide optimal pain medicine for the complete spectrum of issues presented by patients experiencing pain from surgery or other acute conditions and to provide safe and efficient advanced regional anesthesiology techniques where and when indicated. The following elements will distinguish the new regional anesthesiology and APM fellowship program from the current core anesthesiology residency training:

1. ***Core Residency***: By the end of the core residency, the general anesthesiologist shall:
    - **a.** Have provided care for 40 patients undergoing surgical procedures in whom peripheral nerve blocks are used as part of the anesthetic technique or perioperative analgesic management;
    - **b.** Be capable of providing care for patients with acute postoperative pain, with documented involvement in the use of patient-controlled intravenous techniques, neuraxial blockade, and other pain-control modalities.
2. ***After 1 year of fellowship training:*** The subspecialist in regional anesthesiology and APM shall have the knowledge and expertise to:
    - **a.** Provide direct acute pain management and medical consultation for the full spectrum of injuries, medical illnesses, and surgical and other invasive procedures that produce acute pain in the hospital setting;
    - **b.** When indicated, perform a comprehensive range of regional anesthesiology procedures for appropriate indications, understanding the individual risks and benefits of each, in a safe, consistent, and reliable manner;
    - **c.** Act as a consultant to other generalist anesthesiologists, surgeons, nurses, pharmacists, physical therapists, other medical professionals, operating room managers, hospital administrators, and other allied health providers;
    - **d.** Provide leadership in the organization and management of an APM service within the hospital setting, comprising a variety of specialists, to provide a comprehensive, multimodal acute pain management;
    - **e.** Have the knowledge and skills required to establish a new regional anesthesiology and APM program in his or her future practice and to adapt emerging knowledge and techniques for the acute pain management of patients;
    - **f.** Train future generations of generalists and subspecialists in regional anesthesiology and APM.

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Accrediting the subspecialty and creating uniform training requirements will accomplish the following:

- Establish and sustain a cohort of regional anesthesiology and APM physician subspecialists
- Establish and sustain a cohort of anesthesiologists to develop policies, guidelines, standards, practice parameters, and quality management tools to ensure the safe evidence-based practice of regional anesthesiology and APM
- Establish and sustain a faculty who will provide educational and training programs in regional anesthesiology and APM for the core residency, an essential feature for anesthesiology residency programs to comply with the ACGME Residency Review Committee requirements
- Establish and sustain leaders in APM for public service, government entities, and policy groups
- Establish and sustain a cohort of anesthesiologists able to develop new knowledge applicable to regional anesthesiology and APM for future generations

The fellowship-trained regional anesthesiology and APM physician must be capable of leading teams, collaborating with other hospital-based specialists in anesthesiology, surgery, medicine, emergency medicine, nursing, pharmacy, and physical therapy. This physician must be capable of coordinating care to establish multidisciplinary programs that improve pain management along the continuum of acute pain from the pre-hospital and emergency-department settings to the perioperative hospital setting and beyond. Potential downstream positive effects include enhanced rehabilitation outcomes from trauma, surgery, or acute illness, decreased chronic postsurgical pain, reductions in short- and long-term adverse effects of opioids through the use of multimodal analgesia, and decreased healthcare costs.

Educational Challenges and Targets

The panel identified several key targets of education initiatives, including the APM team. Because an ideal continuum of care begins as close as possible to the time and place of injury and continues through complete recovery, the APM team may encompass many medical professionals:

- Physicians
- Hospital administrators
- Nurses
- Pharmacists
- Physical therapists
- Others

Although team members will vary depending on the institution and population it serves, recognition of the team approach is crucial to successful patient care and safety. Developing educational pathways within the interdependent specialties for the management of acute pain

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would broaden the reach and impact of APM on patient care, ultimately setting acute pain management as a system-wide priority. Creating templates, forms, and documents, including a virtual library with videos and podcasts to make APM easy to implement, is crucial to temporal initiative goals.

Research and review articles are necessary to forward the burgeoning science in APM and to educate current medical practitioners. The quality and scope of medical student curricula in the treatment of pain in general have already been identified as urgent needs (156). The regional anesthesiology and APM subspecialty could help fill this gap in the medical student's educational experience.

On the level of practice implementation, third-party payers are a key group in this process. Recognition by payers of the value APM plays in the speed and quality of patient recovery is critical (157-158). Face-to-face meetings with payers, whether governmental or private entities, are necessary. The goal is to emphasize the global scope of safety and cost savings from entry into the healthcare system to recovery rather than separate silos of segmental budget items and areas. For instance, accelerated recovery techniques following surgery require a team approach to preoperative patient education, pre-emptive analgesia and more (159). Furthermore, the perioperative surgical home, a model that includes multi-specialty care teams, has already demonstrated cost savings and quality improvement (160).

Hospital administrators and members of other hospital departments, such as pharmacy and physical therapy, are crucial to advancing pain therapy (161). Communication should take place via individual meetings, articles in relevant professional journals, and by incorporating these disciplines into research.

Last but foremost, is education of the public. Patients and their loved ones have the most to lose if APM techniques fail to keep pace with scientific and practice advancements. Patients often drive demand in the field of medicine. If the population as a whole was educated to realize the advantages that are possible with advanced acute pain management, “a common tide of interest” would rise once more, empowering patients to understand and voice their needs, wants, and rights (1).

Summary

Effective management of acute pain offers a primary prevention strategy to alleviate patient pain and escalation of healthcare costs. The APMSIG Panel, comprising a collaboration of healthcare providers with an interest in acute pain, met with the goal of promoting evidence-based research and education in APM. As part of a 3-year initiative, the panel set priorities aimed at establishing a team-based, multidisciplinary acute pain service as an essential component of quality care in any hospital or acute care setting. With this direction to guide it, APM can advance and serve its role in the pain management continuum.

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Appendix: Panel of the Acute Pain Medicine Shared Interest Group and Affiliations

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Box 1. Vision Statement of the APMSIG

The APMSIG will lead in developing systems, methods, and interventions to obviate suffering from perioperative and acute pain. The APMSIG will advocate for effective perioperative and acute pain management to limit its chronification, whether from trauma, medical conditions, and/or surgical operations by advancing the science and practice of acute pain medicine.

APMSIG: Acute Pain Medicine Shared Interest Group

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Box 2. APMSIG Panel: Working Definition of Acute Pain

Acute pain is the physiologic response and experience to noxious stimuli that can become pathologic, is normally sudden in onset, time limited, and motivates behaviors to avoid actual or potential tissue injuries.

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Box 3. APMSIG Panel: Working Definition of Acute Pain Medicine

Acute pain medicine is the practice of medicine dealing with the prevention, diagnosis, and treatment of acute pain and its consequences.

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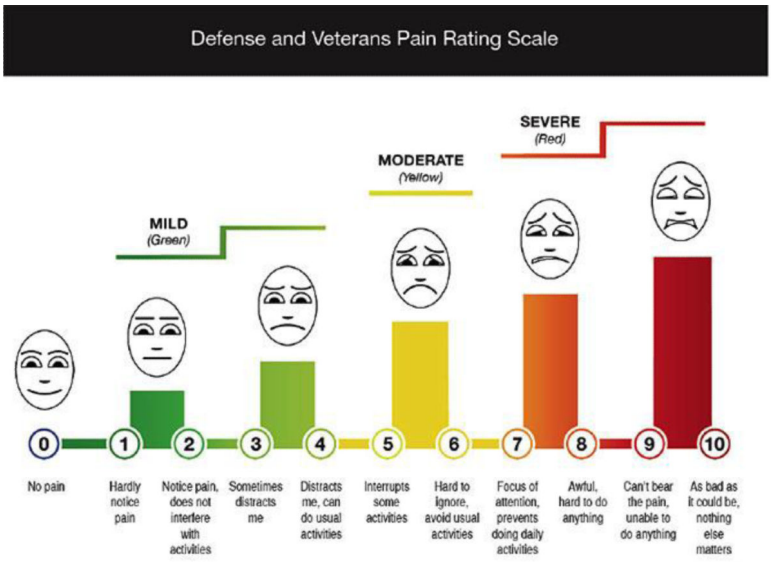

Figure 1.
Defense and veterans pain rating scale

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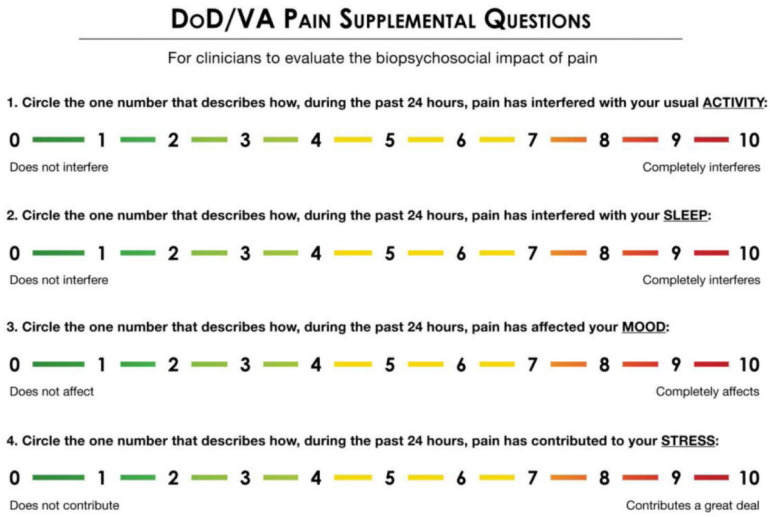

Figure 2.

DoD/VA pain supplemental questions. DoD5U.S. Department of Defense; VA5U.S. Department of Veterans Affairs DoD: U.S.

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Table

Pain-Related Patient-Reported Outcomes: Examples of Reliable and Valid Scales, Items, and Instruments

Patient-Reported Outcomes (PROs)	Scales/Items/Instruments
Pain Intensity	• NRS, VDS • VAS • Faces Pain Scale – Revised, IASP • DVPRS • PROMIS Pain Intensity
Pain Interference	• BPI-SF Subscale: Pain Interference • PROMIS Pain Interference
Pain Relief	• BPI Item: Pain Relief
Pain Character and Quality	• MPQ-SF • NPS • LANSS • NPQ • PROMIS Pain Behavior
Anxiety	• HADS • APS-POQ-R Anxiety Item • PASS • PROMIS Anxiety
Depression	• HADS • APS-POQ-R Depression Item • PROMIS Depression
Anger	• PROMIS Anger
Sleep	• ISI • PSQI • BPI-SF Interference Subscale Item: Sleep • PROMIS Sleep Disturbance • PROMIS Sleep-Related Impairment
Pain Catastrophizing	• Pain Catastrophizing Scale
Pain Fear and Fear Avoidance	• FPQ-III • PASS • TOPS Fear Avoidance Subscale • FABQ
Satisfaction with Pain Care/Outcomes	• APS-POQ-R Satisfaction Item • TOPS Patient Satisfaction with Outcomes and Health Care Satisfaction Subscales
Social Health	• BPI Interference Subscale Item: Relations with Other People • PROMIS Social Health (Ability to Participate in Social Roles and Activities) and Satisfaction with Social Roles and Activities, Social Support, Social Isolation, and Companionship
Patient Impressions of Change	• PGIC Scale

NRS: Numeric Rating Scale

VDS: Verbal Descriptive Scales

VAS: Visual Analog Scale

IASP: International Association for the Study of Pain

DVPRS: Defense and Veterans Pain Rating Scale

BPI-SF: Brief Pain Inventory - Short Form

NIH PROMIS: National Institutes of Health Patient Reported Outcomes Measurement Information System

BPI: Brief Pain Inventory

MPQ-SF: McGill Pain Questionnaire-Short Form

NPS: Neuropathic Pain Scale

LANSS: Leeds Assessment of Neuropathic Symptoms and Signs

NPQ: Neuropathic Pain Questionnaire

HADS: Hospital Anxiety Depression Scale

APS-POQ-R: American Pain Society – Patient Outcomes Questionnaire – Revised

PASS: Pain Anxiety Symptoms Scale

ISI: Insomnia Severity Index

PSQI: Pittsburgh Sleep Quality Index

FPQ-III: Fear of Pain Questionnaire III

TOPS: Treatments Outcomes in Pain Survey

FABQ: Fear-Avoidance Beliefs Questionnaire

PGIC: Patient Global Impression of Change

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