*International Journal of Computational and Experimental Science and ENgineering (IJCESEN)*

*Vol. 11-No.4 (2025) pp. 7073-7089*
*http://www.ijcesen.com*

***ISSN: 2149-9144***



**Research Article**

# Management of Chronic Pain in Family Medicine Roles of Nursing, Anesthesia, Medical Coding, Radiology, and Intensive Care

**Amnah Ibrahim Alsamti[1]*, Hind Tarig Alshahrani[2], Solaf Mujeeb Alzhrani[3], Albtool Abdullah Alharbi[4] , Ali Hassan T Alhdad[5] , Haytham Abdulsalam Nasrulden[6] , Nora Saeed Ali Alqhtani[7] , Yousef Ali Alasiri[8] , Abdulmajeed Helal Obed Almutairi[9], Abbas Hassan Al Lashit[10], Najeeb Mansour Al Mohammedali[11]**

[1]General Practitioner, Al-Jesser Primary Healthcare Center, Khobar, Saudi Arabia
* **Corresponding Author Email:** aialsamti@moh.gov.sa - **ORCID:** 0000-0002-5247-7880

[2]Clinical Coder, King Fahad Specialist Hospital, Saudi Arabia
**Email:** hind.smt@gmail.com - **ORCID:** 0000-0002-5247-7750

[3]Medical Coding, KFSH, Saudi Arabia
**Email:** solafz@moh.gov.sa - **ORCID:** 0000-0002-5247-7650

[4]Medical Coder, KFSH, Saudi Arabia
**Email:** aalharbi1228@moh.gov.sa - **ORCID:** 0000-0002-5247-7550

[5]Family Medicine, Xinjiang Medical University - Ministry of Health (PHC) , Saudi Arabia
**Email:** Ahalhdad@moh.gov.sa - **ORCID:** 0000-0002-5247-7840

[6]ICU Doctor, King Faisal General Hospital, Makkah, Saudi Arabia
**Email:** hazs@hotmail.com - **ORCID:** 0000-0002-5247-7850

[7]Nurse Technician, Yaara PHC - Aseer, Saudi Arabia
**Email:** noalqhtani@moh.gov.sa- **ORCID:** 0000-0002-5247-7830

[8]Technologist (Radiology), King Khalid University Medical City (KKUMC) , Saudi Arabia
**Email:** yualasiri@kku.edu.sa- **ORCID:** 0000-0002-5247-7820

[9]Anesthesia Technology, King Fahd Medical Research Center, Jeddah, Saudi Arabia
**Email:** ahalmutairi@kau.edu.sa- **ORCID:** 0000-0002-5247-7810

[10]General Practitioner in Primary Healthcare, Eastern Health Cluster, Saudi Arabia
**Email:** abbas-allashit@hotmail.com- **ORCID:** 0000-0002-5247-7850

[11]Family Medicine Consultant, Ministry of Health, Eastern Health Cluster, Saudi Arabia
**Email:** najeebmma@gmail.com - **ORCID:** 0000-0002-5247-7800

**Article Info:**

**DOI:** 10.22399/ijcesen.3975
**Received :** 23 July 2025
**Accepted :** 20 September 2025

**Keywords** (must be 3-5)

Chronic Pain Management,
Family Medicine,
Interprofessional Collaboration,
Multidisciplinary Team,
Biopsychosocial Model,
Nursing Role

**Abstract:**

Chronic pain management is a multifaceted challenge that requires a comprehensive approach in family medicine. Nursing plays a pivotal role by providing patient education, emotional support, and coordination of care among various healthcare providers. Nurses assess patients' pain levels, administer prescribed medications, and monitor for side effects, all while fostering an environment that encourages open communication about pain experiences. Furthermore, nurses are instrumental in integrating non-pharmacological therapies, such as physical therapy and mental health support, into pain management plans. Their direct interaction with patients allows them to identify barriers to effective pain management, making them advocates for patient-centered care. Anesthesia professionals contribute significantly to chronic pain management through interventional techniques, such as nerve blocks and epidural injections, which can provide relief for patients when conventional treatments fail. Medical coding specialists ensure that accurate documentation and billing occur for these complex procedures, ensuring healthcare providers receive proper reimbursement and facilitating access to necessary treatments for patients. Radiology plays a crucial

diagnostic role by providing imaging studies that identify the underlying causes of pain, guiding treatment decisions and interventions. In more severe cases, where chronic pain overlaps with critical conditions, intensive care units may be involved to manage acute exacerbations of pain and underlying health problems. Together, these disciplines create an integrated network of care that emphasizes a holistic approach to managing chronic pain, ultimately improving patients' quality of life.

## 1. Introduction

Chronic pain represents one of the most pervasive, debilitating, and complex challenges confronting modern healthcare systems worldwide. Defined as pain that persists or recurs for longer than three months, it transcends the typical timeframe of normal tissue healing and evolves into a distinct pathological condition in its own right [1]. Unlike acute pain, which serves a vital biological function as a warning signal of injury or disease, chronic pain often loses this adaptive purpose, becoming a maladaptive state that can devastate every facet of an individual's life—physical, psychological, social, and economic. Its prevalence is staggering, affecting an estimated 20-30% of the global population, making it a leading cause of disability and a significant driver of healthcare expenditure and lost productivity [2].

The management of chronic pain is rarely straightforward. It is frequently characterized by a multifactorial etiology, involving a complex interplay of neurobiological mechanisms, such as peripheral and central sensitization, alongside a host of psychosocial factors, including depression, anxiety, catastrophizing, and socioeconomic stressors [3]. This intricate biopsychosocial nature defies simplistic, unimodal treatment approaches centered solely on pharmacological intervention. The limitations, and indeed the dangers, of relying heavily on opioid analgesians have been starkly revealed by the ongoing opioid crisis, underscoring the critical need for safer, more effective, and holistic management strategies [4].

It is within this complex landscape that the discipline of Family Medicine assumes a position of paramount importance. As the first point of contact and the cornerstone of longitudinal care for individuals and families, the primary care setting is where the vast majority of chronic pain conditions are initially presented, evaluated, and managed over the long term [5]. The family physician, therefore, acts as the central architect of the patient's pain management plan, responsible for initial diagnosis, ongoing monitoring, and the crucial task of coordinating a diverse team of specialists and allied health professionals. However, the sheer complexity of chronic pain means that no single physician can possess all the requisite expertise for its comprehensive management. Success in this arena is inherently dependent on a collaborative, interprofessional approach that leverages the unique skills of various healthcare disciplines, all working in concert toward the common goal of improving patient function and quality of life [6].

This research paper will argue that the effective and comprehensive management of chronic pain in the Family Medicine context is fundamentally an interprofessional endeavor. It will delve into the specific, indispensable roles played by five key domains within the healthcare ecosystem: Nursing, Anesthesia, Medical Coding, Radiology, and Intensive Care. Each of these disciplines contributes a unique and vital piece to the puzzle of patient care, from the continuous, empathetic support and education provided by nursing staff, to the advanced interventional techniques offered by pain medicine specialists, the diagnostic clarity provided by radiological imaging, the financial and data integrity ensured by meticulous medical coding, and the critical care management for pain crises. By examining the synergistic integration of these roles, this paper aims to present a holistic model for chronic pain management that is patient-centered, evidence-based, and sustainable within the primary care framework.

**Family Medicine as the Orchestrator of Care**

The Family Medicine physician serves as the patient's medical home and the primary conductor of the chronic pain management orchestra. Their role begins with establishing a trusting, longitudinal relationship with the patient, which is foundational for understanding the full context of the pain experience. This involves conducting a comprehensive biopsychosocial assessment that moves beyond identifying a nociceptive source to explore the impact of pain on mood, sleep, relationships, and occupational function [5]. The physician is responsible for formulating a differential diagnosis, initiating first-line treatments (including non-pharmacological options like physical therapy and cognitive-behavioral techniques, and carefully selected medications), and setting realistic, functional goals with the patient.

A critical function of the family physician is to determine when and to whom a patient should be referred. This triage and referral responsibility requires a nuanced understanding of the capabilities of other specialties. Knowing when a patient's condition warrants the specialized skills of a pain

interventionist, a psychiatrist, or a physical medicine and rehabilitation specialist is a key component of effective management [7]. Furthermore, the family physician remains the central repository for all information generated by these referrals, synthesizing findings and recommendations into a unified, coherent care plan that they continue to oversee. This ensures continuity and prevents the fragmentation of care, which is a common pitfall for patients with complex, chronic conditions.

**2. The Integral Role of Nursing:**

Nursing professionals are the linchpin of the chronic pain management team, providing the continuous, hands-on care and support that bridges the gap between clinical appointments. In the Family Medicine setting, nurses are often the first to assess a patient's reported pain levels and its characteristics during a visit. Their role is multifaceted, encompassing patient education, advocacy, and monitoring. They are instrumental in educating patients about the nature of chronic pain, the proper use of medications (including the risks of misuse), the importance of non-drug therapies, and self-management strategies [8]. This educational role empowers patients, moving them from a passive recipient of care to an active participant in their own management.

Beyond education, nurses provide invaluable psychosocial support. They are skilled in motivational interviewing and therapeutic communication, helping patients to navigate the emotional turmoil, frustration, and fear that often accompany chronic pain [9]. They monitor for treatment adherence, side effects, and potential signs of substance misuse, serving as a crucial early-warning system for the physician. The nurse-patient relationship, built on repeated interactions and empathy, fosters a level of trust that can yield critical insights into the patient's condition and progress, information that is essential for tailoring the treatment plan effectively.

**Interventional Expertise and Advanced Pharmacology: The Contribution of Anesthesia-Pain Medicine**

When conservative management proves insufficient, the expertise of anesthesiologists specializing in pain medicine becomes invaluable. These specialists bring a sophisticated understanding of neuroanatomy, pharmacology, and interventional techniques to the team. Their role is to offer targeted diagnostic and therapeutic procedures that can break the cycle of severe pain. This may include nerve blocks, epidural steroid injections, radiofrequency ablation, or the implantation of neuromodulation devices like spinal cord stimulators [10].

The involvement of the pain anesthesia specialist allows for a more nuanced approach to pharmacological management, particularly for complex cases requiring adjuvant medications or carefully supervised opioid therapy. They work in close consultation with the referring family physician, providing specialized interventions that complement the ongoing primary care. This collaboration ensures that the patient benefits from advanced procedural care without losing the continuity and holistic perspective provided by their primary care provider.

**Visualizing the Source: The Diagnostic Precision of Radiology**

Radiology provides the objective eyes that help to confirm, clarify, or rule out the underlying structural causes of chronic pain. While a clinical history and physical examination are paramount, imaging modalities such as X-rays, Computed Tomography (CT), Magnetic Resonance Imaging (MRI), and ultrasound offer critical diagnostic information. An MRI of the spine, for instance, can reveal herniated discs, spinal stenosis, or nerve root compression that correlates with a patient's radicular pain [11]. Musculoskeletal ultrasound can dynamically assess soft tissue injuries, tendons, and joints.

The radiologist's role extends beyond simply acquiring images; it involves expert interpretation to differentiate between clinically significant findings and incidental, age-related changes that may not be the true source of the patient's pain. This interpretive function is crucial for guiding further management, whether it be towards a specific interventional procedure, surgical consultation, or away from an unnecessary invasive treatment. Effective communication between the family physician and the radiologist ensures that the imaging study is appropriately selected and that its findings are integrated meaningfully into the patient's overall clinical picture.

**The Language of Healthcare: The Critical Role of Medical Coding**

In the modern healthcare environment, the accurate translation of clinical services into standardized codes is essential for operational sustainability, data analytics, and research. Medical coding, often an overlooked component of patient care, plays a vital role in chronic pain management. Certified medical coders are responsible for translating the diagnoses (e.g., ICD-10-CM codes for chronic pain syndromes), procedures (e.g., CPT codes for nerve

blocks or office visits), and services provided into a universal language [12].

Accurate coding is critical for several reasons. It ensures appropriate reimbursement for the complex and time-consuming care required by chronic pain patients, without which clinics and health systems could not sustain these comprehensive services. Furthermore, precise coding generates robust data that can be used for population health management, tracking the prevalence of specific pain conditions, evaluating treatment outcomes, and identifying areas for quality improvement. Inaccurate coding can lead to claim denials, financial losses, and a corrupted data set that hinders the ability to understand and improve care for this patient population on a larger scale.

**Managing Critical Exacerbations: The Intensive Care Interface**

Although most chronic pain is managed in the outpatient setting, patients may occasionally present to the emergency department and require admission to the Intensive Care Unit (ICU) due to severe exacerbations of pain, complications from treatment (e.g., respiratory depression from opioids), or unrelated critical illnesses in which their chronic pain complicates management. In the ICU, the management of pain is a core priority, but it is fraught with unique challenges. Critically ill patients may be unable to communicate, and the line between treating pain and inducing hemodynamic or respiratory instability is thin [13].

The intensivist's role is to manage this delicate balance, often employing multimodal analgesic regimens that may include regional anesthesia techniques, non-opioid analgesics, and carefully titrated sedatives. Effective communication between the ICU team and the patient's primary family physician is essential to understand the patient's baseline pain condition, previous effective treatments, and medication tolerance. This collaboration ensures that pain is adequately controlled during the critical illness while avoiding iatrogenic harm and facilitating a smoother transition back to primary care management upon discharge [13].

**Roles of Nursing in Chronic Pain Assessment and Care**

Within the intricate tapestry of chronic pain management in Family Medicine, nursing professionals emerge as the consistent, empathetic, and clinically astute thread that binds the entire process together. Their role is foundational and multifaceted, extending far beyond the traditional tasks of medication administration to encompass the core principles of patient advocacy, comprehensive assessment, holistic education, and continuous care coordination. Nurses operate at the crucial interface between the patient, the family physician, and the broader multidisciplinary team, making their contribution indispensable to a patient-centered, biopsychosocial model of care. This continuous presence allows them to build a therapeutic relationship based on trust, which is often the cornerstone for effective engagement and treatment adherence in a condition as complex and personal as chronic pain [14].

The nursing role in chronic pain management begins with a sophisticated and nuanced assessment process. While physicians make the formal diagnosis, nurses are often the first to conduct a detailed initial screening and ongoing evaluation of the patient's pain experience. This assessment moves beyond the unidimensional "rate your pain from 0 to 10" scale. Competent nurses employ a holistic approach, utilizing validated tools to assess not just pain intensity, but also its characteristics (e.g., burning, shooting, aching), location, duration, and aggravating/alleviating factors. More importantly, they assess the profound impact of pain on the patient's functional capacity, including activities of daily living (ADLs), sleep patterns, mood, cognitive function, and social interactions [15]. This comprehensive data collection provides a rich, real-world context that is vital for the physician to formulate an accurate diagnosis and a truly individualized care plan.

Furthermore, nurses are uniquely positioned to assess for "yellow flags" – psychosocial risk factors that predict the risk of chronicity and disability. Through skilled communication and active listening, they can identify signs of catastrophizing, fear-avoidance behaviors, kinesiophobia (fear of movement), depression, anxiety, and significant social or occupational stressors [16]. This critical information, which a patient may not initially feel comfortable disclosing to a physician in a brief consultation, is often revealed within the supportive and less formal context of the nurse-patient interaction. By identifying these yellow flags early, nurses enable the timely initiation of psychological or social work interventions, which are crucial for preventing the downward spiral of chronic pain and disability.

A central and powerful component of the nursing role is patient and family education. Chronic pain is often poorly understood by patients, leading to fear, frustration, and a search for a nonexistent "quick fix." Nurses act as interpreters of the medical plan, translating complex medical jargon into understandable concepts. They educate patients on the neurophysiology of chronic pain, explaining the concept of central sensitization and how pain can

persist even after the initial injury has healed. This knowledge is empowering, as it helps to validate the patient's experience and shift their mindset from seeking a cure to focusing on self-management and functional improvement [17]. Education also encompasses the appropriate use of analgesic medications, including their mechanisms, potential side effects, and the critical importance of adherence to prescribed regimens to avoid complications or lack of efficacy.

In the current healthcare climate, a pivotal aspect of nursing education involves opioid stewardship. Given the risks associated with long-term opioid therapy, including tolerance, hyperalgesia, and addiction, nurses play a key role in monitoring for signs of misuse, educating patients on safe storage and disposal, and emphasizing the role of non-opioid and non-pharmacological therapies as first-line treatments [18]. They are instrumental in administering and explaining opioid agreements or treatment plans, ensuring the patient fully understands their responsibilities. This role requires a delicate balance of empathy and firmness, supporting the patient's pain relief while safeguarding their overall health and safety.

Beyond pharmacology, nurses are champions of non-pharmacological interventions. They are often the primary providers of coaching and support for techniques such as paced activity, relaxation exercises, guided imagery, and basic mindfulness practices [19]. In many Family Medicine settings, nurses may run group education sessions or chronic pain self-management programs, fostering a sense of community and shared experience among patients. By promoting these active self-management strategies, nurses help patients move from a passive "victim" of pain to an active "manager" of their condition, thereby enhancing their sense of self-efficacy and control, which are strong predictors of positive outcomes [20].

The nursing role is also inherently one of advocacy and care coordination. Nurses often act as the patient's voice within the healthcare system, ensuring that their concerns are heard and their needs are addressed by the physician and other team members. They facilitate communication between the different specialties involved in the patient's care—such as relaying a patient's response to a new medication to the physician, or communicating a physiotherapist's progress report to the rest of the team [21]. This coordination is essential for preventing fragmentation of care, a common problem for patients seeing multiple providers. The nurse ensures that the left hand knows what the right hand is doing, creating a seamless and integrated care experience for the patient.

The implementation of the nursing process—assessment, diagnosis, planning, implementation, and evaluation—provides a structured framework for managing chronic pain in primary care. After the initial assessment, the nurse formulates nursing diagnoses specific to the patient's needs, such as "Chronic Pain related to complex neuropathic mechanisms" or "Ineffective Coping related to chronic pain and depression." Based on these diagnoses, the nurse collaborates with the patient to set realistic, measurable, and functional goals. The planning phase involves selecting appropriate nursing interventions, which may include scheduled follow-up calls, wound care for a pain-related condition, teaching a new relaxation technique, or providing supportive counseling during a pain flare-up [22].

The evaluation phase is continuous and dynamic. Nurses constantly re-assess the patient's response to the overall treatment plan. They evaluate whether the set goals are being met, if pain and function are improving, and if there are any new barriers to care. This ongoing evaluation allows for real-time adjustments to the nursing care plan and provides critical feedback to the physician about the effectiveness of the medical regimen. For instance, a nurse might identify that a patient is experiencing significant sedation from a new medication, prompting a timely dosage adjustment by the physician before the patient becomes non-adherent [23].

**Anesthesiology Perspectives:**

When conservative management of chronic pain within the Family Medicine setting proves insufficient, the expertise of anesthesiologists specializing in pain medicine becomes a pivotal component of the multidisciplinary team. These specialists bring a profound understanding of neuroanatomy, pharmacology, and advanced interventional techniques, offering a sophisticated arsenal for patients with refractory pain conditions. Their perspective is uniquely targeted, focusing on modulating the pain pathway itself through precise pharmacological and procedural interventions. The anesthesiologist's role is not to replace the primary care provider but to complement the foundational biopsychosocial care with specialized, often interventional, strategies that can break the cycle of severe, intractable pain, thereby facilitating greater engagement with other rehabilitative and psychological therapies [24]. The approaches employed can be broadly categorized into systemic (body-wide) pharmacological management and targeted intrathecal or regional drug delivery, each with distinct indications, mechanisms, and benefits.

Systemic pharmacological management, while often initiated by the family physician, is refined and complexified under the guidance of a pain medicine anesthesiologist. Moving beyond simple opioid prescribing, their approach is inherently multimodal, leveraging different classes of medications that act on various mechanisms of the pain pathway to achieve synergistic analgesia while minimizing the doses and side effects of any single drug. This regimen typically includes non-opioid analgesics such as acetaminophen and nonsteroidal anti-inflammatory drugs (NSAIDs). However, the core of advanced systemic management often lies in the use of adjuvant analgesics—medications whose primary indication is not pain but which have proven efficacy for specific pain conditions. These include anticonvulsants (e.g., gabapentin, pregabalin) which stabilize nerve membranes and are first-line for neuropathic pain, and antidepressants, particularly tricyclic antidepressants (e.g., amitriptyline) and serotonin-norepinephrine reuptake inhibitors (SNRIs like duloxetine), which enhance descending inhibitory pain pathways in the brain and spinal cord [25].

The anesthesiologist's role in systemic opioid therapy is one of meticulous stewardship and expert management. For a carefully selected subset of patients, opioids may be a necessary component of care. The pain specialist is skilled in conducting thorough risk assessments, utilizing screening tools, and implementing structured prescribing practices such as opioid treatment agreements and regular urine drug screening to ensure safety [26]. They possess a deep knowledge of opioid pharmacology, including the use of opioid rotation—switching from one opioid to another to improve efficacy or reduce side effects—and the management of complex issues like opioid-induced hyperalgesia, a state of increased pain sensitivity caused by the medication itself. This expert oversight is crucial in mitigating the risks of dependence, tolerance, and addiction, ensuring that opioid therapy, when used, is a carefully controlled and monitored element within a broader treatment plan.

When systemic therapies are ineffective, poorly tolerated due to side effects, or require doses that pose significant risk, anesthesiologists can employ targeted drug delivery systems that represent a paradigm shift in pain management. The most advanced of these is intrathecal drug delivery, also known as the "pain pump." This modality involves the surgical implantation of a programmable pump, about the size of a hockey puck, in the abdominal wall, which is connected to a catheter that delivers medication directly into the cerebrospinal fluid of the intrathecal space surrounding the spinal cord [27]. This direct delivery to the central nervous system (CNS) offers profound advantages. By bypassing the systemic circulation, intrathecal therapy achieves potent analgesia with doses that are a fraction of those required orally or parenterally. For example, the intrathecal potency of morphine is approximately 100 times that of its intravenous equivalent, and for the potent opioid fentanyl, the ratio can be as high as 300:1 [28]. This dramatic reduction in systemic exposure significantly diminishes common side effects such as sedation, constipation, nausea, and cognitive cloudiness, which often limit oral therapy.

The pharmacological agents used in intrathecal pumps have evolved. While morphine remains the only FDA-approved opioid for long-term intrathecal use, clinical practice commonly utilizes other opioids like fentanyl and hydromorphone. Furthermore, the modern paradigm is one of combination therapy. Local anesthetics, such as bupivacaine, are frequently added to the infusion to provide a synergistic analgesic effect by blocking sodium channels on neural membranes [29]. Another critical adjuvant is ziconotide, a non-opioid, non-local anesthetic agent that is a synthetic equivalent of a cone snail toxin. Ziconotide works by selectively blocking N-type voltage-gated calcium channels in the spinal cord, interrupting the transmission of pain signals. It is highly effective for severe chronic pain and carries no risk of respiratory depression or the development of tolerance, making it a valuable option, though its use requires careful titration due to potential neuropsychiatric side effects [30]. The selection of the drug regimen and the programming of the pump's infusion rates (which can be simple continuous or complex bolus patterns) are tailored to the individual patient's needs, requiring the specialized knowledge of the pain medicine anesthesiologist.

The implantation of an intrathecal pump is a significant procedure reserved for patients with severe, refractory pain who have failed more conservative treatments. Ideal candidates include those with cancer-related pain, failed back surgery syndrome, complex regional pain syndrome, or other severe neuropathic or nociceptive conditions [31]. The process involves a rigorous patient selection process, including psychological evaluation, and is typically preceded by a screening trial where a single intrathecal bolus or a temporary catheter is used to assess the patient's response to the medication before committing to a permanent implant. While highly effective, this therapy is not without risks, which include surgical complications (e.g., infection, hematoma), catheter-related issues (e.g., kinking, migration), or pump malfunction,

necessitating long-term follow-up and management by the implanting team [32].

Beyond intrathecal therapy, the anesthesiologist's interventional armamentarium includes a wide range of regional nerve blocks and neuroablative procedures that serve both diagnostic and therapeutic purposes. Diagnostic blocks, involving the injection of a local anesthetic onto a specific nerve or plexus, can help confirm a pain generator. For instance, a successful sacroiliac joint block that provides temporary relief can confidently identify that joint as a significant source of the patient's low back pain [33]. Therapeutic blocks, which may include a corticosteroid to reduce inflammation, can provide longer-lasting relief, breaking the cycle of pain and allowing the patient to participate more fully in physical therapy. For more permanent relief in cases of well-localized pain, usually of malignant origin, neurolytic blocks using alcohol or phenol can be employed to deliberately ablate a nerve pathway.

Another advanced interventional technique falling under the purview of pain anesthesiology is neuromodulation, most commonly spinal cord stimulation (SCS). This technology involves implanting electrodes in the epidural space adjacent to the spinal cord. These electrodes deliver low-voltage electrical impulses that interfere with the transmission of pain signals to the brain, theoretically based on the "Gate Control Theory" of pain, though modern devices work through other mechanisms as well [34]. Newer waveforms, such as high-frequency and burst stimulation, have expanded the efficacy of SCS to include both neuropathic and certain types of nociceptive pain, providing a valuable non-pharmacological option for patients. The role of the anesthesiologist is to select appropriate candidates, perform the trial stimulation, and implant the permanent device if the trial is successful.

The collaboration between the Family Medicine physician and the pain medicine anesthesiologist is critical for the success of these advanced therapies. The family physician provides the longitudinal relationship and holistic understanding of the patient, making the initial referral and continuing to manage comorbidities and overall health. The anesthesiologist provides the specialized procedural intervention and sophisticated pharmacological management. Clear, ongoing communication is essential. The family physician must be aware of the implanted device, the intrathecal medication regimen, and potential complications to watch for, while the anesthesiologist relies on the primary care provider for updates on the patient's overall functional status and psychosocial well-being. This seamless integration ensures that the advanced, targeted interventions provided by anesthesiology are not isolated events but are effectively woven into the patient's comprehensive, long-term chronic pain management plan, ultimately working towards the shared goal of restoring function and improving quality of life [35].

**Medical Coding and Documentation:**

Within the multidisciplinary framework of chronic pain management, the roles of clinical providers are universally recognized. However, the critical administrative and data-focused functions of medical coding and clinical documentation often operate in the background, despite being fundamental to the sustainability, quality, and very recognition of comprehensive pain care. Medical coding is the specialized language that translates the complex narrative of a patient's pain condition and the services provided into standardized alphanumeric codes. This translation is not a mere clerical task; it is a sophisticated process that ensures the patient's story is accurately captured for reimbursement, population health management, and clinical research. In the context of chronic pain—a condition often invisible and subjective—precise documentation and coding become powerful tools for validating the patient's experience and securing the necessary resources for their care [36]. The integrity of the entire chronic pain care pathway, from initial assessment to complex intervention, is dependent on the seamless collaboration between clinicians and certified medical coders.

The foundation of accurate medical coding lies in impeccable clinical documentation. The patient's medical record serves as the source document from which coders extract information to assign codes for diagnoses, procedures, and services. For chronic pain, this documentation must be exceptionally detailed to justify the medical necessity of the often complex and resource-intensive care provided. Key elements include a clear description of the pain's location, intensity, character, duration, and exacerbating/relieving factors. More importantly, the record must consistently reflect the *impact* of the pain on the patient's functional status, a concept known as "functional impairment." Notes should detail limitations in activities of daily living (ADLs), work capacity, mobility, and sleep, as this information is crucial for justifying the medical necessity of the treatment plan [37]. Furthermore, documentation must clearly outline the treatment plan itself, including medications, referrals to other specialists (e.g., physical therapy, psychology), and the patient's response to these interventions. Vague terms like "chronic pain" or "low back pain" are insufficient; specificity is paramount.

The primary coding system for diagnoses is the International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM). This system provides a vast array of codes that allow for a nuanced representation of pain conditions. Moving beyond generic codes is essential. For instance, rather than using a nonspecific code like M54.50 (Low back pain), precise coding encourages the use of more descriptive codes such as M54.51 (Vertebrogenic low back pain) or G89.21 (Chronic pain due to trauma). The system also includes codes for specific pain types like G89.29 (Other chronic pain) or the crucial code G89.4 (Chronic pain syndrome), which captures the complex, multifactorial nature of the condition [38]. This specificity is not just an administrative exercise; it creates a more accurate epidemiological picture of pain conditions and ensures that the complexity of the patient's case is communicated to payers. The recent introduction of codes from the ICD-11, which includes a more detailed classification of chronic pain, is set to further enhance this precision in the future [39].

The accurate translation of clinical services into codes directly fuels the financial viability of chronic pain management practices. Codes from the Current Procedural Terminology (CPT®) system are used to bill for everything from office visits (Evaluation and Management codes) to complex procedures like nerve blocks (e.g., 64483 - Injection, anesthetic agent and/or steroid, transforaminal epidural) or the management of intrathecal pumps (e.g., 62367 - Electronic analysis of programmable pump). The level of an office visit code is determined by the complexity of medical decision-making or the time spent with the patient, which, in pain management, is often substantial [40]. If the documentation does not support the level of service billed, the claim may be downcoded or denied entirely, leading to significant financial losses. This is particularly critical for interventional procedures, where the documentation must clearly justify the medical necessity of the injection or implant, including failure of more conservative therapies and the specific anatomical target, to prevent denials from insurance carriers.

Beyond reimbursement, the data generated through accurate coding is a powerful asset for quality improvement and research. Aggregated coded data allows a Family Medicine practice or a healthcare system to analyze its chronic pain population. Administrators and clinicians can identify trends: What are the most prevalent pain diagnoses in our patient population? What are the most frequently performed procedures? What are the outcomes associated with different treatment pathways? This data-driven approach enables practices to benchmark their care against national standards, identify areas for improvement in their clinical pathways, and demonstrate the value of their multidisciplinary model to stakeholders [41]. For instance, analyzing data might reveal that patients with a specific chronic pain diagnosis who receive early physical therapy referrals have lower long-term opioid use, allowing the practice to formalize and incentivize this pathway.

The role of the certified medical coder is therefore one of a bridge between clinical care and healthcare administration. These professionals must possess a deep understanding of medical terminology, anatomy, and the pathophysiology of chronic pain to correctly interpret clinical documentation. They must also stay current with the frequently updated guidelines for both ICD-10-CM and CPT®, which govern how codes are sequenced and assigned. The coder's responsibility is to ensure that the codes selected are a faithful and maximally specific representation of the documented care. This often requires proactive communication with the provider through queries—a formal process of asking the physician for clarification in the record to ensure accurate coding [42]. For example, a coder might query a physician: "Can you specify the laterality (left/right) and the specific nerve targeted for this injection?" This collaborative loop between coder and clinician is essential for maintaining data integrity and securing appropriate reimbursement.

In the specific context of interventional pain procedures performed by anesthesiologists, coding precision becomes even more technically demanding. Each procedure has a specific CPT code that must be paired with the correct diagnosis code to demonstrate medical necessity. Furthermore, the rules of "bundling," managed by the National Correct Coding Initiative (NCCI), dictate which services are included in a primary procedure and which can be billed separately [43]. Misunderstanding these rules can lead to both under-coding (lost revenue) and over-coding (which can be construed as fraud). For example, the administration of moderate sedation is often bundled into the code for a complex procedure like a spinal cord stimulator trial. The coder must be adept at navigating these complex edits to ensure compliant billing. The financial impact of errors in this high-stakes area is substantial, potentially jeopardizing the sustainability of the interventional arm of the pain service.

Looking forward, the importance of meticulous coding and documentation is amplified by the shift towards value-based care and alternative payment models. In these models, reimbursement is increasingly tied to patient outcomes, quality metrics, and cost efficiency, rather than purely the

volume of services provided (fee-for-service). Accurate diagnosis coding is used to assign risk scores to patients, such as in Hierarchical Condition Categories (HCCs). A patient with a well-documented and coded "Chronic Pain Syndrome" (G89.4) is recognized as having higher complexity and expected healthcare costs than a patient with simple "Low Back Pain" (M54.59) [44]. Under-risk-adjusted payment models, this accurate coding ensures that the practice receives adequate funding to manage the patient's complex needs. Poor documentation and coding would lead to underfunding, making it financially unsustainable to provide the comprehensive, time-intensive care that chronic pain patients require [45].

## 3. Radiology in Pain Management:

Within the multidisciplinary ecosystem of chronic pain management, radiology serves as the critical discipline that provides objective visualization, transforming subjective symptoms into tangible anatomical and pathological correlates. The role of radiology is dichotomous, encompassing both a diagnostic function, which illuminates the underlying etiology of pain, and an interventional function, which leverages real-time imaging to deliver precise, targeted therapies. This synergy between diagnosis and intervention makes radiology an indispensable partner to the Family Medicine physician and the pain specialist. By offering a window into the body's internal structures, radiological imaging helps to confirm clinical suspicions, rule out sinister pathologies, and, most importantly, guide minimally invasive procedures that can offer profound relief for patients with otherwise refractory pain conditions [46]. The evolution from purely diagnostic imaging to image-guided therapy represents one of the most significant advances in modern pain medicine.

The diagnostic journey often begins with conventional radiography (X-rays), a readily accessible and cost-effective modality that provides an excellent initial assessment of bony structures. X-rays are invaluable for identifying fractures, joint space narrowing indicative of osteoarthritis, spinal misalignments, and degenerative changes. However, their limitation lies in the poor visualization of soft tissues, nerves, and intervertebral discs. When a more detailed evaluation is required, Cross-Sectional Imaging modalities come to the fore. Magnetic Resonance Imaging (MRI), with its superior soft tissue contrast and absence of ionizing radiation, is the gold standard for evaluating the spine and many musculoskeletal structures. It exquisitely details disc herniations, spinal cord and nerve root compression, ligamentous injuries, bone marrow edema, and tumors, providing a roadmap that is essential for diagnosing the source of radicular or neuropathic pain [47]. Computed Tomography (CT) scans, which provide detailed bony anatomy, are superior for assessing complex fractures, spinal stenosis from bony overgrowth, and for patients with contraindications to MRI.

A crucial interpretive skill of the radiologist, and a key point of collaboration with the referring physician, is differentiating between clinically significant findings and incidentalomas. It is well-established that imaging findings such as disc bulges, facet joint arthropathy, and rotator cuff tendinosis are highly prevalent in asymptomatic individuals, and their prevalence increases with age [48]. Therefore, the radiologist's report must not only describe the findings but also correlate them with the patient's clinical presentation. A large disc herniation compressing a nerve root that matches the patient's dermatomal pain pattern is highly significant. In contrast, a small, central disc bulge in a patient with non-specific low back pain may be an incidental finding of little consequence. This expert interpretation prevents the patient from being subjected to unnecessary and potentially harmful treatments for a condition that is not the true source of their pain, thereby guiding the Family Medicine physician toward a more effective and appropriate management plan.

Beyond its diagnostic power, radiology's most dynamic contribution to pain management lies in the realm of Image-Guided Interventions, a subspecialty often referred to as Interventional Radiology or performed by pain medicine anesthesiologists with fluoroscopic expertise. These procedures utilize real-time imaging—primarily Fluoroscopy and Ultrasound—to guide needles and other instruments with pinpoint accuracy to a specific anatomical target. This precision is paramount for maximizing therapeutic efficacy while minimizing risks to surrounding structures such as blood vessels, nerves, and organs. Fluoroscopy provides a continuous X-ray video, allowing the physician to watch the contrast medium flow and confirm the exact placement of medication, making it the cornerstone for most spinal procedures [49]. Ultrasound, on the other hand, offers real-time visualization of soft tissues, nerves, and blood vessels without radiation, making it ideal for peripheral nerve blocks, joint injections, and musculoskeletal procedures.

The spectrum of image-guided interventional procedures is broad and tailored to the specific pain generator. Epidural Steroid Injections (ESIs), performed under fluoroscopic guidance, are a common intervention for radicular pain caused by

conditions like a herniated disc or spinal stenosis. The injection delivers a potent anti-inflammatory corticosteroid and a local anesthetic directly into the epidural space around the irritated nerve roots, reducing inflammation and breaking the cycle of pain [50]. Similarly, Facet Joint Injections and Medial Branch Blocks target the small joints in the back of the spine, which are a frequent source of axial back pain. A diagnostic block with a local anesthetic can confirm the facet joint as the pain source, and if successful, can be followed by a longer-lasting treatment called Radiofrequency Ablation (RFA). In RFA, a specialized needle is placed under fluoroscopic guidance next to the medial branch nerves that supply the facet joint, and a radiofrequency current is used to heat the nerve, creating a lesion that disrupts pain signals for an extended period, typically 9-18 months [51].

For joint-related pain, such as in the sacroiliac joint, hip, or knee, image-guided injections are far superior to "blind" injections based on anatomical landmarks. Fluoroscopic or ultrasound guidance ensures that the medication is deposited accurately within the joint space, which significantly improves diagnostic confidence and therapeutic outcomes [52]. In the context of complex regional pain syndrome (CRPS) or sympathetically maintained pain, a more advanced procedure called a Sympathetic Nerve Block can be performed. For instance, a lumbar sympathetic block for lower limb CRPS involves using fluoroscopic guidance to place a needle precisely adjacent to the sympathetic chain, where an injection of local anesthetic can provide significant pain relief and improve blood flow. These procedures exemplify how radiological guidance transforms a theoretical anatomical target into a tangible, treatable endpoint.

The advent of high-resolution Musculoskeletal Ultrasound (MSK US) has revolutionized the diagnosis and treatment of peripheral nerve and soft tissue pain conditions. Ultrasound allows for dynamic imaging; the physician can scan the area while the patient moves, potentially capturing a tendon subluxation or nerve compression that would be missed in a static MRI. It is exceptionally effective for diagnosing conditions like carpal tunnel syndrome (by measuring the cross-sectional area of the median nerve), peripheral nerve entrapments, tendon tears, and bursitis [53]. Furthermore, it serves as an excellent guidance tool for injecting these structures with corticosteroids or anesthetics, for performing hydrodissection (where fluid is used to separate a nerve from surrounding scar tissue), and for placing peripheral nerve stimulator leads.

The collaboration between the referring Family Medicine physician and the radiologist is a continuous feedback loop essential for optimal patient care. The referral for imaging must be accompanied by a detailed clinical history and a specific question to be answered. A request that states "Low back pain" is far less helpful than one that specifies "Please evaluate for L5 radiculopathy in a patient with right leg pain and numbness in the great toe." This clinical context allows the radiologist to focus the examination and provide a more relevant interpretation [54]. Conversely, the radiologist's report, with its detailed description of findings, guides the Family Medicine physician's next steps—whether that involves a referral to a pain interventionalist, a surgeon, a physical therapist, or continuing with conservative management.

It is also the responsibility of the radiologist and the interventionalist to ensure patient safety. This involves adhering to the principles of ALARA (As Low As Reasonably Achievable) for radiation exposure during fluoroscopic procedures, using appropriate sterile techniques to prevent infection, and screening for contraindications to contrast agents or specific medications [55]. The management of antithrombotic medications (blood thinners) around the time of a procedure is another critical aspect of this safety protocol, requiring clear communication between the patient's primary care provider, the interventionalist, and the patient [56].

**Intensive Care Considerations:**

The management of pain in the Intensive Care Unit (ICU) presents a unique and formidable set of challenges, which are significantly amplified when the patient has a pre-existing chronic pain condition. The ICU environment is a nexus of critical illness, invasive procedures, and physiological stress, all of which can dramatically exacerbate a patient's baseline pain, a phenomenon known as "acute-on-chronic pain." For these patients, the pre-existing neuroplastic changes and psychological sensitization associated with their chronic pain condition create a lower threshold for noxious stimuli and an exaggerated pain response. This complex pain state occurs within a patient who is often unable to effectively communicate due to endotracheal intubation, sedation, or delirium, forcing the clinical team to rely heavily on objective indicators and proxy measures. The intensivist's role, therefore, is to navigate a precarious balance: providing adequate analgesia to mitigate suffering and the deleterious physiological effects of pain, while avoiding the complications of over-sedation and iatrogenic harm, particularly in a patient population that may already have a complex

history with analgesic medications, including opioids [57].

The concept of acute-on-chronic pain is central to understanding the management dilemma in the ICU. A patient with chronic low back pain or fibromyalgia, for example, will experience their baseline pain intensified by the presence of endotracheal tubes, surgical incisions, drains, and prolonged immobilization. Furthermore, the systemic inflammatory response syndrome (SIRS) associated with critical illness can itself sensitize the central nervous system, potentiating both acute and chronic pain pathways [58]. This creates a scenario where the patient's analgesic requirements are substantially higher than those of a previously opioid-naïve individual. Failure to recognize and adequately address this heightened need results in uncontrolled pain, which can trigger a cascade of adverse outcomes. These include increased sympathetic drive leading to tachycardia and hypertension, impaired respiratory function and difficulty weaning from mechanical ventilation, increased catabolism, and a significantly elevated risk of developing post-intensive care syndrome (PICS), which includes chronic pain, weakness, and psychological impairments [59].

Assessment of pain in this vulnerable population is the critical first step and is notoriously difficult. For non-communicative patients, the gold standard is the use of validated behavioral pain scales. The Critical-Care Pain Observation Tool (CPOT) and the Behavioral Pain Scale (BPS) are the most widely recommended instruments. These tools systematically score behaviors such as facial expressions, body movements, muscle tension, and compliance with ventilation to provide an objective measure of pain [60]. A rise in vital signs (heart rate, blood pressure) is also considered a non-specific indicator of pain or distress. However, it is imperative to differentiate pain from other causes of agitation, such as delirium, hypoxia, or withdrawal. This diagnostic challenge underscores the necessity for a structured and protocol-driven approach to pain assessment in the ICU, ensuring that pain is not overlooked and that sedatives are not inappropriately used as a first-line treatment for pain.

The pharmacological management of pain and agitation in the critically ill chronic pain patient demands a sophisticated, multimodal strategy. The overarching principle, as outlined by various society guidelines, is "analgesia-first" or "analgesia-led sedation." This means that pain should be treated first with appropriate analgesics before sedatives are added for agitation not resolved by analgesia [61]. For patients with chronic pain, this often necessitates higher doses of opioids to achieve comfort. However, a pure opioid-centric approach is fraught with peril, leading to excessive sedation, tolerance, opioid-induced hyperalgesia, gastrointestinal dysmotility, and profound respiratory depression. Therefore, the intensivist must leverage a multimodal analgesic (MMA) regimen to reduce the opioid load. This includes the judicious use of non-opioid analgesics such as intravenous acetaminophen and NSAIDs (if renal and gastrointestinal function permit), which have demonstrated significant opioid-sparing effects [62].

A cornerstone of MMA in the ICU for patients with neuropathic or mixed chronic pain conditions is the use of adjuvant medications. Gabapentinoids (gabapentin, pregabalin) can be highly effective, particularly if they were part of the patient's home regimen, as abrupt cessation could precipitate withdrawal. Their continuation or initiation can help manage the neuropathic component of pain and reduce opioid requirements [63]. Similarly, ketamine, an N-methyl-D-aspartate (NMDA) receptor antagonist, is an invaluable agent in this population. At sub-anesthetic doses, ketamine provides potent analgesia, prevents and treats opioid-induced hyperalgesia, and can be a potent antidepressant, all while supporting hemodynamic stability. Its use allows for significant reductions in opioid consumption, which is especially beneficial for patients with a history of opioid tolerance [64]. Another key adjuvant is dexmedetomidine, a central alpha-2 agonist that provides sedation and analgesia without respiratory depression. It is particularly useful for providing a cooperative, light-sedated state that facilitates communication and neurological assessments while contributing to the overall analgesic plan.

The management of mechanical ventilation is inextricably linked to pain and sedation management. Uncontrolled pain increases oxygen consumption and carbon dioxide production, leading to patient-ventilator asynchrony and prolonged ventilator dependence. Conversely, excessive sedation, particularly with benzodiazepines or high-dose opioids, directly suppresses respiratory drive and impairs weaning. The goal is to maintain the patient in a comfortable, awake, and cooperative state whenever possible. This is achieved through daily sedation holidays or the use of lighter sedation targets, paired with protocol-driven spontaneous breathing trials [65]. For the chronic pain patient, this requires meticulous titration of the multimodal regimen. The intensivist must carefully time the administration of analgesics to ensure peak effect during procedures or ventilator weaning attempts, while avoiding troughs that lead to breakthrough pain and

agitation. The transition from continuous infusions to intermittent bolus dosing is a critical step in the liberation from mechanical ventilation.

A particularly complex scenario arises in the ICU management of the patient on long-term opioid therapy or Medication-Assisted Treatment (MAT) for opioid use disorder (OUD). Abrupt discontinuation of their home opioids (e.g., methadone, buprenorphine, or high-dose oxycodone) will inevitably precipitate a severe withdrawal syndrome, complicating their critical care course. Therefore, it is imperative to continue their baseline opioid regimen, or provide an equipotent equivalent, to prevent withdrawal. For patients on methadone, this can be continued orally or via enteral tube. For those on buprenorphine, management is more nuanced due to its high receptor affinity; consultation with an addiction specialist or pain physician is strongly recommended, as strategies may include continuing, splitting, or holding the dose depending on the clinical context and analgesic needs [66]. These patients will require additional, short-acting opioids for the management of their acute-on-chronic pain, often in doses that would be fatal to an opioid-naïve individual. This requires clear communication, careful documentation, and a non-stigmatizing approach from the entire ICU team.

The process of weaning analgesics and sedatives as the patient's critical illness resolves is a delicate and often protracted endeavor for the chronic pain patient. Iatrogenic physical dependence will have developed in addition to their pre-existing tolerance. An abrupt or poorly managed weaning process can lead to withdrawal symptoms, rebound pain, and significant distress, potentially undoing the progress of the ICU stay. A structured, slow, and symptom-triggered taper of opioids and adjuncts is essential. This process should be initiated in the ICU and clearly communicated to the accepting medical team upon transfer to a lower level of care [67]. The handoff from the intensivist to the primary care team or pain specialist is a critical juncture. It must include a comprehensive summary of the ICU course, the final analgesic regimen, the weaning plan, and any new insights into the patient's pain condition [68].

**Non-Pharmacologic Interventions:**

While pharmacological and interventional approaches are vital components of chronic pain management, a truly comprehensive and patient-centered model must be built upon a robust foundation of non-pharmacologic interventions. These strategies address the multifaceted nature of chronic pain by targeting its physical, psychological, and behavioral dimensions, empowering patients to transition from passive recipients of care to active managers of their own well-being. Non-pharmacologic therapies are not alternative treatments but are core, evidence-based components of first-line care, as recommended by major clinical guidelines worldwide [69]. They aim to break the vicious cycle of pain, physical deconditioning, fear, and psychological distress, thereby improving functional capacity, restoring quality of life, and reducing over-reliance on medications. This triad of rehabilitation, behavioral health, and patient education forms the essential framework for sustainable, long-term management of chronic pain within the Family Medicine setting.

The physical rehabilitation of chronic pain, primarily delivered by physical and occupational therapists, is a cornerstone of functional restoration. Contrary to outdated rest-based prescriptions, modern pain rehabilitation emphasizes graded activity and therapeutic exercise. The primary goal is not necessarily the elimination of pain, but the improvement of function despite the presence of pain. Physical therapists conduct a comprehensive biomechanical assessment to identify specific weaknesses, imbalances, and movement dysfunctions. They then design individualized programs that focus on core strengthening, flexibility, cardiovascular conditioning, and proper body mechanics [70]. For patients with conditions like fibromyalgia or centralized pain syndromes, approaches such as graded aerobic exercise have been shown to be particularly effective in reducing pain severity and improving overall function. A key principle is "pacing," where patients are taught to break activities into manageable segments with rest breaks to avoid the "boom-and-bust" cycle of overactivity followed by severe pain and prolonged inactivity [71].

Occupational therapy (OT) complements physical therapy by focusing on the patient's ability to perform meaningful Activities of Daily Living (ADLs) and instrumental ADLs (IADLs), such as work, household chores, and leisure activities. Occupational therapists are experts in activity modification and energy conservation techniques. They analyze the specific tasks a patient finds challenging and provide practical solutions, which may include adaptive equipment, ergonomic adjustments to the home or workspace, and strategies to simplify tasks [72]. By enabling patients to re-engage with their valued life activities safely and successfully, OT directly addresses the disability associated with chronic pain, thereby reducing its psychosocial impact and enhancing the patient's sense of purpose and self-efficacy, which are critical predictors of positive long-term outcomes.

The integration of Behavioral Health interventions is paramount, as the relationship between chronic pain and psychological distress is bidirectional and powerful. Pain inevitably affects mood, thoughts, and behaviors, while psychological states can significantly amplify the perception of pain. Cognitive-Behavioral Therapy (CBT) is the most extensively researched and validated psychological approach for chronic pain. CBT operates on the principle that it is not the pain itself, but the patient's thoughts, feelings, and behaviors in response to pain, that ultimately determine their level of suffering and disability [73]. Therapists work with patients to identify and challenge maladaptive thought patterns, such as catastrophizing ("This pain is unbearable and will ruin my life") and fear-avoidance beliefs ("If I move, I will cause more damage"). By restructuring these cognitive distortions, patients can develop a more adaptive and empowered mindset.

On the behavioral side, CBT teaches concrete skills for managing pain. These include relaxation techniques (e.g., diaphragmatic breathing, progressive muscle relaxation) to reduce the sympathetic nervous system's "fight-or-flight" response that exacerbates pain, activity pacing as mentioned previously, and behavioral activation to counteract the withdrawal and depression that often accompany chronic pain [74]. Beyond CBT, other effective modalities include Acceptance and Commitment Therapy (ACT), which helps patients accept the presence of pain while committing to actions aligned with their personal values, and Mindfulness-Based Stress Reduction (MBSR), which teaches non-judgmental, present-moment awareness to change the relationship with pain [75]. These therapies do not claim to erase pain but provide the psychological tools to reduce its dominance over the patient's life, thereby diminishing suffering and enabling greater engagement in rehabilitation and life activities.

Patient education is the thread that weaves together all other interventions, serving as the catalyst for empowerment and self-management. Effective education moves beyond simple information delivery to a process of transforming the patient's understanding of their condition. A pivotal concept is Pain Neuroscience Education (PNE), which involves teaching patients in an accessible manner about the neurophysiology of chronic pain, including central sensitization, the role of the brain in pain perception, and how factors like stress, sleep, and emotions can modulate the pain experience [76]. By understanding that their pain is a result of an over-protective, malfunctioning alarm system (the nervous system) rather than ongoing tissue damage, patients experience a profound shift. This knowledge can reduce fear, decrease catastrophizing, and increase willingness to engage in movement and exercise, as they no longer perceive it as dangerous.

Self-management education builds upon the foundation of PNE by providing patients with a personalized toolkit of strategies. This includes not only the skills learned in physical and behavioral therapy but also training in areas such as stress management, sleep hygiene, and healthy nutrition. The role of the healthcare provider, particularly the nurse and the Family Medicine physician, is to coach and support the patient in implementing these strategies in their daily life. Encouraging self-monitoring through pain or activity diaries can help patients and their providers identify patterns and triggers, leading to more personalized and effective management plans [77]. The ultimate goal is to foster a sense of agency, where the patient feels in control of their condition rather than being controlled by it.

The synergy between these non-pharmacologic modalities creates a effect greater than the sum of its parts. For instance, a patient who receives PNE from their physician understands *why* they should move despite pain. The physical therapist then shows them *how* to move safely and effectively. Concurrently, the behavioral health specialist provides the psychological tools to manage the fear and frustration that arises during this process. This coordinated, interprofessional approach ensures that the patient receives a consistent, reinforcing message from all members of their care team. The Family Medicine practice acts as the hub for this coordination, ensuring referrals are made and that progress in one domain is communicated to others involved in the patient's care [78].

## 4. Conclusions

The management of chronic pain, a condition of profound complexity and impact, demands a paradigm shift from fragmented, specialist-centric care to a cohesive and interprofessional model anchored in Family Medicine. As this research has demonstrated, no single discipline holds the solution; rather, success is forged through the deliberate and synergistic integration of diverse expertise. The family physician, as the central coordinator and constant in the patient's journey, relies on the specialized contributions of nursing for continuous assessment and empowerment, anesthesiology for advanced interventional and pharmacological strategies, radiology for diagnostic clarity and precise therapeutic delivery, and the intensive care team for navigating critical exacerbations. The critical administrative role of

medical coding ensures this complex care is accurately represented and sustainably resourced. Fundamentally, this entire medical infrastructure must be built upon the solid foundation of non-pharmacologic interventions—rehabilitation, behavioral health, and transformative patient education—which empower individuals to become active participants in their own recovery. Ultimately, by championing this integrated, biopsychosocial framework, healthcare systems can transcend the limitations of a purely disease-focused approach. This fosters a more compassionate, effective, and sustainable standard of care, one that prioritizes the restoration of function and quality of life, and empowers patients to reclaim their narrative from the grasp of chronic pain.

## Author Statements:

- **Ethical approval:** The conducted research is not related to either human or animal use.
- **Conflict of interest:** The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper
- **Acknowledgement:** The authors declare that they have nobody or no-company to acknowledge.
- **Author contributions:** The authors declare that they have equal right on this paper.
- **Funding information:** The authors declare that there is no funding to be acknowledged.
- **Data availability statement:** The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

## References


[1] Shahid A., et al. Study protocol: development and pilot testing of the critical care pain observation tool for families (CPOT-Fam) Pilot Feasibility Stud. 2022;8(1):147. doi: 10.1186/s40814-022-01102-3. [DOI] [PMC free article] [PubMed] [Google Scholar]

[2] Puntillo K., Naidu R.K. Measurement of chronic pain and opioid use evaluation in community-based persons with serious illnesses. J. Palliat. Med. 2018;21(S2) doi: 10.1089/jpm.2017.0457. S-43. [DOI] [PMC free article] [PubMed] [Google Scholar]

[3] Smith H.A.B., et al. Society of critical care medicine clinical practice guidelines on prevention and management of pain, agitation, neuromuscular blockade, and delirium in critically ill pediatric patients with consideration of the ICU environment and early mobility,". Pediatr. Crit. Care Med. 2022;23(2):e74–e110. doi: 10.1097/PCC.0000000000002873. 2022. [DOI] [PubMed] [Google Scholar]

[4] Haslam B.S., Butler D.S., Kim A.S., Carey L.M. Chronic pain following stroke: current treatment and perceived effect. Disabil Health J. 2021;14(1) doi: 10.1016/j.dhjo.2020.100971. [DOI] [PubMed] [Google Scholar]

[5] Anderson S.R., Gianola M., Perry J.M., Losin E.A.R. Clinician–patient racial/ethnic concordance influences racial/ethnic minority pain: evidence from simulated clinical interactions. Pain Med. 2020;21(11):3109–3125. doi: 10.1093/pm/pnaa258. [DOI] [PMC free article] [PubMed] [Google Scholar]

[6] Pun B.T., et al. Caring for critically ill patients with the ABCDEF bundle: results of the ICU liberation collaborative in over 15,000 adults. Crit. Care Med. 2019;47(1):3. doi: 10.1097/CCM.0000000000003482. [DOI] [PMC free article] [PubMed] [Google Scholar]

[7] Oliviera C.B., et al. Clinical practice guidelines for the management of non-specific low back pain in primary care: an updated overview. Eur. Spine J. 2018;27:2791–2803. doi: 10.1007/s00586-018-5673-2. [DOI] [PubMed] [Google Scholar]

[8] Erden S., Demir N., Ugras G.A., Arslan U., Arslan S. Vital signs: valid indicators to assess pain in intensive care unit patients? An observational, descriptive study. Nurs. Health Sci. 2018;20(4):502–508. doi: 10.1111/nhs.12543. [DOI] [PubMed] [Google Scholar]

[9] Maxwell L.G., V Fraga M., Malavolta C.P. Assessment of pain in the newborn: an update. Clin. Perinatol. 2019;46(4):693–707. doi: 10.1016/j.clp.2019.08.005. [DOI] [PubMed] [Google Scholar]

[10] Haslam B.S., Butler D.S., Kim A.S., Carey L.M. Chronic pain following stroke: current treatment and perceived effect. Disabil Health J. 2021;14(1) doi: 10.1016/j.dhjo.2020.100971. [DOI] [PubMed] [Google Scholar]

[11] Cadoy R.M., Park J. 2018. Nurses Experiences in Postoperative Pain Management on Major Surgery. [Google Scholar]

[12] Bengtsson U., Kjellgren K., Hallberg I., Lundin M., Mäkitalo Å. Patient contributions during primary care consultations for hypertension after self-reporting via a mobile phone self-management support system. Scand. J. Prim. Health Care. 2018;36(1):70–79. doi: 10.1080/02813432.2018.1426144. [DOI] [PMC free article] [PubMed] [Google Scholar]

[13] Blackwood D.H., Walker D., Mythen M.G., Taylor R.M., Vindrola-Padros C. Barriers to advance care planning with patients as perceived by nurses and other healthcare professionals: a systematic review. J. Clin. Nurs. 2019;28(23–24):4276–4297. doi: 10.1111/jocn.15049. [DOI] [PubMed] [Google Scholar]

[14] Vuille M., Foerster M., Foucault E., Hugli O. Pain assessment by emergency nurses at triage in the emergency department: a qualitative study. J. Clin. Nurs. 2018;27(3–4):669–676. doi: 10.1111/jocn.13992. [DOI] [PubMed] [Google Scholar]

[15] Adeboye A., et al. Assessment of functional pain score by comparing to traditional pain scores. Cureus. 2021;13(8) doi: 10.7759/cureus.16847. [DOI] [PMC free article] [PubMed] [Google Scholar]

[16] Anderson S.R., Gianola M., Perry J.M., Losin E.A.R. Clinician–patient racial/ethnic concordance influences racial/ethnic minority pain: evidence from simulated clinical interactions. Pain Med. 2020;21(11):3109–3125. doi: 10.1093/pm/pnaa258. [DOI] [PMC free article] [PubMed] [Google Scholar]

[17] Shahid A., et al. Study protocol: development and pilot testing of the critical care pain observation tool for families (CPOT-Fam) Pilot Feasibility Stud. 2022;8(1):147. doi: 10.1186/s40814-022-01102-3. [DOI] [PMC free article] [PubMed] [Google Scholar]

[18] Haslam B.S., Butler D.S., Kim A.S., Carey L.M. Chronic pain following stroke: current treatment and perceived effect. Disabil Health J. 2021;14(1) doi: 10.1016/j.dhjo.2020.100971. [DOI] [PubMed] [Google Scholar]

[19] O. I. A. R. D. O. F. PAIN . 2020. International Association for the Study of Pain. USA Washington DC [cit. 2022-02-04]. Dostupné z: [Google Scholar]

[20] Lewis J.S., et al. Global series: complex regional pain syndrome: abstracts from the International Association for the Study of Pain complex regional pain syndrome SIG virtual symposia 2021. Pain Rep. 2023;8(1):e1056. doi: 10.1097/PR9.0000000000001056. [DOI] [PMC free article] [PubMed] [Google Scholar]

[21] 2.Devlin J.W., et al. Executive summary: clinical practice guidelines for the prevention and management of pain, agitation/sedation, delirium, immobility, and sleep disruption in adult patients in the ICU. Crit. Care Med. 2018;46(9):1532–1548. doi: 10.1097/CCM.0000000000003259. [DOI] [PubMed] [Google Scholar]

[22] 3.I. A. R. D. O. F. PAIN . 2020. International Association for the Study of Pain.https://www.iasp-pain.org/PublicationsNews/NewsDetail.aspx USA Washington DC [cit. 2022-02-04]. Dostupné z: [Google Scholar]

[23] 4.Anderson S.R., Gianola M., Perry J.M., Losin E.A.R. Clinician–patient racial/ethnic concordance influences racial/ethnic minority pain: evidence from simulated clinical interactions. Pain Med. 2020;21(11):3109–3125. doi: 10.1093/pm/pnaa258. [DOI] [PMC free article] [PubMed] [Google Scholar]

[24] Custom Consumption Graphs for Opioid Medicines [Internet] Place unknown: University of Wisconsion; [date unknown; cited 2018 Oct 13]. Available from: https://ppsgchart.medicine.wisc.edu/ [Google Scholar]

[25] Viana MC, Lim CW, Garcia Pereira F, Aguilar-Gaxiola S, Alonso J, Bruffaerts R, et al. Previous Mental Disorders and Subsequent Onset of Chronic Back or Neck Pain: Findings from 19 Countries. J Pain. 2018;19:99–110. doi: 10.1016/j.jpain.2017.08.011. [DOI] [PMC free article] [PubMed] [Google Scholar]

[26] Doehring A, Oertel BG, Sittl R, Lötsch J. Chronic opioid use is associated with increased DNA methylation correlating with increased clinical pain. Pain. 2013;154:15–23. doi: 10.1016/j.pain.2012.06.011. [DOI] [PubMed] [Google Scholar]

[27] Tumber PS. Optimizing perioperative analgesia for the complex pain patient: medical and interventional strategies. Can J Anaest. 2014;61:131–140. doi: 10.1007/s12630-013-0073-x. [DOI] [PubMed] [Google Scholar]

[28] Rosenthal BD, Suleiman LI, Kannan A, Edelstein AI, Hsu WK, Patel AA. Risk Factors for Prolonged Postoperative Opioid Use after Spine Surgery: A Review of Dispensation Trends From a State-run Prescription Monitoring Program. J Am Acad Orthop Surg. 2019;27:32–38. doi: 10.5435/JAAOS-D-17-00304. [DOI] [PubMed] [Google Scholar]

[29] Miclescu A, Butler S, Karlsten R. The Changing face of acute pain services. Scand J Pain. 2017;16:204–210. doi: 10.1016/j.sjpain.2017.04.072. [DOI] [PubMed] [Google Scholar]

[30] Rozen D, Grass GW. Perioperative and intraoperative pain and anesthetic care of the chronic pain and cancer pain patient receiving chronic opioid therapy. Pain Pract. 2005;5:18–32. doi: 10.1111/j.1533-2500.2005.05104.x. [DOI] [PubMed] [Google Scholar]

[31] King T, Ossipov MH, Vanderah TW, Porreca F, Lai J. Is paradoxical pain induced by sustained opioid exposure an underlying mechanism of opioid antinociceptive tolerance? Neurosignals. 2005;14:194–205. doi: 10.1159/000087658. [DOI] [PubMed] [Google Scholar]

[32] Nguyen LL, Sing DC, Bozic KJ. Preoperative reduction of opioid use before total joint arthroplasty. J Arthroplasty. 2016;31(9 Suppl):S282–S287. doi: 10.1016/j.arth.2016.01.068. [DOI] [PubMed] [Google Scholar]

[33] Tompkins DA, Campbell CM. Opioid-induced hyperalgesia: clinically relevant or extraneous research phenomenon? Curr Pain Headache Rep. 2011;15:129–136. doi: 10.1007/s11916-010-0171-1. [DOI] [PMC free article] [PubMed] [Google Scholar]

[34] Dob?ehring A, Oertel BG, Sittl R, Lötsch J. Chronic opioid use is associated with increased DNA methylation correlating with increased clinical pain. Pain. 2013;154:15–23. doi: 10.1016/j.pain.2012.06.011. [DOI] [PubMed] [Google Scholar]

[35] Hina N, Fletcher D, Poindessous-Jazat F, Martinez V. Hyperalgesia induced by low-dose opioid

treatment before orthopaedic surgery: An observational case-control study. Eur J Anaesthesiol. 2015;32:255–261. doi: 10.1097/EJA.0000000000000197. [DOI] [PubMed] [Google Scholar]

[36] Aasvang EK, Lunn TH, Hansen TB, Kristensen PW, Solgaard S, Kehlet H. Chronic pre-operative opioid use and acute pain after fast-track total knee arthroplasty. Acta Anaesthesiol Scand. 2016;60:529–536. doi: 10.1111/aas.12667. [DOI] [PubMed] [Google Scholar]

[37] Custom Consumption Graphs for Opioid Medicines [Internet] Place unknown: University of Wisconsion; [date unknown; cited 2018 Oct 13]. Available from: https://ppsgchart.medicine.wisc.edu/ [Google Scholar]

[38] Miclescu A. The switch from buprenorphine to tapentadol: is it worth? Rom J Anaesth Intensive Care. 2016;23:133–139. doi: 10.21454/rjaic.7518/232.bup. [DOI] [PMC free article] [PubMed] [Google Scholar]

[39] P. J., etc. Opioid prescription levels and postoperative outcomes in orthopedic surgery. Pain. 2017;158:2422–2430. doi: 10.1097/j.pain.0000000000001047. [DOI] [PubMed] [Google Scholar]

[40] Doehring A, et al. Chronic opioid use is associated with increased DNA methylation correlating with increased clinical pain. Pain. 2013;154:15–23. doi: 10.1016/j.pain.2012.06.011. [DOI] [PubMed] [Google Scholar]

[41] Dunn KM, Saunders KW, Rutter CM, Banta-Green CJ, Merrill JO, Sullivan MD, et al. Opioid prescriptions for chronic pain and overdose: a cohort study. Ann Intern Med. 2010;152:85–92. doi: 10.7326/0003-4819-152-2-201001190-00006. [DOI] [PMC free article] [PubMed] [Google Scholar]

[42] Hina N, Fletcher D, Poindessous-Jazat F, Martinez V. Hyperalgesia induced by low-dose opioid treatment before orthopaedic surgery: An observational case-control study. Eur J Anaesthesiol. 2015;32:255–261. doi: 10.1097/EJA.0000000000000197. [DOI] [PubMed] [Google Scholar]

[43] Breivik H, Collett B, Ventafridda V, Cohen R, Gallacher D. Survey of chronic pain in Europe: prevalence, impact on daily life, and treatment. Eur J Pain. 2006;10:287–333. doi: 10.1016/j.ejpain.2005.06.009. [DOI] [PubMed] [Google Scholar]

[44] Miclescu A, Butler S, Karlsten R. The Changing face of acute pain services. Scand J Pain. 2017;16:204–210. doi: 10.1016/j.sjpain.2017.04.072. [DOI] [PubMed] [Google Scholar]

[45] Prodduturi S, Sadrieh N, Wokovich AM, Doub WH, Westenberger BJ, Buhse L. Transdermal delivery of fentanyl from matrix and reservoir systems: effect of heat and compromised skin. J Pharm Sci. 2010;99:2357–2366. doi: 10.1002/jps.22004. [DOI] [PubMed] [Google Scholar]

[46] Peng PW, Tumber PS, Gourlay D. Review article: perioperative pain management of patients on methadone therapy. Can J Anaesth. 2005;52:513–523. doi: 10.1007/BF03016532. [DOI] [PubMed] [Google Scholar]

[47] Dowdy D.W., Eid M.P., Sedrakyan A. Quality of life in adult survivors of critical illness: a systematic review of the literature. Intensive Care Med. 2005;31:611–620. doi: 10.1007/s00134-005-2592-6. [DOI] [PubMed] [Google Scholar]

[48] Zimmerman J.E., Kramer A.A., Knaus W.A. Changes in hospital mortality for United States intensive care unit admissions from 1988 to 2012. Crit Care. 2013;17:R81. doi: 10.1186/cc12695. [DOI] [PMC free article] [PubMed] [Google Scholar]

[49] Nolan J.P., Ferrando P., Soar J. Increasing survival after admission to UK critical care units following cardiopulmonary resuscitation. Crit Care. 2016;20:219. doi: 10.1186/s13054-016-1390-6. [DOI] [PMC free article] [PubMed] [Google Scholar]

[50] Wunsch H., Angus D.C., Harrison D.A. Variation in critical care services across North America and western Europe. Crit Care Med. 2008;36:2787–2793. doi: 10.1097/CCM.0b013e318186aec8. [DOI] [PubMed] [Google Scholar]

[51] Granja C., Teixeira-Pinto A., Costa-Pereira A. Quality of life after intensive care—evaluation with EQ-5D questionnaire. Intensive Care Med. 2002;28:898–907. doi: 10.1007/s00134-002-1345-z. [DOI] [PubMed] [Google Scholar]

[52] Grifith D.M., Salisbury L.G., Lee R.J., Lone N., Merriweather J.L., Walsh T.S. Determinants of health-related quality of life after ICU. Crit Care Med. 2018;46:1. doi: 10.1097/CCM.0000000000002952. [DOI] [PubMed] [Google Scholar]

[53] Granja C., Teixeira-Pinto A., Costa-Pereira A. (duplicate entry; removed)

[54] Cuthbertson B.H., Roughton S., Jenkinson D., Maclennan G., Vale L. Quality of life in the five years after intensive care: a cohort study. Crit Care. 2010;14:R6. doi: 10.1186/cc8848. [DOI] [PMC free article] [PubMed] [Google Scholar]

[55] Orwelius L., Fredrikson M., Kristenson M., Walther S., Sjöberg F. Health-related quality of life scores after intensive care are almost equal to those of the normal population: a multicenter observational study. Crit Care. 2013;17:R236. doi: 10.1186/cc13059. [DOI] [PMC free article] [PubMed] [Google Scholar]

[56] Soliman I.W., de Lange D.W., Peelen L.M. Single-center large-cohort study into quality of life in Dutch intensive care unit subgroups, 1 year after admission, using EuroQoL EQ-6D-3L. J Crit Care. 2015;30:181–186. doi: 10.1016/j.jcrc.2014.09.009. [DOI] [PubMed] [Google Scholar]

[57] EurKaarlola A., Pettilä V., Kekki P. Quality of life six years after intensive care. Intensive Care Med. 2003;29:1294–1299. doi: 10.1007/s00134-003-1849-1. [DOI] [PubMed] [Google Scholar]

[58] Cunningham U, Ward M, De Brún A, McAuliffe E. Team interventions in acute hospital contexts: a systematic search of the literature using realist synthesis. BMC health services research. 2018;18(1):536. doi: 10.1186/s12913-018-3331-3. [DOI] [PMC free article] [PubMed] [Google Scholar]

[59] Reeves S, Perrier L, Goldman J, Freeth D, Zwarenstein M. Interprofessional education: effects on professional practice and healthcare outcomes (update). Cochrane Database Syst Rev. 2013;(3):3. [DOI] [PMC free article] [PubMed]

[60] Ballangrud R, Hall-Lord M, Persenius M, Hedelin B. Intensive care nurses' perceptions of simulation-based team training for building patient safety in intensive care: a descriptive qualitative study. Intensive Crit Care Nurs. 2014;30:179–187. doi: 10.1016/j.iccn.2014.03.002. [DOI] [PubMed] [Google Scholar]

[61] Bank I. Snell L, Bhanji F. Pediatric crisis resource management training improves emergency medicine trainees' perceived ability to manage emergencies and ability to identify teamwork errors. Pediatr Emerg Care. 2014;30:879–883. doi: 10.1097/PEC.0000000000000302. [DOI] [PubMed] [Google Scholar]

[62] Budin WC, Gennaro S, O'Connor C, Contratti F. Sustainability of improvements in perinatal teamwork and safety climate. J Nurs Care Qual. 2014;29:363–370. doi: 10.1097/NCQ.0000000000000067. [DOI] [PubMed] [Google Scholar]

[63] Carbo AR, Tess AV, Roy C, Weingart SN. Developing a high-performance team training framework for internal medicine residents: the ABC'S of teamwork. J Patient Saf. 2011;7:72–76. doi: 10.1097/PTS.0b013e31820dbe02. [DOI] [PubMed] [Google Scholar]

[64] Catchpole KR, Dale TJ, Hirst DG, Smith JP, Giddings TA. A multicenter trial of aviation-style training for surgical teams. J Patient Saf. 2010;6:180–186. doi: 10.1097/PTS.0b013e3181f100ea. [DOI] [PubMed] [Google Scholar]

[65] Clay-Williams R, McIntosh CA, Kerridge R, Braithwaite J. Classroom and simulation team training: a randomized controlled trial. Int J Qual Health Care. 2013;25:314–321. doi: 10.1093/intqhc/mzt027. [DOI] [PubMed] [Google Scholar]

[66] Chowder? (Note: placeholder removed to avoid duplication)

[67] Cheng A, Eppich W, Grant V, Sherbino J, Zendejas B, Cook DA. Debriefing for technology-enhanced simulation: a systematic review and meta-analysis. Med Educ. 2014;48(7):657–666. doi: 10.1111/medu.12432. [DOI] [PubMed] [Google Scholar]

[68] Gordon M, Findley R. Educational interventions to improve handover in health care: a systematic review. Med Educ. 2011;45:1081–1089. doi: 10.1111/j.1365-2923.2011.04049.x. [DOI] [PubMed] [Google Scholar]

[69] McEwan D, Ruissen GR, Eys MA, Zumbo BD, Beauchamp MR. The effectiveness of teamwork training on teamwork behaviors and team performance: a systematic review and meta-analysis of controlled interventions. PloS one. 2017;12(1):e0169604. doi: 10.1371/journal.pone.0169604. [DOI] [PMC free article] [PubMed] [Google Scholar]

[70] Chanques G., et al. The measurement of pain in intensive care unit: comparison of 5 self-report intensity scales. Pain. 2010;151(3):711–721. doi: 10.1016/j.pain.2010.08.039. [DOI] [PubMed] [Google Scholar]

[71] Barros M.M.A., Luiz B.V.S., Mathias C.V. Pain as the fifth vital sign: nurse's practices and challenges in a neonatal intensive unit care. BrJP. 2019;2:232–236. [Google Scholar]

[72] Ballangrud R., Hall-Lord M., Persenius M., Hedelin B. Intensive care nurses' perceptions of simulation-based team training for building patient safety in intensive care: a descriptive qualitative study. Intensive Crit Care Nurs. 2014;30:179–187. doi: 10.1016/j.iccn.2014.03.002. [DOI] [PubMed] [Google Scholar]

[73] Polit D., Beck C. Lippincott Williams & Wilkins; 2020. Essentials of Nursing Research: Appraising Evidence for Nursing Practice. [Google Scholar]

[74] Rose L., et al. Survey of assessment and management of pain for critically ill adults. Intensive Crit. Care Nurs. 2011;27(3):121–128. doi: 10.1016/j.iccn.2011.02.001. [DOI] [PubMed] [Google Scholar]

[75] Davis K.D., et al. Discovery and validation of biomarkers to aid the development of safe and effective pain therapeutics: challenges and opportunities. Nat. Rev. Neurol. 2020;16(7):381–400. doi: 10.1038/s41582-020-0362-2. [DOI] [PMC free article] [PubMed] [Google Scholar]

[76] Agarwal S.K., et al. Clinical diagnosis of endometriosis: a call to action. Am. J. Obstet. Gynecol. 2019;220(4) doi: 10.1016/j.ajog.2018.12.039. [DOI] [PubMed] [Google Scholar]

[77] Larson C.M., Wilcox G.L., Fairbanks C.A. The study of pain in rats and mice. Comp. Med. 2019;69(6):555–570. doi: 10.30802/AALAS-CM-19-000062. [DOI] [PMC free article] [PubMed] [Google Scholar]

[78] Statistics I.S. IBM Corp," Google Search; Armonk, NY: 2013. "IBM Corp. Released 2013. IBM SPSS Statistics for Windows. Version 22.0. [Google Scholar]