

The Importance of Providing Multimodal Analgesia: A Literature Review of
Nonpharmacologic Pain Treatments

Miriam L. Swartzentruber

A Senior Thesis submitted in partial fulfillment
of the requirements for graduation
in the Honors Program
Liberty University
Spring 2021

Abstract

Pain is a central aspect of the human experience. While painful stimuli can be beneficial in alerting the brain to the fact that there is something wrong, left untreated, pain can cause devastating long-term effects on the individual, both physically and mentally. Pain has traditionally been either undertreated or managed solely using pharmacologic methods, with less thought given to the importance of supplementing therapy with nonpharmacologic interventions. By incorporating nonpharmacologic methods of pain management into nursing care, patients can be provided with holistic treatment that improves patient outcomes, decreases healthcare costs, avoids future complications, and improves overall quality of life.

A Literature Review of Nonpharmacological Pain Treatments

Background

Pain perception, tolerance, and presentation vary from patient to patient. Therefore, pain is a highly individualized phenomenon, making it difficult to describe, assess, and treat (Plaisance & Logan 2017). Pain has historically been treated pharmacologically (Collier, 2018) with less funding, education, and consideration given to supplementing treatment with nonpharmacologic methods. However, current research highlights that providing patients with nonpharmacologic treatments in addition to analgesics exerts synergistic effects, and by targeting multiple factors known to cause pain, patients are provided with heightened pain control (Arnstein, 2011; Maciel et al., 2019).

Currently, opioids are the primary form of pain management prescribed to patients with severe pain (Smiley & McGuire, 2018). This drug class is overutilized specifically for somatic disorders, pain associated with depression, peripheral neuropathy, and other chronic pain disorders where increasing serotonin and norepinephrine would provide greater analgesia (Stahl, 2013). Opioids also produce side effects such as respiratory depression, ileus, and dependency or addiction. Smiley and McGuire go on to state the societal and economic costs of pain management are too large to ignore, therefore making the development of multimodal pain management strategies an absolute necessity. Also, because untreated pain has devastating side effects on patients themselves, it is all the more important to attend to the complexity of pain by promoting multifaceted, multidisciplinary pain management from the onset (King & Fraser, 2013).

Objectives

To treat pain adequately and holistically, the combined utilization of pharmacologic and nonpharmacologic methods is necessary. In light of this fact, the Joint Commission (2017) has required hospitals to provide nonpharmacologic pain treatment modalities as of January 2018. Because nurses are paramount in ensuring adequate pain management for their patients, it is of great importance for both patient well-being and adequate fulfillment of Joint Commission requirements that nurses be aware of valid nonpharmacologic methods. In this literature review, non-drug approaches to pain management will be discussed and analyzed, along with both the barriers to implementation, and recommendations for future practice based on the available evidence.

Data Sources & Study Eligibility Criteria

Having a specific focus on the experience of pain related to nonpharmacologic pain management methods facilitated the literature search stage. This primarily included the: history of, different types of, implementation barriers of, and attitudes of nurses and nursing students towards nonpharmacologic pain management methods. Data has been collected from a variety of databases, including ProQuest, Pubmed, Directory of Open Access Journals, Ebscohost and Science Direct. Inclusion criteria limited content solely to scholarly, peer reviewed, full-text journal articles published within the past ten years. This was done to ensure the credibility and relevancy of the literature. The only exceptions to this ten-year publication date restriction included sources necessary to give an accurate representation of historical background. A newsletter by the Joint Commission (2017) is the only exception to the peer-reviewed journal article inclusion criteria.

Rationale

Pain is defined by the International Association for the Study of Pain (1986) as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage” (para. 1). This definition highlights the fact that pain is more than just a function of neuronal activity; it encompasses higher-level cognitive processes which interpret and define the experience of pain. This also emphasizes that pain can be understood as an inherently subjective experience which, with or without existing identifiable tissue damage, is clinically significant and necessary of treatment.

Literature Review***The Historical Background of Pain Management***

Traditionally, treatment for pain has been heavily focused on utilizing pharmacological methods rather than exploring nonpharmacologic options (Collier, 2018). Historical research states that in the 1600s, European physicians gave their patients opium for pain relief, and by the 1800s ether and chloroform were introduced to anesthetize patients prior to surgery (Collier, 2018). Tompkins et al. (2017) emphasize that prior to the 1800s, pain was predominantly attributed to aging and accepted as a natural, existential experience, and therefore went largely untreated. However, as knowledge of pain pathophysiology developed, the widespread medicalization of pain management began.

Morphine and heroine came into use for analgesia during the twentieth century, but upon the passage of the Harrison Narcotic Act in 1914, many physicians became uncomfortable prescribing opioids due to the reported high potential for addiction (Tompkins et al., 2017). But as palliative care specialists recognized cancer patients were living their last days in agony, the World Health Organization developed cancer pain treatment guidelines. Tompkins et al. state

that these new guidelines, published in 1986, marked the first time opioids were formally advised for usage in the treatment of pain. Furthermore, this document also marked the beginning of pain treatment being labeled as a universal right.

By the 1990s, the American Pain Society and the Joint Commission began ensuring the proper assessment and treatment of pain. In 1998, the Federation of State Medical Boards stated physicians would no longer receive excessive scrutiny for prescribing significant amounts of opioids (Joranson et al., 2002). The Drug Enforcement Agency in 2001 also agreed to follow a “balanced policy” which actually encouraged health care providers to prescribe opioids for analgesia. Additionally, patient satisfaction scores became more significant in healthcare, and clinicians were encouraged by hospital leadership to utilize opioids to control their patients’ pain as quickly and completely as possible (Tompkins et al., 2017).

Although these changes in protocol led to benefits for both patients and clinicians (such as lower patient pain scores and increases in pain research and education), the looming problem of opioid overreliance grew. The idea of opioids being the paramount method for managing pain was perpetuated exponentially by an overemphasis on the findings of two small retrospective studies. These studies suggested that when prescribed opioids for pain management, patients actually *rarely* developed opioid addictions (Porter & Jick, 1980; Portenoy & Foley, 1986). As these two reports became heavily cited in academic peer-reviewed literature, they began receiving extensive recognition by professionals in all fields of health care, and fears of opioid addiction due to over-prescription were minimized.

This was aided by the introduction of Oxycontin (oxycodone extended-release) in 1996, which was marketed as a minimally addictive opioid due to its extended-release formulation (Van Zee, 2009). The high availability of Oxycontin correlated with the increased prescription,

abuse, diversion, and addiction, leading it to become the most abused prescription opioid by 2004 (Cicero et al., 2005). Due to this combination of factors, opioid prescription skyrocketed, and an opioid crisis ensued.

The opioid crisis is a complex problem resulting from a multitude of causes. Unfortunately, it cannot be solved with a mere single intervention; it requires a multifaceted solution (Jones et al, 2018). One way in which healthcare professionals in particular can contribute is by incorporating more nonpharmacologic methods of pain treatments into patient care. This not only decreases the amount of opioid dosage necessary to control pain, but also increases the degree to which they are effective (Gumus et al., 2020; Bonnie et al., 2017).

Nonpharmacologic Pain Management: What it is and How it Works

Nonpharmacologic pain management simply refers to the physical, behavioral, cognitive, and complementary interventions that allow patients to experience more completely controlled pain. Those who have done research on nonpharmacologic pain management strongly recommend nurses to utilize non-drug methods when providing patient care. As the primary individual providing hands on care and patient interaction, the nurse is responsible for ensuring the patient receives thorough pain management. Therefore, the researchers “explicitly recommend” that nurses apply nonpharmacologic therapies when treating their patients’ pain (Kalinowski et al., 2015, p. 467).

Although there is still much to learn about pain, researchers Gonzalez et al. (2011) highlight that the process of pain is better understood now more than ever. Traditionally, pain has been thought to be comprised solely of interpretation and modulation of nociceptive impulses. Gonzalez et al. point out how now, the experience of pain is known to encompass not

only the interpretation of nociceptive stimuli, but also the metabolic activity, stress, and emotional responses which exacerbate pain perception.

Gonzalez et al. (2011) state pain perception begins in the emotional motor system. This highly complex system is composed of the autonomic nervous system, the greater limbic system, the hypothalamic-pituitary-adrenal (HPA) axis, and the cranial nerves. The central and peripheral nervous system provides the brain with input from afferent signals, thoughts, and emotions, and the brain processes and interprets this information. Nociceptive stimuli cause stimulation of the autonomic nervous system and the HPA axis (Gonzalez et al., 2011). The limbic system, particularly the amygdala, acts as a neural substrate of the interaction between pain and emotion, and links the experience of pain with negative emotions, such as anxiety, hopelessness, and despair. This small region of the brain is incredibly significant in modulating the experience of pain, as it is linked to both facilitatory and inhibitory pathways.

This biological phenomenon is further supported by numerous studies that have shown the undeniable link between emotion and pain. Research has shown those who have anxiety, depression, or both are more prone to perceive and rate pain as worse than their mentally healthy counterparts (Geziriy et al., 2018). Geziriy et al. also point out how there is a cyclical pattern of chronic pain leading to depression and depression leading to a worsening of chronic pain, creating a mutually enforcing relationship where the client is both mentally and physically unwell, thereby experiencing a severely diminished quality of life. The profound connection between emotions and the modulation of pain supports the theory that heightened levels of anxiety may cause increased pain perception and decreased coping (Gonzalez et al., 2011). This also highlights why nonpharmacologic methods are so useful in decreasing pain, as the

mechanism of action of many of these interventions is centered around decreasing patient anxiety levels and promoting feelings of well-being.

The Importance of Managing Pain

When pain is left inadequately treated, the patient experiences harmful physical, psychological, social, and economic consequences as a result (King & Fraser, 2013). Untreated acute pain increases the sympathetic nervous system response (Hughes et al., 2012), causing signs and symptoms such as an increase in muscle tension, heart rate, respiratory rate, and blood pressure. This in turn leads to further problems, such as diaphoresis, agitation, fatigue, anorexia, and sleep alterations (Mwanza et al., 2019), all of which notably impair the normal healing process. Researchers Wu et al. (2018) echo Mwanza et al. in pointing out how unrelieved pain also reduces patient mobility, resulting in potentially fatal complications (such as pressure ulcers, deep venous thrombosis, pulmonary embolus, atelectasis, urinary tract infections and pneumonia) which would have been otherwise preventable if adequate pain management was provided.

Mwanza et al. (2019) also state that untreated pain eventually leads to cardiac, endocrine, immune, neurologic, musculoskeletal, and respiratory complications due to the physiologic effects pain exerts on the human body system. When an area of the body experiences severe and persistent pain, it ceases normal coordinated movement and essentially “self-splints,” causing muscle, nerve, and joint weakness (Tennant, 2012). Tennant goes on to explain that the rest of the anatomy attempts to compensate for this loss of function, and the joints, muscles, and nerves that do so eventually experience deterioration.

If this overuse continues chronically, it leads to tissue breakdown at secondary pain sites causing arthropathies, myopathies and neuropathies (Tennant, 2012). Tennant points out that

many patients who struggle with chronic pain eventually experience greater pain in the secondary sites compared to the original location due to the pathological process that untreated pain creates. This leads to further complications, more complex pathological issues, increased health care costs, and decreased quality of life.

Uncontrolled pain also leads to serious alterations in normal endocrine and cardiovascular function. The response to pain from the sympathetic nervous system causes excessive catecholamine and glucocorticoid release which alters insulin and lipid metabolism (Tennant, 2012). This accelerates the atherogenic process, consequentially leaving those with chronic pain more susceptible to ischemic events. This, coupled with the fact that individuals with chronic pain are less likely to engage in regular cardiovascular exercise, further increases their risk for developing further complications (Majeed, et al., 2019). The general consensus of relevant literature concludes that chronic pain significantly increases the likelihood for cardiovascular disease and ischemic events (Van Hecke et al., 2017), making pain all the more important to curtail and manage well.

Hormonally, pain profoundly impacts the HPA axis, and unresolved pain is what researchers refer to as possibly one of the most potent stressors to stimulate this system (Tennant, 2012; Rijdsdijk et al., 2014). As previously noted, persistent pain produces excess secretion and high serum concentrations of catecholamines and glucocorticoids. This is done as the body attempts to control pain, prevent damage, and maintain homeostasis. While the adverse effects of uncontrolled pain on the other endocrine organs such as the pituitary, thyroid, pancreas, pineal gland, testes, and ovaries are less obvious compared to the HPA axis, it is thought that each of these organs are individually impacted as well.

Pain and inflammation are managed naturally in the body by the local actions of endogenous glucocorticoids (Rijsdijk et al., 2014). However, Tennant (2012 & 2013) states when severe, persistent pain remains uncontrolled, it results in adrenal exhaustion and decreased serum levels of glucocorticoids, namely adrenocorticotropin, cortisol and pregnenolone. Tennant (2013) explains that because these glucocorticoids are so critical in modulating homeostasis and pain control, a deficiency can significantly worsen pain and impede healing. When serum levels of hormones are outside the normal range, it is almost impossible to achieve adequate pain control. Patients who experience persistent pain can demonstrate states of glucocorticoid excess and deficiency over time (Rijsdijk, et al., 2014). Prolonged abnormality in these levels can manifest with symptoms of either Cushing or Addison syndromes, and can have debilitating consequences such as mental deficiencies, muscle weakness, edema, osteoporosis, diabetes, and stone formation (Tennant, 2013).

Ultimately, acute pain that is left untreated delays healing and leads to immunological and neural changes that eventually progress to chronic pain (Mwanza et al., 2019). It is well documented that 20% of acute pain progresses to episodic or persistent chronic pain (Sessle, 2011). When pain becomes chronic and continues to go untreated, common physical sequelae include decreased mobility, impaired immunity, decreased concentration, and sleep disturbances (King & Fraser, 2013).

King and Fraser (2013) point out psychological consequences can result as well, as those with unresolved chronic pain are four times more likely to develop depression than their counterparts without chronic pain. A Canadian survey found that 50% of people with chronic pain state their pain significantly reduces their quality of life (Sessle, 2011). The survey also found those who suffer from chronic pain are twice as likely to commit suicide compared to the

average adult. This could be in part due to not only the excruciating and exhausting physical aspects of chronic pain, but the social isolation individuals experience as they become dependent on caregivers and experience impairment of relationships with family and friends (King & Fraser, 2013).

Improperly treated pain causes financial problems as well, for both the individual and the healthcare system. King and Fraser (2013) point out that those with chronic pain experience burdens such as absenteeism, income loss, healthcare costs, and workers compensation. Untreated chronic pain places economic strain on the United States greater than that of cancer and cardiovascular disease, costing the nation up to \$635 billion annually (Smith & Hillner, 2019).

Different types of Nonpharmacologic Pain Management Across the Lifespan

There are numerous ways to supplement pain management using nonpharmacologic methods. Overall, it is generally understood that nonpharmacologic methods are not intended to replace necessary pain medication, but rather to provide additional (and ideally, complete) pain relief for patients (Short et al., 2019). McNair et al. (2019) point out that while there is still limited understanding on the underlying mechanics of how exactly many nonpharmacologic methods exert their effects, these non-drug measures are nevertheless known to be effective and relatively free from adverse effects. Managing pain with nonpharmacologic methods is also known to be incredibly cost effective (Short et al., 2019; Andronis, 2017; MacPherson, 2017), thereby reducing healthcare costs on the individual and societal level.

Nonpharmacologic Pain Management in Children. The experience of pain is one shared by all human beings, including infants and children. As previously discussed, mismanaged pain has a multitude of devastating effects in both the short and long term. Research

has shown that pain has exceptionally detrimental long-term effects for this particular patient population, such as altered perception of painful stimuli, pain memories with lasting effects, increased physical complaints, and difficulties with cognitive and emotional development (Short et al., 2019). Young patients that suffer from uncontrolled pain while hospitalized are also less likely to be compliant with future medical procedures as a result of the negative, painful experiences that become cognitively paired with medical care. Children between 0-17 years of age are considered a vulnerable population, and the younger a child is, the less adequate pain management they typically receive (Abiezza et al., 2020; Friedrichsdorf & Goubert, 2019; Short et al. 2019).

Because children have been highlighted as a high-risk group for undertreatment of pain, specific evidence-based guidelines have been implemented into patient care protocols (Friedrichsdorf & Goubert, 2019). Friedrichsdorf and Goubert state the overwhelming evidence now mandates that for procedures involving elective needle injections, such as blood draws, intravenous access, injections, or vaccinations, at least 4 specific modalities need to be offered to each child, every time. This includes providing topical anesthesia such as lidocaine 4% cream, comfort positioning (skin-to-skin contact for infants and allowing children to sit up without restraint), sucrose or breastfeeding for infants, and age-appropriate distraction (Friedrichsdorf & Goubert).

Friedrichsdorf and Goubert (2019) also point out that if for whatever reason these methods are unavailable, a deferral process may include sedation and nitrous gas analgesia. If medical facilities fail to implement this evidence-based pain prevention and treatment for children, it is now considered to be an unacceptably poor standard of care (Friedrichsdorf &

Goubert), as there is such a myriad of evidence pointing to the necessity of these interventions. Nurses are paramount in ensuring these guidelines are followed on a daily basis.

In light of the evidence, Short et al. (2019) point out medical professionals should use all the possible tools at their disposal to relieve pain in children. They state this includes utilizing nonpharmacologic methods proven to be effective in reducing the pain, apprehension, and distress experienced by neonatal, infant, and pediatric patients during medical procedures and hospitalization. Furthermore, parents feel greater satisfaction with the hospital experience when they perceive their child's pain is being managed holistically, which leads to better patient outcomes and patient-satisfaction scores.

When deciding which particular nonpharmacologic therapy to employ, the practitioner must take into consideration the age and developmental stage of the particular patient, along with how the patient has coped with painful experiences in the past (Short et al., 2019). This can be done by asking the patient and primary caregiver(s) a few simple questions regarding the patient's past experience with pain and what pain management strategies have worked previously. Short et al. encourage healthcare professionals to do so, as involving the patient and his or her primary caregiver(s) in the task of creating an individualized pain plan fosters autonomy and provides family-centered care.

In infants and neonates, nonpharmacologic therapy has been used as a long-standing practice, as sufficient evidence has proven it effective for managing painful procedures (McNair et al., 2019). When performing needle puncture procedures, interventions such as sucrose solutions, skin to skin contact, and breastfeeding have been applied with great success. Adjuncts to therapy include music therapy, sensorial saturation, rocking and holding, swaddling and containment pacifier, and non-nutritive sucking (McNair et al.). These additional

nonpharmacologic therapies are encouraged to be used along with sucrose solutions, skin to skin contact, and breastfeeding to ensure adequate management during painful medical procedures.

Research done by Short et al. (2019) highlights the important role that soothing parental contact can have on decreasing pain scores in neonates and infants. The nurse can encourage the parent(s) to be present during painful medical procedures to hold the child, and if the procedure does not facilitate such, even simply maintaining eye contact with the child has proven effective. This provides nonpharmacologic pain control, as the distraction cognitively intervenes and refocuses the child's sensory neurons onto a positive stimulus: the caregiver's familiar and comforting presence (Short et al.). Older infants may benefit from light-up or sound toys, and these can be used as a distraction if parental contact is unavailable.

Parental anxiety has been shown to be directly correlated to triggering increased pain scores in their children (Short et al., 2019). In light of this, the healthcare professional can empathize with the parent's concerns, provide education, and reassure the parent. Then, the clinician can coach the uneasy parent on how to engage their child with empathy and encouragement. This has proven to be a helpful intervention for children of all ages, and when parents comfort and encourage their children, it contributes to decreased pain scores.

Environmental adjustments can be made as well to supplement pain management in a nonpharmacologic, holistic way. Interventions such as lowering lights, reducing noise, and clustering care all promote a peaceful, non-stimulating environment, and are positively correlated with reduced pain scores (Short et al., 2019). Younger infants also benefit from swaddling, as it provides a sense of security.

Short et al. (2019) go on to explain that toddlers and preschoolers do best when prepared just prior to the medical procedure. Distraction, blowing bubbles, singing familiar songs, and

creating art have proven to be highly effective methods of non-drug pain management for this age group (Short et al). Toddlers and preschoolers also rate pain less severely when they are sitting upright as opposed to laying supine, as it increases feelings of autonomy and decreases procedural fear (Short et al.). McNair et al. (2019) state the calming effects of nonpharmacologic methods prove extremely useful, particularly when working with pediatric patients who are unaccustomed to medical procedures and naturally experience greater levels of pre-procedural anxiety.

For school age children, nonpharmacologic methods of providing pain management include asking the child about their interests, allowing them to use their electronic devices, and/or providing them with I-Spy or seek-and-find books (Short et al., 2019). Studies have shown children rate their pain scores significantly lower when playing a video game or watching someone else play a video game (Abiezza et al., 2020). Guided imagery also has proven to be effective in providing non-drug pain management, as it cognitively refocuses the child's attention on a stimulus other than pain (Abiezza et al.; Gonzalez et al., 2010). Therapeutic play is another useful tool with school age children, as it has been shown to help children understand and process what they are going through better while simultaneously decreasing pain (Short et al., 2020).

Adolescents are slightly different, as they highly value their independence and appreciate being involved in the development of their care plans. To facilitate this autonomy and provide patient-centered care, the nurse should ask the adolescent which particular nonpharmacologic forms of pain management they feel would help them best. According to Short et al. (2019), teenage patients benefit most from desensitization, which involves seeing photographs of the procedural rooms and equipment, as well as holding the medical equipment that is intended to be

used in their care. Because many adolescents are unfamiliar with hospitalization, informative preparation dispels anxiety (Short et al., 2019). Short et al. also point out how other methods, such as positive self-talk (e.g., “this is uncomfortable, but I can handle it if I take deep breaths”), guided imagery, and distraction are helpful in managing acute pain in adolescents. Music therapy is also a common and effective nonpharmacologic method of controlling pain, and teenage patients should be encouraged to listen to their favorite music to provide distraction.

Physical measures that modulate acute pain for children of all ages include using hot or cold compresses, applying pressure or massage, deep breathing, and repositioning (Abiezza et al., 2020). For children suffering from chronic pain, physical therapy and/or occupational therapy are vital components in managing pain, as well as electrical nerve stimulation, aerobic weight bearing exercises, stretching, contrast bath hydrotherapy, and tactile desensitization (Abiezza et al., 2020).

Nonpharmacologic Pain Management in Adults. Nonpharmacologic therapies are important adjuncts to surgical and pharmacologic pain management (Till et al., 2017). Till et al. conclude from their research on pain management that nonpharmacologic therapies should be considered integral to providing a comprehensive treatment approach, as they significantly improve pain, function, and quality of life. Different types of nonpharmacologic therapies including cognitive-behavioral interventions, complementary therapies, and physical interventions that can be utilized when providing holistic care.

Cognitive Behavioral Interventions. Cognitive behavioral interventions purposefully focus on modifying cognition and behavior with the intention of decreasing sensations of pain. These interventions include counseling, guided imagery, deep breathing, relaxation training, positive reframing, and specific mindfulness interventions. Amplifying pain treatment with these

interventions has been found to decrease healthcare costs, reduce patient distress and caregiver burden, and increase patient's feelings of overall well-being (Bennett & Chang, 2016).

Researchers Kimbi et al. (2016) used questionnaires to survey nurses regarding which nonpharmacologic interventions they used most frequently in managing their patients' pain, and counseling proved to be one of the most commonly utilized treatments. Counseling, where the nurse attempts to help the patient by means of purposeful conversation, allows the patient to express their thoughts and feel understood. It is not fully known how exactly this method works, but nurses and patients each notice drops in patient pain scores after patients receive counseling from their nurses.

Guided imagery is another method of providing cognitive-behavioral pain management. Gonzalez et al. (2010) found guided imagery has strikingly long lasting, positive effects on providing relaxation and pain control. Adults were split into test and control groups, with each group given 28 minutes of privacy prior to their surgical procedures. However, during those 28 minutes, the test group listened to a guided imagery CD, while the control group had no intervention. Immediately after participating in guided imagery, the test group reported significantly lower levels of anxiety. After surgery, 2 hours later, the guided imagery group not only reported less pain and required less pain medication than the control group, but they were also discharged from the postoperative anesthesia care unit (PACU) quicker than the control group. The researchers concluded that using guided imagery in preoperative care can significantly reduce anxiety associated with surgical procedures, which results in less postoperative pain and earlier PACU discharge times (Gonzalez et al., 2011).

One of the greatest advantages of this form of nonpharmacologic therapy is its ability to be utilized by a patient without the help of a trained specialist. Patients can be taught how to use

this method on their own using CDs, tapes, or reading materials. This form of nonpharmacologic therapy also places no additional financial burden on the healthcare facility; in fact, it actually decreases costs, as patients who practice guided imagery prior to surgery experience shorter PACU stays and require less analgesic medication (Gonzalez et al., 2011).

A study done using combination therapy of lidocaine injection and cognitive behavioral therapies further emphasizes the legitimacy of these non-drug interventions. Participants engaged in cognitive-behavioral therapies such as deep breathing, relaxation training, and positive reframing, and the group who had these interventions demonstrated a significant decrease in pain scores when compared to the control group (Jibb et al., 2015). This highlights that using nonpharmacologic methods in combination with analgesia produces additive effects, leaving the patient in much less pain than if the nonpharmacologic method was disregarded.

A literature review by Bennett & Chang (2016) points out how studies have shown the validity of using behavioral interventions. They discuss methods which have been tested and proven effective in the treatment of chronic pain, including mindful enjoyment, acceptance and commitment therapy, integrated cognitive behavioral therapy, and motivational interviewing. Mindful enjoyment refers to the conscious decision that individuals make to seek out and appreciate pleasant experiences as appropriate. This is associated with promoting increased coping skills and resiliency in clients. Acceptance and commitment therapy targets and exposes avoidance, by encouraging the individual to control what they can and develop psychological flexibility. Integrated cognitive behavioral therapy challenges the individual to reframe their thoughts about themselves and their situations by changing their behaviors. Motivational interviewing is similar, as the clinician uses empathy, active and reflexive listening, and open ended questions to generate the desire to change in the individual.

When used in combination, these cognitive behavioral therapies have proven to decrease pain scores in those who suffer from chronic pain (Bennett & Chang, 2016). Till et al. (2017) agree, and report based on their findings that cognitive behavioral therapy and mindfulness have demonstrated significant improvements in pain, function and quality of life in patients with a variety of chronic pain conditions. They remark that these interventions are promising avenues for future research.

Complementary Therapies. Complementary therapies refer to interventions that are intended to draw the patient's attention away from the painful stimulus and refocus them on another, more positive one. Often referred to as "alternative medicine," complementary therapy involves the use of a nonmainstream, Eastern approach to Western conventional medicine (Johnson & Cosgrove, 2015, p. 32). The National Institutes of Health state that complementary methods involve interventions such as acupuncture, massage therapy, meditation, movement therapies, and relaxation techniques (Johnson & Cosgrove, 2015). Other forms of complementary therapies include art therapy, music therapy, and aroma therapy.

Acupuncture is considered to be one of the world's oldest forms of nonpharmacologic therapy (Geziry et al., 2018), as its first documented use for diagnosis and treatment dates back to 100 BCE (Hao & Mittleman, 2014). By inserting needles into very specific locations, nerves are stimulated, which increases wound healing, circulation, and pain modulation (Geziry et al.). This has to be done by a licensed acupuncture therapist, making it an unpopular method of managing inpatient pain. A literature review done by Johnson and Cosgrove (2015) found that studies disagree regarding just *how* effective acupuncture is, but that the general consensus of the literature is that, overall, it is a useful way to manage pain.

Researchers Cherkin et al. (2011) state massage has proven to be an effective nonpharmacologic treatment, as it induces a natural state of relaxation, decreases blood pressure, reduces anxiety and induces feelings of overall well-being. By deactivating the sympathetic nervous system's fight or flight response, the experience of pain is diminished. It is understood that massage also increases endogenous endorphin release, thereby providing conflicting stimuli and overriding the pain signals (Geziriy et al., 2018). Geziriy et al. also state that massage therapy can target myofascial and neuromuscular pain by stimulating blood flow and lymphatic drainage, as well as decreasing inflammation, edema, and muscle spasms.

Cherkin et al. (2011) conducted a study on over 400 participants with chronic back pain, where one group received massage while the other did not. After 10 weeks of treatment, 39% of individuals who received massage therapy stated that they felt significant improvement compared to the control group. Because of these strong analgesic effects, massage is now the most common complementary therapy for neck and back pain (Johnson & Cosgrove, 2015).

Gutgsell et al. (2013) studied the effects of music therapy on palliative care patients. They found this intervention significantly decreases pain levels assessed by the numeric pain scale, FLACC pain scale, and functional pain scale. They concluded based on their research that even a single music therapy session incorporating therapist-guided autogenic relaxation and live music could be considered an effective nonpharmacologic tool for lowering pain in patients, especially patients undergoing palliative care.

However, even just listening to one's preferred type of music has incredibly strong effects on modulating pain. Researchers Bernatzky et al. (2011) conclude that music can be used as adjuvant pain management therapy for all types of pain. In cases of mild pain, music has been found to be just as effective as drug therapy. They state this is because music acts upon the

central nervous system, specifically the limbic system and nucleus accumbens, producing generalized and widespread effects. Music positively affects different regions of the brain that have been shown to stimulate the mental and physical healing processes. By reducing, and at times, even superseding the need for pharmaceuticals, costs of medical care are reduced. Additionally, music therapy has little to no side effects and therefore can easily be incorporated into a multimodal pain management program.

Other methods, such as the utilization of aromatherapy and art therapy, have proved useful in decreasing pain. A study done by Akbari et al. (2019) found peppermint oil attenuated the pain caused by IV catheterization. Creative art therapy also has been shown to increase quality of life and decrease pain scores in those who suffer from chronic pain (Jibb et al., 2015). While these two complementary methods hold great promise, more research is required to confirm their legitimacy.

Physical Interventions. Physical interventions used to manage pain include methods such as exercise, positioning, hold and cold compresses, muscle relaxation, transcutaneous electrical nerve stimulation, and cryoneurolysis. Researchers Till et al. (2017) found that exercise, including aerobic conditioning, muscle strengthening, flexibility training, and movement therapies are incredibly beneficial ways of managing pain, especially chronic pain. Exercise is known to release endorphins, which act similarly to opioids in decreasing pain and anxiety (Till et al.). When physical activity is applied with appropriate frequency, intensity, and duration, pain has been found to significantly improve (Ambrose & Golightly, 2015).

Geziry et al. (2018) and as Gunus et al. (2020) point out methods such as positioning and using hot and cold compresses are simple, commonly used, and cost-effective ways of providing nonpharmacologic pain relief. Positioning not only helps prevent further complications of

bedrest by improving blood circulation and preventing edema, but also relieves musculoskeletal pain and discomfort. When used appropriately, heat therapy proves beneficial in decreasing heart rate, pain, anxiety, and nausea. It does so by stimulating epidermal thermoreceptors, thereby closing the pain gating system at the spinal cord. Heat can also significantly improve joint pain in particular, as it reduces the viscosity of synovial fluid, which alleviates stiffness and improves range of motion. Cold therapy is also a useful tool, as it increases the pain threshold, suppresses inflammation, and decreases edema.

Progressive muscle relaxation is another useful physical intervention for decreasing pain. This technique requires the participant to progressively tighten and relax different muscle groups throughout the body. In a double-blind randomized clinical trial, progressive muscle relaxation was found to decrease pain intensity and muscle tenderness (Geziry et al., 2018). It is particularly helpful for conditions such as back pain, phantom limb pain, headache, and stress (Geziry et al., 2018).

Transcutaneous electrical nerve stimulation (TENS) uses low-voltage electrical impulses in a series of alternating electrical current impulses to treat pain (Till et al., 2017). By stimulating large afferent nerve fibers, pain-transmitting fibers are blocked (Geziry et al., 2018). Geziry et al. state experts believe using TENS activates the release of natural endorphins at the pituitary level. It is known to help patients who suffer from mild to moderate acute pain, chronic back pain, arthritis, and neuropathic pain. TENS is also reportedly free from side effects (Geziry et al., 2018).

Cryoneurolysis is a less common but incredibly effective method of relieving chronic pain. It is a minimally invasive, nonsurgical, nonpharmacologic pain management technique that uses cold temperatures to ablate the sensory nerves causing pain (Smiley & McGuire, 2018).

Because of its safe and reversible nature, Smiley and McGuire state cryoneurolysis should be considered as part of a multimodal pain management plan for patients experiencing pain originating from sensory nerves.

Barriers to Implementing Nonpharmacologic Therapies

Lack of Education. The research is clear: pain should be managed using a multimodal approach, employing a combination of pharmacologic and nonpharmacologic methods (King & Fraser, 2013). Overall, the literature has highlighted that one of the largest barriers to treating pain using methods other than solely drugs is the lack of education among both health care workers and patients. Despite significant attempts from statewide Pain Initiatives and accrediting agencies, Plaisance and Logan (2017) conclude that knowledge of pain management is nevertheless inadequate, and an increase in education is necessary.

A study on nursing homes was done to assess the nonpharmacologic therapies provided in nursing homes, with the goal of enhancing the application and prescription of nonpharmacologic pain management techniques (Kalinowski et al., 2015). The researchers found that the nurses, prescribers, and residents were undereducated regarding nonpharmacologic therapies, and that additional education is necessary for healthcare professionals. The researchers also pointed out that due to the already high workload of nurses, the residents and their primary caregivers should receive education on how to manage their pain using non-drug measures. This would provide not only a slight decrease in workload for the nurses, but also enrich self-care and foster feelings of autonomy in nursing home residents.

Kimbi et al. (2016) found that when surveyed via questionnaire, the number one reason why patients did not request nor trust nonpharmacologic methods of pain management was due to their strong belief in solely pain medication. 50% of patients surveyed stated that they did not

believe in the effectiveness of non-drug pain control measures. This highlights the importance and the necessity of providing patient education on the matter, as patients should be informed of all the options for pain management at their disposal.

This lack of education reaches as far as physicians in the primary care setting. Opioids are reportedly the primary method of managing chronic pain and are regularly prescribed by primary care physicians (Giannitrapani et al., 2018). While it is widely understood that opioids are necessary for controlling high levels of pain, patient pain scores could be further reduced by the addition of nonpharmacologic therapies. In light of this, researchers Giannitrapani et al. (2018) suggest that providing additional education and clinical reminders to these physicians would help increase the prescription and recommendation of nonpharmacologic pain management methods. Without recommendation from the primary care physician, patients rarely seek out non-drug measures to control their pain.

Nurses and nursing students also need more education on pain management. Nurse-researchers Stewart and Cox-Davenport (2015) studied how both nurses and nursing students feel implementing nonpharmacologic pain treatments. Only 65% of nursing students and 51% of nurses reported feeling adequately educated on the subject. The fact that only half of registered nurses feel educated on an aspect so central to the daily task of providing holistic patient care further emphasizes the need for additional education. While Kimbi et al. (2016) point out that 87% of nurses have previously been somewhat trained in non-pharmacologic pain management, the research makes it clear that nurses could benefit from a better education during nursing school and continued education on current standards of best practice throughout employment.

Providing better education to nursing students regarding alternative pain treatments is vital to ensure optimal pain management for their future patients (Stewart & Cox-Davenport,

2015). Researchers Plaisance and Logan (2017) conducted a study on nursing students in both baccalaureate and associate degree programs to assess their level of understanding. When tested on their clinical skills pertaining to pain management, both groups performed poorly, with a combined mean score of 64% out of 100% overall. In light of this information, these researchers encourage nursing faculty to carefully review their curricula, with the intent of determining whether students are being taught comprehensive and current information on pain management. They also point out the importance of incorporating evidence-based research as well as current standards of care when educating students on all aspects of clinical pain management.

Lack of education is the primary barrier that prevents patients from getting access to holistic pain management, but thankfully there is a solution. The general consensus of the literature states by providing healthcare professionals with more information about nonpharmacologic methods, including the effectiveness, different types, and methods of application, they will be greater educated and therefore greater equipped to provide holistic pain management to the patients they serve (Khalil, 2018). While nurses agree that they are undereducated on the matters at hand, 88% of nurses state they are eager to learn about and implement nonpharmacologic strategies (Tracy et al., 2015). Some studies have suggested providing periodical reminders to prescribers (Giannitrapani et al., 2018), educational seminars (Kalinowski et al., 2015), and more clinical experience for students to ensure they learn the full potential of nonpharmacologic pain management prior to entering the workforce (Stewart & Cox-Davenport, 2015).

High Nurse Workloads. A literature review completed by Gumus, Musuroglu, Karaman Ozlu, and Tasci (2020) points out that in general, the factors that complicate and prevent the use of the nonpharmacologic methods are not merely limited to a lack of education on the matter.

Although that is the largest issue overall, other barriers include high nurse workload, desires to control acute pain as quickly as possible, and not having the available resources.

Researchers Kimbi et al. (2016) agree, as their questionnaire-based study found that the major barrier to nurses implementing nonpharmacologic methods of pain control was high nurse workload. 40% of nurses surveyed explicitly stated that their workload is too high to regularly implement nonpharmacologic methods of pain management. Khalil (2018) reports a similar finding, as nurses confessed they feel as though they do not have enough time to implement nonpharmacologic pain management strategies. This highlights a deeper issue, high nurse workloads, which hinders nurses from being able to provide the high quality of care that they would like to (Carlesi et al., 2017).

Conclusion

Pain is an aspect of the human experience that leads to devastating consequences when managed improperly. As the ones who spend the most time with patients, nurses are primarily responsible for advocating and ensuring patients receive adequate pain treatment during their treatment. While pharmacology is incredibly useful in managing pain, nonpharmacologic modalities can be added to supplement treatment and further lower pain scores. When pain is optimally managed, healthcare costs decrease, the healing process is accelerated, and future complication are avoided. Moreover, optimal pain management is considered a universal right, and when pain is managed well, the patient experiences a higher quality of life, a better recovery, and is treated with the dignity and respect that they deserve.

Implications for Practice

The research makes it clear there are numerous implications for practice going forward. Because of the well documented adverse short- and long-term effects of mismanaging pain, it is

of utmost importance that healthcare professionals assess and treat pain as effectively as possible. This looks like asking each patient what their past experience with pain has been, how they have previously managed their pain, what has worked well in the past, and which nonpharmacologic interventions they would be open to learning about and utilizing.

Assessing pain correctly also involves frequently and regularly observing nonverbal signs and symptoms of pain while taking the patient's self-pain rating seriously. Patients should be asked to describe their pain, and nurses should document all available information to promote optimal continuity of care. Based off assessment information, the nurse can advocate for her patient and request either additional analgesia and/or the addition of particular nonpharmacologic therapies the nurse feels would benefit the patient. Many nonpharmacologic interventions do not require a prescriber's order such as positioning, application of cold, counseling, etc.; however, the nurse should be knowledgeable regarding the many different modalities of pain management discussed in this paper so patients can be best cared for.

Recommendations

After synthesizing the relevant literature, there are three particular recommendations for future practice and research. First, there is a need for health care professionals to be better educated on how to best assess and treat pain. Nursing students need to receive a more comprehensive education of pain during their schooling, current nurses need to be provided with opportunities for continuing education on pain management, and prescribers need to be offered periodic reminders regarding holistic pain treatment. Patients would also benefit from an increased knowledge base, as being knowledgeable about holistic pain management allows them to autonomously help themselves and relieve some caregiver burden.

While education is a great first step, even the most educated nurse is unable to go above and beyond in care delivery if he/she does not have sufficient time to do so. This highlights the second point, which is that nurse workload must be decreased. As the literature has pointed out, nurses are unable to provide the level of care that they would like to when they have a high case load. In fact, high nurse workloads are correlated with an increase in not only adverse events, but patient mortality (Zolot, 2018). This is a complex issue that will require a multifaceted solution as the profession of nursing matures.

Finally, more research must be done regarding nonpharmacologic pain management. While there clearly is current literature that supports the use of these interventions, overall, additional research would significantly assist in promoting the popularity of nonpharmacologic pain therapies. Research is the springboard for implementing changes in practice; therefore, the more research that is done on the validity of nonpharmacologic interventions, the more they will be implemented into practice.

References

- Abiezza, C., Ranaraja, A., Kilano, R., Keane, J., Mauro, A., Goldstein, L. (2020). Pediatric pain management: A review of clinical diagnosis and management. *Practical Pain Management, 20*(3), 32-35.
<https://www.practicalpainmanagement.com/pain/other/pediatric-pain-management-review-clinical-diagnosis-management>
- Akbari, F., Rezaei, M., & Khatony, A. (2019). Effect of peppermint essence on the pain and anxiety caused by intravenous catheterization in cardiac patients: A randomized controlled trial. *Journal of Pain Research, 12*, 2933-2939. doi:10.2147/jpr.s226312
- Ambrose, R., & Golightly, M. (2015). Physical exercise as non-pharmacological treatment of chronic pain: Why and when. Best practice & research. *Clinical Rheumatology, 29*(1), 120–130. <https://doi.org/10.1016/j.berh.2015.04.022>
- Andronis, L., Kinghorn, P., Qiao, S., Whitehurst, G., Durrell, S., McLeod, H. (2017). Cost-Effectiveness of non-invasive and non-pharmacological interventions for low back pain: A systematic literature review. *Appl Health Econ Health Policy, 15*(2):173-201. doi:10.1007/s40258-016-0268-8. PMID: 27550240.
- Arnstein, P. (2011). Multimodal approaches to pain management. *Nursing* (Jenkintown, Pa.), *41*(3), 60-61. <https://doi.org/10.1097/01.NURSE.0000394384.65192.3c>
- Bernatzky, G., Presch, M., Anderson, M., & Panksepp, J. (2011). Emotional foundations of music as a non-pharmacological pain management tool in modern medicine. *Neuroscience and Biobehavioral Reviews, 35*(9), 1989–1999.
<https://doi.org/10.1016/j.neubiorev.2011.06.005>
- Bonnie, R. J., Ford, M. A., & Phillips, J. K. (2017). *Pain management and the opioid epidemic:*

- Balancing societal and individual benefits and risks of prescription opioid use: Committee on Pain Management and Regulatory Strategies to Address Prescription Opioid Abuse*. Retrieved February 6, 2021, from <https://www.ncbi.nlm.nih.gov/books/NBK458655/>.
- Carlesi, K. C., Padilha, K. G., Toffoletto, M. C., Henriquez-Roldán, C., & Juan, M. A. (2017). Patient safety incidents and nursing workload. *Revista Latino-Americana de Enfermagem*, 25, e2841. <https://doi.org/10.1590/1518-8345.1280.2841>
- Chang, Y. & Barrette, K.(2016). Behavioral interventions targeting chronic pain, depression, and substance use disorder in primary care. *Journal of Nursing Scholarship: an Official Publication of Sigma Theta Tau International Honor Society of Nursing*, 48(4), 345–353. <https://doi.org/10.1111/jnu.12213>
- Cherkin, D., Sherman, K., Kahn, J., Wellman, R., Cook, A., Johnson, E., ... Deyo, R. (2011). A comparison of the effects of 2 types of massage and usual care on chronic low back pain. *ANNALS OF INTERNAL MEDICINE*, 155(1). <https://doi.org/10.7326/0003-4819-155-1-201107050-00002>
- Cicero, T., Inciardi, J., & Muñoz, A. (2005). Trends in abuse of OxyContin® and other opioid analgesics in the United States: 2002-2004. *Journal of Pain Official Journal of the American Pain Society.*, 6(10), 662–672. <https://doi.org/10.1016/j.jpain.2005.05.004>
- Collier, R. (2018). A short history of pain management. *CMAJ: Canadian Medical Association Journal*, 190(1), E26-E27. <https://doi.org/10.1503/cmaj.109-5523>
- Friedrichsdorf, S. J., & Goubert, L. (2019). Pediatric pain treatment and prevention for hospitalized children. *Pain reports*, 5(1), e804. <https://doi.org/10.1097/PR9.0000000000000804>

Geziry, E., Toble, Y., Kadhi, A., & Nobani, P. (2018). Non-Pharmacological Pain Management.

IntechOpen. doi: 10.5772/intechopen.79689

Giannitrapani, K. F., Ahluwalia, S. C., McCaa, M., Pisciotta, M., Dobscha, S., & Lorenz, K. A.

(2018). Barriers to using nonpharmacologic approaches and reducing opioid use in primary care. *Pain Medicine, 19*(7), 1357-1364.

<https://doi.org/ezproxy.liberty.edu/10.1093/pm/pnx220>

Gonzales, E. A., Ledesma, R. J., McAllister, D. J., Perry, S. M., Dyer, C. A., & Maye, J. P.

(2010). Effects of guided imagery on postoperative outcomes in patients undergoing same-day surgical procedures: A randomized, single-blind study. *AANA Journal, 78*(3), 181-8.

Gumus, K., Musuroglu, S., Karaman Ozlu, Z., & Tasci, O. (2020). Determining the use of nonpharmacologic methods by surgical nurses for postoperative pain management and the influencing professional factors: A multicenter study. *Journal of PeriAnesthesia Nursing, 35*(1), 75-79. <https://doi.org/10.1016/j.jopan.2019.04.011>

Gutgsell, K. J., Schluchter, M., Margevicius, S., Degolia, P. A., Mclaughlin, B., Harris, M., ...

Wiencek, C. (2013). Music therapy reduces pain in palliative care patients: A randomized controlled trial. *Journal of Pain and Symptom Management, 45*(5), 822–831. <https://doi.org/10.1016/j.jpainsymman.2012.05.008>

Hao, J. J., & Mittelman, M. (2014). Acupuncture: past, present, and future. *Global advances in*

health and medicine, 3(4), 6–8. <https://doi.org/10.7453/gahmj.2014.042>

Hughes, C. G., McGrane, S., & Pandharipande, P. P. (2012). Sedation in the intensive care setting. *Clinical Pharmacology: Advances and Applications, 4*, 53-63.

<http://dx.doi.org/10.2147/CPAA.S26582>

International Association for the Study of Pain. (1986). International Association for the Study of

Pain Classification of chronic pain: Descriptions of chronic pain syndromes and definitions of pain terms. *International Association for the Study of Pain, Subcommittee on Taxonomy Pain*, S1-226.

Jibb, A., Nathan, C., Stevens, J., Yohannes, L., & Stinson, N. (2015). Psychological and physical interventions for the management of cancer-related pain in pediatric and young adult patients: an integrative review. *Oncology Nursing Forum*, 42(6), E339.

Johnson, A., & Cosgrove, D. (2015). Complementary and alternative medicine for chronic musculoskeletal pain. *Federal Practitioner: For the Health Care Professionals of the VA, DoD, and PHS*, 32(9), 31–36.

Joint Commission. (2017, July). New and revised standards related to pain assessment and management. *The Joint Commission Perspectives*, 27(2), 3.

Jones, M. R., Viswanath, O., Peck, J., Kaye, A. D., Gill, J. S., & Simopoulos, T. T. (2018). A brief history of the opioid epidemic and strategies for pain medicine. *Pain and Therapy*, 7(1), 13–21. <https://doi.org/10.1007/s40122-018-0097-6>

Joranson, D. E., Gilson, A. M., Dahl, J. L., & Haddox, J. D. (2002). Pain management, controlled substances, and state medical board policy: A decade of change. *Journal of Pain and Symptom Management*, 23(2), 138-147. [https://doi.org/10.1016/S0885-3924\(01\)00403-1](https://doi.org/10.1016/S0885-3924(01)00403-1)

Kalinowski, S., Budnick, A., Kuhnert, R., Könnner, F., Kissel-Kröll, A., Kreutz, R., & Dräger, D. (2015). Nonpharmacologic pain management interventions in german nursing homes: A cluster randomized trial. *Pain Management Nursing*, 16(4), 464–474. <https://doi.org/0.1016/j.pmn.2014.09.002>

- Khalil, N. S. (2018). Critical care nurses' use of non-pharmacological pain management methods in Egypt. *Applied Nursing Research, 44*, 33-38.
<https://doi.org/10.1016/j.apnr.2018.09.001>
- Kimbi, Ambola, R. B., Ajong, N. V. S., & Tufon, E. N. (2016). Non-pharmacological interventions for pain management used by nurses at the mezam polyclinic bamenda, cameroon. *Research Journal of Pharmacology and Pharmacodynamics, 8*(4), 157-160.
<http://doi.org/ezproxy.liberty.edu/10.5958/2321-5836.2016.00028.8>
- King, N. B., & Fraser, V. (2013). Untreated pain, narcotics regulation, and global health ideologies. *PLoS medicine, 10*(4), e1001411.
<https://doi.org/10.1371/journal.pmed.1001411>
- Maciel, H., Costa, M. F., Costa, A., Marcatto, J. O., Manzo, B. F., & Bueno, M. (2019). Pharmacological and nonpharmacological measures of pain management and treatment among neonates. Medidas farmacológicas e não farmacológicas de controle e tratamento da dor em recém-nascidos. *Revista Brasileira de Terapia Intensiva, 31*(1), 21–26.
<https://doi.org/10.5935/0103-507X.20190007>
- MacPherson, H., Vickers, A., & Bland, M. (2017) Cost-effectiveness of non-pharmacological adjunct treatments for patients with osteoarthritis of the knee. *Southampton (UK): NIHR Journals Library*, Chapter 5. Available from:
<https://www.ncbi.nlm.nih.gov/books/NBK409486/>
- Majeed, M. H., Ali, A. A., Khalil, H. A., Bacon, D., & Imran, H. M. (2019). A review of the pharmacological management of chronic pain in patients with heart failure. *Innovations in Clinical Neuroscience, 16*(11-12), 25–27.
- McNair, C., Campbell-Yeo, M., Johnston, C., & Taddio, A. (2019). Nonpharmacologic

- management of pain during common needle puncture procedures in infants. *Clinics in Perinatology*, 46(4), 709–730. <https://doi.org/10.1016/j.clp.2019.08.006>
- Plaisance, Louise & Logan, Cynthia. (2017). Nursing students' knowledge and attitudes regarding pain. *Pain management nursing: Official Journal of the American Society of Pain Management Nurses*. <https://doi.org/7.167-75>. 10.1016/j.pmn.2006.09.003.
- Portenoy, R., & Foley, K. (1986). Chronic use of opioid analgesics in non-malignant pain: Report of 38 cases. *Pain*, 25(2), 171–186. [https://doi.org/10.1016/0304-3959\(86\)90091-6](https://doi.org/10.1016/0304-3959(86)90091-6)
- Porter, J., & Jick, H. (1980). Addiction rare in patients treated with narcotics. *The New England Journal of Medicine*, 302(2), 123-123. <https://doi:10.1056/NEJM198001103020221>
- Rijsdijk, M., van Wijck, A., Kalkman, C., Yaksh, T. (2014). The effects of glucocorticoids on neuropathic pain. *Anesthesia & Analgesia*, 118(5), 1097-1112 doi: 10.1213/ANE.0000000000000161
- Short, S., Pace, G., & Birnbaum, C. (2017). Nonpharmacologic techniques to assist in pediatric pain management. *Clinical Pediatric Emergency Medicine*, 18(4), 256-260. <https://doi.org/10.1016/j.cpem.2017.09.006>
- Smiley, A., & McGuire, J. (2018). Cryoneurolysis for the treatment of sensory nerve pain. *AANA Journal*, 86(6), 495-503.
- Smith T. J., & Hillner B. E. (2019). The cost of pain. *JAMA New Open*, 2(4):e191532. doi:10.1001/jamanetworkopen.2019.1532
- Stahl, S. (2013). Chronic pain and its treatment. *Stahl's essential psychopharmacology neuroscientific basis and practical application*. doi: 9781107686465
- Stewart, M., & Cox-Davenport, R. A. (2015). Comparative analysis of registered nurses and nursing students' attitudes and use of nonpharmacologic methods of pain

- management. *Pain Management Nursing*, 16(4), 499–502. <https://doi.org/10.1016/j.pmn.2014.09.010>
- Tennant, F. (2012). Complications of uncontrolled, persistent pain. *Practical Pain Management*, 4(1). <https://www.practicalpainmanagement.com/pain/other/co-morbidities/complications-uncontrolled-persistent-pain>
- Tennant F. (2013). The physiologic effects of pain on the endocrine system. *Pain and Therapy*, 2(2), 75–86. <https://doi.org/10.1007/s40122-013-0015-x>
- Till, S. R., Whal, H. N., & As-Sanie, S. (2017).
- Tompkins, D. A., Hobelmann, J. G., & Compton, P. (2017). Providing chronic pain management in the “Fifth vital sign” era: Historical and treatment perspectives on a modern-day medical dilemma. *Drug and Alcohol Dependence*, 173(Suppl 1), S11-S21. <https://doi.org/10.1016/j.drugalcdep.2016.12.002>
- Tracy, M. F., Lindquist, R., Savik, K., Watanuki, S., Sendelbach, S., Kreitzer, M. J., & Berman, B. (2005). Use of complementary and alternative therapies: A national survey of critical care nurses. *American Journal of Critical Care: An Official Publication, American Association of Critical-Care Nurses*, 14(5), 404.
- Van Hecke, O., Hocking, L. J., Torrance, N., Campbell, A., Padmanabhan, S., Porteous, D. J., McIntosh, A. M., Burri, A. V., Tanaka, H., Williams, F. M., & Smith, B. H. (2017). Chronic pain, depression and cardiovascular disease linked through a shared genetic predisposition: Analysis of a family-based cohort and twin study. *PloS one*, 12(2), e0170653. <https://doi.org/10.1371/journal.pone.0170653>
- Van Zee, A. (2009). The promotion and marketing of OxyContin: Commercial triumph, public health tragedy. *American Journal of Public Health*, 99(2), 221-227.

<https://doi:10.2105/AJPH.2007.131714>

Wu, X., Li, Z., Cao, J., Jiao, J., Wang, Y., Liu, G., Liu, Y., Li, F., Song, B., Jin, J., Liu, Y., Wen, X., Cheng, S., & Wan, X. (2018). The association between major complications of immobility during hospitalization and quality of life among bedridden patients: A 3 month prospective multi-center study. *PloS one*, *13*(10), e0205729.

<https://doi.org/10.1371/journal.pone.0205729>

Zolot, Joan. (2018). Higher than optimal nurse workloads increase the odds of patient mortality. *American Journal of Nursing* *118*(8), <https://doi:10.1097/01NAJ.0000544153.14198.44>