USE OF MUSIC LISTENING TO ENHANCE ACUTE SURGICAL PAIN MANAGEMENT WITH PATIENTS UNDERGOING ORTHOPEDIC SURGERY

By

JOANNE MARGARET LAFRAMBOISE-OTTO

A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

2017

To my father and mother, Leo and Margaret Laframboise, who so faithfully believed in me and supported me throughout this educational endeavor.
Thank you.
I love you and miss you.
“A good education is easy to carry around.” - Mom

ACKNOWLEDGMENTS

Words cannot adequately express the extent of my gratitude to my Dissertation Committee members, Dr. Cynthia Garvan, Dr. Saunjoo Yoon, and Dr. Dale Campbell for their expertise, knowledge, and support throughout this dissertation process. I am so very grateful to my Committee Chair, Dr. Ann Horgas for her expertise in the research process and in the study of pain. She truly exemplifies a Nurse Scientist, and I feel so privileged to have been her student.

I am grateful to my family, my husband Bruce, my son Eddie, and my brother Charles for their continued love and support throughout this educational endeavor. Without their support I would not have been able to accomplish this educational dream. Thank you Max, my German shepherd, for all of your trips into my office to give me hugs.

TABLE OF CONTENTS

page

LIST OF TABLES

LIST OF FIGURES

Figure page

LIST OF ABBREVIATIONS

Drowsiness	Decreased level of consciousness occurring as an adverse effect or side effect of analgesic medication.
EPIC	An electronic documentation system used for medical information in the hospital. Included in this system is information about medication administered to patients, and patient reports to nurses of pain intensity.
Music intervention	A planned and deliberate playing of patient-selected music via an iPhone, iPad, or similar computer device provided by postoperative knee or hip joint replacement patients.
Nausea	An unpleasant, queasy, or wavelike sensation in the back of the throat, epigastrium, or abdomen that may or may not lead to the urge or need to vomit occurring as an adverse effect or side effect of analgesic medication.
Orthopedic hip joint arthroplasty patient	A person who has undergone either left or right orthopedic hip joint arthroplasty surgery. In this study, inclusion criteria limit the sample to non-emergent orthopedic surgery patients.
Orthopedic knee joint arthroplasty patient	A person who has undergone either left or right orthopedic knee joint arthroplasty surgery. In this study, inclusion criteria limit the sample to non-emergent orthopedic surgery patients.
Pain	An unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage.
Pain distress	The emotional distress experienced with pain.
Pain intensity	The physical intensity experienced with pain.
State anxiety	A transitory emotional state that varies in intensity and fluctuates over time.

Abstract of Dissertation Presented to the Graduate School
of the University of Florida in Partial Fulfillment of the
Requirements for the Degree of Doctor of Philosophy

USE OF MUSIC LISTENING TO ENHANCE ACUTE SURGICAL PAIN MANAGEMENT WITH PATIENTS UNDERGOING ORTHOPEDIC SURGERY

By

Joanne Margaret Laframboise-Otto

December 2017

Chair: Ann Horgas
Major: Nursing Sciences

In the hospital setting, nurses have the major responsibility of pain management and comfort care with patients undergoing surgery. Further, patients commonly look to nurses for help in relieving pain and achieving comfort. If not adequately managed, uncontrolled pain not only causes needless suffering, but can contribute to cardiovascular, respiratory, gastrointestinal, genitourinary, and neuroendocrine problems after surgery. When implementing best practices, nurses need to determine if pain management strategies like music therapy can support the strengths and meet the needs of surgical patients, with the intentions of relieving physical pain, achieving psychological comfort, and promoting recovery from surgery.

The purpose of this study was to investigate the use of a music intervention as an adjuvant with prescribed analgesics to help reduce acute surgical pain, analgesic usage, and analgesic side effects of nausea and drowsiness with patients undergoing orthopedic surgery.

A convenience sample of 50 participants who had undergone either hip or knee joint replacement surgery at UF Health in Gainesville, FL comprised the study sample. In this randomized clinical trial, twenty-five participants were randomly assigned to the

treatment group and were asked to listen to music of their choice, three times a day, for 30 minutes duration, when they experienced pain after surgery, using a personal internet access device. These participants were asked to rate and document pain intensity and pain distress before and after music listening, and rate nausea and drowsiness (side effects which can be experienced from opioid analgesia taken), during the evening of surgery, during postoperative days 1 and 2 in hospital, and two days post-discharge from hospital. Twenty-five participants who comprise the control group were asked to rate and document pain intensity and pain distress before and after scheduled mealtimes, (breakfast, lunch, and dinner) along with rating nausea and drowsiness during the same time periods in hospital and post-discharge. Electronic medical records (EPIC) of opioid and non-opioid analgesics taken by participants were recorded, as were participant reports of analgesics taken after discharge recorded in their log booklets. On the third discharge day from hospital a telephone interview was conducted with study participants to survey their experience with music listening (treatment group) and their overall pain experience in hospital after surgery (treatment and control groups).

Results of the study indicated that participants who listened to music after surgery (treatment group – music plus analgesic medications) reported experiencing less pain intensity and pain distress postoperatively in hospital and after discharge from hospital, but they did not report fewer opioid side effects (nausea and drowsiness) after surgery compared to participants who do not listen to music after surgery (control group – analgesic medications alone). Further, treatment group participants did not use less opioid and non-opioid pain medication after surgery compared to participants who do

not listen to music after surgery (control group). The study findings have implications for nurses to develop evidence-based protocols involving the strategic use of music listening as an adjuvant therapy, along with analgesic medications, to enhance acute surgical pain management with patients in both in the hospital and discharge (home) settings.

CHAPTER 1
INTRODUCTION

Statement of the Problem

According to the Centers for Disease Control and Prevention (CDC), in the United States an estimated 48 million surgical procedures are performed each year in the inpatient hospital setting, with an additional 53.3 million surgical and non-surgical procedures performed during ambulatory surgery visits (CDC Statistics, 2010). Depending on the surgical procedure, the symptom of pain is frequently experienced by patients after surgery (Gordon et al., 2016). If not adequately managed, acute pain can have deleterious effects, both physiological and psychological, on patients' recovery from surgery (Sinatra, 2010).

In addition to analgesic medications, the Agency for Healthcare Research and Quality (AHRQ) recommends for acute surgical pain management the use of cognitive-behavioral modalities such as relaxation, music, distraction, and imagery

(Carr & Jacox, 2006). These cognitive-behavioral modalities are also recommended for use with surgical patients by the American Pain Society and related pain professional organizations in their Clinical Practice Guidelines (Chou et al., 2016). These modalities have been shown to improve the management of pain and anxiety with surgical patients, and possibly reduce the amount of pain medication used by patients after surgery (Chou et al., 2016; Gordon et al., 2016). More specifically, studies examining the effects of music on acute surgical pain have shown music to help reduce anxiety and pain intensity, and decrease opioid intake with surgical patients in the perioperative period (Gooding et al., 2012; Hole et al., 2015).

Background and Significance

It is the professional and ethical responsibility of nurses and other health care providers to assess, intervene, and evaluate pain with surgical patients, and to relieve acute surgical pain, thereby minimizing the deleterious effects of unrelieved pain. Further, nurses spend more time with patients than any other health care providers and therefore are in an ideal position to implement additional strategies, besides offering prescribed analgesics, for pain relief. Cognitive-behavioral modalities such as music have been recommended for use with surgical patients for acute pain management by the Agency for Healthcare Research and Quality (AHRQ) for years, and need to be offered as adjuvants, along with analgesic medications, for postoperative pain relief.

Although acute pain is a predictable part of the postoperative experience, inadequate management of pain is not uncommon and this in turn can have significant implications. Unrelieved postoperative pain can contribute to clinical and psychological problems with patients resulting in negative clinical outcomes, including problems such as deep vein thrombosis, pulmonary embolism, coronary ischemia, myocardial infarction, pneumonia, poor wound healing, insomnia, anxiety and depression (Sinatra, 2010). Associated with these clinical problems are economic and medical issues such as extended lengths of hospital stay and patient dissatisfaction with medical and nursing care (Sinatra, 2010).

Pharmacological management with opioid analgesics continues to be the mainstay treatment for acute surgical pain. However, opioid analgesics can impair the postoperative recovery of surgical patients because of their sedative and emetic side effects. Practitioners who advocate for the use of complementary medical modalities

support the use of non-pharmacological adjuvants such relaxation and music for managing patients' clinical symptoms including pain.

Recently published systematic reviews have found evidence among related published studies which support using music to help decrease perioperative anxiety, postoperative pain, and reduce opioid analgesic usage with surgical patients (Cepeda et al., 2013; Economidou et al., 2012; Hole et al., 2015; Matsota et al., 2013; Sin & Chow, 2015). In recently published studies, music listening as an intervention has been found to decrease postoperative pain and in some cases, analgesic usage postoperatively in adult surgical patients (Allred, Myers, & Sole, 2010; Chen et al., 2015; Cutshall et al., 2011; Good et al., 2010; Ignacio et al., 2012; Jose et al., 2012; Lin et al., 2011; Lui & Petrini, 2015; Madison & Silverman, 2010; Mondanaro et al., 2017; Ozer et al., 2013; Vaajoki et al., 2012). These studies will be reviewed in the following chapter.

In summary, there is good empirical evidence to support the use of music as an effective adjuvant to help reduce postoperative pain with adult surgical patients, and some evidence to support the use of music to help decrease analgesic usage (The Joanna Briggs Institute, 2010). However, there are a number of methodological differences among recently published studies. For example, in published studies, use of music as an intervention varied significantly among these studies in terms of timing (when music was introduced and used during the study), dose (time allotment recommended or required for listening to music in minutes duration), frequency (number of times recommended or required for listening to the music intervention and specified time or times suggested for its use during the postoperative period), choice (either patient driven or investigator driven), and type of music (ranging from culturally sensitive

offerings to music varying in tone, rhythm, and beat). Also, studies failed to report controlling for the number of times study participants actually listened to the music intervention. In addition, postoperative pain was measured in these studies at different times during the postoperative period. These methodological issues can make meaningful comparisons among published studies somewhat difficult. Recommendations for future research often suggest that music timing, dose, frequency, choice, and type of music be examined as a means of determining the best or optimal use for implementation with surgical patients (Good et al., 2005, 2010).

These published studies examined outcomes of pain and anxiety reduction when using music for postoperative pain management with patients in the hospital setting. None of these studies examined the use of music for managing acute surgical pain post-discharge from hospital. Surgical patients are now being discharged from hospital earlier due to improved surgical techniques, and to a health care system agenda supporting outpatient and home care for surgical patients. Patients experience significant levels of pain in the early postoperative period both in hospital and when discharged from hospital. Therefore, it is necessary to empirically examine the use of non-pharmacological adjuvants such as music for acute surgical pain relief with patients post-discharge from hospital. In this study the investigator examined the use of music as a non-pharmacological adjuvant, along with prescribed analgesic, to help managing acute surgical pain with orthopedic surgery patients in both the hospital setting and after discharge from hospital.

Conceptual Framework

The conceptual model for this research study was the theory of “Balance between Analgesia and Side Effects” (Good & Moore, 1996). This middle-range theory

was chosen to guide this research study because it is a tested prescriptive theory for pain relief, and it guided this researcher to empirically identify effective pain relief practices for orthopedic surgery patients.

The Good and Moore (1996) theory of “Balance between Analgesia and Side Effects,” is a nursing pain management theory which proposes that multimodal intervention, attentive care, and patient education are needed for optimal pain relief. This theory is comprised of eight intervention concepts in three propositions that predict the outcome concept of balance (Figure 1-1). The propositions predict that (1) multimodal interventions, (2) attentive pain management, and (3) patient participation contribute to the balance between analgesia and side effects. Good (1998) purported that this balance is important because when opioids are used, the risk of side effects such as nausea, itching, and drowsiness also increases and should be countered. Further, Good (1998) indicated "the reduction of severe pain and control of medication side effects are important for ethical, humanitarian, and economic reasons" (p. 120).

The structure of the theory of “Balance between Analgesia and Side Effects,” (Good & Moore, 1996) is shown in Figure 1-1, with concepts, relationships, and propositions. The propositions from this theory are as follows:

1. Multimodal intervention: giving potent pain medication along with pharmacologic and non-pharmacologic adjuvants contributes to achieving a balance between analgesia and side effects.
2. Attentive care: regular pain assessment, regular side effect assessment, identification of unrelieved pain and unwanted side effects, and a process of intervention, reassessment, and re-intervention contributes to a balance between analgesia and side effects.
3. Patient participation: patient teaching and patient goal setting for pain relief contribute to achieving a balance between analgesia and side effects (Good, 1998).

Development of hypotheses from theoretical statements begin with deduction of specific research concepts of interest from the broader theoretical constructs (Good, 1998). In this pain theory, Good (1998) referred to two "component outcomes" that can be deduced from the theoretical construct of a balance between analgesia and side effects: decreased pain and decreased side effects from opioids (see Figure 1-2). Further, more specific concepts can be deduced from these constructs; for example, pain intensity and pain distress from the construct of pain, and nausea and drowsiness from the construct of side effects (see Figure1-3). Good (1998) explained that after research outcomes have been identified, specific research intervention concepts can be deduced. For example, with regard to the proposition of multimodal interventions and for the construct of non-pharmacologic adjuvant, the effectiveness of a music intervention on pain in addition to analgesic usage can be tested (Good, 1998).

The mechanism for the effect of music can be found in Melzack and Wall's (1965, 1996) Gate Control Theory of Pain in that mental attention to a distracting stimulus, for example, music, can modify the transmission of potentially painful impulses in the spinal cord. Music provides input into the central nervous system that allows the patient to attend to the music rather than to the pain. The pleasant and familiar stimulus of music relaxes muscles, distracts thoughts from pain and illness, evokes an effective response via descending nerve fibers, and closes the gate to perception of the sensory and affective components of pain (Good et al., 2005). The reduced tension also decreases the sympathetic nervous system stimulation of the hypothalamus, which activates endogenous opiates to inhibit the transmission of impulses that result in pain (Good et al., 2005).

Based on Good & Moore's (1996) conceptual framework and a preliminary review of the literature, it was proposed that a music intervention, used as a non-pharmacological adjuvant, would reduce postoperative pain and decrease analgesic usage. In addition, it was proposed that music would decrease analgesic side effects (nausea and drowsiness) among orthopedic surgery patients due to decreased analgesic usage.

Specific variables measured in this study to assess the patient's response to the music intervention included pain intensity, pain distress, state anxiety, opioid and non-opioid analgesic usage, and analgesia side effects of nausea and drowsiness. Figures 1-2 & 1-3 illustrate the operationalization and adaptation of the theory of "Balance between Analgesia and Side Effects," (Good & Moore, 1996) in this research study.

Significance of the Study

This study investigated the use of a music intervention on pain intensity, pain distress, nausea, drowsiness, and analgesic usage in a sample of orthopedic surgery patients during the postoperative period in hospital and post-discharge from hospital. A follow-up interview was conducted with study participants to gather additional information regarding their perceptions of using music to help relieve postoperative pain and their perceptions of their overall pain experience in hospital after surgery. It was proposed that the positive effects of a music intervention on pain intensity, pain distress, nausea, drowsiness, and analgesic usage would reduce the deleterious effects of unrelieved postoperative pain with study participants. Examining how the effective use of postoperative analgesics and music therapy can balance analgesia (pain relief) and analgesic side effects (for example, nausea and drowsiness) with postoperative patients is important for nurses to determine so nurses can prescribe effective interventions for

postoperative pain management that will result in positive outcomes for surgical patients.

Assumptions

This research was based on several assumptions. First, it was assumed that the human response to pain is multifactorial and interrelated, with significant individual variation. Second, it was assumed that humans develop a pain response to noxious stimuli. Third, it was assumed that the measurement tools used were valid and reliable instruments. Fourth, it was assumed that study participants answered the self-reporting measurement tools of Pain Intensity Scale (NRS), Pain Distress Scale (NRS), the STAI Form Y-1 State Anxiety Scale, and the numerical rating scales used for Nausea and Drowsiness truthfully.

Purpose of the Study

The purpose of this study was to investigate the use of a music intervention as an adjuvant with prescribed analgesia to help reduce postoperative pain with patients undergoing knee or hip joint replacement surgery.

Aims of the Study

This research study was a prospective randomized trial that evaluated the use of a music intervention along with prescribed analgesia to reduce postoperative pain with patients who had undergone knee or hip joint replacement surgery. The specific aims of this study were:

1. To determine the effect of music listening on pain intensity, pain distress, opioid side effects of nausea and drowsiness, and opioid and non-opioid analgesic usage in the early postoperative period (evening of surgery, days one and two postoperatively, and two days post-discharge from hospital);

2. The examine patients' perceptions of their music listening experience after surgery, and their perceptions of their overall pain experience in hospital after surgery.

Research Questions

Question 1. What are the levels of pain intensity, pain distress, opioid side effects of nausea and drowsiness, and opioid and non-opioid analgesic usage among adult patients undergoing joint arthroplasty surgery the evening of surgery, during the first two postoperative days in hospital, and during the first two days post-discharge from hospital?

Question 2. In adults undergoing joint arthroplasty surgery, is state anxiety associated with postoperative symptoms of pain (intensity and distress), nausea, and drowsiness the evening of surgery?

Question 3. In adults undergoing joint arthroplasty surgery, is a combined intervention (music therapy plus analgesic medications) more effective than analgesic medications alone in reducing postoperative symptoms (pain intensity, pain distress, nausea, drowsiness) the evening of surgery, during the first two postoperative days in hospital, and during the first two days post-discharge from hospital?

Question 4. In adults undergoing joint arthroplasty surgery, do participants who receive the combined intervention (music therapy plus analgesic medications) use less opioid and non-opioid analgesics than those participants who receive analgesic medications alone during the first two postoperative days in hospital, and during the first two days post-discharge from hospital?

Question 5. What are study participants' perceptions of their music listening experience after surgery (music group), and their perceptions of their overall pain experience in hospital after surgery (music and control groups)?

Hypotheses of the Study

Hypothesis 1. State anxiety will be significantly associated with higher levels pain intensity, pain distress, and nausea, and lower levels of drowsiness in study patients the early postoperative period (evening of surgery).

Hypothesis 2. Controlling for pre-test symptom levels, (pain intensity, pain distress, nausea and drowsiness scores), patients who listened to music after surgery as an adjuvant to analgesic medications will report significantly lower pain intensity, pain distress, nausea, and drowsiness symptoms after listening to music compared to patients who received analgesic medications alone the evening of surgery, during the first two postoperative days in hospital, and during the first two days post-discharge from hospital.

Hypothesis 3. Patients who listened to music after surgery as an adjuvant to analgesic medications will use significantly less opioid and non-opioid analgesics compared to patients who received analgesic medications alone during the first two postoperative days in hospital, and during the first two days post-discharge from hospital.

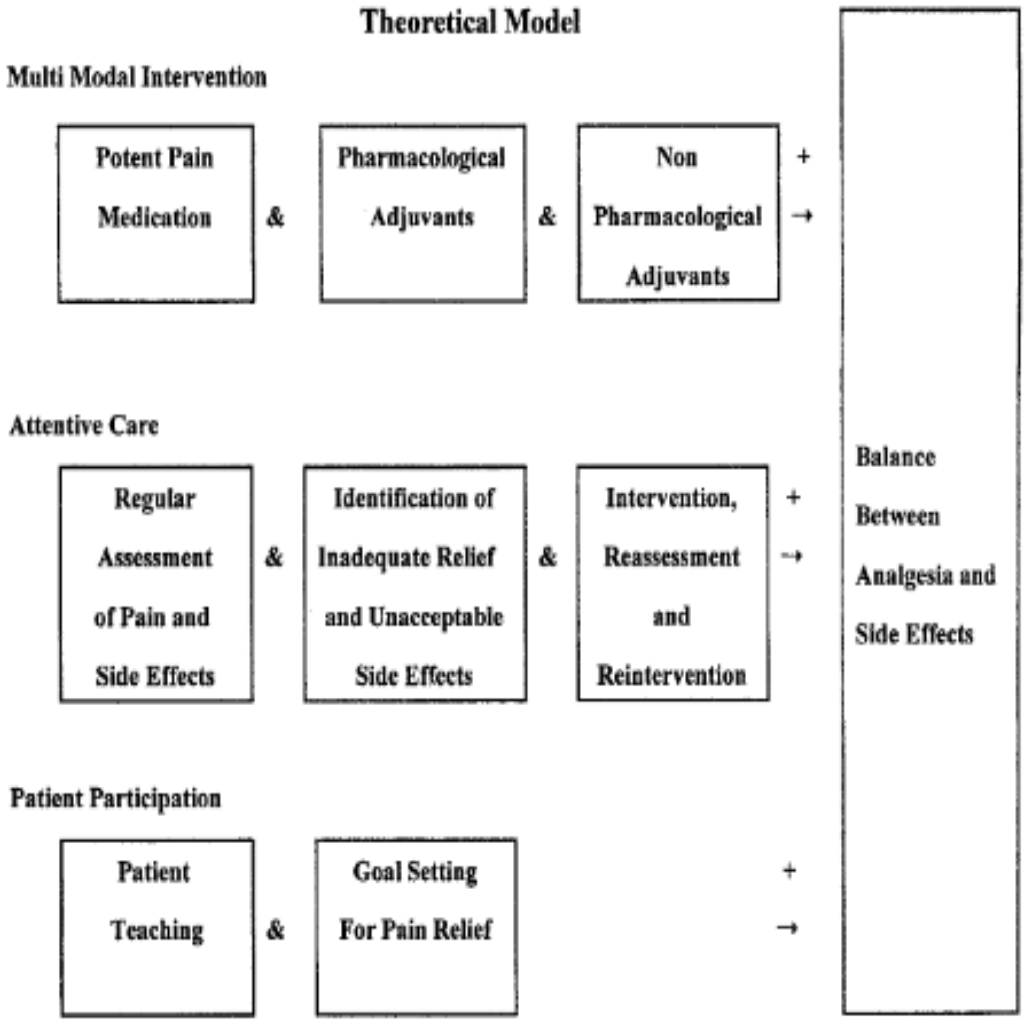


Figure 1-1. Good & Moore's (1996) Theory of Balance between Analgesia and Side Effects (Parent Model of study)

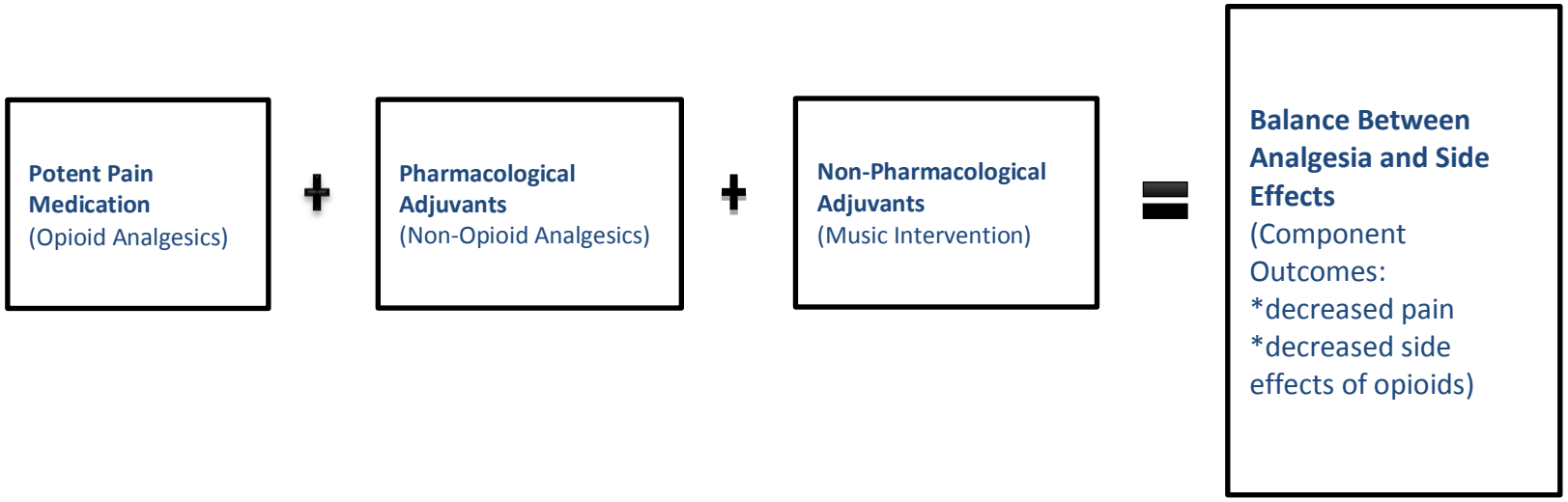


Figure 1-2. Multi-Modal Intervention from the Theory of Balance between Analgesia and Side Effects (Good & Moore, 1996) applied to Use of Music Listening to Enhance Acute Surgical Pain Management with Patients Undergoing Orthopedic Surgery (Conceptual Model of study).

Construct	Potent Pain Medications	Pharmacological Adjuvants	Non-Pharmacological Adjuvants	Enhanced	Post-operative	Pain Management
Theoretical Concepts	**Opioids:** -prescribed -administered -equianalgesic dose (morphine equivalent)	**Non-Opioids:** -prescribed -administered -equianalgesic dose (acetaminophen equivalent)	**Music Intervention:** -study treatment	**Pain Reduction /Relief:** -pain intensity -pain distress	**Analgesic Usage Reduction:** -opioids & non-opioids given	**Decreased Side Effects of Analgesics** (Nausea, Drowsiness) following surgery
Empirical Indicators	**Opioids:** -# doses administered during select postop periods; -total amount in equianalgesic dose administered during select postop periods	**Non-Opioids:** -# doses administered during select postop periods; -total amount in equianalgesic dose administered during select postop periods	**Music Intervention:** -patient choice of music -music listening 3 x per day, 30 minutes duration during select postop periods	**Pain Reduction:** -Pain Intensity “at worst/right now” with NRS during select postop periods; -Pain distress “at worst/right now” with NRS during select postop periods	**Analgesic Usage:** -total amount in equianalgesic dose administered during select postop periods	**Side Effects:** -Nausea “at worst/right now” with NRS during select postop periods; -Drowsiness “at worst/right now” with NRS during select postop periods

Figure 1-3. Constructs, Theoretical Concepts, & Empirical Indicators (CTE) for Use of Music Listening to Enhance Acute Surgical Pain Management with Patients Undergoing Orthopedic Surgery.

CHAPTER 2
LITERATURE REVIEW

Postoperative Pain: An Overview

Postoperative pain is an unpleasant symptom that is commonly experienced by surgical patients. It has been reported that 77- 98% of surgical patients experience postoperative pain, and of these, 40-80% report moderate-to-severe pain, and half (40-50%) further report unsatisfactory pain management (Lin, 2011). Moderate to severe acute surgical pain not well managed after surgery can contribute to the development of chronic persistent surgical pain problems (Bruce & Quinlan, 2011). Uncontrolled postoperative pain contributes to respiratory, cardiovascular, gastrointestinal, genitourinary, muscular, endocrine, and metabolic system complications for patients after surgery (Sinatra, 2010). For the patient, this can result in prolonged hospitalization and delayed recovery from surgery (Sinatra, 2010). Further, the Joint Commission on the Accreditation of Health Care Organizations (TJC) requires that pain be assessed and managed for all hospitalized patients. This accreditation requirement stresses the importance that health care providers should place on adequately managing pain with hospitalized patients. In nursing practice, pain management is considered a fundamental and important component of effective patient care.

Treatment of Postoperative Pain

In order to achieve effective pain control after surgery, it is widely recommended in clinical practice guidelines that nurses use non-pharmacological measures such as relaxation, guided imagery, music, and distraction, along with administering prescribed analgesics, to holistically and effectively manage the surgical patient's pain experience (Carr et al., 1992; The Joanna Briggs Institute, 2011). These measures are believed to

be useful because some patients can experience significant adverse effects and side effects with prescribed opioid analgesic use. While analgesics are prescribed to primarily manage the physiological component of pain, non-pharmacological measures are believed to manage the emotional and psychological components of the surgical patient's pain experience (Good et al., 2010). Music was chosen as the intervention for use in this study. The rationale for choosing music was music has additional benefits that other cognitive-behavioral modalities may not in that it provides complex sounds including characteristics such as pitch, rhythm, and tempo that evoke personal meaning and often pleasant memories for individuals (McCaffery & Good, 2000).

Music as a Treatment Intervention: Marion Good's Pioneering Program of Research

Since 1995, noted nurse researcher and theorist Dr. Marion Good has developed a body of theoretical and research knowledge regarding the efficacy of complementary therapies for pain management and stress. Her scholarly work which spans two decades, is based on best practices and has influenced health care policy within and outside of the United States. In her body of research Dr. Good has developed complementary or non-pharmacological nursing interventions using relaxation training, music therapy, and patient teaching for pain management for use with a variety of patient populations. Dr. Good and colleagues have examined the use of culturally appropriate variations in music therapy for use with patients from Taiwan, Korea, and Thailand. In 1996, along with Dr. Shirley Moore, Dr. Good developed the theory of "Balance between Analgesia and Side Effects." This theory was one of the first middle range prescriptive theories in nursing and pain management (Good & Moore, 1996). In her subsequent research, Dr. Good and colleagues have tested constructs of her theory

in studies examining non-pharmacological nursing interventions to manage pain and stress. Findings from research studies in which she examined the use of relaxation and music therapy to manage pain and stress with various patient populations are summarized and presented in chronological order below.

In Good's first published study in 1995 which was based on her doctoral dissertation work, she reported on an experimental study she conducted in which she examined the effects of jaw relaxation and music, administered individually and combined, on the sensory and affective components of pain and narcotic intake with a sample of 84 subjects during first ambulation effort on postoperative day one following abdominal surgery. She reported that the interventions were neither effective nor significantly different from one another statistically during patient ambulation. The relaxation intervention tape was used the least among relaxation group participants, perhaps, as Good (1995) offered, because it was less interesting than the music or combination tapes used in the study. Anecdotally, Good (1995) reported that experimental group participants who used relaxation and music, either individually or combined, did indicate that during the first two days after surgery, participants found the interventions helpful for relieving sensation and distress from postoperative pain. She reported that the majority of study participants found the intervention tape moderately or very helpful (76%), felt it reduced pain sensation and distress from pain (89%), indicated that they would use it again for surgery (92%), and would recommend it to others (95%). Good (1995) offered a number of factors as possible reasons for the difficulty in demonstrating effect in the study including higher and more vulnerable pain experienced by postoperative patients during first ambulation effort, as well as the

difficulty of initiating the study intervention techniques during the complex activity of ambulation.

In 1998, Good and Chin published a study in which Western music was tested for its effectiveness in reducing postoperative pain, and explored the acceptability and preferences for this music with a sample of 38 Taiwanese subjects who had undergone major abdominal surgery. Using a pretest-posttest experimental design, pain sensation and distress of pain were measured using visual analog scales. Treatment group participants received tape-recorded music and choose from among 5 types of Western music while control group participants received usual care. On postoperative day 1 and day 2, the effectiveness of the tape-recorded music was examined with participants during 15 minutes of rest in bed. On postoperative day 3, participants were interviewed to determine their liking of the music, its calming effects, and the helpfulness of the music in reducing pain after surgery.

Results from their study indicated that participants who listened to music experienced a greater decrease in pain distress on postoperative day 1 ($p<0.05$) (not on postoperative day 2) and a greater decrease in pain sensation on postoperative day 2 ($p<0.05$) (but not on postoperative day 1) than participants who did not listen to music. Further, they reported that participants' liking for the music were similar to subjects in previous studies conducted by Dr. Good in the United States. They reported music to be helpfulness in relieving pain sensation and pain distress from surgery; however, fewer Taiwanese participants found the Western music choices calming, and instead chose harp music over jazz music. These investigators concluded that findings from their study support the use of culturally acceptable music, in addition to analgesic

medication, for the relief of postoperative pain with Taiwanese patients who had undergone abdominal surgery (Good & Chin, 1998).

In 1999, Good and colleagues published a study reporting on a large randomized clinical trial conducted to determine the effect of jaw relaxation, music, and the combination of jaw relaxation and music on patients' postoperative pain with a sample of 500 subjects during ambulation and rest on postoperative days 1 and 2 after major abdominal surgery. They measured pain and distress at four time periods on postoperative days 1 and 2: before preparing for ambulation, after preparing for ambulation, after ambulation, and after recovery from ambulation.

Good and colleagues (1999) found that in all three treatment groups, participants reported experiencing significantly less sensation and distress from pain than control group participants at three of the four ambulation times: before preparing for ambulation, after preparing for ambulation, and after recovery from ambulation on both postoperative days ($p=0.028 - 0.000$). Specifically, combination (jaw relaxation and music) group participants reported significantly less sensation and distress from pain than control group participants at these same periods on both postoperative days ($p=0.035 - 0.000$), and relaxation and music group participants reported significantly less sensation and distress from pain than control group participants at these same time periods on both postoperative days ($p=0.022 -0.000$). They found that after ambulation, participants using relaxation did not have significantly less pain than control group participants on postoperative days 1 and 2, and participants using music did not have significantly less pain than control group participants on postoperative day 2. In explaining these findings they offered that there was likely a decrease in mastery of the

study interventions from pre- to post-ambulation, suggesting the need for reminders to help patients focus on the intervention during this painful activity (Good et al., 1999). The investigators indicated the results of their study supported Good and Moore's (1996) pain management theory in that with patients, non-pharmacological adjuvants, along with analgesic medications, reduce pain more than analgesic medications alone.

In 2002, Good and colleagues published a study reporting on a randomized clinical trial conducted to investigate the effect of three non-pharmacologic nursing interventions: relaxation, music, and the combination of relaxation and music on pain with a sample of 311 women subjects during ambulation and rest on postoperative days 1 and 2 after gynecologic surgery. They found that participants in the three treatment groups reported experiencing significantly less sensation and distress from pain than control group participants (p=.022 - .001). They determined that participants who received the interventions plus routinely ordered patient-controlled analgesics (PCA) had 9% to 29% less pain than control group participants who used PCA alone. The investigators offered that the results of their study supported Good and Moore's (1996) theory of pain management theory that adjuvant use of non-pharmacologic methods of pain relief result in less pain than use of analgesic medications alone.

In 2003, Phumdoung and Good published a study reporting on a randomized clinical trial conducted to examine the effects of music on sensation and distress from pain with a sample of 110 first pregnancy Thai women during the active phase of labor. Participants in the music group listened to soft music without lyrics for 3 hours starting early in the active phase of labor. They found that music group participants reported experiencing significantly less sensation and distress from pain than did control group

participants ($p<.001$, effect size .12-.15). They offered that in their study, music- a mild to moderate strength intervention - consistently provided significant relief from severe pain across 3 hours of labor, and that music should be provided to laboring women during their active phase when contractions are strong and women suffer.

In 2004, Voss, Good, and colleagues published a study reporting on a randomized clinical trial conducted to determine the effectiveness of non-pharmacological methods (sedative music and scheduled rest) in reducing anxiety and pain during chair rest with a sample of 61 subjects who had undergone open-heart surgery. Using a three-group pretest-posttest experimental design, participants were randomly assigned to receive sedative music, scheduled rest, or treatment as usual during chair rest. They found that participants in the sedative music and scheduled rest groups reported significantly less anxiety, sensation and distress from pain than treatment as usual (control) participants ($p<0.001$ - 0.015). Further, they found that participants in the sedative music group reported significantly less anxiety, sensation and distress from pain than rest group or treatment as usual (control) group participants ($p<0.001$ - 0.006). They concluded that in their study, sedative music used as an adjuvant, along with analgesic medications, was more effective than scheduled rest or treatment as usual to decrease anxiety and pain in open-heart surgery patients during first time chair rest in the early postoperative period.

In 2005 Good and colleagues published a study reporting on a randomized control trial conducted to determine the effectiveness of three non-pharmacological nursing interventions (relaxation, chosen music, and their combination), in reducing pain sensation and distress in a sample of 167 patients during ambulation and rest on

postoperative days 1 and 2 after intestinal surgery. They found that all three treatment group participants reported significantly less pain sensation and distress than control group participants on both postoperative days after rest and at three of six ambulation efforts during these postoperative days (p=.024 - .001). In explanation of these mixed findings, they offered that in their study, participants reported large variations in pain experienced in addition to having difficulty relaxing while returning to bed. The investigators indicated that study evidence at most data points supported the Good and Moore (1996) theoretical proposition that non-pharmacological modalities, in addition to analgesics, are more helpful for satisfactory pain relief than use of analgesics alone.

In 2006, Siedliecki and Good published a report on a randomized controlled clinical trial examining the effect of music on patients' perceptions of power, pain, depression, and disability comparing the effects of researcher-provided music (standard music) with subject-preferred music (patterning music) for a sample of 60 working age African American and Caucasian adult subjects with chronic non-malignant pain (CNMP). Study participants listened to either researcher-provided music or subject-preferred music for 1 hour each day over a period of 7 days, and were asked to keep a diary of their music listening experience and pain experience each day. Control group participants were asked to keep a diary of their pain experience each day. Pain was measured using the short form McGill Pain Questionnaire. They found that music group participants reported feeling more power (p=0.048), less pain (p=0.002), less depression (p=0.002), and less disability (p=0.024) than control group participants. However, there were no statistically significant differences between the two music intervention participant groups' reports on these study measures. The investigators

offered that findings in their study suggested that with individuals who experience chronic non-malignant pain, music interventions altered patterns of pain, depression, and disability associated with CNMP, and music interventions facilitated the perception of power among study participants.

In 2008, Good and Ahn published a study reporting on a randomized clinical trial conducted to examine the effects of music on pain after gynecologic surgery with a sample of 73 Korean women, comparing pain relief between women who chose American or Korean music. Using a quasi-experimental pretest-posttest design, Korean women assigned to the experimental group were instructed to choose among Korean (ballads and religious and popular songs) and American (soft slow piano and orchestra) music, and were instructed to listen to their chosen music at four time points the morning and afternoon of postoperative days 1 and 2. Control group participants were instructed to rest in bed during these same four time points. Pain was measured in this study using sensation and distress visual analog scales. They found that two-thirds of women in the music group chose Korean music and one-third of women chose American music. Among these music group participants, there were no differences in reported pain sensation and distress, and both were effective in relieving postoperative pain. When comparing music group participants and control group participants, there was a significant difference in reported pain sensation and distress at three of the four postoperative time points ($p=0.001 - 0.040$). The investigators determined that results from their study support Good and Moore's (1996) nursing pain management theory in that a balance of pharmacologic and non-pharmacologic methods provided up to 23% better pain management than analgesics alone. Further, they indicated their study

supported offering music that would include culturally and religious-based music choices to women after gynecologic surgery to aid in relieving their postoperative pain.

In 2010, Good and colleagues published a study reporting on a large randomized clinical trial conducted to examine the effectiveness of the use of audiotaped patient teaching for different combinations of non-pharmacological pain treatments: audiotaped preoperative patient teaching for pain management (PT), audiotaped jaw relaxation technique and music (RM), and a combination of audiotaped preoperative patient teaching for pain management and jaw relaxation and music (PTRM) with a sample of 517 subjects who had undergone abdominal surgery. Their study is described in detail in the upcoming literature review section entitled, Recent Studies Examining Music Therapy.

Lastly, in 2013, Good and colleagues published a study reporting on determining whether two interventions, preoperative patient teaching (PT) for pain management and relaxation/music (RM), reduced cortisol levels, an indicator of stress, with subjects who had undergone abdominal surgery. Their data was a secondary analysis from the large randomized clinical trial of the effects of these interventions on pain, a parent study referred to as the Pain Study (N=517) (Good et al., 2010). Subjects with complete data at pre- and post-test were analyzed in this secondary analysis.

As background information to better understand the relevance for nurses to study the clinical variable of cortisol level empirically, the following explanation was provided by Dr. Good: In surgical patients, increased cortisol level is a physiological response of the body to the creation of a surgical incision, excision of body tissue during surgery, trauma to the body tissue experienced during surgery, and pain associated with major

surgery. Cortisol levels are an indicator of the physiological and psychological stress of surgery and postoperative pain, and can result in patients being more susceptible to infection and complications after surgery (Good et al., 2013). Therefore, it behooves nurses to study this clinical variable empirically and examine nursing interventions that would aid in not only relieving postoperative pain but have a significant physiological effect on decreasing cortisol levels with surgical patients.

Using a 2 x 2 factorial design, Good and colleagues (2013) compared groups for PT effects and RM effects on cortisol levels. From the parent study (Good et al., 2010), participant salivary cortisol levels (N=205) were measured before and after 20 minute tests of the interventions in the morning and afternoon of postoperative days 1 and 2. The investigators reported there was no empirical evidence to suggest a PT effect or RM effect on cortisol levels in either the morning or afternoon of postoperative days 1 and 2 among study participants. They found that participants varied in their stress/cortisol responses to the two nursing interventions (PT & RM). They suggested that because there were no adverse effects noted in their cortisol/stress study, nurses can offer relaxation and choice of music to patients on postoperative days 1 and 2 to relieve pain and stress. They recommended that nurses continue to use relaxation training and music therapy to relieve postoperative pain with surgical patients based on the findings of their parent Pain Study (Good et al., 2010).

In summary, Dr. Good's scholarly work, which spans close to two decades, provides a sound empirical base to support the clinical use of relaxation training and music therapy as non-pharmacological treatment interventions nurses can use to help reduce postoperative pain with surgical patients. Further, in her empirical work she

tested the efficacy and found support for use of her pain management theory “Balance between Analgesia and Side Effects” (Good & Moore, 1996) to guide nursing research on pain management. It is noteworthy that among her many studies she did not specifically investigate the effect of non-pharmacological treatment interventions on the incidence or intensity of side effects (for example, nausea, itchiness, drowsiness) that can be experienced by patients when taking opioid analgesics to relieve pain. This observation is consistent with e-mail correspondence between Dr. Good and this investigator (dated 07/14/14). Therefore, exploring this gap in the use of her theory “Balance between Analgesia and Side Effects,” (Good & Moore, 1996) is an additional and further step needed to determine the efficacy of this theory for use in nursing research and pain practice.

Music as a Non-Pharmacological Treatment Intervention

In the empirical literature, relaxation, guided imagery, music therapy, therapeutic touch, and massage are examples of non-pharmacological measures that have been examined for use with surgical patients to help reduce postoperative pain. This review was limited to the past seven years, and focuses on recent studies and systematic reviews that have examined the use of music therapy in reducing postoperative pain with adult surgical patients.

Recent Studies Examining Music Therapy

Cognitive-behavioral approaches for pain management have been studied by investigators using a variety of surgical patients. Music therapy, a cognitive-behavioral approach, is believed to decrease anxiety in the perioperative period and reduce pain in the postoperative period among surgical patients. A number of investigators examined the use of music therapy as an adjuvant intervention in reducing postoperative pain and

reducing analgesic usage with surgical patients. Studies published within the past seven years that examined the use of music therapy to reduce postoperative pain in adult surgical patients will be synopsized below. These studies will be presented by type of surgery.

Cardiovascular Surgery Studies

Lui and Petrini (2015) examined the effectiveness of music listening on pain, anxiety, and vital signs among patients after thoracic surgery. They conducted a randomized controlled trial with repeated measures design at two tertiary teaching hospital in China. The convenience sample included 112 patients who were randomly assigned to experimental (n=56) (odd admission day numbers) or control (n=56) (even admission day numbers) groups. Experimental group participants received standard care and a 30 minute soft music intervention for 3 days, while control group participants received only standard care. Outcome measures included pain (using the Faces Scale), anxiety (using the State-Trait Anxiety Inventory), vital signs (blood pressure, heart rate, and respiratory rate), patient controlled analgesia (PCA) (opioid drug dosage used was counted), and diclofenac sodium (a non-steroidal anti-inflammatory drug) suppository use (consumption in milligrams used). Experimental group participants were visited on postoperative day 1, and pre-test data (pain, anxiety, vital signs) collected, and provided a 30 minute music session. Soft music with 60-80 beats per minute or less was offered to participants via a MP3 (digital audio) player with earphones. After listening to music, post-test measures were obtained with participants. Study investigators continued pre- and post-test measures with the music intervention on postoperative days 2 and 3 with experimental group participants. Control group participants received only standard care (not described by investigators) and stated only

that the same pre-test and post-test tests were conducted with participants in this group. After all data were collected, the investigators reported offering music to control group participants if wanted. Descriptive, non-parametric (Chi-Squared Test), and parametric statistics (Independent t-Tests, Repeated Measures of Analysis of Variance) were used to analyze the study data.

Results of this study indicated no significant differences between demographics and baseline (pre-test) measures on study variables among participants. Experimental group participants did report significant decreases in pain (Wald $\chi 2=5.498$, $p=0.019$), anxiety ($F=5.560$, $p=0.02$), systolic blood pressure ($F=4.495$, $p=0.04$), and hear rate ($F=4.379$, $p=0.04$) postoperative days 1, 2 and 3, compared to the control group participants, but no significant differences were found between group participants in diastolic blood pressure, respiratory rate, opioid analgesic usage (via PCA) and diclofenac sodium suppository use.

These investigators concluded that findings from their study provided further evidence to support the practice of using music therapy to reduce postoperative pain and anxiety, and lowering systolic blood pressure and heart rate in patients after thoracic surgery (Lui & Petrini, 2015). Their lack of significant findings for music lowering diastolic blood pressure, respiratory rate, and opioid analgesic usage was consistent with some past studies but inconsistent with other past studies cited in their work.

Ozer and colleagues (2013) examined the effect of listening to personal choice of music on self-reported pain intensity and physiological parameters of blood pressure, heart rate, oxygen saturation, and respiratory rate in patients undergoing open heart

surgery (coronary bypass graft surgery or valve replacement surgery). Their quasi-experimental design study was conducted using a convenience sample of 87 adult subjects: 44 music group participants and 43 control group participants. Participants who were randomly assigned to the music group listened via a portable cassette player with earphones for 30 minutes duration to music in the mid-afternoon of postoperative day one. (This was the standard postoperative protocol time in the intensive care unit (ICU) setting for all patients to rest in bed). The self-selected music was from the investigators' collection of 20 musical pieces which contained a variety of different types of music including Turkish classic music, Turkish folk music, and Turkish art music. Fifteen minutes prior to the scheduled bed rest time on postoperative day one, the investigators gathered demographic and physiological data, and asked participants to rate their pain using a verbal descriptor pain intensity scale. Physiological parameters were recorded and pain intensity was rated immediately after 30 minutes of music was completed with experimental group participants and after 30 minutes of scheduled bed rest with control group participants.

Results of this study indicated that there was a significant difference between the mean pain intensity ratings of music group participants after the music therapy and the mean pain intensity ratings of control group participants after the bed rest period ($p = .000$), but there was no difference between the group means pain intensity ratings at pre-test. There were no significant differences between post-test means for systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR), oxygen saturation (Sp02), and respiratory rate (RR) physiological parameters for music group and control group participants. However, when examining within group differences,

investigators found that after music therapy, comparing pre- & post-test scores, there was a significant decrease in mean pain intensity ratings of music group participants (p=.000). With regard to physiological parameters, findings indicated that music therapy resulted in an increase in the mean Sp02 (partial pressure of oxygen saturation) score of music group participants (p=0.00). No significant differences were found between the groups for the other four physiological parameters (SBP, DBP, HR, & RR). In the control group, no significant differences were found on any of the physiological parameters.

The investigators concluded that listening to music after surgery did reduce postoperative pain with patients who had undergone open heart surgery. Ozer and colleagues (2013) concluded that their findings were consistent with other studies that examined the effects of music on postoperative pain with patients who had undergone cardiac surgery.

In another study involving cardiovascular surgery patients, Jose and colleagues (2012) examined the effect of music therapy on pain perception and physiological parameters of blood pressure and pulse rate in patients who had undergone surgery and were being treated on the postoperative ward in the Cardiothoracic Vascular Surgery Department of a hospital in New Delhi. Their pretest-posttest experimental design study was conducted with a convenience sample of 60 adult subjects, with patients randomly assigned to receive music therapy (n=30) (treatment group) or rest (n=30) (control group). Treatment group participants received music therapy which included listening to old Hindi songs, devotional songs, and instrumental songs. These study participants were instructed to listen to music provided via a MP3 (digital audio)

player with headphones for a duration of 20 minutes. (The investigators did not specify whether participants were allowed to choose the type of music they would listen to, and they did not indicate what day or time after surgery the music listening occurred with treatment group participants). Pre-test pain perception was measured with treatment and control group participants using a numerical rating scale. (The investigators did not define or describe pain perception in their study). Pre-test blood pressure and pulse rate were assessed with participants in both groups. Treatment group participants were instructed to listen to music for a duration of 20 minutes, and then they were asked to rest for 10 minutes. Participants in the control group were asked to rest for a duration of 30 minutes. Post-test pain perception, blood pressure, and pulse rate were assessed with participants in both groups.

Results of this study indicated that treatment and control groups were homogeneous with regard to pain and physiological parameters of blood pressure and pulse rate. Importantly, these investigators found there were significant decreases in mean post-test scores of music group participants with regard to pain ($p<0.05$), systolic ($p<0.05$) and diastolic ($p<0.05$) blood pressure, and pulse rate ($p<0.05$). Further, they found significant differences between treatment and control groups with regard to mean post-test scores for pain ($p<0.05$), systolic ($p<0.05$) and diastolic ($p<0.05$) blood pressure, and pulse rate ($p<0.05$). In addition, treatment group participants who listened to music reported music had helped reduce their pain, had a soothing effect, and effected their mood in a positive way (from unpleasant to pleasant). Interestingly, after interviewing staff nurses and doctors at the study hospital about their attitude towards using music therapy as a pain management strategy, the investigators reported

80% of doctors and nurses had moderately favorable attitudes and only 20% of doctors and nurses had highly favorable attitudes. The investigators concluded that in their study, music therapy was effective in reducing pain perception scores and had positive effects on the physiological parameters (blood pressure and pulse rate) with patients who had undergone cardiac surgery.

In another study with cardiovascular surgery patients, Cutshall and colleagues (2011) examined the efficacy and feasibility of ambient music with nature sounds on postoperative pain and anxiety. The study sample consisted of 100 adult participants (n=49 in the music group; n=51 in the control group). Participants were randomized to treatment groups in the following manner: at the start of postoperative day 2, participant pain levels were assessed on a scale from 0 (no pain) to 10 (the most intense pain). Randomization was based on a pain level of 4 or less (the institution's pain level goal) or greater than 4 (pain levels of 5 to 10). The randomization was blocked to ensure balanced allocation throughout the course of the study. A stratified randomized experimental design was used to assign patients to standard postoperative care in combination with ambient music sessions (music group) or to standard postoperative care in combination with matched quiet resting sessions (control group). On the morning of postoperative day 2, pain, anxiety, overall satisfaction with the study intervention (not defined further in the study), and relaxation were measured with visual analog scales (VAS), and physiological parameters of blood pressure and heart rate were assessed with all study participants. Participants in the music group were given a choice of one of four compact discs consisting of ambient music with nature sounds, and using CD (compact disc) players in the privacy of their rooms, listened to the music

for 20 minutes duration twice daily, in the morning and afternoon of postoperative days 2, 3, and 4. After 20 minutes of music therapy, measurements were repeated for pain, anxiety, relaxation, overall satisfaction before and after with the study intervention, In addition, blood pressure and heart rate were measured at this time. Data were collected on age, sex, surgical procedure, and total daily dosage of opioids administered over the 3-day period for both music and control groups. Participants assigned to the control group were encouraged to rest in bed for 20 minutes duration twice daily in the mornings and afternoons of postoperative days 2, 3, and 4. Pain, anxiety, relaxation, blood pressure, and heart rate were collected before and after rest periods with control group participants.

Results of this study indicated a significant decrease in mean pain scores in the afternoon session on postoperative day 2 only for music group participants when compared to control group participants mean pain scores (p=.001). Results indicated mean relaxation scores improved in the morning session of postoperative day 2 for music group participants compared to control group participants mean relaxation scores (p=.03). Besides these differences, results indicated no significant differences between music group participants and control group participants mean anxiety levels or satisfaction overall with the music intervention. With regard to participants' analgesic usage during their hospital stay, results indicated no significant differences between group participants.

These investigators concluded that mixed results in their study were consistent with other studies which examined the effects of music listening with hospitalized patients. They recommended that interventions such as ambient music should be

considered as an adjuvant for more complete relief of postoperative pain with cardiac surgery patients (Cutshall et al., 2011).

Neurosurgery Studies

Mondanaro and colleagues (2017) conducted a mixed-methods study examining the effects of music therapy interventions on the recovery of patients after spinal surgery. Their study combined standard medical approaches and integrative music therapy. Sixty patients (35 female, 25 male), ranging in age from 40-55 years, undergoing anterior, posterior, or anterior-posterior spinal fusion, were randomly assigned to music therapy plus standard care (medical and nursing care with scheduled pharmacologic pain intervention) or standard care only. Patients in the experimental group received one 30 minute music therapy session during an 8 hour period within 72 hours of surgery. Music therapy involved the use of patient-preferred live music that supported tension release/relaxation through incentive-based clinical improvisation, singing, and/or rhythmic drumming or through active visualization supported by live music that encompassed tension resolution. The live music intervention was provided by a licensed music therapist, and individualized to preferences of study participants. At the end of the live music experience, participants were asked to share with the music therapist their thoughts, impressions, or issues that contributed to their perceptions of their surgical outcome. The investigators failed to describe, short of not receiving the live music intervention, what was done with control group participants who received only standard care.

Measurements in both groups were completed before and after the music intervention and included pain ratings using a visual analog scale (primary outcome measure), and anxiety and depression ratings using the Hospital Anxiety and

Depression Scale (HADS), fear of movement ratings using the Tampa Scale for Kinesiophobia (TSK) (secondary outcome measures). Qualitative data from the post live music intervention interview with music therapy participants were coded, and grouped into themes that had been peer-tested by members of the research team. Descriptive statistics were used to analyze demographic data, and quantitative data, specifically the outcome measures, were analyzed using parametric (repeated-measures analysis of variance) statistics.

Results from their study indicated control and music therapy group participants reported significantly different pain ratings (measured by visual analog scale) before and after music intervention (p=.01). Control and music group participants did not differ in scores on the Hospital Anxiety and Depression Scale (HADS), anxiety (p = 0.62) and depression (p=0.85) or on the Tampa Scale for Kinesiophobia (p=0.93). Perceptions of surgical outcome in participants' responses were coded across 3 themes: (1) optimistic: belief and hope in returning to original baseline of functionality; (2) indifferent: neither hopeful nor cynical about results of surgery; and (3) pessimistic: belief that nothing will restore the quality of life that existed before the spinal condition.

These investigators concluded that music therapy, specifically patient-preferred live music, offered within a therapeutic relationship (a licensed music therapist) favorably affected pain perception in patients recovering from spinal surgery. (Mondanaro et al., 2017). They recommended hospitals look into developing structured postoperative music therapy programs to benefit postoperative patients experiencing pain.

Lin and colleagues (2011) examined the effects of music therapy on anxiety, postoperative pain, and physiological reactions to emotional and physical distress in patients undergoing spinal surgery. The study was conducted using a quasi-experimental pretest and posttest design with a sample of 60 adult subjects who were assigned to the study group (n=30) or control group (n=30), depending on the day of their surgery. Participants in the music group selected their favorite music from prepared music offerings from the investigators. These music offerings included pop music, classical music, sounds found in nature, and sacred music, all soft melodies in the participants' native language of Chinese. Music group participants listened to their music selection via a MP3 (digital audio) player for 30 minutes duration the evening before surgery, 1 hour before surgery, and in the mid-afternoon on the first and second day after surgery. In addition, participants were encouraged to listen to music at any other times they desired. Measurements of participants' levels of pain intensity and anxiety using a visual analogue scale (VAS) and measurements of the physiological parameters pulse rate and blood pressure were recorded before and after scheduled music listening times. On the evening before surgery and on the second day after surgery, state anxiety was measured using the State-Trait Anxiety Inventory. In addition, participants' urine was collected for 24 hour analysis before surgery and each postoperative morning at 7:00 A.M. until the third day after surgery to test for cortisol, norepinephrine, and epinephrine concentrations in urine. (The investigators indicated that cortisol excretion in 24-hour urine samples have correlated reliably with secretion of hormones from the adrenal gland in response to physiological and emotional stress

such as surgery). Participants in the control group did not listen to music but rather rested in bed for 30 minutes before measurements of pain and anxiety were taken.

Investigators found significant differences in VAS mean anxiety scores between music group participants and control group participants at each time measurement (p=0.018-0.001). They also found significant differences in VAS mean pain scores between music group participants and control group participants at each time measurement (p=0.001). Investigators did not find any significant differences between music and control group participants' levels of cortisol in urine samples measured.

The investigators concluded that results of their study indicated patients undergoing spinal surgery would benefit from receiving music therapy in the preoperative period and early postoperative period (that is, evening before and morning of surgery, days 1 and 2 postoperatively). Their results suggested that the provision of self-selected music enhanced the well-being of surgical patients during the early postoperative period (Lin et al., 2011).

Abdominal (GI, Renal) Surgery Studies

Vaajoki and colleagues (2012) examined the effectiveness of audiotaped music listening on pain intensity and pain distress with a convenience sample of 166 subjects who had undergone major abdominal surgery. Participants were assigned to experimental (n=83) and control (n=83) groups based on using an alternate week of surgery arrangement until each group had the requisite number of participants. The study design was a quasi-experimental, repeated measures, pretest-posttest design. The music listening intervention used in this study included experimental participants' choice of favorite music from a selection of the most popular and classic music in their native Finland. Selections of music were added according to participants' wishes and

included domestic and foreign hit songs. Music listening via a MP3 (digital audio) player with headphones, 30 minutes duration, was offered to experimental group participants seven times during the postoperative period: the evening of surgery, morning, noon, and evening on the first and second postoperative days. On the third postoperative day, music was not played but measures were taken once to evaluate the long-term effects of music listening with experimental group participants. Control group participants did not listen to music but rather had a 30 minute break between pre- and post-test measurements. Participants in both groups had 15 assessments: seven times before and seven times after the music listening intervention or break, and once during a follow-up visit on the third postoperative day.

In this study, seven main outcome measures were employed: pain intensity and pain distress measured with Visual Analog Scales (VAS) as well as numeric rating scales (NRS), blood pressure, heart rate, and respiratory rate. The amount of analgesia used and its adverse effects during the first 72 hours after surgery, the duration of epidural pain management, and length of hospital stay were also measured for study participants.

The investigators found that experimental group participants who received standard care and listened to music after surgery reported significantly lower pain intensity on postoperative day two (measured in the morning, at noon, and in the evening) compared with control group participants at bed rest (p=. 0.02), during deep breathing (p=0.03), and in shifting position in bed (p=0.02). They also found that these experimental participants reported significantly less pain distress on postoperative day two (measured in the morning, at noon, and in the evening) compared with control

group participants at bed rest (p=0.01), during deep breathing (p=0.04) and in shifting position (p=0.04). However, there were no significant differences in reported pain intensity and pain distress between experimental and control group participants on postoperative day one (measured in the morning, at noon, and in the evening). On the third postoperative day there were no significant differences between experimental and control group participants on levels of pain intensity and pain distress at bed rest, during deep breathing, and when shifting position in bed. Lastly, there were no significant differences in analgesic usage, adverse effects of analgesics, and length of hospital stay between experimental and control group participants.

The investigators concluded that their study results supported earlier findings which indicated that music listening can be a beneficial adjuvant to other non-pharmacological and pharmacological pain relief methods for surgical patients (Vaajoki et al., 2011).

In another study of abdominal surgery patients, Good and colleagues (2010) compared the effectiveness of three different combinations of non-pharmacological pain treatment: preoperative patient teaching for pain management (PT), audiotaped jaw relaxation technique and music (RM), and a combination of audiotaped patient teaching and jaw relaxation and music (PTRM). Preoperative patient teaching for pain management (PT) was defined as information taught to patients to empower them by increasing their knowledge and self-efficacy for engaging in general postoperative care activities including use of patient-controlled analgesia. Relaxation and music (RM) consisted of a jaw relaxation technique with a choice of sedative music in the background. Soft music, without lyrics and relaxing and sedative in nature, was chosen

by participants from the following types: synthesizer, harp, and piano, and orchestra, slow jazz, and inspirational music. The music was provided via a tape recorder and a remote control. All interventions were introduced before surgery. The study sample consisted of 517 adult subjects who had undergone major abdominal surgery and received patient-controlled analgesia. A 2 x 2 factorial design was used to assess the effects of PT versus RM on study participants' reported pain intensity. Purposive sampling was used to increase the numbers of men, Blacks, and persons with intestinal and urological surgeries to improve the generalizability of study findings. Participants were assigned randomly via minimization to four groups: PT, RM, combination of the two (PTRM), and control (no intervention). Minimization, (via a computer program; Zeller, Good, Anderson, & Zeller, 1997) was designed to balance groups according to gender, type of surgery, chronic pain, race, smoking, and alcohol use. Experimental interventions were given in addition to standard-care PCA with instruction and reinforcement to all study participants. To sample effects at different regular time points during postoperative recovery, study measurements were scheduled in the mornings and afternoons of the first two days after surgery. Pain was measured using the Sensation and Distress Visual Analog Scales (VAS). Each scale consisted of a 100-millimeter horizontal line with verbal anchors of "no sensation" and "most sensation," and "no distress" and "most distress."

In this study, the two groups of participants who received relaxation and music (RM and PTRM) reported significantly less posttest pain on postoperative day 1 AM, PM, and postoperative day 2 AM compared to participants who did not use RM (PT and controls). Also, there were no significant effects on opioid intake in the PT or RM

groups on postoperative days 1 and 2. These investigators concluded that patient teaching (PT) alone did not reduce pain but that relaxation and music therapy were effective non-pharmacological adjuvants to provide postoperative pain relief for abdominal surgical patients.

Orthopedic Surgery Studies

Chen and colleagues (2015) examined the effects of listening to music on psychophysiological parameters (blood pressure, heart rate, and respiratory rate) during preoperative and postoperative days, and looked to determine whether it could lower postoperative pain intensity and opioid dosage in patients who had undergone total knee replacement surgery. A two group repeated measures design was used with 30 subjects, ages 53-85 years, scheduled for total knee replacement surgery. Participants were randomly assigned to music group or control group. Psychophysiological measures were obtained from patients' in-room hospital monitors. A visual analog scale was used with participants to report postoperative pain. Opioid analgesic dosage was recorded from participants' hospital medication record, and converted to standardized units.

Results of their study indicated no significant differences between music and control group participants' preoperative and postoperative blood pressure and heart rate measurements, reported pain intensity, or opioid analgesic dosage. Respiratory rates while in the surgical waiting area (preoperative measurements) were lower for music group participants compared to control group participants ($p=0.02$). Within group comparisons showed systolic blood pressure measurements of music group participants significantly and consistently decreased during postoperative days ($p=0.007$).

These investigators concluded listening to music after surgery could stabilize systolic blood pressure in patients during postoperative recovery from total knee replacement surgery. However, the effects of music on psychophysiological parameters (diastolic blood pressure, heart rate, and respiratory rate), and on pain intensity and opioid analgesic dosage after surgery required further research.

Ignacio and colleagues (2012) compared the effects of music versus no music on postoperative pain, state anxiety, and analgesic usage with a convenience sample of 21 subjects who had undergone elective orthopedic surgery (spinal, hip, or knee arthroplasty). Using an experimental design, participants were randomized to music (n=12) and non-music (n=9) groups. Outcome measures in the study were pain (measured by a visual analog scale), state anxiety (measured by the State-Trait Anxiety Inventory), and analgesic usage (total amount of pain medications used on postoperative day 1 and day 2). In this study, the music intervention was administered on postoperative day 1 and day 2, but the time of day this intervention was carried out with study participants was not reported. Also, the type of music offered to participants was not reported. The duration of music listening was reported to be 30 minutes; however, how music was delivered to study participants was not reported. The investigators indicated that because of the small sample size and unequal variances and abnormal distributions of normality in the outcome measures, non-parametric tests were used for data analysis.

Results of their study indicated no demographic characteristic differences between music and control group participants. On the outcome measure of state anxiety, investigators found no significant differences between music and control group

participants on state anxiety scores. However, there was a significant decrease in state anxiety scores found within the music group on postoperative day 2 (Z=2.04, p=0.041). Music did not significantly reduce reported pain levels with music group participants compared to control group participants on either postoperative day 1 or day 2; however, there were significant decreases in pain levels found within the music group on postoperative day 1 (Z=2.98, p=0,003) and day 2 (Z=2.80, p=0.005). No significant differences were found between music and non-music group participants' analgesic usage on postoperative day 1 or day 2. The investigators reported that all music group participants indicated they were satisfied with the music provided, but less than half of participants listened to music beyond the study intervention time.

The investigators concluded their mixed findings for the effect of music on anxiety and pain reduction for patients who have undergone orthopedic surgery were both consistent and inconsistent with recent studies reported (Allred et al, 2010, Lin et al., 2011), and findings were primarily influenced by the small sample size in their study (Ignacio et al., 2012).

In another study of orthopedic surgery patients, Allred, Byers, and Sole (2010) examined the effect of listening to music on postoperative anxiety and pain as well as its effect on mean arterial blood pressure, heart rate, respiratory rate, and oxygen saturation with patients who had undergone total knee arthroplasty orthopedic surgery. The study sample consisted of 56 adult subjects (n=28 experimental group; n=28 comparative rest group) with a mean age of 63.9 years, and 44.6% were men and 55.4% were female. Randomization into either the experimental group or the comparative rest group was determined by a sealed envelope system. An experimental

design was used to examine the effects of music and/or quiet rest period on postoperative pain, anxiety, and physiological parameters measured on postoperative day 1. The music intervention consisted of listening with headphones to a compact disc of participant selected easy-listening music choices provided by the investigators. These music choices were six different Compass Production Compact Disc Selections from “Lifescapes - TM”. Participants in the experimental group listened to their music selection for 20 minutes duration before their first ambulation effort postoperatively with the Physical Therapist, and listened again for 20 minutes duration during the rest period after their ambulation effort. Participants in the comparative rest group did not listen to music before their first ambulation effort and instead rested quietly for a 20 minute period after their ambulation effort. Data collection was carried out on postoperative day 1 and began 20 minutes before the first physical therapy session for all participants. Instruments used included the McGill Pain Questionnaire – Short Form (MPQ-SF), participant reported pain and anxiety measured using visual analog scales (VAS), and physiological measurements of heart rate, blood pressure, respiratory rate, and oxygen saturation. Data collection occurred at four points: 20 minutes before first physical therapy (PT) session (T1), just before PT (T2), immediately after PT (T3), and 20 minutes after PT (T4). The amount of opioid used from the initiation of the music intervention to 6 hours later was recorded by the investigators.

Results indicated that group participants reported significantly different pain scores as measured with the VAS over time ($F = 6.713$; $p=.001$). Also, post hoc pairwise comparisons found significant differences in participant reported pain (using the MPQ-SF) between T1 and T2 ($p=.000$) and between T2 and T3 ($p=.000$).

Interestingly, no significant differences in participant reported pain scores measured with VAS were found between the two groups at any measurement point (F=1.120; p=.337). With regard to music and anxiety, the results indicated that within group participants reported significantly different anxiety scores over time (F=4.124; p=.011). Also, post hoc pairwise comparisons found significant differences in participant reported anxiety between T1 and T2 (p=.035) and between T2 and T3 (p=.014). Interestingly, no significant differences in participant reported anxiety scores were found between the two groups at any measurement point (F=1.566; p=.206). With regard to music and physiological parameters, the results indicated that participants in both groups had significant decreases in mean arterial blood pressure (MAP) over time (F=9.891; p=.000). However, there were no significant differences in MAP between participants in the two groups (F=.388; p=.658). Also, there were no significant differences in heart rate, respiratory rate, or oxygen saturation across time within groups, and similarly, no significant differences found in all of these parameters between groups at any study measurement times. Investigators reported that all study participants received patient-controlled analgesia (PCA) at equivalent doses and all participants had their PCA discontinued the first morning after surgery. Therefore, only “as needed” oral pain medications were available to participants within 6 hours of the study intervention. There were no significant differences between participant groups regarding oral analgesic intake.

In interpreting their study findings the investigators noted that in previously published studies which reported music to be effective in reducing anxiety and pain with surgical patients, the studies did not examine the effect of music just before and just

after a known painful experience – that is, first ambulation effort after knee joint replacement surgery. They indicated that this difference may account for the study findings. Another reason offered by the investigators to explain the possible lack of significance in their study was in their study, the quiet rest period used in their study could have acted as an intervention itself, therefore the comparative rest group did not truly act as a control group but acted instead as a second intervention group.

The investigators concluded that the results of their study provide evidence to suggest that in conjunction with traditional pharmacological interventions, pain and anxiety can be reduced while listening to music or when having a rest period just before and just after first ambulation effort after total knee replacement surgery (Allred et al., 2010).

Transplant Surgery Study

Madson and Silverman (2010) examined the immediate effect of music therapy on self-reported measures of anxiety, relaxation, pain, and nausea levels with a sample of solid organ transplant patients. Both organ donor and transplant recipients, ranging in age from 18-70 years, comprised the study sample of 58 adult subjects who were offered music therapy sessions. Organ transplant study participants experienced a range of pathologies including end-stage renal disease, infection due to previous transplant, and multiple transplants such as pancreas and kidney. After meeting the required sample size, all patients on the hospital transplant unit were given the opportunity to receive music therapy.

The study was a pretest-posttest design without randomization of subjects or a control group. The investigators used participant self-report ratings to measure the effects of music therapy on relaxation, anxiety, pain level, and nausea using four

separate 10-point scales. Each scale was anchored with “1” representing a patient feeling completely relaxed, or free of anxiety, or experiencing no pain, or experiencing no nausea, and “10” representing a patient feeling complete lack of relaxation, or high levels of anxiety, or high levels of pain, or high levels of nausea. The investigators commented that these measures and corresponding anchors were determined based on recommendations from the Head Nurse on the transplant unit, and these measures were congruent with the unit’s assessment measures. Participants were asked to verbally report his or her levels of relaxation, anxiety, pain, and nausea before the music therapy session. The investigator then played patient-preferred music while encouraging verbal interactions between songs. All music was played live on a guitar and sung by the principal investigator. The music therapy sessions lasted from 15-35 minutes in duration. Immediately after the music therapy session, the investigator asked participants to assess his/her levels of relaxation, anxiety, pain, and nausea. It is noteworthy that music therapy sessions were offered to all patients on the transplant unit on a weekly basis; however, only data from a single session of music therapy per participant were analyzed in the study. Also noteworthy was that investigators failed to report in their study the postoperative day the music therapy session was analyzed for study participants.

Results of this study indicated that there were significant differences in study participant reports for all four outcomes measured before and after the music therapy session with posttest mean scores improving for all evaluated self-report variables: relaxation ($p<.001$), anxiety ($p<.001$), pain ($p<.01$), and nausea ($p<.05$). The investigators also looked to determine if the music therapy session positively affected

participants who reported high levels of pain (rating of 8 or higher on the Likert-type pain scale) prior to the music therapy intervention. They found that there were no significant differences between pre- and post-test pain scores of study participants who initially reported high levels of pain.

The investigators concluded that music therapy was a viable intervention for postoperative transplant recipients and donors, and that their results were congruent with other medical music therapy literature which has shown music therapy to be effective in reducing anxiety, reducing levels of pain and nausea, and increasing relaxation with surgical patients (Madson & Silverman, 2010).

Recent Systematic Reviews of Studies Examining Music Therapy

In the past five years, five systematic reviews have been published by researchers who systematically reviewed studies examining music therapy as an adjuvant intervention for reducing postoperative pain with adult surgical patients. Findings from these recent systematic reviews will be synopsized below.

Hole and colleagues (2015) conducted a systematic review and meta-analysis to assess whether music improves recovery after surgical procedures. They included randomized controlled trials (RCTs) of adult patients undergoing surgical procedures, excluding those involving the central nervous system or head and neck, published in any language. Surgical procedures of studies reviewed varied from minor endoscopic interventions to transplantation surgery. Included were RCTs in which any form of music was proved, initiated before, during, or after surgery, and compared these with standard care or other non-drug interventions. Their search included MEDLINE, Embase, CINAHL, and the Cochrane Library. In total they reviewed 73 RCTs with sample sizes varying between 20 and 458 participants. Choice of music, timing, and

duration varied among the studies reviewed. Comparisons with music included routine care, headphones with no music, white noise, and undisturbed bedrest. In their review of 45 RCTs examining use of music after surgery, they found music reduced postoperative pain (SMD -0.77 {95% CI -0.99 to -0.56}), anxiety (-0.68 {-0.95 to -0.41}), and analgesic use (-0.37 {-0.54 to -0.20}), and increased patient satisfaction (1.09 {0.51 to 1.68}), but did not reduce length of stay in hospital for study participants (SMD -0.11 {-0.35 to 0.12}). Subgroup analyses showed that choice of music used and timing of delivery of music, and type of control used made little difference to study outcomes. They found no difference in pain reduction if measured between 0 to 4 hours after surgery and measured more than 4 hours before surgery. Pain seemed to be reduced most when music was played preoperatively (SMD -1.28 {-2.03 to -0.54}), then intraoperatively (SMD -0.89 {-1.20 to -0.57}), and then postoperatively (SMD -0.71 {-1.03 to -0.39}). A similar pattern was noted with anxiety measures and analgesic usage among studies reviewed.

These investigators concluded that sufficient research has been done to show that music should be offered to surgical patients as a way to help reduce pain and anxiety after surgery. They suggested that the timing and delivery of music as an intervention could be adapted to clinical settings, medical teams, phases in the perioperative period, and individual patient care situations (Hole et al., 2015).

In their literature review, Sin and Chow (2015) appraised current evidence from studies which examined the use of music therapy and postoperative pain management among gynecological surgery patients, to determine the effect of music therapy for: (1) reducing postoperative pain intensity and consumption of analgesics; (2) minimizing the

physiological symptoms of pain including but not limited to fatigue, nausea, and vomiting; and (3) minimizing anxiety level. The databases used to search for relevant studies included Medline, CINAHL, British Nursing Index, PsycINFO, and Allied and Complementary Medicine. Selection criteria for studies in their review included those published 1995 to present, with adult female patients undergoing gynecological surgery, using music therapy as the intervention, with comparison groups without a music component, with outcomes measured including pain intensity, and experimental or quasi-experimental design.

The results of their review of 7 studies, found 5 of 7 studies indicated significant and positive effects of music therapy on the reduction of postoperative pain ($p < .05 – p < .001$). (Sample sizes for these five studies ranged from 73 to 311 participants). Of the 7 studies included in their review, 3 studies examined the effects of music therapy on pain-related physiological outcomes including fatigue, nausea and vomiting, as well as anxiety level. One of these three studies found a significant effect for music therapy on reducing fatigue ($p<.001$) but no significant differences in the incidence of nausea and vomiting compared to the control group (study sample size N = 90). The second of the three studies found no significant effect for music therapy on reducing the incidence of nausea and vomiting (study sample size N = 84). The third of these three studies found a significant effect for music therapy in reducing anxiety level after receiving the music intervention ($p < .05$ to $P < .001$) (study sample size N = 102). There was no evidence presented by these investigators as to the effect of music therapy on analgesic consumption from the 7 studies reviewed.

These investigators concluded that findings from their review indicated music therapy appears to be effective in reducing pain intensity for patients undergoing gynecological surgery, but it had no impact on postoperative nausea and vomiting. They continued music therapy may be effective in minimizing fatigue and reducing anxiety with gynecological surgical patients.

Cepeda and colleagues (2013) conducted a systematic review of 51 randomized controlled studies that evaluated the effect of music on various types of pain in both children and adults. These studies included 1867 participants who had been exposed to music and 1796 control participants. In their review, they calculated the mean difference in pain intensity levels, percentage of patients with at least 50% pain relief, and opioid requirements. To explore heterogeneity, studies that evaluated adults, children, acute, chronic, malignant, labor, procedural, or experimental pain were evaluated separately, as well as those studies in which patients chose the type of music used.

They found in 31 studies evaluating mean pain intensity as the outcome, there was considerable variation in the effect of music on pain intensity with subjects exposed to music. These studies which permitted patients to select the music did not reveal significant benefits (such as postoperative pain reduction) from music. However, they did find in 4 studies evaluating mean pain intensity as the outcome, subjects exposed to music had a 70% higher likelihood of having significant pain reduction than subjects not exposed to music. They found in 3 studies evaluating opioid requirements two hours after surgery as the outcome, subjects exposed to music required significantly less morphine than subjects not exposed to music. They found in 5 studies evaluating

morphine requirements 24 hours after surgery as the outcome, subjects exposed to music required significantly less morphine than subjects not exposed to music.

These authors concluded that among the studies reviewed, the majority of studies did not report a significant effect on pain intensity reduction for subjects exposed to music. However, exposure to music did reduce pain intensity levels and opioid requirements among some study subjects, but the magnitude of these benefits were small and therefore they felt the clinical importance of music exposure with surgical patients was unclear (Cepeda et al., 2013).

Matsota and colleagues (2013) conducted a comprehensive systematic review of 41 studies including 7,617 participants in which the effect of music on perioperative stress and anxiety, perception of pain during procedures, postoperative pain intensity and analgesic requirements, and treatment of chronic pain were examined. Inclusion criteria in their review were randomized controlled trials, meta-analyses, reviews, and controlled clinical trials written in English, included on PubMed during the last 20 years, and based on holistic care with surgery. The authors reported on 4 controlled studies and 1 randomized clinical trial which examined the use of music or its combination with relaxation or therapeutic suggestions to reduce acute surgical pain in the immediate postoperative period (post-anesthetic care unit- PACU) and in the early postoperative period. They indicated the presence of supportive data in these studies (reducing pain, anxiety, discomfort), describing study evidence as positive ($p=0.001$-0.05), and suggested that music can serve as a complementary method for treating perioperative stress and acute pain (Matsota et al., 2013).

In a systematic literature search performed on Medline, Embase, CINAHL, and the Cochran Library to identify all studies looking at music's impact on postoperative pain, Economidou and colleagues (2012) found six randomized controlled trials that included 866 participants who had undergone elective surgery (varicose vein, inguinal hernia repair, abdominal hysterectomy, major abdominal, orthopedic, and gynecologic). These studies examined the impact of music on study patients' postoperative pain and postoperative analgesic usage.

The authors found that these studies reported music significantly reduced postoperative pain among adult surgical patient group participants. They found evidence in only one study with patients who had undergone open hernia repair as day care surgery indicating that participants who listened to music intraoperatively and in the post anesthetic care unit (PACU) required significantly less morphine in these settings compared with the control group participants (p value <0.05) (Economidou et al., 2012).

Summary of Review of Recent Literature Examining Music Therapy

There is considerable evidence from recently published studies as well as recently published systematic reviews to indicate that music therapy, used as adjuvant therapy along with analgesic medications, is effective in reducing postoperative pain and in some instances, effective in reducing opioid analgesic usage among surgical patients. It is noteworthy that among these studies, besides differences in study methodologies, types of surgical patients sampled, and outcomes measured, there were between-study differences in types of music intervention used, duration of the music intervention, timing of administering the music intervention, frequency of use of the music intervention, and results of study participants' perceived effectiveness of the music intervention in reducing postoperative pain. Also noteworthy is some studies had

methodological limitations due to inadequate sample sizes, lack of random assignment to treatment and control groups, no assurance of pretest equivalence on the dependent variable(s) measured, delayed posttest measurement of the dependent variable(s), and lack of control for analgesics taken at time of testing, all factors which may reduce the validity of study conclusions.

Indications for this Study

The studies reviewed above examined the effect of music therapy on postoperative pain with surgical patients looking at, for the most part, the outcome of postoperative pain reduction while patients were recovering in hospital from surgery. None of these studies examined the effect of music therapy on postoperative pain with surgical patients after discharge from hospital. Acute surgical pain after joint replacement surgery persists beyond discharge from hospital, generally lasts for several days, and worsens for patients during postoperative mobilization (Harlocker, 2010). Unrelieved pain can impede effective physical therapy which is important if the patient is to regain good range of motion and optimize their surgical outcome (Labraca et al., 2011). Therefore, patients who have undergone joint replacement surgery need to optimally control their pain after surgery in order to maximize their surgical outcome, and prevent complications after surgery. After discharge from hospital, orthopedic patients need to have available to them strategies to use, along with prescribed analgesic medications, to help reduce their pain.

In this study this investigator examined the use of a music intervention for reducing postoperative pain with patients who had undergone orthopedic joint arthroplasty surgery. The study intervention was used by music group participants both in hospital and after discharge from hospital. It was anticipated that results from this

study would direct nurses to recommend music as an adjuvant, along with prescribed analgesic medications, for use in hospital and after discharge, with patients who had undergone orthopedic joint arthroplasty surgery. An adjuvant therapy like music can help patients manage acute pain after surgery, facilitate mobilization after surgery, therefore optimizing their clinical outcome from surgery. In addition, in this study the investigator examined the usefulness of Good and Moore's (1996) nursing pain management theory "Balance between Analgesia and Side Effects," for guiding this research and pain management practices.

CHAPTER 3
METHODS

An experimental design is the appropriate research strategy to use when the question to be answered requires the testing of theory or causal relationships (Polit & Beck, 2008). The major strength of this design lies in its ability to control variance and to take into account factors that may contribute to differences in the dependent variable (Polit & Beck, 2008). In this study, the investigator used a prospective randomized trial to examine the relationships among study variables.

Sample and Setting

A convenience sample of orthopedic surgery patients were recruited to participate from the target population of surgical patients for this study. Use of a nonprobability sample limits the generalization of study findings to the sample; however, in light of the inherent difficulties in accessing this population, this sampling technique is justified (Polit & Beck, 2008). Because pain character and intensity may vary by location and extensiveness of the surgery, only two types of surgical patient groups were eligible to participate in order to maintain homogeneity of the study sample: patients who had undergone knee joint arthroplasty surgery, and patients who had undergone hip joint arthroplasty surgery.

A sample size of 50 participants was used in this study in order to meet the requirements for statistical analysis and to account for losses due to attrition (Cohen, 1988). This sample size was determined based on a power analysis for the covariance using a large effect size (d=.80), power of 0.80 and alpha = 0.05 (Cohen, 1988). Participants were randomly assigned to treatment and control groups using the coin toss method. This provided some degree of certainty that participant characteristics

(e.g. biological, psychological, and sociocultural characteristics) which could influence the dependent variable were evenly distributed between the two groups (Polit & Beck, 2008).

The sampling frame included every eligible patient listed for elective knee or hip joint replacement surgery in a major university-affiliated teaching hospital in the southeastern United States during a 5 month period (specifically, UF Health, Gainesville, FL). Patients were identified by the orthopedic surgeon at preoperative visits, and eligibility for inclusion in the study was determined in consultation with the investigator. Potential study subjects were initially approached by the orthopedic surgeon to obtain agreement to meet with the investigator at the preoperative office visit. During this selection process, patient privacy was maintained in accordance with US government-mandated HIPAA regulations.

Consent to participant in the study was obtained from patients who agreed to participate in the study at the preoperative office visit after they received an explanation of the study from the investigator.

Inclusion Criteria

Criteria for inclusion in the study were: 1) male and female patients, ages 35 to 100 years; 2) scheduled for elective orthopedic knee or hip joint arthroplasty surgery (total, partial arthroplasty, or revision surgery); 3) oriented to person, place, time, and conversation; 4) anticipated receiving nerve block for pain relief postoperatively, 5) anticipated hospitalization of two or more days postoperatively; and 6) had access to an internet-enabled device such as a smartphone or tablet that can access on-line radio music like Pandora.

Exclusion Criteria

Criteria for exclusion in the study were: 1) having verbal, visual, auditory or psychomotor impairments that would impede the patient's ability to participate in the study (for example, inability to communicate verbally with study staff, visual impairments not allowing the patient to view study measurement instruments and use the music listening device, auditory impairments not allowing the patient to use a device for music listening, or psychomotor impairments not allowing the patient to write data collection information in log booklets or use a device to listen to music); 2) having cognitive or affective impairments that impede their ability to participate in the study (e.g. severe anxiety, severe depression, or thought-processing disorders requiring hospitalization within the past year); 3) having a postoperative stay in any intensive care unit (ICU) or step-down unit because of a medical or surgical complication experienced during the perioperative period: and 4) non-English speaking patients because study measurement instruments and verbal instructions for use of the music intervention were administered in English.

Measures

Demographic Characteristics

All participants were asked to provide demographic data such as age, gender, marital status, race, educational level, and number of concurrent conditions causing pain were recorded by the investigator on a standard form. These variables were used as descriptive variables in the study.

Pain: Intensity and Distress

In order to measure the total pain experience, instruments used in this study assessed both the sensory and emotional components of pain. A numeric rating scale

(NRS) was used in this study to measure the sensory component of pain: pain intensity. This is a ten-centimeter rating scale anchored by “no pain” (0) at one end and 10 (“most pain imaginable”) at the other end with numbers 2 thru 9 at 1 centimeter increments. Study participants were asked to use this scale to rate pain intensity as it was consistent with what was used in the clinical agency. Support for use of the NRS to measure pain intensity is found in recent research indicating that single-item scales are psychometrically acceptable measures of global pain ratings (McCarthy, et al., 2005).

The Distress Scale (Johnson, 1973), a descriptive rating scale which includes words describing the degree of distress experienced from pain, was adapted for use in this study to measure the emotional component of pain. Validity of this scale was supported by Johnson (1973) who found that participants could differentiate between pain intensity and distress during induced ischemic pain. The Distress Scale is widely used in clinical research with a variety of patient groups and found to be a valid, reliable, and sensitive measure of pain (Good et al., 2001). A numeric rating scale (NRS) was used to measure pain distress, anchored by “no distress” (0) at one end and 10 (“most distress imaginable”) at the other end with numbers 2 thru 9 at 1 centimeter increments. Because pain is a multidimensional concept, it is reasonable to have used more than one measure to capture the pain experience (that is, pain intensity and pain distress) of participants in the study. Pain (intensity and distress) was measured once the evening of surgery, at three time periods daily during postoperative days 1 and 2, and at three time periods daily the first two days post-discharge from hospital. Study participants were instructed to document all pain scores in a log booklet designated for use in hospital, and in another log booklet designated for use after discharge from hospital.

Nausea and Drowsiness

Side effects from opioid analgesia administered postoperatively were measured in the study the evening of surgery, at three time periods daily on postoperative days 1 and 2 and at three time periods daily the first two days post-discharge from hospital, and included the opioid side effects of nausea and drowsiness. The level of these side effects were measured using numerical rating scales (NRS) with scores ranging in intensity from “0” no nausea or drowsiness, to “10” worst nausea or drowsiness imaginable. Study participants were asked to rate these side effects whenever rating pain intensity and pain distress, and to document these scores in a log booklet designated for use in hospital, and in another log booklet designated for use after discharge from hospital.

State Anxiety

Anxiety is a common reaction among patients to surgery. Anxiety is known to alter the patient’s perception of pain and therefore will be examined in this study as a possible covariate. Spielberger (1983) described state anxiety as existing in a transitory emotional state that varies in intensity and fluctuates over time. This describes the type of anxiety experienced by surgical patients when measured at one time period during the postoperative course; therefore, in this study, state anxiety was measured using the State-Trait Anxiety Inventory (STAI Form—Y1) (Spielberger, 1983). This instrument includes 20 items, each with a scoring range of 1 to 4; the total possible score ranges from 20-80, with higher scores indicating higher levels of state anxiety. This instrument has been widely used with patients in clinical practice and research, and has good reported reliability and validity (Spielberger, 1983). State anxiety was measured at one time period –the evening of surgery after patients had returned from surgery, and was

measured in this study to determine its relationship to patient reports of pain intensity, pain distress, nausea, and drowsiness.

Analgesic Usage

Information regarding participant use of opioid analgesics (drug types prescribed and used) on postoperative days 1 and 2 were obtained from the patient's medical record (EPIC). Consistent with standard practice, an opioid equianalgesic chart was used to convert all opioid intake to milligrams of morphine equivalency (Equivalent Opioid Calculator, ClinCalc.com). This calculator was chosen because the equianalgesic conversions used in it are based on the American Pain Society's guidelines and critical review papers regarding equianalgesic dosing. Information regarding participant use of non-opioid analgesia (drug types prescribed and used) on postoperative days 1 and 2 were obtained from the participant's hospital record. Similarly, total non-opioid analgesic usage was to be calculated by converting all non-opioid doses received by the patient to acetaminophen equivalency. An equivalency calculator was not needed for acetaminophen equivalency as these determinations were not necessary because oral acetaminophen was the only non-opioid drug received by study patients in hospital and prescribed for postoperative pain relief after discharge from hospital. All study participants received pain medication as medically prescribed without influence from the investigator.

Music Listening Experience after Surgery Survey

Treatment group participants were asked to rate five statements, using a five-point Likert scale ranging from "strongly agreed" (1) to strongly disagree (5), which captured their perception of their music listening experience after surgery. This survey

ended with an open-ended question asking for participants' comments. Information obtained from this survey was analyzed quantitatively.

Overall Pain Experience in Hospital after Surgery Survey

All study participants were asked to rate five statements, using a five-point Likert scale ranging from "strongly agree" (1) to "strongly disagree" (5), which captured their perception of their overall pain experience in hospital after surgery. This survey ended with an open-ended question asking for participant comments. Information from this survey was analyzed quantitatively.

Table 3-1 summarizes the measures used in this study, organized in the order of their use in the study protocol: screening, postoperative days in hospital, and post-discharge assessments. Table 3-2 summarizes the measurement protocol during postoperative days in hospital and post-discharge days.

Study Intervention: Music Listening

The American Music Therapy Association defines music therapy as "the clinical and evidence-based use of music interventions to accomplish individualized goals within a therapeutic relationship by a credentialed professional who has completed an approved music therapy program" (AMTA.org). In this study, music as an intervention was offered by the study investigator, a licensed Registered Nurse who was not a credentialed professional from an approved music therapy program. However, the study investigator did consult with two credentialed professionals, the director and a residence/coordinator of the Center for Arts in Medicine Program affiliated with the clinical agency study site, for input in implementing music listening as the intervention for this study.

When healthcare providers recommend a cognitive-behavioral modality for use with a patient to manage symptoms like postoperative pain, the amount of energy the patient can put forth to effectively utilize the approach should be considered. An approach recommended for use in clinical practice guidelines (AHCPR) to manage acute surgical pain with patients and chosen for use as the intervention in this study was music (Carr et al., 1992). This approach is simple, easy for patients to learn and use, is "portable", and feasible for use by patients in the postoperative clinical and home settings. Since "nurse time" is so limited on busy surgical units, this simple approach for pain management is reasonable for a surgical nurse to instruct and facilitate with patients on the surgical unit. In this study, study participants assigned to the treatment group were instructed to listen to music of their choice, for 30 minutes duration, three times a day when they experienced pain. They were instructed to listen to music beginning the evening of surgery, and again on postoperative days 1 and 2 when in hospital. Once discharged from hospital, treatment group participants were asked to continue listening to music three times a day the first two days post-discharge from hospital. If treatment group participants listened to music more than the three times daily as instructed for the study, they reported this to the investigator. If control group participants listened to music during the study period, they were to report this to the investigator. Music listening was achieved by patients accessing internet radio music using a personal electronic device such as an i-phone or i-pad brought by the patient to hospital and later used by the patient after discharge from hospital.

Procedure

Preoperative Office Visit

At the preoperative office visit located in the hospital-affiliated orthopedic clinic, potential study participants were identified initially by the orthopedic surgeon according to inclusion criteria. Potential participants were asked if they would be willing to meet with the study investigator to discuss the study. During the pre-operative clinic appointment, the investigator met with potential participants to explain the study, determine interest in participating, and screen for exclusion criteria using a brief screening tool. Potential participants were read a list of six items including sensory, mental, and emotional conditions, and asked if they currently experienced any of the conditions listed (without identifying specific conditions). If they answered "yes" they were excluded from the study. If interested and eligible, informed written consent was reviewed with potential participants following an explanation of the study per the University of Florida Health Sciences Center Institutional Review Board (UF HSC IRB) protocol. Signed consent was obtained by the investigator – one signed copy was given to the participant, and one signed copy was kept for the study participant's file. A signed copy of the Informed Consent was scanned into the participant's electronic medical record (EPIC).

The investigator randomly assigned each participant to either the treatment or control group using the coin toss method. Following this, a brief, structured interview was conducted to collect demographic data such as age, gender, marital status, race, educational level, and data regarding current pain conditions experienced. Contact information of personal phone number (cell or home) was obtained from study participants for the follow-up telephone call placed to participants the third day post-

discharge from hospital. Participants were informed that the investigator would meet up with them again the evening of the surgery to continue with the study.

Evening of Surgery Hospital Visit

Treatment group participants

Treatment group participants met with the study investigator the evening of surgery when they returned to the surgical unit after surgery. The purpose of the study, the study protocol, and measurement instruments used were reviewed with participants. Pain intensity, pain distress, nausea, and drowsiness were rated the evening of surgery, using numeric rating scales (NRS), and participants were instructed on how to document these ratings in the Hospital Log Booklet (Music Group). Following this, state anxiety was measured using the State-Trait Anxiety Inventory (STAI Form Y-1).

After taking these measurements, treatment group participants were instructed on how to access internet radio music, like Pandora, with their personal device brought with them to hospital. They were instructed to listen to their chosen music selection for a duration of 30 minutes three times a day on postoperative days 1 and 2, including the evening of surgery. Before and after the music listening sessions, treatment group participants were instructed to rate and document in their hospital booklet their pain intensity, pain distress, nausea, and drowsiness levels. The investigator gave them suggestions for listening to music in a relaxed manner, and suggested posting a sign on the participant's closed hospital room door indicating, "Music listening in session – do not disturb". These signs had been created by the nursing staff on the surgical unit. They were asked to document any personal methods used for controlling pain during the music listening sessions.

In preparation for discharge from hospital, treatment group participants were instructed to continue music listening as they had in hospital, and to rate and document their pain intensity, pain distress, nausea, and drowsiness levels as they had in hospital for the first two days post-discharge from hospital. They were given a Discharge Booklet (Music Group) to document their music listening sessions and variable ratings. In this booklet were two surveys that they were asked to complete after discharge: 1) Music Listening Experience after Surgery Survey, and 2) Overall Pain Experience in Hospital after Surgery Survey. They were informed that per the study protocol, the investigator would conduct a follow-up telephone call with them on the third day discharged from hospital to discuss the music listening and variable ratings the first two days post-discharge from hospital, and to review their responses to the two study surveys found in their Discharge Booklet. Participants were thanked for their participation in the study, and reminded to mail in the return self-addressed stamped envelope, their completed Discharge Booklet.

Information regarding opioid and non-opioid analgesia prescribed and used by treatment group participants the evening of surgery, and on postoperative days 1 and 2 were gathered from the participants' medical record, specifically from the electronic medication record (EPIC). Information regarding opioid and non-opioid analgesia prescribed and taken by treatment group participants during the first two days post-discharge from hospital were gathered from documentation in the Discharge Booklet (Music Group) and from participant reports during the telephone follow-up call by the investigator the third day discharged from hospital.

Control group participants

Control group participants met with the study investigator the evening of surgery when they returned to the surgical unit after surgery. The purpose of the study, the study protocol, and measurement instruments used were reviewed with participants. Pain intensity, pain distress, nausea, and drowsiness were rated the evening of surgery, using numeric rating scales (NRS), and participants were instructed on how to document these ratings in the Hospital Log Booklet (Control Group). Following this, state anxiety was measured using the State-Trait Anxiety Inventory (STAI Form Y-1). After taking these measurements, control group participants were instructed to rate their pain intensity, pain distress, nausea, and drowsiness before and after scheduled mealtimes (that is, breakfast, lunch, and dinner) in hospital. These measurements reflected the frequency (three times per day) and duration (about 30 minutes) of the music listening sessions for treatment group participants. They were asked to document any personal methods used for controlling pain during their hospital stay.

In preparation for discharge from hospital, control group participants were instructed to continue with mealtime ratings as they had in hospital, and to rate and document their pain intensity, pain distress, nausea, and drowsiness levels for the first two days post-discharge from hospital. They were given a Discharge Booklet (Control Group) to document their mealtime variable ratings. In this booklet was one survey they were asked to complete after discharge: 1) Overall Pain Experience in Hospital after Surgery Survey. They were informed that per the study protocol, the investigator would conduct a follow-up telephone call with them on the third day discharged from hospital to discuss mealtime variable ratings the first two days post-discharge from hospital, and to review their responses to the one study survey found in their Discharge Booklet

(Control Group). Participants were thanked for their participation in the study, and reminded to mail in the return self-addressed stamped envelope their completed Discharge Booklet (Control Group) to the study investigator.

Information regarding opioid and non-opioid analgesia prescribed and used by control group participants the evening of surgery, and on postoperative days 1 and 2 were gathered from the participants' medical record, specifically from their electronic medication record (EPIC). Information regarding opioid and non-opioid analgesia prescribed and taken by control group participants during the first two days post-discharge from hospital were gathered from the documentation in the Discharge Booklet (Control Group) and from participant reports during the telephone follow-up call by the investigator the third day discharged from hospital.

Postoperative Days 1 and 2 Visits or Phone Calls

Treatment group

Treatment group participants were either visited in hospital or received a telephone call from the investigator on postoperative days 1 and 2 to discuss their adherence to the study protocol, and answer any questions that had arisen about the study. Participants were reminded about the need to continue the study protocol for the first and second day post-discharge from hospital. They were reminded about the follow-up telephone call they would receive from the study investigator on the third day post-discharge from hospital. Also, they were reminded about the need to mail back to the study investigator via United States Postal Service (USPS) the Discharge Booklet (Music Group) in the self-addressed stamped envelope provided to them the evening of surgery. They were informed to leave their completed Hospital Booklet (Music Group) with the registered nurse upon discharge from hospital. The study investigator made

arrangements with the Nurse Manager on the surgical unit to collect these booklets from participants and keep them securely stored in her locked office until the next day the investigator arrived to the unit to retrieve participants' hospital booklets.

Control group

Control group participants were either visited in hospital or received a telephone call from the investigator on postoperative days 1 and 2 to discuss their adherence to the study protocol, and answer any questions that had arisen about the study. Participants were reminded about the need to continue the study protocol for the first and second day post-discharge from hospital. They were reminded about the follow-up telephone call they would receive from the study investigator on the third day post-discharge from hospital. Also, they were reminded about the need to mail back to the study investigator via USPS the Discharge Booklet (Control Group) in the self-addressed stamped envelope provided to them the evening of surgery. They were informed to leave their completed Hospital Booklet (Control Group) with the registered nurse upon discharge from hospital. The study investigator had made arrangements with the Nurse Manager on the surgical unit to collect these booklets from participants and keep them securely stored in her locked office until the next day the investigator arrived to the unit to retrieve participants' hospital booklets.

Third Day Post-Discharge from Hospital Follow-Up Telephone Call

Treatment group

On the third day post-discharge from hospital, treatment group participants received a follow-up telephone call from the study investigator to review the information they had documented in their Discharge Booklet (Music Group) regarding music listening and variable ratings (pain intensity, pain distress, nausea, and drowsiness)

during the first two days post-discharge from hospital, and to review responses to the two study surveys found in their Discharge Booklet (Music Group): Music Listening Experience after Surgery Survey, and Overall Pain Experience in Hospital after Surgery Survey. They were reminded about the need to mail back to the study investigator the Discharge Booklet (Music Group) in the self-addressed stamped envelope provided to them in hospital. They were informed that the study had concluded, and were thanked for their participation in the study.

Control group

On the third day post-discharge from hospital, control group participants received a follow-up telephone call from the study investigator to review the information they had documented in their Discharge Booklet (Control Group) regarding mealtimes and variable ratings (pain intensity, pain distress, nausea, and drowsiness) during the first two days post-discharge from hospital, and to review responses to the one study survey found in their Discharge Booklet (Control Group): Overall Pain Experience in Hospital after Surgery Survey. They were reminded about the need to mail back to the study investigator the Discharge Booklet (Control Group) in the self-addressed stamped envelope provided to them in hospital. They were informed that the study had concluded, and were thanked for their participation in the study.

Timeline for Contact with Study Participants

There was a seven day timeline for contact with study participants in hospital and post-discharge from hospital, from postoperatively the evening of surgery (contact #3) until the follow-up telephone call the third day post-discharge from hospital (contact #6). This timeline for contact with study participants is shown in Figure 3-1.

Data Analysis

Statistical analysis were carried out in this study using the Statistical Package for the Social Sciences Software (SPSS, Version 24, Chicago, IL). Both parametric and non-parametric tests were carried out to analyze study data. Demographic data were analyzed using descriptive statistics to describe the sample characteristics, and inferential statistics were used to compare treatment and control group means on study dependent variables. Chi-Square testing was used to determine if there were significant differences between treatment and control groups on following demographic variables: gender, marital status, race, educational level, and concurrent pain conditions, and independent t-test was carried out to report means, standard deviations, and percentages for the demographic variable of age by group. Descriptive statistics were computed to present means and standard deviations by group for the study variables of pain intensity, pain distress, and opioid side effects of nausea and drowsiness. Descriptive statistics were computed to present frequencies of types of opioid and non-opioid analgesics by group. Descriptive statistics for study dependent variables were computed for both in hospital and post-discharge periods. State anxiety was examined in this study as a possible covariate. Correlations between evening of surgery level of state anxiety and evening of surgery levels of pain intensity, pain distress, nausea, and drowsiness were examined using Pearson correlation coefficient.

Controlling for pre-measure differences in pain intensity, pain distress, nausea, and drowsiness, Analysis of Covariance (ANCOVA) was used to compare differences between treatment group (music listening + analgesic medications) and control group (analgesic medications only) participants' adjusted means for pain intensity, pain distress, nausea, and drowsiness levels. The significance level was set at 0.05 for the

study. As a method of statistical control, use of ANCOVA is suggested in order to reduce the error term (the variance within groups) by separating out the variance resulting from confounding variables (pre-measure study variables) (Polit, 2010; Zeller, Good, Anderson, & Zeller, 1997). ANCOVA testing comparing differences between treatment and control group participants' adjusted means for study dependent variables was carried out for both in hospital and post-discharge periods.

In this study, mean differences between opioid and non-opioid analgesic usage between treatment and control group participants was examined using independent t-Tests. T-Tests were carried out for both in hospital and post-discharge analgesic usage. Descriptive statistics were used to analyze study participants' reported frequencies of response ratings to questions on the Music Listening Experience after Surgery Survey (completed by treatment group participants) and the Overall Pain Experience in Hospital after Surgery Survey (completed by treatment and control group participants).

Institutional Review Board Study Approval

The University of Florida Health Sciences Center Institutional Review Board (UF HSC IRB 01) approved this study.

Study Enrollment and Data Diagram

Enrollment of participants in this study is depicted in Figure 3-2. At the clinical agency study site, a total of 510 patients had undergone either knee or hip arthroplasty during the 5 month enrollment period, January to May, 2017. During this period, a total of 205 patients had undergone arthroplasty surgery with one of the three participating orthopedic surgeons. From this 205 patient pool, the investigator was able to screen 97 patients for potential enrollment in the study. Among those screened, 47 patients were

excluded from the study because they either did not meet the inclusion criteria (n=28) or declined to participate in the study (n=19). Reasons for exclusion from the study included not having an internet access device to bring to hospital to listen to music (n=10), sensory deficits related to hearing or vision (n=3), or already listening to music for pain relief (n=2). When given, reasons for declining to participate in the study included, "pressed for time" or "a lot going on" (n=2), "don't like music" (n=2), or "already listening to music" (n=1). Therefore, a total of 50 patients agreed to participate in the study; 24 participants were randomly assigned to the treatment group (music listening + analgesic medications) and 23 participants were assigned to the control group (analgesic medications only).

After the Preoperative Clinic visit but before scheduled surgery, 2 participants withdrew from the study due to personal reasons, and 1 participant's surgery date was missed by the investigator; therefore 3 participants, all from the control group, did not follow through and complete the study.

Study follow-up post-discharge from hospital yielded missing data for 6 participants in the music group, and 4 participants in the control group. These data were missing because participants could not be contacted by the investigator for their follow-up telephone interview on discharge day 3, and because they did not return their Discharge Log Booklets with self-reported data by USPS as requested. Further, 2 participants in the music group did not complete hospital assessments: one participant because of uncontrolled pain along with the need to remain in the post-anesthetic care unit (PACU) due no hospital bed availability, and the second participant because he did not bring an internet access device to hospital to listen to music. Therefore, for the

music group, 22 participants completed some hospital assessments, and 18 participants completed some post-discharge assessments. In the control group, 23 participants completed some hospital assessments, and 19 participants completed some post-discharge assessments.

Table 3-1. Measurement Battery

Construct	Measure
Demographics	Age, sex, race, marital status, educational level, # of concurrent pain condition(s)
Pain: Intensity & Pain Distress	Numeric Rating Scales (NRS) (0-10); self-recorded in hospital & discharge booklets
Analgesics: in hospital	Medication administration info found in EPIC
Analgesics: post-discharge	Self-reported analgesic use; recorded in discharge booklets
Opioid Side-Effects: nausea & drowsiness	Numeric Rating Scales (NRS) (0-10); self-recorded in hospital & discharge booklets
State Anxiety	State Trait Anxiety Inventory (STAI Form Y-1)
Music Listening Experience after Surgery Survey	5 Likert-like scale statements to rate perceptions of music listening experience
Overall Pain Experience in Hospital after Surgery Survey	5 Likert-like scale statements to rate perceptions of overall pain experience in hospital after surgery

Table 3-2. Measurement Protocol

		Post-operative (in hospital) Day			Post-discharge (from hospital) Day		
	Group & Assessment	DOS	1	2	1	2	3
Pain Intensity & Distress:	Treatment (Music Listening) • 3x/day: pre and post-music listening • analgesics taken • self-recorded in logs	•	•	•	•	•	
Pain Intensity & Distress	Control (No Music Listening) • 3x/day: pre and post-meals • analgesics taken • self-recorded in logs	•	•	•	•	•	
Analgesics: in hospital	Both Groups • as recorded by nursing staff in EPIC • self-recorded in logs	•	•	•			
Analgesics: post-discharge	Both Groups • self-recorded in logs				•	•	
Opioid Side-Effects: Nausea & Drowsiness	Both Groups • self-recorded in logs along with pain intensity/distress	•	•	•	•	•	
State Anxiety	Both Groups	•					
Music Listening Experience After Surgery Survey*	Treatment (Music) Group • telephone interview						•
Overall Pain Experience in Hospital after Surgery Survey*	Both Groups • telephone interview						•

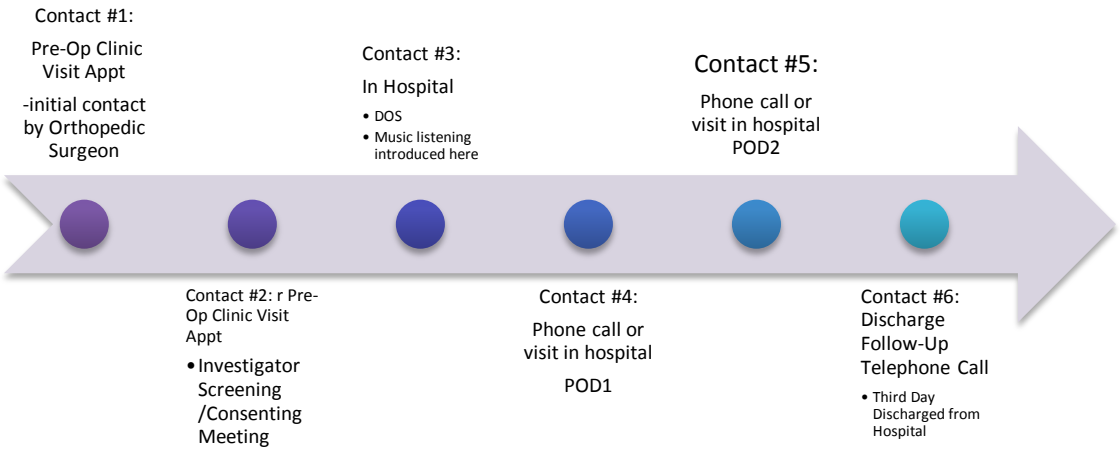


Figure 3-1. Timeline for Contact with Study Participants.

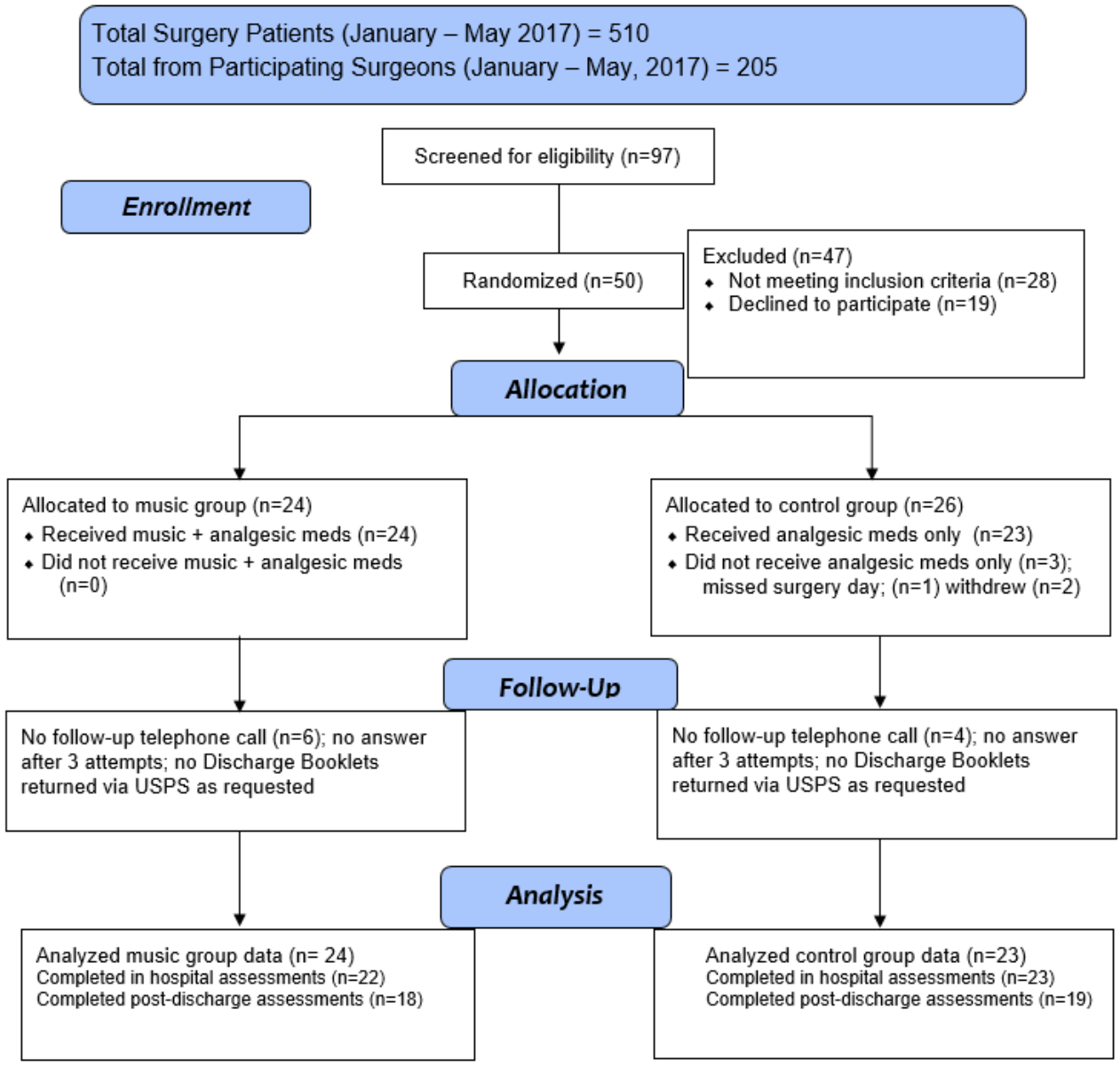


Figure 3-2. CONSORT Enrollment & Data Diagram

CHAPTER 4
RESULTS

The purpose of this study was to investigate the use of a music intervention as an adjuvant with prescribed analgesic medications to reduce postoperative pain with patients undergoing knee or hip joint arthroplasty surgery. This research study was a prospective randomized trial that evaluated the effectiveness of a combined intervention (music plus analgesic medications) in reducing pain and other related symptoms compared to a control group who received analgesic medications alone.

The research questions were as follows:

1. What are the levels of pain intensity, pain distress, and opioid side effects of nausea and drowsiness, state anxiety, and opioid and non-opioid analgesic usage among adult patients undergoing joint arthroplasty surgery the evening of surgery, during first two postoperative days in hospital, and the first two days post-discharge from hospital?

2. In adults undergoing joint arthroplasty surgery, is state anxiety associated with postoperative symptoms of pain (intensity and distress), nausea, and drowsiness?

3. In adults undergoing joint arthroplasty surgery, is a combined intervention (music listening plus analgesic medications) more effective than analgesic medications alone in reducing postoperative symptoms (pain intensity, pain distress, nausea, drowsiness) the evening of surgery, during the first two postoperative days in hospital, and the first two days post-discharge from hospital?

4. In adults undergoing joint arthroplasty surgery, do participants who receive the combined intervention (music listening plus analgesic medications) use less opioid and non-opioid analgesics than those participants who do not receive the treatment intervention during the first two postoperative days in hospital and the first two days post-discharge from hospital?

5. What are participants' perceptions of their music listening experience after surgery (music group), and perceptions of their overall pain experience in hospital after surgery (music and control groups)?

Sample Characteristics

The sample consisted of 50 participants, 24 were randomly assigned to the treatment group and 26 to the control group. Demographic characteristic of the study sample are presented in Table 4-1. Using Chi Square and t-tests, there were no significant differences between music group participants and control group participants on any of the demographic measures. Thus, demographic characteristics of the full sample are described. The mean age of study participants in this sample was 66.64 years (R = 45-81 years, SD = 8.711). The sample was approximately equal in terms of sex; 21 (42%) males, and 29 (58%) females. The majority of the sample was White (n=40, 80%), married (n=26, 52%), and had a high school education (n=45, 90%). The majority of participants reported experiencing one concurrent pain condition (n=43, 86%), with 14% (n=7) patients experiencing 2-3 concurrent pain conditions. Forty-seven participants completed the study. Of those completers, 30 participants (63%) had total knee arthroplasty surgery, and 17 (36%) had undergone total hip joint arthroplasty surgery. The majority of procedures were primary joint arthroplasty surgeries (n=37, 79%) and 10 (21%) were revisions of previous arthroplasty surgeries.

Main Study Results

In the following section, analysis of each research question will be presented. The results are organized and presented separately for hospital and post-discharge from hospital.

Descriptive Analysis of Main Study Variables

Question 1. What are the levels of pain intensity, pain distress, opioid side effects of nausea and drowsiness, and opioid and non-opioid analgesic usage among adult patients who had undergone joint arthroplasty surgery the evening of surgery,

during the first two postoperative days in hospital, and during the first two days post-discharge from hospital?

Hospital

Pain (intensity and distress) and opioid analgesic side effects (nausea and drowsiness), were assessed the evening of the day of surgery, three times per day on postoperative days one and two in hospital. Descriptive results for these variables are presented separately for each symptom. See Table 4-2 through Table 4-5 for summary of means. In addition, data on analgesic medication use in hospital is presented in Table 4-6.

The descriptive results indicate that participants in this study reported experiencing moderate pain immediately after surgery, and mild symptoms associated with opioid analgesic use after surgery, specifically nausea and drowsiness. In the early postoperative period, participants experienced pain at rest, and increased pain associated with physical therapy exercises and mobility necessary for rehabilitation after joint arthroplasty surgery.

It should be noted that there was incomplete data at each measurement point during the evening of surgery and on postoperative days 1 and 2 in hospital. This was due to incomplete recording of study measures (pain intensity, pain distress, nausea, and drowsiness) by participants in hospital log booklets, and to variations in length of hospital stay among study participants.

Table 4-6 summarizes the type of prescribed analgesic medications taken by study participants in hospital. This table and figure represent the type of analgesia, both opioid and non-opioid, prescribed for and taken by study patients in hospital.

All study participants were prescribed analgesic medications to treat postoperative pain. Most participants were administered analgesics on a routine basis. Oral opioid drugs taken as prescribed were oxycodone (87.2 % of participants) and tramadol (93.5% of participants). In hospital, participants could refuse routinely prescribed analgesics and take these drugs on a pro re nata (PRN) or as needed basis for pain relief. Intravenous (IV) morphine was prescribed for patients on a prn basis for pain not controlled by routinely prescribed oral opioids. Only 25.5% of participants requested IV morphine for pain relief during their hospital stay. Another analgesic drug prescribed for participants on a routine basis was the non-opioid acetaminophen. Oral acetaminophen was taken in hospital by almost all study participants (97.7%).

Post-Discharge

Pain (intensity and distress) and opioid analgesic side effects (nausea and drowsiness) were assessed three times per day on days 1 and 2 post-discharge from hospital. Descriptive results for these variables are presented separately for each symptom. See Tables 4-7 through Table 4-10 for summary of means. In addition, analgesic medication use after discharge is presented in Table 4-11.

The descriptive results indicate that participants in this study continued to report experiencing moderate levels of pain from surgery during the first two days post-discharge from hospital. They reported mild to moderate symptoms of drowsiness and negligible symptoms of nausea after discharge from hospital. It should be noted that there was incomplete data at each measurement point during days 1 and 2 post-discharge from hospital. This was due to incomplete recording of study measures (pain intensity, pain distress, nausea, and drowsiness) in discharge log booklets, to booklets

not being mailed back to the investigator from study participants, and to follow-up telephone calls not being completed.

Table 4-11 summarizes the type of prescribed analgesic medications taken by study participants post-discharge from hospital. This table and figure represent the type of analgesia, both opioid and non-opioid, prescribed for and reportedly taken by participants post-discharge from hospital.

Analgesic drugs were prescribed for participants on an as needed basis (prn) for pain relief in their discharge instructions from the hospital. Participants were instructed by their physician to take oral oxycodone as needed for pain intensity of 8 or greater (on a scale of 0 to 10). Oral opioid oxycodone was taken by 54.2% of reporting participants post-discharge. Oral tramadol was also prescribed on a prn basis for pain (instructions by their physician were to take as needed for pain), and the majority of reporting participants (78.3%), took this opioid medication. Similarly, the oral non-opioid analgesic acetaminophen was prescribed to participants for use on an as needed basis, and was taken by about half 47.8%) of the reporting study participants for pain relief. Figure 4-2 presents the type of analgesic usage among reporting study participants post-discharge from hospital.

Relationship between State Anxiety and Postoperative Symptoms

Question #2. In adults undergoing joint replacement surgery, is state anxiety associated with postoperative symptoms of pain (intensity and distress), nausea, and drowsiness the evening of surgery?

State anxiety was measured once in this study, the evening of the day of surgery, as a potential covariate. It was hypothesized that state anxiety would be significantly associated with postoperative symptoms. Results indicate relatively low levels of

anxiety in both groups (mean = 36.82 for treatment group; mean = 34.81 for control group). The results of correlation analyses are presented in Table 4-12. In the total sample, no significant relationship was found between state anxiety and pain intensity, pain distress, nausea, or drowsiness measured the evening of surgery prior to first music listening time or first mealtime after returning from surgery. Thus, state anxiety was not considered a covariate in subsequent analyses.

Postoperative Pain Management Intervention: Nerve Block

All patients in the study sample (N = 47) received nerve block intervention for pain management postoperatively. This intervention was ordered for patients by the Acute Pain Service, Department of Anesthesiology, at the study hospital. Length of time the nerve block remained in place varied significantly from patient to patient, ranging in hours from 13.0 to 119.0, with the mean length of time in place being 34.9 hours. Fifty-nine point one percent (59.1%) of study patients had their nerve block removed within 24 hours postoperatively while in hospital. Some study patients had their nerve block remain in place for up to 48 hours (27.3%), having it removed at a later time during their postoperative hospital stay. A small number of study patients (13.6%) were discharged with the nerve block in place, having it later discontinued and removed by a visiting home care nurse.

Clinical decisions about length of time the nerve block remained in place with patients varied and depended on a number of factors including reports of pain intensity from the patient, past allergies/adverse reactions to opioid analgesics experienced by the patient, and patient preference of managing postoperative pain with anesthetic drugs rather than opioid analgesics.

Many factors related to the use of an anesthetic nerve block for postoperative pain management with study patients were beyond controlling for in this study; for example, type and amount of anesthetic drug used. However, the potential confounding effect of nerve block use in this study was examined by examining the length of time the nerve block was in place for participants in the music group (mean = 29.27, SD = 22.47) compared to participants in the control group (mean = 40.52, SD = 36.23). Independent t-Test results indicate there was no significant difference in length of time for nerve block placement between participants in the two groups ($t = -1.24$, $df = 42$, $p = 0.22$), thus this variable was not included as a covariate in further analyses.

Effect of Intervention on Postoperative Symptoms

Question 3. In adults undergoing joint replacement surgery, is a combined intervention (music therapy plus analgesic medications) more effective than analgesic medications alone in reducing postoperative symptoms (pain intensity, pain distress, nausea, and drowsiness) the evening of surgery, during the first two postoperative days in hospital, and during the first two days post-discharge from hospital?

Analysis of covariance (ANCOVA) was used to test the effects of group membership (intervention versus control) on postoperative symptoms, controlling for pre-treatment symptom levels. For participants in the intervention group, pre-treatment symptom scores were used as the covariate. For those in the control group, measurement was conducted around meals. Thus, pre-meal symptom scores were used as the covariate. Results are presented for the first two postoperative days in hospital and for the first two days post-discharge from hospital.

Hospital

The results indicate significant effects of the adjuvant music intervention on all four symptoms investigated. Compared to the control group, participants in the music listening group had significantly lower pain intensity on the day of surgery and for the first two measurement points on postoperative day one. Pain distress was significantly lower in the music listening group than the control group on postoperative day 1 and day 2. No significant intervention effects were found for nausea or drowsiness. These results are summarized in Tables 4-13 through 4-16. It should be noted that there was incomplete data at each measurement point during the evening of surgery and on postoperative days 1 and 2 in hospital. This was due to incomplete recording of study measures (pain intensity, pain distress, nausea, and drowsiness) by participants in hospital log booklets, and to variations in length of hospital stay among study participants.

Post-Discharge

The results indicate significant effects of the adjuvant music intervention on two of the four symptoms investigated. Compared to the control group, participants in the music listening group had significantly lower pain intensity at all six measurement points during discharge day 1 and day 2. Pain distress was significantly lower in the music listening group at one measurement point on discharge day 1, and at two measurement points on discharge day 2. No significant intervention effects were found for nausea or drowsiness during discharge day 1 and day 2. These results are summarized in Tables 4-17 through 4-20. It should be noted that there was incomplete data at each measurement point during discharge days 1 and 2 post-discharge from hospital. This was due to incomplete recording of study measures (pain intensity, pain distress,

nausea, and drowsiness) in discharge log booklets by study participants, to booklets not mailed back to the investigator from participants as requested, and to follow-up telephone calls not completed.

Effects of Intervention on Postoperative Analgesic Use

Question 4. In adults undergoing joint arthroplasty surgery, do patients who receive the combined intervention (music therapy plus analgesic medications) use less opioid and non-opioid analgesics than those patients who receive analgesic medications alone during the first two postoperative days in hospital and during the first two days post-discharge from hospital?

Independent t-Tests were used to test the effects of group (intervention versus control) on participants' analgesic usage. Total opioid analgesic usage was calculated by converting all opioid doses received by the participant to morphine equivalency using an Equivalent Opioid Calculator (ClinCalc.com). Similarly, total non-opioid analgesic usage was to be calculated by converting all non-opioid medications to acetaminophen equivalency. In this study, however, acetaminophen was the only non-opioid medication prescribed or reported and thus conversion was not necessary. Results are presented for the first two postoperative days in hospital and for the first days post-discharge from hospital.

Hospital

The results indicate no significant effects of the adjuvant music intervention on opioid and non-opioid analgesic usage between participants in the music group and those in the control group on the first and second postoperative days in hospital. These results are summarized in Table 4-21.

Post-Discharge

The results indicate no significant effects of the adjuvant music intervention on opioid and non-opioid analgesic usage between participants in the music group and those in the control group on the first two days post-discharge from hospital. These results are summarized in Table 4-22.

Perceptions of Music Intervention and Overall Pain Management

Question 5. What are study participants' perceptions of their music listening experience after surgery (music group), and their perceptions of their overall pain experience in hospital after surgery (music and control groups)? Descriptive data addressing this research question are listed in Table 4-24 which presents the ratings of responses from study participants in the music group to five questions listed in the survey entitled, "Music Listening Experience after Surgery Survey."

Results from this survey indicated that the majority of study participants in the music group perceived music listening as helpful in reducing acute surgical pain (88.9% either agreed or strongly agreed) and helpful in reducing anxiety after surgery (77.8% either agreed or strongly agreed). Participants agreed or strongly agreed (83.4%) that the combined intervention of music therapy plus analgesic medications reduced their levels of postoperative pain after surgery. Importantly, participants agreed or strongly recommended (89.5%) music listening as an intervention for postoperative pain management for other patients undergoing surgery.

Participants in both the intervention and control groups responded to five questions in the survey entitled, "Overall Pain Experience in Hospital after Surgery Survey." Results in Table 4-24 indicate there were no significant differences between music and control group participants in responses to any of the five survey questions.

Table 4-25, summarizes the participants' responses about their overall pain experience in the hospital. Results from this survey indicated that the majority of study participants perceived their surgical pain in hospital to be well controlled (63.9% either agreed or strongly agreed) and their distress from pain well controlled (66.7% either agreed or strongly agreed). Participants agreed or strongly agreed (69.5%) that side effects experienced from opioid analgesics such as nausea and drowsiness, were well controlled in hospital. Lastly, participants agreed or strongly agreed (66.7%) with the statement that pain medications worked well to control their pain in hospital.

Table 4-1. Characteristics of the Sample, Overall and by Group (N = 50)

Demographic Variables	Total Sample (N = 50)	Music Group (n=24) n %	Control Group (n=26) n %	Statistic	df	p-value
Age mean (SD) (n)	66.64 (8.72)	64.58 (8.81) (24)	68.69 (8.62) (26)	t = 1.67	48	0.10
Gender Male/ Female	21/29	11/13 (22%/26%)	10/16 (20%/32%)	X^2=0.28	1	0.60
Marital Status						
Married	36	10 (20%)	16 (32%)			
Widowed	7	3 (6%)	4 (8%)			
Divorced/separated	10	7 (14%)	3 (6%)			
Never married	7	4 (8%)	3 (6%)	X^2 =3.20	3	0.36
Race						
White	40	19 (38%)	21 (42%)			
African-American	8	4 (8%)	4 (8%)			
Asian	2	1 (2%)	1 (2%)	X^2=0.02	2	0.99
Highest Level of Education						
High school/GED	45	21 (42%)	24 (48%)			
Some college or vocational school	2	1(2%)	1(2%)			
College graduate	2	1 (2%)	1 (2%)			
Post-graduate/professional	1	1 (2%)	0 (2%)	X^2 =1.12	3	0.77
Concurrent Pain Condition						
1 condition	43	20 (40%)	23 (46%)			
2-3 conditions	7	4 (8%)	3 (6%)	X^2 =0.27	1	0.60
Type of Surgery (N=47)						
1 = knee	30	11 (23%)	19 (40%)			
2 = hip	17	10 (21%)	7 (15%)	X^2 =2.16	1	0.14
Revision Surgery (N=47)						
1 = yes	10	6 (13%)	4 (8%)			
2 = no	37	15 (32%)	22 (47%)	X^2=1.20	1	0.27

Table 4-2. Mean Post-Surgical Pain Intensity Scores[a] in Hospital

Time	Treatment Group Mean (SD) (n)	Control Group Mean (SD) (n)
Day of Surgery		
Time 3 ac[b]	4.56 (2.90) (16)	4.43 (2.84) (23)
Time 3 pc[c]	4.29 (2.87) (14)	4.45 (2.58) (22)
Postoperative Day One		
Time 1 ac	4.20 (2.29) (20)	4.13 (2.88) (23)
Time 1 pc	3.53 (2.34) (19)	4.17 (2.86) (23)
Time 2 ac	4.21 (2.37) (19)	4.62 (3.09) (21)
Time 2 pc	3.29 (2.02) (17)	4.33 (3.09) (21)
Time 3 ac	5.00 (2.67) (8)	5.00 (2.30) (10)
Time 3 pc	5.00 (2.08) (7)	5.70 (2.50) (10)
Postoperative Day Two		
Time 1 ac	4.30 (2.63) (10)	5.80 (2.66) (10)
Time 1 pc	4.00 (2.18) (9)	5.50 (2.46) (10)
Time 2 ac	5.57 (2.15) (7)	6.25 (2.25) (8)
Time 2 pc	4.71 (2.69) (7)	5.88 (2.10) (8)
Time 3 ac	5.75 (2.06) (4)	7.00 (2.00) (3)
Time 3 pc	4.75 (2.63) (4)	7.00 (2.00) (3)

[a] Pain intensity measured on 0 – 10 scale (NRS)

[b] ac = before music (treatment group) or before meal (control group);

[c] pc = after music (treatment group) or after meal (control group)

Table 4-3. Mean Post-Surgical Pain Distress Scores[a] in Hospital

Time	Treatment Group Mean (SD) (n)	Control Group Mean (SD) (n)
Day of Surgery		
Time 3 ac[b]	3.25 (3.53) (16)	2.70 (3.05) (23)
Time 3 pc[c]	2.67 (3.20) (15)	2.43 (2.73) (23)
Postop Day One		
Time 1 ac	2.50 (2.54) (20)	2.57 (2.33) (23)
Time 1 pc	1.40 (1.73) (20)	2.70 (2.95) (23)
Time 2 ac	2.32 (2.52) (19)	3.38 (3.01) (21)
Time 2 pc	1.44 (1.58) (18)	3.14 (3.10) (21)
Time 3 ac	3.63 (2.77) (8)	4.90 (3.45) (10)
Time 3 pc	2.75 (2.05) (8)	4.70 (3.23) (10)
Postop Day Two		
Time 1 ac	2.80 (2.15) (10)	3.10 (2.96) (10)
Time 1 pc	1.89 (1.83) (9)	3.10 (2.96) (10)
Time 2 ac	4.14 (3.13) (7)	4.38 (2.88) (8)
Time 2 pc	2.71 (2.43) (7)	4.38 (2.88) (8)
Time 3 ac	4.50 (2.52) (4)	3.33 (3.51) (3)
Time 3 pc	3.75 (2.99) (4)	3.00 (3.00) (3)

[a] Pain distress measured on 0 – 10 scale (NRS)

[b] ac = before music (treatment group) or before meal (control group);

[c] pc = after music (treatment group) or after meal (control group)

Table 4-4. Mean Post-Surgical Nausea Scores[a] in Hospital

Time	Treatment Group Mean (SD) (n)	Control Group Mean (SD) (n)
Day of Surgery		
Time 3 ac[b]	0.94 (2.57) (16)	0.83 (2.10) (23)
Time 3 pc[c]	0.50 (1.87) (14)	0.83 (2.10) (23)
Postoperative Day One		
Time 1 ac	0.35 (1.56) (20)	1.70 (3.46) (23)
Time 1 pc	0.16 (.69) (19)	1.65 (3.39) (23)
Time 2 ac	0.32 (1.16) (19)	1.10 (2.57) (21)
Time 2 pc	0.06 (0.24) (17)	1.05 (2.44) (21)
Time 3 ac	0.63 (1.77) (8)	0.70 (2.21) (10)
Time 3 pc	0.00 (0.00) (7)	0.70 (2.21) (10)
Postoperative Day Two		
Time 1 ac	1.00 (2.11) (10)	0.60 (1.90) (10)
Time 1 pc	1.11 (2.21) (9)	0.60 (1.90) (10)
Time 2 ac	0.50 (1.07) (8)	0.00 (0.00) (8)
Time 2 pc	0.63 (0.92) (8)	0.00 (0.00) (8)
Time 3 ac	0.60 (0.89) (5)	0.00 (0.00) (3)
Time 3 pc	0.25 (0.50) (4)	0.00 (0.00) (3)

[a] Nausea measured on 0 – 10 scale (NRS)

[b] ac = before music (treatment group) or before meal (control group);

[c] pc = after music (treatment group) or after meal (control group)

Table 4-5. Mean Post-Surgical Drowsiness Scores[a] in Hospital

Time	Treatment Group Mean (SD) (n)	Control Group Mean (SD) (n)
Day of Surgery		
Time 3 ac[b]	2.06 (2.98) (16)	3.17 (3.66) (23)
Time 3 pc[c]	1.71 (2.87) (14)	3.48 (3.85) (23)
Postoperative Day One		
Time 1 ac	1.65 (3.28) (20)	3.70 (3.60) (23)
Time 1 pc	1.68 (3.37) (19)	3.57 (3.68) (23)
Time 2 ac	2.37 (3.66) (19)	4.62 (3.51) (21)
Time 2 pc	2.59 (3.81) (17)	4.52 (3.61) (21)
Time 3 ac	2.13 (3.68) (8)	4.00 (3.30) (10)
Time 3 pc	2.29 (3.95) (7)	4.00 (3.30) (10)
Postoperative Day Two		
Time 1 ac	1.60 (2.50) (10)	2.50 (2.68) (10)
Time 1 pc	1.78 (2.59) (9)	2.50 (2.68) (10)
Time 2 ac	1.63 (2.78) (8)	3.88 (3.95) (8)
Time 2 pc	1.63 (2.77) (8)	3.88 (3.95) (8)
Time 3 ac	0.25 (0.50) (4)	3.33 (5.78) (3)
Time 3 pc	0.25 (0.50) (4)	3.33 (5.78) (3)

[a] Drowsiness measured on 0 – 10 scale (NRS)

[b] ac = before music (treatment group) or before meal (control group);

[c] pc = after music (treatment group) or after meal (control group)

Table 4-6. Type of Analgesic Medications taken by Study Participants in Hospital

Analgesic Drug Type	Administered	
	Yes	No
Opioid		
Oxycodone PO*[a]	87.2%	12.8%
Tramadol PO	93.5%	6.5%
Morphine IV[b]	25.5%	74.5%
Non-Opioid		
Acetaminophen PO	97.9%	2.1%

[a] by mouth; oral

[b] intravenous

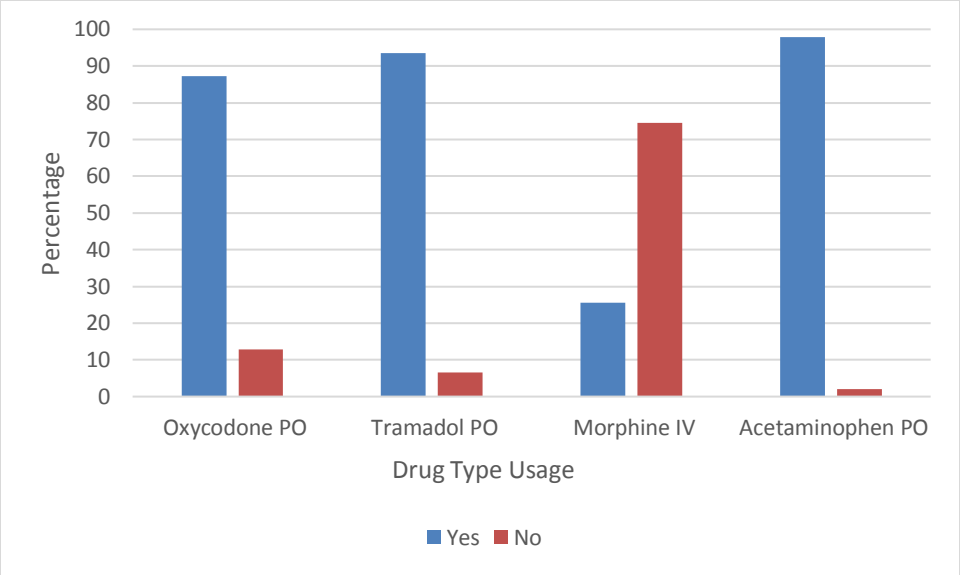


Figure 4-1. Type of Analgesic Usage among Study Participants in Hospital.

Table 4-7. Mean Post-Surgical Pain Intensity Scores[a] after Discharge

Time	Treatment Group	Control Group
	Mean (SD) (n)	Mean (SD) (n)
Discharge Day One		
Time 1 ac[b]	4.92 (2.19) (12)	6.47 (2.22) (19)
Time 1 pc[c]	3.50 (2.07) (12)	6.21 (2.49) (19)
Time 2 ac	4.92 (1.68) (12)	5.56 (2.38) (18)
Time 2 pc	3.25 (2.10) (12)	5.61 (2.33) (18)
Time 3 ac	5.14 (1.68) (7)	6.17 (2.09) (18)
Time 3 pc	3.57 (1.81) (7)	6.00 (2.30) (18)
Discharge Day Two		
Time 1 ac	4.60 (2.27) (10)	5.56 (2.43) (18)
Time 1 pc	3.00 (2.16) (10)	5.39 (2.40) (18)
Time 2 ac	4.33 (1.92) (12)	5.28 (2.11) (18)
Time 2 pc	2.93 (1.98) (12)	5.00 (2.25) (18)
Time 3 ac	4.14 (1.87) (7)	5.18 (1.88) (17)
Time 3 pc	2.43 (2.15) (7)	4.71 (2.09) (17)

[a] Pain intensity measured on 0 – 10 scale (NRS)

[b] ac = before music (treatment group) or before meal (control group)

[c] pc = after music (treatment group) or after meal (control group)

Table 4-8. Mean Post-Surgical Pain Distress Scores[a] after Discharge

Time	Treatment Group	Control Group
	Mean (SD) (n)	Mean (SD) (n)
Discharge Day One		
Time 1 ac[b]	3.00 (2.49) (12)	4.79 (2.88) (19)
Time 1 pc[c]	2.17 (2.33) (12)	4.42 (3.01) (19)
Time 2 ac	2.58 (2.50) (12)	4.11 (2.95) (18)
Time 2 pc	1.92 (2.35) (12)	3.94 (3.08) (18)
Time 3 ac	3.29 (2.75) (7)	4.56 (2.75) (18)
Time 3 pc	2.29 (2.22) (7)	4.33 (2.89) (18)
Discharge Day Two		
	2.30 (2.98) (10)	4.06 (2.71) (18)
Time 1 pc	1.20 (2.10) (10)	3.61 (2.55) (18)
Time 2 ac	2.08 (2.35) (12)	3.50 (2.09) (18)
Time 2 pc	1.25 (1.87) (12)	3.11 (2.37) (18)
Time 3 ac	1.71 (2.06) (7)	3.00 (2.37) (17)
Time 3 pc	0.86 (1.57) (7)	2.82 (2.40) (17)

[a] Pain distress measured on 0 – 10 scale (NRS)

[b] ac = before music (treatment group) or before meal (control group)

[c] pc = after music (treatment group) or after meal (control group)

Table 4-9. Mean Post-Surgical Nausea Scores[a] after Discharge

Time	Treatment Group	Control Group
	Mean (SD) (n)	Mean (SD) (n)
Discharge Day One		
Time 1 ac[b]	1.42 (3.03) (12)	1.11 (2.36) (19)
Time 1 pc[c]	1.42 (3.03) (12)	1.11 (2.36) (19)
Time 2 ac	1.08 (2.47) (12)	1.00 (1.97) (18)
Time 2 pc	1.08 (2.47) (12)	1.00 (1.97) (18)
Time 3 ac	0.29 0.76) (7)	0.89 (1.68) (18)
Time 3 pc	0.29 (0.76) (7)	0.89 (1.68) (18)
Discharge Day Two		
Time 1 ac	0.70 (1.49) (10)	0.78 (1.59) (18)
Time 1 pc	0.70 (1.49) (10)	0.78 (1.59) (18)
Time 2 ac	0.17 (0.58) (12)	0.61 (1.42) (18)
Time 2 pc	0.17 (0.58) (12)	0.61 (1.42) (18)
Time 3 ac	0.29 (0.76) (7)	0.53 (1.18) (17)
Time 3 pc	0.29 (0.76) (7)	0.53 (1.18) (17)

[a] Nausea measured on 0 – 10 scale (NRS)

[b] ac = before music (treatment group) or before meal (control group)

[c] pc = after music (treatment group) or after meal (control group)

Table 4-10. Mean Post-Surgical Drowsiness Scores[a] after Discharge

Time	Treatment Group	Control Group
	Mean (SD) (n)	Mean (SD) (n)
Discharge Day One		
Time 1 ac[b]	3.00 (2.49) (12)	4.79 (2.88) (19)
Time 1 pc[c]	2.17 (2.33) (12)	4.42 (3.01) (19)
Time 2 ac	2.58 (2.50) (12)	4.11 (2.95) (18)
Time 2 pc	1.92 (2.35) (12)	3.94 (3.08) (18)
Time 3 ac	3.29 (2.75) (7)	4.56 (2.75) (18)
Time 3 pc	2.29 (2.22) (7)	4.33 (2.89) (18)
Discharge Day Two		
Time 1 ac	2.30 (2.98) (10)	4.06 (2.71) (18)
Time 1 pc	1.20 (2.10) (10)	3.61 (2.55) (18)
Time 2 ac	2.08 (2.35) (12)	3.50 (2.09) (18)
Time 2 pc	1.25 (1.87) (12)	3.11 (2.37) (18)
Time 3 ac	1.71 (2.06) (7)	3.00 (2.37) (17)
Time 3 pc	0.86 (1.57) (7)	2.82 (2.40) (17)

[a] Drowsiness measured on 0 – 10 scale (NRS)

[b] ac = before music (treatment group) or before meal (control group)

[c] pc = after music (treatment group) or after meal (control group)

Table 4-11.Type of Analgesic Medications taken by Reporting Study Participants after Discharge

Analgesic Drug Type	Administered	
	Yes	No
Opioids		
Oxycodone PO[a]	54.2%	45.8%
Tramadol PO	78.3%	21.7%
Non-Opioid		
Acetaminophen PO	47.8%	52.2%

[a] by mouth; oral

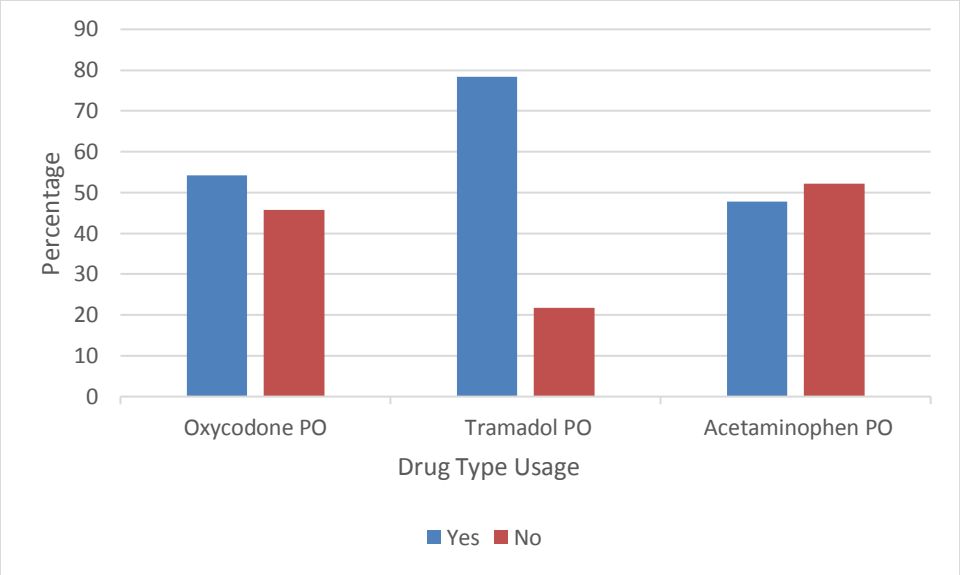


Figure 4-2. Type of Analgesic Usage among Reporting Study Participants after Discharge

Table 4-12. Correlations between State Anxiety and Postoperative Symptoms the Evening of Surgery in Hospital

ac scores (before music time or mealtime)	State Anxiety r (n)	p-value
Pain Intensity	0.20 n=36	0.25
Pain Distress	0.31 n=36	0.06
Nausea	-0.76 n=36	0.66
Drowsiness	-.054 n=36	0.75

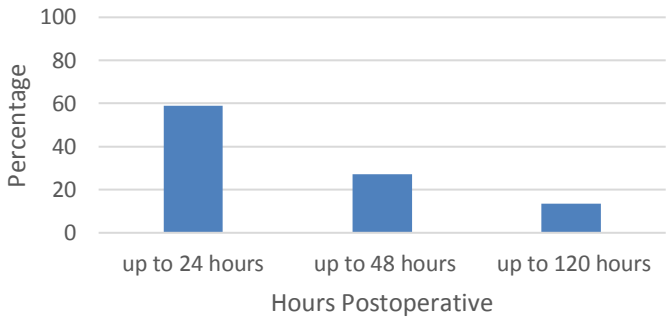


Figure 4-3. Length of Time Nerve Block in Place Postoperatively for Study Patients

Table 4-13. Comparison of Post-test Pain Intensity Scores between Music and Control Groups, Controlling for Pre-test scores (ANCOVA) in Hospital

Time Period	Music Group Adjusted Means (n)	Control Group Adjusted Means (n)	F	p-value
Day of Surgery				
Time 3	3.94 (14)	4.67 (22)	5.70	0.02*
Postop Day 1				
Time 1	3.39 (19)	4.29 (23)	4.52	0.04*
Time 2	3.25 (17)	4.36 (21)	6.74	0.01*
Time 3	5.05 (7)	5.67 (10)	1.76	0.21
Postop Day 2				
Time 1	4.49 (9)	5.06 (10)	3.60	0.08
Time 2	5.08 (7)	5.55 (8)	1.10	0.31
Time 3	5.36 (4)	6.18 (3)	2.60	0.18

*$p < 0.05$ level

Table 4-14. Comparison of Post-test Pain Distress Scores between Music and Control Groups, Controlling for Pre-test scores (ANCOVA) in Hospital

Time Period	Music Group Adjusted Means (n)	Control Group Adjusted Mean (n)	F	p-value
Day of Surgery				
Time 3	2.28 (15)	2.69 (23)	1.32	0.26
Postop Day 1				
Time 1	1.42 (20)	2.67 (23)	5.69	0.02*
Time 2	1.86 (18)	2.79 (21)	7.26	0.01*
Time 3	3.33 (8)	4.24 (10)	3.40	0.09
Postop Day 2				
Time 1	1.88 (9)	3.11 (10)	12.54	0.003**
Time 2	2.81 (7)	4.30 (8)	3.19	0.09
Time 3	3.26 (4)	3.65 (3)	0.29	0.62

* $p < 0.05$ level

**$p < 0.005$ level

Table 4-15. Comparison of Post-test Nausea Scores between Music and Control Groups, Controlling for Pre-test scores (ANCOVA) in Hospital

Time Period	Music Group Adjusted Means (n)	Control Group Adjusted Means (n)	F	p-value
Day of Surgery				
Time 3	0.70 (14)	0 .70 (23)	0 .00	1.00
Postop Day 1				
Time 1	1.07 (19)	0.90 (23)	1.09	0.30
Time 2	0.60 (17)	0.61 (21)	0.02	0.89
Time 3	0.41 (7)	0.41 (10)	n/c*	n/c*
Postop Day 2				
Time 1	0.84 (9)	0.84 (10)	n/c*	n/c*
Time 2	0.48 (8)	0.14 (8)	1.63	0.22
Time 3	0.14 (4)	0.14 (3)	n/c*	n/c*

* n/c = not calculated/sample sizes insufficient

Table 4-16. Comparison of Post-test Drowsiness Scores between Music and Control Groups, Controlling for Pre-test scores (ANCOVA) in Hospital

Time Period	Music Group Adjusted Means (n)	Control Group Adjusted Means (n)	F	p-value
Day of Surgery				
Time 3	2.60 (14)	2.94 (23)	0.68	0.42
Postop Day 1				
Time 1	2.79 (19)	2.65 (23)	0.84	0.37
Time 2	3.72 (17)	3.61 (21)	1.12	0.30
Time 3	3.29 (7)	3.29 (10)	n/c*	n/c*
Postop Day 2				
Time 1	2.16 (9)	2.16 (10)	0.00	1.00
Time 2	2.75 (8)	2.75 (8)	n/c*	n/c*
Time 3	1.57 (4)	1.57 (3)	n/c*	n/c*

* n/c = not calculated/sample sizes insufficient

Table 4-17. Comparison of Post-test Pain Intensity Scores between Music and Control Groups, Controlling for Pre-test scores (ANCOVA) after Discharge

Time Period	Music Group Adjusted Means (n)	Control Group Adjusted Means (n)	F	p-value
Disch. Day 1				
Time 1	4.46 (12)	5.61 (19)	16.38	0.000**
Time 2	3.64 (12)	5.35 (18)	58.18	0.000**
Time 3	4.35 (7)	5.70 (18)	24.01	0.000**
Disch. Day 2				
Time 1	3.57 (10)	5.07 (18)	28.25	0.000**
Time 2	3.48 (12)	4.63 (18)	16.68	0.000**
Time 3	3.18 (7)	4.40 (17)	9.22	0.006*

* $p < 0.05$ level **$p < 0.00$ level

Table 4-18. Comparison of Post-test Pain Distress Scores between Music and Control Groups, Controlling for Pre-test scores (ANCOVA) after Discharge

Time Period	Music Group Adjusted Means (n)	Control Group Adjusted Means (n)	F	p-value
Disch. Day 1				
Time 1	3.11 (12)	3.83 (19)	1.54	0.23
Time 2	2.81 (12)	3.35 (18)	3.43	0.08
Time 3	3.15 (7)	4.00 (18)	5.12	0.03*
Disch. Day 2				
Time 1	2.04 (10)	3.14 (18)	4.95	0.04*
Time 2	2.01 (12)	2.60 (18)	2.47	0.13
Time 3	1.69 (7)	2.48 (17)	5.76	0.03*

* $p < 0.05$ level

Table 4-19. Comparison of Post-test Nausea Scores between Music and Control Groups, Controlling for Pre-test scores (ANCOVA) after Discharge

Time Period	Music Group Adjusted Means (n)	Control Group Adjusted Means (n)	F	p-value
Disch. Day 1				
Time 1	1.23 (12)	1.23 (19)	0.00	1.00
Time 2	1.03 (12)	1.03 (18)	0.00	1.00
Time 3	0.72 (7)	0.72 (18)	0.00	1.00
Disch. Day 2				
Time 1	0.75 (10)	0.75 (18)	0.00	1.00
Time 2	0.43 (12)	0.43 (18)	n/c*	n/c*
Time 3	0.46 (7)	0.46 (17)	n/c*	n/c*

* n/c = not calculated/sample sizes insufficient

Table 4-20. Comparison of Post-test Drowsiness Scores between Music and Control Groups, Controlling for Pre-test scores (ANCOVA) after Discharge

Time Period	Music Group Adjusted Means (n)	Control Group Adjusted Means (n)	F	p-value
Disch. Day 1				
Time 1	1.87 (12)	1.87 (19)	n/c*	n/c*
Time 2	1.70 (12)	1.70 (18)	0.00	1.00
Time 3	1.88 (7)	1.88 (18)	0.00	1.00
Disch. Day 2				
Time 1	1.71 (10)	1.71 (18)	0.00	1.00
Time 2	1.57 (12)	1.51 (18)	0.62	0.44
Time 3	1.79 (7)	1.79 (17)	0.00	1.00

* n/c = not calculated/sample sizes insufficient

Table 4-21. Comparison of Total Analgesic Usage (Opioid and Non-Opioid) between Music and Control Groups in Hospital - Independent t-test

Drug Type/ Surgical Day	Music Group Mean (SD)(n)	Control Group Mean (SD) (n)	t	do	p-value
OME[a] Total Postop Day 1	51.52 (37.49) (23)	35.00 (27.43) (23)	1.71	44	0.10
OME[a] Total Postop Day 2	42.81 (35.54) (16)	40.56 (32.93) (9)	0.16	23	0.88
NOAE[b] Total Postop Day 1	1814.58 (1027.39) (24)	1554.35 (969.85) (23)	0.89	45	0.38
NOAE[b] Total Postop Day 2	1746.88 (1310.12) (16)	1661.11 (1715.47) (9)	0 14	.23	0.89

[a] OME = Opioid Morphine Equivalency (mg)

[b] NOAE = Non-Opioid Acetaminophen Equivalency (mg)

Table 4-22. Comparison of Reported Total Analgesic Usage (Opioid and Non-Opioid) between Music and Control Groups after Discharge – Independent t-test

Drug Type/ Surgical Day	Music Group Mean (SD) (n)	Control Group Mean (SD) (n)	t	df	p-value
OME[a] Total Discharge Day 1	18.33 (14.38) (6)	21.00 (23.29) (5)	-0.23	9	0.82
OME[a] Total Discharge Day 2	23.75 (29.26) (4)	15.83 (22.23) (6)	0.49	8	0.64
NOAE[b] Total Discharge Day 1	354.17 (607.54) (6)	600.17 (800.10) (6)	-0.60	10	0.56
NOAE[b] Total Discharge Day 2	575.00 (675.14) (4)	516.67 (775.67) (6)	0.12	8	0.91

[a] OME = Opioid Morphine Equivalency (mg)

[b] NOAE = Non-Opioid Acetaminophen Equivalency (mg)

Table 4-23. Music Listening Experience after Surgery Survey Responses (N = 17)

Survey Question	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
Q1. Music Choice Good for Me	55.6%	33.3%	11.1%	0.0%	0.0%
Q2. Music Reduced Pain	16.7%	72.2%	5.6%	5.6%	0.0%
Q3. Music Reduced Anxiety	16.7%	61.1%	16.7%	5.6%	0.0%
Q4. Pain Meds Music Reduced Pain	27.8%	55.6%	5.6%	11.1%	0.0%
Q5. Would Recommend Music	42.1%	47.4%	5.3%	5.3%	0.0%

Table 4-24. Overall Pain Experience after Surgery Survey by Group (N=36)

Survey Question	Music Group (n=18) n %	Control Group (n=18) n %	Chi-Square	df	p-value
Q. 1.My pain in hospital after surgery was what I expected	[a]11(61.1) [b]4(22.2) [c]3(16.7)	11(61.1) 3(16.7) 4(22.2)	X=.029	2	0.87
Q. 2. Intensity of my pain in hospital after surgery was well controlled	12(66.7) 1(5.6) 5(27.8)	11(61.1) 3(16.7) 4(22.2)	X^2=1.16	2	0.56
Q. 3. Distress I experienced from pain in hospital after surgery was well controlled	12(33.3) 3(16.7) 3(16.7)	12(33.3) 3(16.7) 3(16.7)	X^2=0.00	2	1.00
Q. 4. The side effects from pain medication received in hospital after surgery were well controlled	12(66.7) 3(16.7) 3(16.7)	12(66.7) 3(16.7) 3(16.7)	X^2=0.24	2	0.89
Q. 5. Pain medication received in hospital after surgery worked well to control my pain.	13(72.2) 2(11.1) 3(16.7)	11(61.1) 4(22.2) 3(16.7)	X^2=0.83	2	0.66

[a] agree or strongly agree

[b] neither agree nor disagree

[c] disagree or strongly disagree

Table 4-25. Overall Pain Experience in Hospital Survey Responses (N = 36)

Survey Question	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
Q1. Pain Was What I Expected	13.9%	47.2%	19.4%	16.7%	2.8%
Q2. Pain Intensity Controlled	27.8%	36.1%	11.1%	25.0%	0.0%
Q3. Pain Distress Controlled	16.7%	50.0%	16.7%	16.7%	0.0%
Q4. Pain Med SEs Controlled	13.9%	55.6%	13.9%	16.9%	0.0%
Q5. Pain Meds Controlled Pain	27.8%	38.9%	16.7%	11.1%	5.6%

CHAPTER 5
DISCUSSION

Summary of Results

In a sample of adult patients who had undergone total knee or hip joint arthroplasty surgery, the effect of a music intervention on reducing levels of pain intensity, pain distress, opioid side effects of nausea and drowsiness, and opioid and non-opioid analgesic usage the evening of surgery, during the first two postoperative days in hospital, and the first two days post-discharge from hospital was examined. Forty-seven patients participated in this prospective randomized trial. The results of this study are summarized here.

As expected, participants in the study who had undergone knee or hip joint arthroplasty surgery experienced acute pain after surgery. Although all study participants received an anesthetic nerve block to help manage pain after surgery, and all participants were given or had available to them, opioid and non-opioid analgesics to relieve pain, they still reported experiencing moderately intense pain. In hospital mean pain intensity scores were relatively consistent for participants across the evening of surgery, and postoperative days 1 and 2 day study periods (mean scores across groups ranging from 3.50 to 7.00 on a 0-10 numerical rating scale), and continued to be relatively consistent for participants post-discharge on discharge days 1 and 2 (mean scores across groups ranging from 2.43 to 6.47). Pain distress scores revealed lower levels of distress across the in hospital study periods (mean scores across groups ranged from 1.40 to 4.38), and continued to be relatively consistent for participants across the post-discharge study periods (mean scores across groups ranged from 0.86 to 4.79) The availability of options for relief of postoperative pain (intravenous

morphine prn, application of ice therapy, and therapeutic positioning) may have contributed to lower levels of reported pain distress after surgery.

The symptom of postoperative nausea was infrequent and well controlled with prophylactic anti-emetics during the early postoperative period. Nausea once discharged from hospital was insignificant as the clinical reasons for its occurrence no longer existed (that is, post-anesthetic nausea typically resolves within 24 hours after surgery). However, opioid analgesic usage among study participants post-discharge likely contributed to its existence after discharge. Participants reported very low levels of nausea across the in hospital study periods (mean scores across groups ranged from 0.00 to 1.70), and across the post-discharge study periods (mean scores across groups ranged from 0.29 to 1.42). Participants reported experiencing mild to moderate drowsiness during hospitalization likely due to sleep deprivation before surgery, anesthetic and analgesic drugs given intraoperatively, sleep interruption during hospitalization, and side effects of opioid analgesics taken for pain control. Low to moderate levels of drowsiness were reported by participants during in hospital study periods (mean scores across groups ranging from 0.25 to 4.62) and during post-discharge study periods (mean scores across groups ranging from 0.86 to 4.79).

As expected, participants were prescribed opioid and non-opioid analgesic medications to be given routinely during the first two postoperative days in hospital, and all but one participant took analgesic drugs to treat pain. They were prescribed, on an as needed basis, opioid and non-opioid analgesic medications for use post-discharge. Participants took oral oxycodone, oral tramadol, and oral acetaminophen for pain relief after surgery. In the early postoperative period, they experienced pain at rest, and

increased pain associated with physical therapy exercises and mobility necessary for rehabilitation after joint arthroplasty surgery.

Anxiety is an emotional response to a stressful event, and surgery is perceived by many individuals as a stressful event. Thus, it was hypothesized that state anxiety would be significantly associated with postoperative pain and related symptoms. In this study, levels of state anxiety were relatively low and not significantly related to the postoperative symptoms; thus, this hypothesis was not supported. This may be due to the fact that participants were relieved that their surgery was complete and they would now get relief from the chronic pain they had been experiencing before surgery. Also, all participants received an anesthetic nerve block postoperatively, thus relieving, or for some participants, eliminating acute pain in the immediate postoperative period (i.e. the evening of surgery). Perhaps measuring state anxiety later in the postoperative period, for example, on postoperative day 1 or 2, along with pain intensity and distress, or measuring trait anxiety (that is, the stable tendency to attend to experiences, and report negative emotions across many situations) would more accurately reflect the measure of postoperative anxiety experienced by participants in this study.

The purpose of this study was to evaluate whether music as an adjuvant analgesics would reduce pain and related postoperative symptoms more that analgesic medications alone. The results revealed patients who participated in the music intervention had significantly lower levels of pain intensity and pain distress during the first 24 hours postoperatively, and during the first 24-48 hours post-discharge than those in the control group (analgesics medications only). No group differences were detected during the second postoperative day in hospital. This is likely due to missing

data because of varied discharge days from hospital among study participants. Many study participants were discharged from hospital on postoperative day 1 (n=20; 43%), some on postoperative day 2 (n=16; 34%), and some on postoperative day 3 (n=10, 21%). Time of discharge on discharge days was typically 12 noon. (One study participant was discharged on postoperative day 4). Controlling for pre-test levels of pain intensity and pain distress, the study results revealed significant group differences in treatment effects, with significantly lower post-test pain scores for those who participated in music listening. Thus, the hypothesis was supported for the first 24 hours postoperatively and 24-48 hours post-discharge from hospital.

With regard to the other postoperative symptoms, there were no significant differences between music and control group participants in levels of nausea, drowsiness, or analgesic usage at any of the time periods in hospital or post-discharge. This was likely due in part to use of a nerve block to manage postoperative pain the first 24 hours after surgery. For many participants, this resulted in less pain and therefore less use of opioid analgesics for pain relief. Use of less opioid analgesics resulted in fewer side effects associated with opioid use (i.e. nausea and drowsiness). With nausea, effective usage of anti-emetic drugs after surgery likely contributed to the decreased incidence of this postoperative symptom after surgery. Therefore, the hypothesis that adjuvant music would significantly lower nausea and drowsiness and reduce analgesic usage was not supported.

Many factors can influence analgesic usage with patients who have undergone surgery. In this study, use of an anesthetic nerve block in hospital and for some participants, continued use after discharge, likely influenced participant reports of pain

intensity and pain distress, reports of opioid side effects of nausea and drowsiness, and analgesic usage in hospital and after discharge. Nerve block provides superior analgesia for surgical patients without the side effects associated with opioid analgesic use. Prescribed analgesics used and use of an anesthetic nerve block, its drugs and dosing, were not controlled for in this study. However, there were no significant differences found between music group participants and control group participants in opioid or non-opioid analgesic taken in hospital or reportedly taken by participants post-discharge from hospital. Further, there was no significant difference in length of time for nerve block placement between participants in the study groups. Anesthetic nerve block usage among study participants was not controlled for in this study.

On the third day post-discharge from hospital, participants in the study were asked to rate their overall pain experience in hospital after surgery, and those in the music listening group were asked to rate their music listening experience after surgery. Participants expressed satisfaction with their postoperative pain management. The majority of respondents reported that pain was well-controlled, nausea and drowsiness were well managed, and that analgesics were effective in reducing pain. Those who received adjuvant music therapy perceived music listening as helpful in reducing surgical pain and anxiety. Further, these participants strongly recommended music listening as an intervention for postoperative pain management.

Use of an adjuvant therapy, specifically music listening, was found in this study to help relieve participants' pain after surgery – both the acute surgical pain experienced in hospital and the acute surgical pain experienced after discharge from hospital. These findings supported Good and Moore's (1996) theory. However, among treatment group

participants in this study, use of music listening after surgery did not impact the amount of opioid or non-opioid analgesics taken by participants after surgery, nor did it impact the levels of nausea or drowsiness experienced by study participants after surgery. Therefore, these findings did not support Good and Moore's (1996) theory. Good and Moore's nursing pain management theory, first published in 1996, does not reflect current practice with patients undergoing orthopedic surgery in terms of pain management; that is, use of nerve block for pain management the first 24 hours postoperatively, and prophylactic use of anti-emetic drugs to control the symptom of nausea. Therefore, this theory may not be the best fit for this study to help explain the relationships among study variables. .

Strengths and Limitations of the Study

This was the first randomized trial study that examined the use of a music intervention as adjuvant therapy along with prescribed analgesia to help reduce acute surgical pain in both the hospital and post-discharge (home) settings. The randomized trial design chosen for use in this study and the study protocol examining effect over time are both strengths of the study. The ability to access participants' analgesic usage in hospital from the electronic medical record (EPIC) made recording these data feasible, accurate, and complete, and is also a strength of the study. The ability to collaborate with the Orthopedic Center surgeons, nurses, and clinical research coordinator to facilitate recruitment was key to successful recruitment. This partnership facilitated the introduction of the study to the patients at their preoperative clinic visit, and greatly facilitated enrollment and timely completion of this study. This collaboration was a strength of the study.

A limitation of this study was its small sample size. This study was intended as a pilot study to test the feasibility of using post-discharge assessments and the use of personal portable music devices. The sample size of 50 for this study was determined based on a power analysis using an estimated large effect size (d=.80), power of 0.80 and alpha = 0.05 (Cohen, 1988). However, there was loss of data at several measurement points both in the hospital and post-discharge that resulted in small sample sizes for specific comparisons. Using robust parametric statistics like Analysis of Covariance (ANCOVA) in this study does violate some assumptions of its use; for example, normality, homogeneity of variance, and random independent samples. Therefore, the study should be replicated with a larger sample size in order to reduce the risk of Type II error and strengthen statistical conclusion validity,

Problems with implementing the study intervention was a limitation of the study. Some music group participants initially had difficulty accessing the hospital's internet Wi-Fi system (broadband wireless network) to access their on-line radio for music listening. At times, internet Wi-Fi system access varied from hospital room to hospital room on the orthopedic unit. The nursing staff informed participants that this was commonplace at times in the hospital. This resulted in music group participants needing to use the internet access system of their own device. If a music therapy program were to be implemented in this clinical setting, and importantly showed improved patient outcomes and satisfaction with hospital care, this might be the impetus needed by administration in the clinical agency to improve internet access to the agency's Wi-Fi system for hospitalized patients.

Challenges with carrying out the study intervention was a limitation of the study. In the busy and noisy hospital environment, music listening for some music group participants was interrupted, in spite of signage on their hospital door indicating that music listening was being conducted, and "do not disturb." Some participants in both music and control groups experienced postoperative symptoms of nausea, vomiting, or drowsiness which affected their ability to either carry out music listening or to eat at scheduled mealtimes.

Analgesic drug administration before music listening with treatment group participants was not measured in this study. Further, analgesic drug administration before mealtimes with control group participants was not measured in the study. Therefore, these omissions threatened the internal validity of the study and is a limitation of the study.

Study participants were discharged from hospital after surgery at various times during their postoperative course – postoperative day 1, day 2, or day 3. The orthopedic surgeon's decision to discharge participants was based in part on the participants' hemodynamic stability, acceptable pain levels, absence of postoperative symptoms of nausea, vomiting, and drowsiness, and acceptable mobility levels. Therefore, this resulted in incomplete data comparisons of study variables for participants in hospital, especially on postoperative day 2. Incomplete data comparisons due to varied discharge days from hospital was a limitation of the study.

One purpose of this study was to determine the feasibility of conducting this research in the clinical setting and into the discharge (home) setting. The majority of participants were discharged either home with home health nurse and physical therapy

visitations (n=42, 89%), and a few (n=5, 11%) were discharged to a pre-arranged rehabilitation facility for recovery after surgery. In this study, accessing study participants once discharged home or to a rehabilitation facility proved for some, to be difficult. In some instances (n=10, 21%), participants could not be contacted at the telephone number given to the investigator at the preoperative clinic visit in order to conduct the telephone interview on discharge day 3. Also, in several instances (n=25, 53%), participants did not return their discharge booklets with documented study data as requested. Fortunately, study data from discharge booklets could be obtained during the telephone interview with participants. Not being able to access study participants via telephone for interview and not receiving data booklets once discharged from hospital resulted in incomplete data for some participants and was a limitation of the study.

Fidelity to music listening was not examined in this study. Whether music group participants truly listened to music for the frequency and duration instructed was not verified beyond reviewing documentation received from these participants and conversations with them by the study investigator. Further, control group participants refraining from listening to music in hospital and post-discharge was not verified in the study beyond conversations with them by the study investigator. Lack of verification of fidelity to music listening, the study intervention, was a limitation of the study.

Only orthopedic patients undergoing joint replacement surgery (either knee or hip joint replacement surgery) were chosen for inclusion in this study. Therefore, the generalizability of results of this study is limited to patients undergoing these types of

orthopedic surgery. Generalizability of study findings was another limitation of the study.

Implications for Education

Educating patients on the use of music, in addition to opioid and non-opioid analgesic usage, would enhance acute surgical pain management with patients in both the hospital and discharge (home) settings. At required group preoperative information sessions and at preoperative clinic visits, patients should be educated about the potential benefits of music in reducing pain, and encouraged to bring a device for music listening with them to hospital and use it at home.

Educating nurse managers, nursing staff, nurse educators, and nursing students on use of music in order to implement evidence-based practice is necessary to help patients achieve positive surgical outcomes. Such information sharing can occur during nursing team meetings, brown bag lunches, classroom discussions, or other such sessions, in order to inform nurses of the importance of offering music as an adjuvant, along with analgesic medications, to enhance postoperative pain management with surgical patients in the hospital and discharge (home) settings.

Implications for Practice

Nurses are to base their professional practice on sound evidence from sources such as clinical research, and it is believed that such evidence helps nurses to make appropriate, cost effective, and efficacious decisions for good client outcomes (Polit, 2010). This research study examined the use of music listening to enhance acute surgical pain management with patients who had undergone orthopedic surgery, specifically knee and hip joint arthroplasty surgery, and provides empirical evidence indicating that music is an effective adjuvant, along with analgesic medications, in

reducing acute postoperative pain. This empirical evidence provides support for nurses to recommend music for acute surgical pain management with patients undergoing orthopedic surgery. In addition to administering analgesic medications to help control acute pain after surgery, encouraging music as an intervention for surgical patients can improve pain management outcomes. This intervention is low-cost, portable, and easily accessible to patients who own a smartphone or tablet. Before surgery, at their group preoperative information session held at the Orthopedic Clinic, patients should be educated about the potential benefits of music in reducing pain, and encouraged to bring a device for music listening with them to hospital. In the hospital setting, clinicians and managers should consider having low-cost devices available for use by patients who to do not have one. Further, patients should be encouraged to continue to use music listening, along with analgesic medications, for pain control once discharged home.

A challenge for nurses is to help manage pain with patients at times when it is exacerbated during pain-provoking but clinically necessary maneuvers; for example, during dressing changes with burn patients, range of motion exercises or ambulation efforts with joint replacement patients, and during deep breathing and controlled coughing exercises with thoracotomy patients. Development of protocols that use music to help relieve pain-provoking clinical maneuvers would be beneficial to patients in the clinical setting.

Nurses should participate in developing evidence based music listening programs. Nursing Practice Committees can examine the measures needed to implement music listening in the practice setting with patients. In the clinical agency

where this study was conducted, an Arts in Medicine Program exists, and includes art therapy services provided by professionals specifically trained to facilitate, for example, Music Therapy with patients in hospital. The Nursing Practice Committee in this clinical agency can team up with these professionals to develop an evidence-based program for patients hospital-wide, or for patients experiencing specific illnesses or surgeries. Programs can continue to be implemented with patients after discharge from hospital to home and supervised by clinicians who see patients in their home environment for rehabilitation; for example, the homecare nurse and physical therapist. This is the future direction that music use with patients after surgery is heading, as orthopedic joint replacement surgery is now being performed as same day surgery for some candidates.

Implications for Research

This study is the first randomized trial to examine the use of music listening for acute surgical pain management with orthopedic patients beyond the hospital setting. There were a number of limitations of this study, and challenges with implementing it in both the hospital and discharge settings. Changes discussed in the strengths and limitations section above would strengthen the study power and improve the statistical conclusion validity of the study findings. Future research should focus on and include designs of randomized trials with adequate sample sizes and statistical power to strengthen statistical conclusion validity.

Barriers to implementing the study intervention was a challenge in this study. In future studies, music group participants could be instructed to use ear pieces or headphones with their internet access device when listening to music thereby eliminating the noise of the hospital environment. With implementation of a music therapy program, health care providers on the unit would more likely facilitate music

listening by keeping interruptions with participants to a minimum at music listening times.

Lack of verification of fidelity to music listening was an issue in this study. In future studies, measures to verify fidelity to music listening need to be included in the study design. This could include having a research assistant present in hospital during the participants' hospital stay, and having the Home Care Nurse and Physical Therapist, who visit participants at home to carry out rehabilitation therapy, continue music listening verification.

Lack of measurement of analgesic usage prior to music listening or scheduled mealtimes with study participants was an issue in this study. In future studies, time since last analgesic dosing as well as drug type and dose received need to be examined for their effects on the major study variables.

Incomplete data due to varied discharge days from hospital was an issue in this study. In future studies, changes to data collection measurement points would need to be instituted to reflect times patients now stay in hospital after orthopedic joint arthroplasty surgery. Some patients undergo orthopedic surgery for joint arthroplasty during same day surgery. This supports the need for patient education discharge instructions to include use of music for pain management in the home setting.

Incomplete data due to contact and mail return problems post-discharge was an issue in this study. In future studies, contact with study participants once discharged home could include daily telephone calls on discharge days 1 and 2 for the study investigator to review same day log booklet entries, and for the treatment group, use of music listening. This strategy would decrease participant recall bias. Follow-up

reminder postcards could be mailed to study participants if telephone contact or mail return of log booklets were delayed. As an incentive to maintain follow-up contact, study participants could be offered monetary Visa gift cards for completion of telephone interviews and return of study log booklets. Also, on-line survey templates to collect study data might be an option with study participants, but participants would need to have internet access available.

In addition to data collection issues, there were issues in this study with measurement timing and dosing of the music listening intervention with study participants. Music group participants were instructed, per the study protocol, to listen to music for 30 minutes duration, three times a day when they were experiencing pain after surgery both in hospital (evening of surgery, postoperative days 1 and 2) and when discharged from hospital (discharge days 1 and 2). During the evening of surgery, some participants were not experiencing pain due to the presence of the anesthetic nerve block. Therefore, in future studies, evening of surgery as the beginning measurement time period may not be appropriate for patients who have nerve blocks in place postoperatively. Anesthetic nerve block was typically removed with study participants around 8:00 o'clock in the morning on postoperative day one in hospital. In future studies, better timing to begin implementing the study intervention and begin study measurements (after nerve block removal), would decrease the incidence of missing data the evening of surgery (first measurement period in hospital) and the morning of postoperative day 1 (second measurement period in hospital). .

The inclusion of vulnerable populations such as the critically ill, the very young and old, and the cognitively-impaired would help identify strategies for implementing

music therapy with individuals who experience but cannot verbally communicate their pain. This should be a focus of future studies.

What are the optimal multimodal combinations (pharmacological and non-pharmacological) for effectively managing acute postoperative pain with patients after surgery? These combinations need to be empirically examined in order to identify those combinations that are most effective for specific surgical patient populations. Nurses can collaborate with physicians to help determine such evidence generation that would in turn inform clinical practice guidelines for acute postoperative pain management (Chou et al, 2016).

Conclusions

Effective acute-surgical pain management is important to both clinicians and patients. Clinical practice guidelines such as those published by the American Pain Society (Chou et al., 2016) and Agency for Healthcare Research and Quality (AHRQ) (Carr & Jacox, 2006) advocate for the use of evidence-based non-pharmacological interventions such as music to help achieve optimal pain management with patients following surgery.

The results of this study lend further evidence to support the use of music listening, along with prescribed analgesic medications, to enhance acute surgical pain management following joint arthroplasty surgery. Despite the study limitations, results indicated participants who used music listening after surgery for approximately 30 minutes up to three times per day, along with analgesic medications, reported significant reductions in pain intensity and pain distress compared to participants who used analgesics alone. Further, these results provide support for the use of music in both the hospital and post-discharge (home) settings.

Professional nurses are the health care providers who spend the most time with postoperative patients. Thus, they are in the ideal position to offer and implement supportive interventions to help enhance postoperative pain management. Music is a non-invasive, safe, and inexpensive intervention that can be delivered easily and successfully with patients in both the hospital and home settings. Sufficient research has been conducted to indicate that music should be made available to all patients undergoing operative procedures (Chou et al., 2016). Implementing music listening for pain relief with patients after surgery can be considered an evidence based nursing practice.

APPENDIX A
DEMOGRAPHICS SHEET

Acute Surgical Pain Management Study

PARTICIPANT DEMOGRAPHIC DATA SHEET

Q. 1. **What is your sex?** 1. Male 2. Female

Q. 2. **What is your age?** (In years): _____

Q. 3. **What is your marital status?**

1. Married
2. Widowed
3. Divorced/separated
4. Never married

Q.4. **What is your race?**

1. White
2. Black or African American
3. Native American/Native Alaskan
4. Asian
5. Native Hawaiian/Other Pacific Islander
6. Other

Q. 5. **What is the highest grade of school that you completed?**

1. 8th grade or less
2. Some high school
3. High school Diploma or GED
4. Some college or vocational school
5. College graduate
6. Post-graduate/professional

Q. 6. **Do you have any concurrent acute or chronic pain conditions? If yes, how many?**

1. None
2. 1 condition
3. 2-3 conditions
4. 4 or more conditions

APPENDIX B
BOOKLETS: MUSIC GROUP: HOSPITAL & DISCHARGE

USE OF MUSIC LISTENING TO ENHANCE ACUTE SURGICAL PAIN MANAGEMENT WITH PATIENTS UNDERGOING ORTHOPEDIC SURGERY

Hospital Log Booklet

Music Group Participants

If you have any questions or concerns, please contact:

Study Co-Investigator: **Joanne Laframboise-Otto, MSN, RN, at (352) 222-0374**

Or her supervisor: **Dr. Ann Horgas at (352) 273-7622**

We hope you are having an uneventful and speedy recovery from your surgery.

It is important that you listen to your preferred music for 30 minutes at least three times a day to help relieve your pain after surgery.

You are encouraged to listen to music in addition to taking your prescribed pain medication to relieve your surgical pain.

Please remember, study staff have asked that you write down in this booklet the following information:

1. •**music listening** (times during the day and duration of each music listening session)

2. •**pain intensity and pain distress ratings before and after** music listening

3. •**pain medication taken throughout the day** (drug, dose. route, time taken)

4. •**pain intensity and pain distress ratings before and about 30 minutes after** pain medication taken

5. •**intensity of side effects** (if any) experienced (specifically nausea and drowsiness)

Study staff will visit you postoperatively on your day of surgery and call or visit you on your first and second postoperative days, asking you about your music listening, pain, pain medication taken, and side effects. It will be easier to write this information in this booklet throughout day rather than to try to remember it later when study staff call or visit.

Remember to give **your completed hospital log booklet** to nursing staff on the day you are discharged from the hospital. Your booklet will be given to Study staff.

Numerical Rating Scales

Pain Intensity:

0____1____2____3____4____5____6____7____8____9____10
No Pain **Worst Pain Imaginable**

Pain Distress:

0____1____2____3____4____5____6____7____8____9____10
No Distress **Worst Distress Imaginable**

Nausea Intensity:

0____1____2____3____4____5____6____7____8____9____10
No Nausea **Worst Nausea Imaginable**

Drowsiness Intensity:

0____1____2____3____4____5____6____7____8____9____10
No Drowsiness **Worst Drowsiness Imaginable**

PARTICIPANT REPORTED PAIN SCORES AND RECORDED PAIN MEDICATIONS TAKEN					Music	ID#: ____		IRB#: _____	
Date ____	PAIN BEFORE MUSIC		Music Listening	PAIN MEDICATION ADMINISTERED		PAIN AFTER MUSIC		Side Effects	
POD ____	Time	Intensity (0-10)		MEDICATION: Drug, Dose, Route	Time	Time	Intensity (0-10)	Nausea	Drowsy

Thank you for participating in the music study while you were in hospital.

Remember to give this booklet to nursing staff when you are discharged from hospital.

We will be in touch by telephone on the 3rd day you are discharged.

USE OF MUSIC LISTENING TO ENHANCE ACUTE SURGICAL PAIN MANAGEMENT WITH PATIENTS UNDERGOING ORTHOPEDIC SURGERY

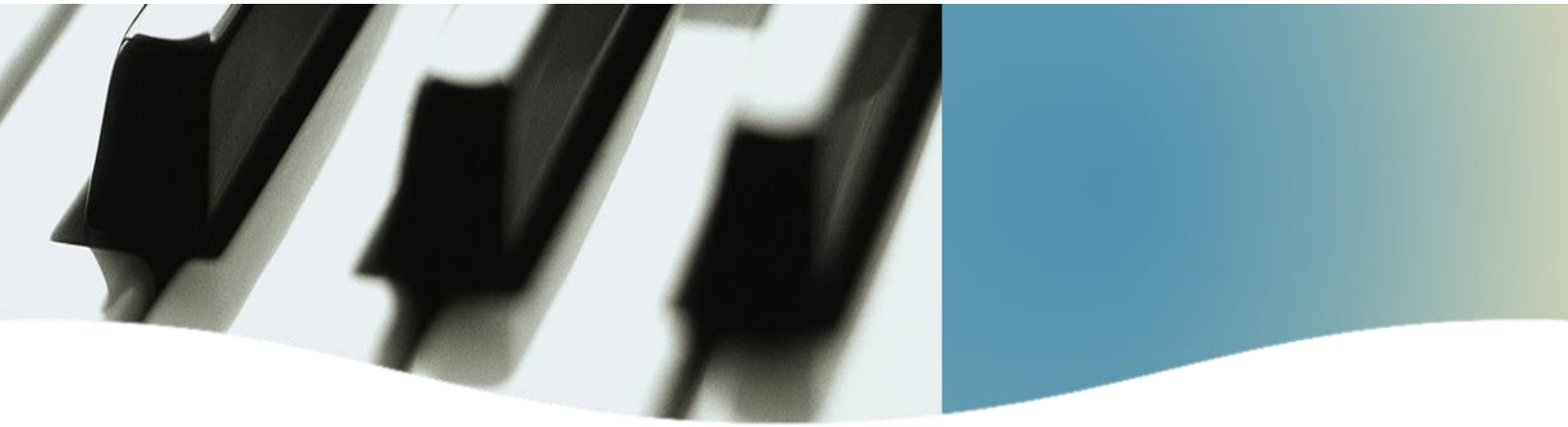
Discharge Log Booklet

Music Group Participants

If you have any questions or concerns, please contact:

Study Co-Investigator: **Joanne Laframboise-Otto, MSN, RN at (352) 222-0374**

Or her supervisor: **Dr. Ann Horgas at (352) 273-7622**



Dear Music Group Participant:

We hope you are having a comfortable stay now that you have been discharged from hospital.

It is important that you continue to **use your preferred music for 30 minutes at least three times a day** when discharged to help relieve your pain after surgery.

You are encouraged to listen to music in addition to taking your prescribed pain medication to relieve your surgical pain when discharged.

Please remember, study staff have asked that you write down in this booklet the following information:

1. **music listening** (three times each day and duration of each music listening session)
2. **pain intensity and pain distress ratings before and after** music listening
3. **pain medication taken throughout the day** (drug, dose, time taken)
4. **pain intensity and pain distress ratings before and about 30 minutes after** pain medication taken
5. **the intensity of side effects** (if any) experienced (specifically nausea and drowsiness)

Study staff will be calling you on the 3rd day you are discharged asking you about your music listening, pain, pain medication taken, and side effects in order to complete the study. It is easier to write this information down each day rather than to try to remember it later when study staff call.

Remember to mail via USPS, in the stamped, self-addressed, no return address envelope provided to you in hospital prior to your discharge, **your discharge log booklet**, mailing it to study co-investigator Ms. Joanne Laframboise-Otto, MSN, RN.

Numerical Rating Scales

Pain Intensity:

0____1____2____3____4____5____6____7____8____9____10
No Pain **Worst Pain Imaginable**

Pain Distress:

0____1____2____3____4____5____6____7____8____9____10
No Distress **Worst Distress Imaginable**

Nausea Intensity:

0____1____2____3____4____5____6____7____8____9____10
No Nausea **Worst Nausea Imaginable**

Drowsiness Intensity:

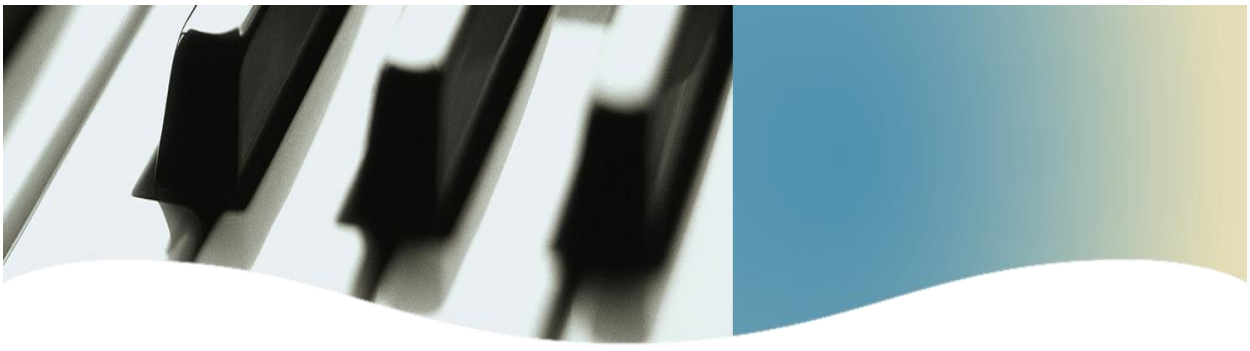
0____1____2____3____4____5____6____7____8____9____10
No Drowsiness **Worst Drowsiness Imaginable**

PARTICIPANT REPORTED PAIN SCORES AND RECORDED PAIN MEDICATIONS TAKEN Music ID#: _____ IRB#: _____										
Date _____ POD _____		PAIN BEFORE MUSIC		Music Listening	PAIN MEDICATION ADMINISTERED		PAIN AFTER MUSIC		Side Effects	
		Time	Intensity (0-10)		MEDICATION: Drug, Dose, Route	Time	Time	Intensity (0-10)	Nausea	Drowsy

Thank you for participating in the music study while you were discharged.

Remember to mail this booklet in the stamped, pre-addressed, no return address envelope provided to you.

We wish you continued recovery from your surgery.



APPENDIX C
BOOKLETS: CONTROL GROUP: HOSPITAL & DISCHARGE

USE OF MUSIC LISTENING TO ENHANCE ACUTE SURGICAL PAIN MANAGEMENT WITH PATIENTS UNDERGOING ORTHOPEDIC SURGERY

Hospital Log Booklet

Control Group Participants

If you have any questions or concerns, please contact:

Study Co-Investigator: **Joanne Laframboise-Otto, MSN, RN, at (352) 222-0374**

Or her supervisor: **Dr. Ann Horgas at (352) 273-7622**

Dear Control Group Participant:

We hope you are having an uneventful and speedy recovery from your surgery.

You are encouraged to take your prescribed pain medication in order to relieve your pain after surgery.

While you are in hospital, we ask that you **not** **listen to music** during your hospital stay.

Please remember, study staff have asked that you write down in this booklet the following information:

1. •**pain intensity and pain distress ratings before and after** hospital scheduled mealtimes

2. •**pain medication you receive throughout the day** (drug, dose, route, & time taken)

3. •**pain intensity and pain distress ratings before and about 30 minutes after** pain medication taken

4. **intensity of side effects** (if any) experienced (specifically nausea and drowsiness)

Study staff will visit you postoperatively on your day of surgery and either visit or call you on your first and second postoperative days asking you about your pain, pain medication taken, and side effects. It will be easier to write this information in this booklet throughout day rather than to try to remember it later when study staff call or visit.

Remember to give your **completed hospital log booklet** to nursing staff the day you are discharged from the hospital. Your booklet will be given to Study staff.

Numerical Rating Scales

Pain Intensity:

0____1____2____3____4____5____6____7____8____9____10
No Pain **Worst Pain Imaginable**

Pain Distress:

0____1____2____3____4____5____6____7____8____9____10
No Distress **Worst Distress Imaginable**

Nausea Intensity:

0____1____2____3____4____5____6____7____8____9____10
No Nausea **Worst Nausea Imaginable**

Drowsiness Intensity:

0____1____2____3____4____5____6____7____8____9____10
No Drowsiness **Worst Drowsiness Imaginable**

PARTICIPANT REPORTED PAIN SCORES AND RECORDED PAIN MEDICATIONS TAKEN Control ID#: ____ IRB#: _____										
Date ____ POD ____		PAIN BEFORE MEAL		Mealtimes	PAIN MEDICATION ADMINISTERED		PAIN AFTER MEAL		Side Effects	
		Time	Intensity (0-10)		MEDICATION: Drug, Dose, Route	Time	Time	Intensity (0-10)	Nausea	Drowsy

Thank you for participating in the music study while you were in hospital.

Remember to give this booklet to nursing staff when you are discharged from hospital.

We will be in touch by telephone on the 3rd day you are discharged.

USE OF MUSIC LISTENING TO ENHANCE ACUTE SURGICAL PAIN MANAGEMENT WITH PATIENTS UNDERGOING ORTHOPEDIC SURGERY

Discharge Log Booklet

Control Group Participants

If you have any questions or concerns, please contact:

Study Co-Investigator: **Joanne Laframboise-Otto, MSN, RN, at (352) 222-0374**

Or her supervisor: **Dr. Ann Horgas at (352) 273-7622**

Dear Control Group Participant:

We hope you are having a comfortable stay now that you have been discharged from hospital.

You are encouraged to take your prescribed pain medication to relieve your surgical pain as you did when you were in hospital.

Just like when you were in hospital, we ask that you **not listen to music** during the first two days you are discharged.

Please remember, study staff have asked that you write down in this booklet the following information:

1. **pain intensity and pain distress ratings around common meal times:** breakfast, lunch, and dinner

2. **pain medication you take throughout the day** (drug, dose, time taken)

3. **pain intensity and pain distress ratings before and about 30 minutes after** pain medication taken

4. **the intensity of side effects** (if any) experienced (specifically nausea and drowsiness)

Study staff will be calling you on the 3rd day you are discharged asking you about your pain, pain medication taken, and side effects in order to complete the study. It is easier to write this information down each day rather than to try to remember it later when study staff call.

Remember to mail via USPS, in the stamped, self-addressed, no return address envelope provided to you in hospital prior to your discharge, **your discharge log booklet**, mailing it to study co-investigator Ms. Joanne Laframboise-Otto, MSN, RN.

Numerical Rating Scales

Pain Intensity:

0____1____2____3____4____5____6____7____8____9____10
No Pain **Worst Pain Imaginable**

Pain Distress:

0____1____2____3____4____5____6____7____8____9____10
No Distress **Worst Distress Imaginable**

Nausea Intensity:

0____1____2____3____4____5____6____7____8____9____10
No Nausea **Worst Nausea Imaginable**

Drowsiness Intensity:

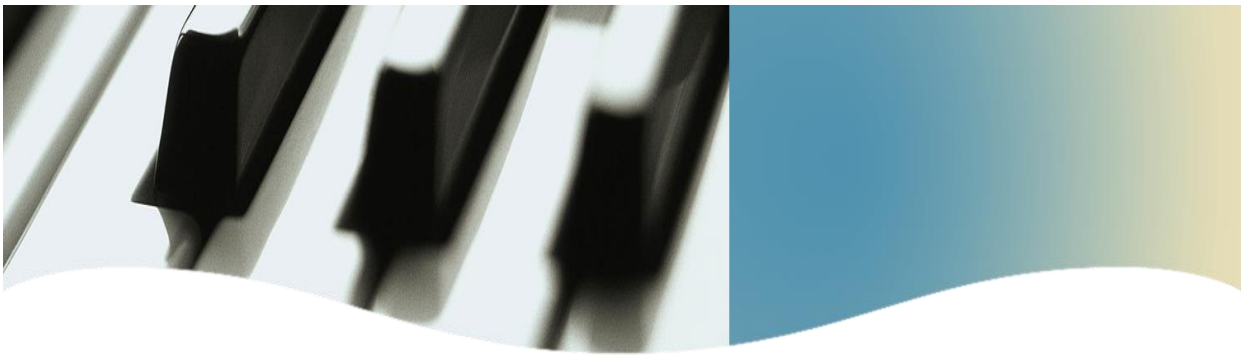
0____1____2____3____4____5____6____7____8____9____10
No Drowsiness **Worst Drowsiness Imaginable**

PARTICIPANT REPORTED PAIN SCORES AND RECORDED PAIN MEDICATIONS TAKEN Control ID#: _____ IRB#: _____										
Date _____ POD _____		PAIN BEFORE MEAL		Mealtimes	PAIN MEDICATION ADMINISTERED		PAIN AFTER MEAL		Side Effects	
		Time	Intensity (0-10)		MEDICATION: Drug, Dose, Route	Time	Time	Intensity (0-10)	Nausea	Drowsy

Thank you for participating in the music study while you were discharged.

Remember to mail this booklet in the stamped, pre-addressed, no return address envelope provided to you.

We wish you continued recovery from your surgery.



APPENDIX D
SURVEYS: MUSIC LISTENING & OVERALL PAIN EXPERIENCE

MUSIC LISTENING EXPERIENCE AFTER SURGERY SURVEY

(Experimental Group Participants)

Please rate the following statements in terms of your experience with music listening after surgery.

1. **The music I chose to listen to after surgery was a good choice for me.**

Strongly agree ☐ Agree ☐ Neither Agree nor Disagree ☐ Disagree ☐ Strongly Disagree ☐

2. **The music I listened to helped to reduce my pain after surgery.**

Strongly agree ☐ Agree ☐ Neither Agree nor Disagree ☐ Disagree ☐ Strongly disagree ☐

3. **The music I listened to helped to reduce my anxiety after surgery**.

Strongly agree ☐ Agree ☐ Neither Agree nor Disagree ☐ Disagree ☐ Strongly disagree ☐

4. **The pain medication I received worked well with my music to help reduce my pain after surgery.**

Strongly agree ☐ Agree ☐ Neither Agree nor Disagree ☐ Disagree ☐ Strongly disagree ☐

5. **I would recommend music listening to other patients after surgery.**

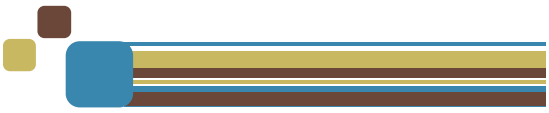
Strongly agree ☐ Agree ☐ Neither Agree nor Disagree ☐ Disagree ☐ Strongly disagree ☐

What suggestions do you have for improving your music listening experience after surgery?

_____

_____

_____



OVERALL PAIN EXPERIENCE IN HOSPITAL AFTER SURGERY SURVEY

(All Participants)

Please rate the following statements in terms of your pain experience in hospital after surgery.

1. **My pain in hospital after surgery was what I expected.**

Strongly agree ☐ Agree ☐ Neither Agree nor Disagree ☐ Disagree ☐ Strongly Disagree ☐

2. **The intensity of my pain in hospital after surgery was well controlled.**

Strongly agree ☐ Agree ☐ Neither Agree nor Disagree ☐ Disagree ☐ Strongly disagree ☐

3. **The distress I experienced from my pain in hospital after surgery was well controlled.**

Strongly agree ☐ Agree ☐ Neither Agree nor Disagree ☐ Disagree ☐ Strongly disagree ☐

4. **The side effects from pain medication that I received in hospital after surgery were well controlled.**

Strongly agree ☐ Agree ☐ Neither Agree nor Disagree ☐ Disagree ☐ Strongly disagree ☐

5. **The pain medication I received in hospital after surgery worked well to control my pain.**

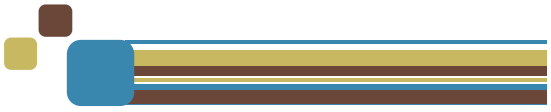
Strongly agree ☐ Agree ☐ Neither Agree nor Disagree ☐ Disagree ☐ Strongly disagree ☐

What suggestions do you have for improving your overall pain experience in hospital after surgery?

_____

_____

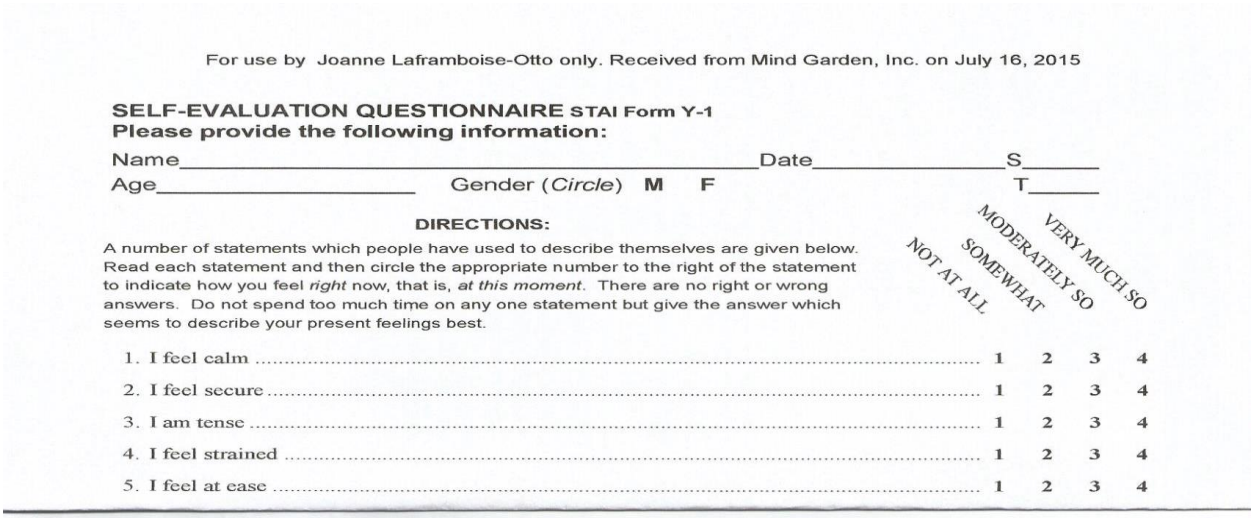
_____



APPENDIX E
EPIC DATA SHEET: PAIN REPORTS TO NURSES & PAIN MEDS IN HOSPITAL

ID#: _____	IRB#: _____	NURSE REPORTED AND RECORDED PAIN SCORES & PAIN MEDS							From EPIC/eMAR	
TIME		PAIN BEFORE MED			PAIN MEDICATION ADMINISTERED		PAIN AFTER MED			
POD _____		INTENSITY (0-10)	DISTRESS (0-10)		MEDICATION: Drug, Dose, Route	Time	INTENSITY (0-10)	DISTRESS (0-10)		
MORNING (6 AM - 12 NOON)										
MID-DAY (12 NOON- 6 PM)										
EVENING (6 PM - 12 MN)										
NIGHT (12 MN - 6 AM)										

APPENDIX F
STATE ANXIETY INVENTORY (FORM Y-1) (SAMPLE USED WITH PERMISSION)



SELF-EVALUATION QUESTIONNAIRE STAI Form Y-1
Please provide the following information:

Name_____Date_____S_____
Age_____ Gender (*Circle*) **M** **F** T_____

DIRECTIONS:

A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you feel *right* now, that is, *at this moment*. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

	NOT AT ALL	SOMEWHAT	MODERATELY SO	VERY MUCH SO
1. I feel calm	1	2	3	4
2. I feel secure	1	2	3	4
3. I am tense	1	2	3	4
4. I feel strained	1	2	3	4
5. I feel at ease	1	2	3	4

mind garden

www.mindgarden.com

To whom it may concern,

This letter is to grant permission for the above named person to use the following copyright material for his/her thesis or dissertation research.

Instrument: ***State-Trait Anxiety Inventory for Adults***

Authors: ***Charles D. Spielberger, in collaboration with R.L. Gorsuch, G.A. Jacobs, R. Lushene, and P.R. Vagg***

Copyright: ***1968, 1977 by Charles D. Spielberger***

Five sample items from this instrument may be reproduced for inclusion in a proposal, thesis, or dissertation.

The entire instrument may not be included or reproduced at any time in any other published material.

Sincerely,

Robert Most
Mind Garden, Inc.
www.mindgarden.com

REFERENCE LIST

Acute Pain Management Guideline Panel, Agency for Health Care Research and Quality (1992). *Clinical Practice Guideline: Acute Pain Management: Operative or Medical Procedures and Trauma. AHCPR Publication No. 920032.* Rockville, MD: Public Health Service, U. S. Department of Health and Human Services.

Allred, K., Byers, J. & Sole, M. (2010). The effect of music on postoperative pain and anxiety. *Pain Management Nursing, 11,* 15-25.

American Music Therapists Association. What is Music Therapy? Accessed at: www.musictherapy.org.

Bruce, J. & Quinlan, J. (2011). Chronic post-surgical pain. *British Journal of Pain, 5*, 23-29.

Campbell, D., & Stanley, J. (1973). *Experimental and quasi-experimental designs for research.* Chicago: Rand McNally.

Carr, D., & Jacox, A. (2006). *Acute pain management: Operative or medical procedures and trauma. Clinical practice guideline. Agency for Healthcare Research and Quality.* http://www.ahrq.gov/clinic/medtep/acute.htm. Accessed February 15, 2017.

Carr, D., Jacox, A., Chapman, C. et al. (1992). *Acute pain management: Operative or medical procedures and trauma. Clinical practice guideline No 1, AHCPR Pub. No. 92-0032.* Rockville, MD: Agency for Health Care Policy and Research, Public Health Service, U.S. Department of Health and Human Services.

Cepeda, M., Carr, D., Lau, J., & Alvarez, H. (2013). Music for pain relief. *Conchrane Database of Systematic Reviews, 10*. Database: CINAHL.

Chen, J., Chen, T., Huang, C., Hsieh, Y. & Jai, H. (2015). Effects of music on psychophysiological responses and opioid dosage in patients undergoing total knee replacement surgery. *Japan Journal of Nursing Science, 12*, 309-319.

Chou, R., Gordon, D., de Leon-Casasola, O., Rosenbreg, J., Bickler, S., Brennan, T., Carter, T., Cassidy, C., Chittenden, E., Degenhardt, E., Griffith,S., Manworen, R., McCaraberg, B., Montgomery, R., Murphy, J., Perkal, M., Suresh, S., Sluka, K., Strassels, S., Thirlby, R., Viscusi, E., Walco, G., Warner, L., Weisman, S. & Wu, C. (2016). A Clinical Practice Guideline from the American Pain Society, the American Society of Regional Anesthesia and Pain Medicine, and the American Society of Anesthesiologists' Committee on Regional Anesthesia, Executive Committee, and Administrative Council. *The Journal of Pain, 17*, 131-157.

Cook, T. & Campbell, D. (1979). *Quasi-experimentation: design & analysis issues for field settings.* Boston: Houghton Mifflin.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd Ed.). Hillsdale, NJ: L. Eribaum Associates.

Cutshall, S., Anderson, P., Prinsen, S., Wentworth, L., Olney, T., Messner, P., Brekke, K., Li, Z., Sundt, T., Kelly, R., & Bauer, B. (2011). Effect of the combination of music and nature sounds on pain and anxiety in cardiac surgery patients: A randomized study. *Alternative Therapies, 17*, 16-23.

Economidou, E., Klimi, A., Cicilaki, V., & Lykeridou, K. (2012). Does music reduce postoperative pain? A review. *Health Science Journal, 6,* 365-377.

Engwall, M., & Duppils, G. (2009). Music as a nursing intervention for postoperative pain: a systematic review. *Journal of Peri Anesthesia Nursing, 24*, 370-383.

Good, M. (1998). A middle-range theory of acute pain management: Use in research. *Nursing Outlook, 46,* 120-124.

Good, M., & Moore, S. (1996). Clinical practice guidelines as a new source of middle-range theory: Focus on acute pain. *Nursing Outlook, 44*, 74-79.

Good, M. (1996). Effects of relaxation and music on postoperative pain: a review. *Journal of Advanced Nursing, 24,* 905-914.

Good, M. (1995). A comparison of the effects of jaw relaxation and music on postoperative pain. *Nursing Research, 44*, 52-57.

Good, M. & Ahn, S. (2008). Korean and American music reduces pain in Korean women after gynecologic surgery. *Pain Management Nursing, 9,* 96-103.

Good, M., Albert, J., Arafah, B., Cranston Anderson, G., Wotman, S., Cong, X., Lane, D., & Ahn, S. (2013). Effects on postoperative salivary cortisol of relaxation/music and patient teaching about pain management. *Biological Research for Nursing, 15,* 318-329.

Good, M., Albert, J., Cranston Anderson, G., Wotman, S., Cong, X., Lande, D., & Ahn, S. (2010). Supplementing relaxation and music for pain after surgery. *Nursing Research, 59*, 259-269.

Good, M. & Chin, C. (1998). The effects of Western music on postoperative pain in Taiwan. *Kaohsiung Journal of Medical Science, 14,* 94-103.

Good, M., Cranston Anderson, G., Ahn, S., Cong, Z. & Stanton-Hicks, M. (2005). Relaxation and music reduce pain following intestinal surgery. *Research in Nursing & Health, 28,* 240-251.

Good, M., Cranston Anderson, G., Stanton-Hicks, M., Grass, J. & Makii, M. (2002). Relaxation and music reduce pain after gynecologic surgery. *Pain Management Nursing, 3,* 61-70.

Good, M., Stanton-Hicks, M., Grass, J., Cranston Anderson, G., Choi, C., Schoolmeesters, L. & Salman, A. (1999). Relief of postoperative pain with jaw relaxation, music and their combination. *Pain, 81,* 163-172.

Good, M., Stiller, C., Zauszniewski, J., Anderson, G., Stanton-Hicks, M., & Grass, J. (2001). Sensation and distress of pain scales: Reliability, validity, and sensitivity. *Journal of Nursing Measurement, 9*, 219-238.

Gooding, L., Swezey, S., & Zwischenberger, J. (2012). Using music interventions in perioperative care. *Southern Medical Journal, 105,* 486-490.

Gordon, D., de Leon-Casasola, O., Wu, C., Sluka, K., Brennan, T. & Chou, R. (2016). Research gaps in Practice Guidelines for Acute Postoperative Pain Management in Adults: Findings from review of the evidence for an American Pain Society Clinical Practice Guideline. *The Journal of Pain, 7,* 158-166.

Harlocker, T. (2010). Pain management in total joint arthroplasty: a historical review. *Orthopedics, 33*, 14-19.

Hole, J., Hirsch, M., Ball, E. & Meads, C. (2015). Music as an aid for postoperative recovery in adults: a systematic review and meta-analysis. *The Lancet, 386*, 1659-1671.

Ignacio, J., Chan, M., Teo, S., Tsen, L. & Goy, R. (2012). Research in brief – The effect of music on pain, anxiety, and analgesic use on adults undergoing an orthopedic surgery: A pilot study. *Singapore Nursing Journal, 39*, 49-51.

Johnson, J. (1973). Effects of accurate expectations about sensations on the sensory and distress components of pain. *Journal of Personality and Social Psychology, 20,* 55-64.

Joint Commission for the Accreditation of Healthcare Organizations, Improving the Quality of Pain Management through Measurement and Action. Accessed at: www.jcaho.org.

Jose, J., Verma, M. & Arora, S. (2012). An experimental study to assess the effectiveness of music therapy on the postoperative pain perception of patients following cardiac surgery in a selected hospital in New Delhi. *International Journal of Nursing Education, 4,* 198-201.

Labraca, N., Castro-Sanchez, A., Mataran-Penarrocha, G., Arroyo-Morales, M., Sanchez-Joya, M. & Moreno-Lorenzo, C. (2011). Benefits of starting rehabilitation within 24 hours of primary total knee arthroplasty: randomized clinical trial. *Clinical Rehabilitation, 25,* 557-566.

Lin, P. (2011). An evaluation of the effectiveness of relaxation therapy for patients receiving joint replacement surgery. *Journal of Clinical Nursing, 21*, 601-608.

Lin, P., Lin, M., Huang, L., Hsu, H., & Lin, C. (2011). Music therapy for patients receiving spinal surgery. *Journal of Clinical Nursing, 20*, 960-968.

Liu, Y., & Petrini, M. (2015). Effects of music therapy on pain, anxiety, and vital signs in patients after thoracic surgery. *Complementary Therapy in Medicine, 23*, 714-718.

Madson, A., & Silverman, M. (2010). The effect of music therapy on relaxation, anxiety, pain perception, and nausea in adult solid organ transplant patients. *Journal of Music Therapy, 47,* 220-232.

Matsota, P., Christodoulopoulou, T., Smyrnioti, M., Pandazi, A., Kanellopoulos, I., Koursoumi, E., Karmanis, P., & Kostopanagiotou, G. (2013). Music's use for anesthesia and analgesia. *The Journal of Alternative and Complementary Medicine, 19,* 298-307.

McCaffery, R. & Good, M. (2000). The lived experience of listening to music while recovering from surgery. *Journal of Holistic Nursing, 18*, 378-390.

McCarthy, M., Chang, C., Pickard, A., Giobbie-Hurder, A., Price, D., Jonasson, O., Gibbs, J., Fitzgibbons, R., & Neumayer, L. (2005). Visual analog scales for assessing surgical pain. *Journal of the American College of Surgeons, 201*, 245-252.

Melzack, R., & Wall, P. (1996). Pain mechanisms: A new theory. *Pain Forum, 5*, 3-11.

Melzack, R., & Wall, P. (1965). Pain mechanisms: A new theory. *Science, 150*, 971-979.

Mondanaro, J., Homel, P., Lonner, B., Shepp, J., Lichtensztejn, M. & Loewy, J. (2017). Music therapy increases comfort and reduces pain in patients recovering from spine surgery. *The American Journal of Orthopedics, 1*, E13-E22.

Nilsson, U. (2008). The anxiety- and pain-reducing effects of music interventions: a systematic review. *AORN J, 87*, 780-807.

Ozer, N., Karaman Ozlu, Z., Arslan, S., & Gunes, N. (2013). Effect of music on postoperative pain and physiologic parameters of patients after open heart surgery. *Pain Management Nursing, 14,* 20-28.

Phumdoung, S. & Good, M. (2003). Music reduces sensation and distress of labor pain. *Pain Management Nursing, 4,* 54-61.

Polit, D. (2010). *Statistics and data analysis for nursing research* (2nd Ed.). Upper Saddle River, NJ: Pearson.

Polit, D. & Beck, C. (2008). *Nursing research: Generating and assessing evidence for nursing practice* (8th Ed.). Philadelphia: Lippincott Williams & Wilkins.

Portney, L. & Watkins, M. (2008). *Foundations of clinical research. Applications to practice* (3rd Ed.). Upper Saddle River, NJ: Prentice- Hall.

Pyrczak, F. (2009). *Making sense of statistics: A conceptual overview* (5th Ed.). Los Angeles: Pyrczak Publishing.

Siedliecki, S. & Good, M. (2006). Effect of music on power, pain, depression and disability. *Journal of Advanced Nursing, 54*, 553-562.

Sin, W. M., & Chow, K. M. (2015). Effect of music therapy on postoperative pain management in Gynecological patients: A literature review. *Pain Management Nursing, 16,* 978-987.

Sinatra, R. (2010). Causes and consequences of inadequate management of acute pain. *Pain Medicine, 11*, 1859-1871.

Spielberger, C. (1983). *Manual for the State-Trait Anxiety Inventory (Form Y).* Palo Alto, CA: Mind Garden.

The Joanna Briggs Institute. (2011). The Joanna Briggs Institute Best Practice Information Sheet: Music as an intervention in hospitals. *Nursing and Health Sciences, 13,* 99-102.

U.S. Department of Health and Human Services, Centers for Disease Control and Prevention: Inpatient Surgery. Available at: http://www.cdc.gov/nchs/fastats/inpatient-surgery.htm. Accessed September 15, 2017.

U.S. Department of Health and Human Services, Centers for Disease Control and Prevention: National Health Statistics Report. Ambulatory Surgery in the United States, 2010. Available at: http://www.cdc.gov/nchs/data/nhsr/nhsr001.pdf. Accessed September 15, 2017.

Vaajoki, A., Pietila, A., Kankkunen, P., & Vehvilainen-Julkunen, K. (2013). Music intervention study in abdominal surgery patients: Challenges of an intervention study in clinical practice. *International Journal of Nursing Practice, 19,* 206-213.

Vaajoki, A., Pietila, A., Kankkunen, P., & Vehvilainen-Julkunen, K. (2012). Effects of listening to music on pain intensity and pain distress after surgery: an intervention. *Journal of Clinical Nursing, 21*, 708-717.

Voss, J., Good, M., Yates, B., Baun, M., Thompson, A. & Hertzog, M. (2004). Sedative music reduces anxiety and pain during chair rest after open-heart surgery. *Pain, 112*, 197-203.

Zeller, R., Good, M., Anderson, G., & Zeller, D. (1997). Strengthening experimental design by balancing potentially confounding variables across treatment groups. *Nursing Research, 46*, 345-349.

BIOGRAPHICAL SKETCH

Joanne Margaret Laframboise-Otto was born in Chatham, Ontario, Canada. She began her career in nursing after graduating from the University of Western Ontario, London, Canada in 1982 with a Bachelor of Science in Nursing (BScN). Her first clinical position was at Sunnybrook Medical Center in Toronto, Ontario, in the clinical specialty of neurosurgery nursing. Shortly after graduating, and knowing that she wanted to teach nursing, she returned to Western to complete her Master of Science in Nursing (MScN) in 1987. She was hired at Western University to teach fundamentals and medical-surgical nursing in the baccalaureate nursing program. She taught at Western University from 1987 until 1994, holding positions of Clinical Instructor, Lecturer, and Assistant Professor in the Faculty of Nursing. Always interested in pursuing higher education, she left Ontario, Canada to come to Florida having been accepted into the PhD in Nursing Sciences Program at the University of Florida in the fall, 1994. Working part-time at Shands Hospital in the Medical ICU and later in Central Staffing Office, she continued her PhD studies part-time for several years. During this time she worked as a Teaching Assistant and Research Assistant in the College of Nursing at UF. Life has a way of interjecting and she met her husband Bruce and later married in December, 2000. Shortly afterwards, they welcomed their son Eddie into the world, with Eddie being born at Shands Hospital in Gainesville, FL in 2001. She took a short leave from her PhD studies at UF to pursue full-time teaching employment at the rank of Assistant Professor at Santa Fe College in Gainesville, FL, and later continued full-time employment as a Professor of Nursing at Florida Gateway College in Lake City, FL. After completing her PhD in Nursing Sciences at UF in December, 2017, she plans to continue teaching and begin a trajectory of research following her dissertation work.