2021

Integration of Morphine and Virtual Reality: Pain Management for Adult Hospice Cancer Patients

Arlisa Hurd
Walden University

Walden University

College of Social and Behavioral Sciences

This is to certify that the doctoral dissertation by

Arlisa Hurd

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

Review Committee
Dr. Alethea Baker, Committee Chairperson, Psychology Faculty
Dr. Michael Johnson, Committee Member, Psychology Faculty
Dr. Magy Martin, University Reviewer, Psychology Faculty

Chief Academic Officer and Provost
Sue Subocz, Ph.D.

Walden University
2021

Abstract

Integration of Morphine and Virtual Reality: Pain Management

for Adult Hospice Cancer Patients

by

Arlisa Hurd

MS, University of Phoenix, 2010

BS, Paul Quinn College, 2003

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Clinical Psychology

Walden University

June 2022

Abstract

There is currently a problem in that cancer patients engaging in hospice may experience an excessive amount of perceived pain and a decreased quality of life. The purpose of this study was to explore an intervention that could lessen the perceived pain experienced by, and increase the quality of life of, cancer patients engaging in hospice. Immersion music virtual reality (IMVR) allows a user to interact with a realistic, computer-generated environment. 3D music (IMVR) is likely suited for pain management with patients in hospice and was used for this study. The theory for the study is the gate control theory. The model for the study is the biopsychosocial model. This study focused on whether there is a difference in pain experienced, pain perceived, and quality of life for cancer patients in hospice using only morphine and patients using IMVR and morphine. A two-group nonexperimental design addressed the research problem using archival data from the National Hospice and Palliative Care Organization. Participants included 176 (88 control group, 88 IMVR groups) adult cancer patients in hospice. This study provided valuable knowledge for the use of IMVR and treatment of chronic pain, which promises to facilitate positive social change in terms of improving the quality of life for cancer patients in hospice.

Integration of Morphine and Virtual Reality: Pain Management for Adult Hospice Cancer Patients

by

Arlisa Hurd

MS, University of Phoenix, 2010

BS, Paul Quinn College, 2003

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Clinical Psychology

Walden University

June 2022

Dedication

This journey would not have been possible without the love and support of my family. I dedicate my dissertation work to my children; Ariel, Tate IV and Crystal'Lynn for their endurance while pursing my goals and dreams.

A special gratitude to my momma who's words of encouragement guided me and supported me throughout this journey. Thanks to my family for making a success in my life.

Acknowledgments

I want to take this opportunity to thank several important people for their guidance and support. A special thanks to my amazing chair person, Dr. Alethea Baker who were generous with her expertise and time. Thank you very much for all that you did to guide me through the dissertation process. I would also like to thank my second committee member, Dr. Michael Johnson, for his guidance throughout my dissertation process. It is my deepest appreciation for navigating me, challenging me, and supporting me throughout the dissertation process. Lastly, Dr. Magy Martin, my URR committee member, thank you for reviewing my dissertation.

Table of Contents

List of Tables

Chapter 1: Introduction to the Study

This quantitative research study was designed to address a gap in the literature concerning the need for further information to improve pain management for cancer patients who suffer chronic pain at the end of life. While there has been substantial research supporting the use of virtual reality (VR) and immersion music virtual reality (IMVR) in particular for chronic pain management, investigations have been conducted to further understand VR's role in chronic pain management with patients in hospice (Li, Montano, Chen, & Gold, 2011).

In this study I investigated those patients' perceived pain, experienced pain, and quality of life, and assessed whether there were a difference in those three categories for patients using only morphine and those using IMVR and morphine. This study has promoted positive social change by potentially improving the quality of life for cancer patients in hospice. In this chapter, I provide an in-depth description of the background followed by the problem statement, the purpose, the research questions and hypotheses, and the theoretical foundation of my study. The chapter has ended with a discussion of the nature of the study, definitions, assumptions, scope and delimitations, limitations, the significance of the study, and a summary.

Background

There was a gap in knowledge concerning the use of both morphine and IMVR for decreasing chronic pain in cancer patients in hospice. Addressing the need for further information to improve pain management for cancer patients, who suffer chronic pain, may provide a model specifically compatible with medical constructs for good end-of-life

care. I used the gate control theory (Melzack and Wall, 1965) to examine the role psychological factors play in perception and experience of pain, and the biopsychosocial models of pain (Engel, 1980) to address the biological pathophysiological components of pain.

Gazerani (2016) stated that (VR) technology creates a sense of immersion in a virtual environment analogous to the real world. VR has increasingly gained attention for pain management based on current evidence demonstrating its analgesic affects in certain experimental, acute and chronic pain conditions. Based on recent studies, VR-induced distraction has been indicated highly effective in alleviating pain. The analysis found that VR was more effective in experimental pain compared to clinical pain. Gazerani reviewed another study and found strong overall evidence for immediate and short-term pain reduction and a moderate evidence for the reduction of pain and functional impairment after application of immersive VR. The study concluded that 3-D immersive virtual environments have resulted in lower subjective pain ratings, promising analgesic potentials of VR in acute pain conditions, and positive effects of VR for chronic pain conditions. Gazerani stated that it is not yet known if VR could contribute to relief of anxiety or other comorbidities accompanying chronic pain conditions. It is also not known which type of chronic pain would respond better to VR and if there would be pain elevation after VR. Gazerani concluded that it seems reasonable to consider VR as a potentially valuable tool for chronic pain management. However, lack of sufficient evidence and potential challenges logically call for more efforts to obtain a better understanding of VR both in design and application for an optimal use in chronic pain

management. Gazerani also concluded that future studies may consider investigating the effects of age, gender, race and level of disability-functionality or medical status; identifying different factors that can affect analgesic effect of VR including quality, content, form and level of complexity; and underpinning VR mechanisms at psychological and neurological levels.

According to Li et al., (2011), studies have investigated VR for chronic pain management describing VR as a fast developing new technology, and finding that pain was significantly lower for participants using VR. Currently, VR headsets or multiprojected environments are used to generate realistic images, sounds and often sensations that stimulate a user's physical presence in a virtual environment. Cancer hospice patients were able to interact with 3D worlds with the use of VR (Oyama, 1997). VR may very well decrease the pain, unpleasantness, and anxiety associated with painful cancer procedures and treatments.

Problem Statement

There was currently a problem with cancer patients engaging in hospice care experiencing an excessive amount of perceived pain and a decreased quality of life. Past research indicated there was a link to VR and morphine for pain management with patients in hospice. In particular, an online journal (Li et al., 2011) noted intravenous medication alone was used with patients in hospice. However, few studies have been conducted to explore patients in hospice using VR. The current state of VR as a tool for pain management was still in its early developmental stages. In addition few studies have looked at the positive effects on patients in hospice care using VR and morphine.

According to Smith et al. (2012) hospice care and other palliative care services at the end of life have increased, and most patients are enrolled in hospice less than 3 weeks before their deaths, which limits the benefit they may gain from these services. Understanding the limitations of the past studies, this study explored the integration of morphine and IMVR in relieving pain for patients in hospice and the length of time necessary for the treatment to be effective. Examining these patients in a hospice setting conjunction with length of time has possibly aided understanding of how the integration of morphine and VR can maintain a successful end of life experience.

Recent research has indicated VR, when linked to morphine treatment, has been effective for pain management (Li et al., 2011). These authors noted VR can decrease the unpleasantness and anxiety associated with common painful cancer procedures and treatments. Although these studies explored the power of VR and morphine to control pain in cancer patients, there was very little research regarding the use of VR and morphine with cancer patients in hospice.

VR as a tool for pain management is still in its early developmental stages (Li et al., 2011). Li et al. (2011) found immersion music VR to be effective as a nonpharmacological intervention for pain management with adult cancer patients in hospice. IMVR allows a user to interact with a realistic, computer-generated environment. An IMVR system typically consists of a 3-dimensional (3D) computer generated environment that renders an interactive virtual experience. IMVR experiences are primarily visual and auditory. In this study, I identified the effects IMVR and morphine interventions have on cancer patients in hospice.

According to National Hospice and Palliative Care Organization (NHPCO, 2013), the total number of days that a hospice patient receives care is referred to as the length of service. Length of service is influenced by a number of factors including disease course, timing of referral, and access to care. The hospice team (e.g., physicians and nurses) develops a care plan that meets each patient's need for pain management (NHPCO, 2013). In this study, sampling was the process of selecting participants from the population of interest. Every member of the population of interest had an equal opportunity of being selected. In this study, the sampling frame listed all individuals who were representative of the cancer hospice population. The sample for this study was drawn from archival data provided by NHPCO. The research helped fill the gap by focusing specifically the effectiveness of the integration of morphine and VR: on pain management with adult cancer patients in hospice by decreasing pain intensity and unpleasantness, while increasing comfort and support (Li et al., 2011).

Purpose of the Study

The purpose of the current study was to explore an intervention that could lessen the perceived pain experienced by, and increase the quality of life of, cancer patients engaging in hospice. This study was designed to determine if a link exists between morphine and IMVR and hospice cancer patients' experiences of pain, perceptions of pain, and quality of end of life. This study's dependent variables were (a) the experiences of pain, perceptions of pain, and quality of life for end-of-life cancer patients; and (b) the use of morphine and IMVR.

Research Questions and Hypotheses

*R*Q1*:* Is there a difference in pain experienced by hospice cancer patients using (a) only morphine or (b) IMVR and morphine?

H_0l: There is no difference in pain experienced by hospice cancer patients using (a) only morphine or (b) IMVR and morphine.

H_A1: There is a difference in pain experienced by hospice cancer patients using (a) only morphine or (b) IMVR and morphine.

*R*Q2: Is there a difference in pain perceived by hospice cancer patients using (a) only morphine or (b) IMVR and morphine?

H_0l: There is no difference in pain perceived by hospice cancer patients using (a) only morphine or (b) IMVR and morphine.

H_A2*:* There is a difference in pain perceived by hospice cancer patients using (a) only morphine or (b) IMVR and morphine.

*R*Q3: Is there a difference in perceived quality of life by hospice cancer patients using (a) only morphine or (b) IMVR and morphine?

H_0l: There is no difference in perceived quality of life by hospice cancer patients using (a) only morphine or (b) IMVR and morphine.

H_A3: There is a difference in the perceived quality of life by hospice cancer patients using (a) only morphine or (b) IMVR and morphine.

Theoretical Foundation

I used one theory, the gate control theory (Melzak and Wall, 1965), and one model, the biopsychosocial model (Engel, 1980) for the theoretical framework for this

study. Melzack and Wall's (1965) gate control theory holds that the human pain-modulating system involves a neural gate present in the spinal cord. This gate can open and close, thereby modulating a person's perception of pain. The gate control theory suggests that psychological factors play a role in perceptions of pain (Melzack, 1996). This theory also suggests that the level of attention paid to the pain, the emotion associated with the pain and the past experience of the pain all play a role in how the pain will be interpreted (Melzack & Wall, 1965). The gate-like function proportions the amount of conveyed impulses from the periphery. The periphery transmits nerve signals to and from the central nervous system of the dorsal horn. Through inhibitory processes at the neuronal level, the quantity and intensity of the signals of the central nervous system are controlled (Gatchel, Peng, Peters, Fuchs, & Turk, 2007).

Engel's (1980) biopsychosocial model focuses primarily on the construal of the biological or pathophysiological component of pain (Gatchel et al., 2007). Theorist Erikson (1986) used the term "psychosocial" to describe the interplay between our inner emotional lives (psycho), and our outer social circumstances (social). Erikson theorized the late adulthood stage of life as defined by a conflict between ego integrity and despair. Adults at this stage feel content if they look back at their lives and feel that they have been productive and happy. They try to find a sense of meaning in their lives that will help them face the inevitability of death. Gatchel et al. (2007) emphasized the significant role that psychosocial factors potentially play in the perception of pain. According to Turk and Flor (1999), the biopsychosocial model views illness as an interaction between

biological, psychological, and sociocultural variables that shape the persons response to pain.

Nature of the Study

This quantitative study was designed to answer the question: "Is there a difference in pain experienced, pain perceived, and quality of life for cancer patients in hospice using only morphine and patients using IMVR and morphine?"

A report by the NHPCO (2013) outlined the demographic characteristics of the two groups (experimental and control). The characteristics are as follows:

> More than half of hospice patients were females. In 2012, 83.4% of hospice patients were 65 years of age or older and more than one-third of all hospice patients were 85 years of age or older. Following U. S. Census guidelines, the NHPCO reported that Hispanic ethnicity is a separate concept from race. In 2012, more than 6% of patients were identified as being of Hispanic or Latino origin. Percentages of hospice patients by race were accounted for by Whites/Caucasians (82.8%). Today, cancer diagnoses account for less than half of all hospice admission (37.7%). (NHPCO, 2013; pp. 6-7)

Quantitative research involves a detailed method of data collection and analysis. I conducted secondary analysis of archival data from intake/finish assessments (pre-existing participants) for this study. "Archival data" refers to research information collected for other purposes that can subsequently be used by others as comparison data or as part of new research. I hypothesize that an analysis of this data would identify a

relationship among variables (i.e., perception of pain, experience of pain, morphine medication only, morphine medication and IMVR, and quality of life).

The independent variable (morphine only) was the variable that was changed or controlled to test the effects on the dependent variable. The dependent variable (IMVR and morphine) was tested and measured in the experiment. The dependent variable responded to the independent variable. The null hypothesis was that there would be no between-group differences in the dependent variables. The alternative hypothesis was that there would be a between-group difference in the dependent variables (i.e., pain perception and pain experience). In this study, the primarily interest was the quality of life of the population of interest. However, I investigated if there would be in- between-group differences in pain perceived or experienced, and explored the possibility that the between-group differences in quality of life are moderated by the participants' pain (perceived and/or experienced).

I utilized archival data for the population of adult cancer patients in hospice using the NHPCO data. Cancer is the primary diagnosis for nearly 37% of hospice patients. The NHPCO represents over 80% of hospices nationwide (http://www.nhpco.org).

Definitions

Throughout this study, I used specific terms to discuss different aspects of the research. These terms are defined in this section to provide clear and concise understanding:

Chronic cancer pain: Chronic cancer pain is pain lasting beyond the normal expectancy for an illness to be resolved. Pain that can be persistent and pain can be stressful for body and soul (Portenoy & Hagen, (1990)).

End-of-life care: End-of-life care is a term used to describe the support and health care given during the time surrounding death (Westerhoff, 2017).

Hospice: This term refers to an approach to end-of-life care, and to a facility for supportive care of terminally ill patients (National Hospice Palliative Care, 2013).

Immersion music virtual reality: IMVR is a system that typically consists of a 3-dimensional (3D) computer generated environment that renders an interactive virtual experience (Chlan, 2013).

Nonpharmacological analgesics: Nonpharmaceutical analgesics are methods for treating pain and suffering without using medications. Musical therapy is a non-pharmacologic method aimed at promoting relaxation, alteration in mood, a sense of control and self-expression (Pak & Micalos, 2015).

Pain experienced: Pain experienced is a term that describes painful experience such as aches, soreness, and physical discomfort (Sagha & Eshelman et al., 2018).

Pain management: Pain management is an approach for controlling or reducing pain, easing suffering and improving the quality of life for patients living with pain. The treatment approaches to chronic pain include nonpharmacological (such as VR) and pharmacologic (Sagha, Eshelman et al., 2018).

Pain perception: Pain perception is a reaction to pain influenced by genetic, psychological, social, and cultural variables (Sagha, Eshelman et al., 2018).

Quality of life: This term refers to the general well-being of an individual. This includes all social, emotional, and physical aspects of the individual's life (Sagha, Eshelman et al., 2018).

Virtual reality: VR is a technology that enables a user's immersion in a virtual world. VR has been used in clinical settings as a nonpharmacological form of pain management that is thought to alter the body's pain modulation system (Li et al., 2011).

Assumptions

I adopted several assumptions were going into this study. First, I assumed that every cancer patient in hospice was given morphine for pain. This assumption was based on findings from the literature review. Another assumption was the success of IMVR combined with morphine can be determined by the generalizability to the population at large. This assumption was based on the validity and reliability of assessment tools used by NHPCO in their dataset. Finally, I assumed that each hospice patient's identifying characteristics would be matched effectively with data collected from the archives. This assumption was based on using archival data and the particular demographic information that was collected.

Scope and Delimitations

This study examined the effects morphine and IMVR have on cancer patients in hospice. The control group design allowed me to utilize archival data that already existed for cancer patients in hospice using the same measurement tools. According to the NHPCO (2013), length of services refers to the total number of days that a hospice patient receives care. Length of service can be influenced by a number of factors

including disease course, timing of referral, and access to care. The criteria for participation in the study required that the patient must: (a) have a primary diagnosis of concern and currently be in hospice, (b) be able to speak English, (c) have no vision or hearing impairment, (d) be female, (e) be at least 65 years of age, (f) be Caucasian and (g) be receiving regularly scheduled medication.

The delimitations of my study explained the exclusion criteria for participation in the study, excluding everyone not meeting the criteria. Those would be participants that were outside the scope of my study. Another delimitation of my study was to narrow the focus of my research questions. This limits my ability to answer questions beyond the scope of my study.

Limitations

A possible limitation of this study was the population and sample size. Due to the availability of archival data and the control group design, internal validity was limited due to the selection process. Another possible limitation of this study was its reliance on the data gathered from questionnaire-based measures. This study was limited because the findings from the chosen sample were generalizable only to the general population of hospice patients.

Significance of the Study

This research was unique because it addressed the need for further information to improve pain management for cancer patients who suffer chronic pain at the end of life. As indicated above, while there were substantial research supporting the use of VR for chronic pain management, investigations are still being conducted to further understand

VR's role in chronic pain management with patients in hospice (Li, et. al, 2011). The results of this study provided needed insight into the processes by which morphine and IMVR together effectively decreased pain in these patients. Insights from this study may aid health care teams in helping cancer patients in hospice cope successfully with pain, thus enhancing the patient's quality of life at the end of their life. This research provided valuable knowledge regarding the use of IMVR in the treatment of chronic pain, which promises to facilitate positive social change in terms of improving the quality of life for cancer patients in hospice.

Summary

With many of the issues that cancer patients in hospice face when it comes to the end-of-life care, it was important to understand the physical and emotional suffering that affected them. In this study, the focus measured and defined the experiences and perceptions of suffering, and asked, "How is pain perceived, experienced, expressed, and responded to by the patient?" A significant difference in pain experienced, pain perceived, and quality of life between hospice cancer patients using only morphine, and those using morphine and IMVR in conjunction was identified.

The purpose of the current study was to explore an intervention that could lessen the perceived pain experienced by, and increase the quality of life of, cancer patients engaging in hospice. In this study I explored a possible way to alleviate the excessive pain and increase quality of life. The results of this study addressed the need for further information to improve pain management for cancer patients who suffer chronic pain at

the end of life. The research method addressed the research questions and helped fill the gaps in the literature as described by Li et al. (2011).

The next chapter includes a review of the theoretical and empirical literature pertaining to pain management for adult hospice cancer patient.

Chapter 2: Literature Review

Introduction

A thorough literature review identified that there has been little research on using VR with cancer patients in hospice. The current problem was that cancer patients engaging in hospice experience an excessive amount of perceived pain and a decreased quality of life. The purpose of the current study was to explore an intervention that could lessen the perceived pain experienced by, and increase the quality of life of, cancer patients engaging in hospice. This chapter is an exploration of the literature relevant to understanding pain management. This was done through a review of the empirical work addressing the possible linkage between the emotional/physical experiences of end of life cancer patients and pharmacological analgesics and IMVR.

Early research has shown many cancer patients nearing the end of life tend to respond well to morphine (Kaye, 1990). Although oral opiate is clearly the effective analgesic given orally, most patients will require an alternative to the oral opiate due to factors such as: nausea, vomiting, sedation, delirium, bowel obstruction, swallowing impairment, and how the body is affected by oral opioids after administration in terms of its absorption, distribution, metabolism, and excretion (Barnett, 2001). Intravenous opiate is another option. The challenge was to reliably determine intravenous equivalent morphine dose compatible with the oral opioid dose.

Although Kaye (1990) and Mahrer (2009) explored pain in cancer patients, a thorough review of recent literature identified that there has been little research using VR with cancer patients in hospice for pain management. More recent research indicates that VR is a relatively new technology that enables individuals to immerse themselves in a

simulated world, thus distracting these patients and resulting in a nonpharmacologic analgesic (Forest, 2017). Earlier studies have addressed the use of nonpharmacologic analgesics and they are the focus of the review that follows. A VR tool for pain management is still in its early development stages (Jones, Moore, & Choo, 2016). Johnson and Coxon (2016) found IMVR to be effective as a nonpharmacologic intervention for pain management with adult cancer patients. However, this technique has not been used with cancer patients in hospice, which could be a group affected positively by this technique.

The remainder of this chapter provides insights into the current study's literature review process, theoretical foundation, relevant literature, and the study's key variables and concepts. The chapter concludes with a summary.

Literature Search Strategy

I used electronic searches to gather relevant articles. The databases searched included PubMed, Sage Online Journals, Science Direct, NCBI Articles, and Psych INFO. The search terms used were *pain management, virtual reality, morphine, cancer pain, chronic pain, pain perception, quality of life, pain relief, treatment, satisfaction, pain experienced, care at the end of life,* and *end-of-life.* The articles selected were dated from 1965 to 2018. Although most articles were are from recent years, some older ones are included in order to provide a better understanding of the background of this study. A limited number of database sources for music VR relating to chronic pain dates from 2013 to 2014. Most of the information on this review came from articles focused on pain management, which was the basis for this research.

Theoretical/Conceptual Foundation

I used one theory, the gate control theory (Melzak and Wall, 1965) and one model; the biopsychosocial model (Engel, 1980) as the theoretical framework for this study. Melzack and Wall (1965) gate control theory holds that the human pain-modulating system involves a neural gate present in the spinal cord. This gate can open and close thereby modulating a person's perception of pain. The gate control theory suggests that psychological factors play a role in perceptions of pain (Melzack, 1996). This theory also suggests that the level of attention paid to the pain, the emotion associated with the pain and the past experience of the pain all play a role in how the pain will be interpreted (Melzack & Wall, 1965). The gate-like function proportions the amount of conveyed impulses from the periphery. The periphery transmits nerve signals to and from the central nervous system of the dorsal horn. Through inhibitory processes at the neuronal level, the quantity and intensity of the signals of the central nervous system are controlled (Gatchel et al., 2007).

Engel's (1980) biopsychosocial model focuses primarily on the construal of the biological or pathophysiological component of pain (Gatchel et al., 2007). Theorist Erikson (1986) used the term "psychosocial" to describe the interplay between our inner emotional lives (psycho), and our outer social circumstances (social). Erikson theorized the late adulthood stage of life as defined by a conflict between ego integrity and despair. Adults at this stage feel content if they look back at their lives and feel that they have been productive and happy. They try to find a sense of meaning in their lives that will help them face the inevitability of death. Gatchel et al. (2007) emphasized the significant

role that psychosocial factors potentially play in the perception of pain. According to Turk and Flor (1999), the biopsychosocial model views illness as an interaction between biological, psychological, and sociocultural variables that shape the persons response to pain. The questions addressed in this study can be linked to Melzack and Wall's (1965) gate control theory and the biopsychosocial model (Engel, 1980).

Gate Control Theory

The gate control theory suggests that psychological factors play a role in pain perception (Melzack, 1996). Melzack and Wall (1965) suggested that the level of attention paid to the pain, the emotion associated with pain and the past experience of the pain, all play a role in how the pain will be interpreted. According to this theory, the spinal cord contains a neurological "gate" that either blocks pain signals or allows them to continue on to the brain. This "gate" operates by differentiating between the types of fibers carrying pain signals. Pain signals traveling via small nerve fibers are allowed to pass through while signals sent by large nerve fibers are blocked. The gate control theory is often used to explain chronic pain. Following an injury, pain signals are transmitted to the spinal cord and then up to the brain. Melzack and Wall suggested that before the information is transmitted to the brain, the pain messages encounter "nerve gates" that control whether these signals are allowed to pass through to the brain. This gating mechanism takes place in the dorsal horn of the body's spinal cord. Both large and small fibers for touch, pressure, and other skin senses carry information to two areas of the dorsal horn. The two areas either transmit cells that carry information up to the spinal cord to the brain or the inhibitory interneurons that halt or impede the transmission of

sensory information. The authors suggested that an increase in normal touch sensory helps to inhibit the pain fiber activity, therefore reducing the perception of pain. Melzack and Wall proposed that a mechanism in the dorsal horns of the spinal cord acts like a gate that inhibits or facilitates transmission from the body to the brain on the basis of the diameters of the active peripheral fibers, as well as the dynamic action of brain processes. As a result psychological variables such as past experiences, attention, and other cognitive activities have been integrated into current research and therapy on pain processes.

The gate control theory presents a physiological explanation for previously observed effect of psychology on pain perception. Concepts derived from the specificity theory and the peripheral pattern theory (Moayedi & Davis, 2012); give way to the gate control theory. The gate control theory is considered to be one of the most influential theories of pain because it provided a neural basis which reconciled the specificity and pattern theories and ultimately revolutionized pain research. The gate control theory remains the only theory of pain that most accurately accounts for the physical and psychological aspects of pain perception.

Implications of gate control theory for the present study. The gate control theory of pain is still considered the dominant theory today. The gate control theory accounts for the clinically recognized importance of the mind and brain in pain perception. This theory provides a physiological basis for the complex phenomenon of pain. It does this by determining the complex structures of the nervous system. The basic conception remains unchanged. Melzack and Wall (1965) visualized the mechanism of

pain perception in a new dimension and it has laid the foundation for various pain management strategies. It inspired basic research and clinical applications. Melzack's work has led to advancements in the assessments of pain using the McGill Pain Questionnaire. Assessment of patients experiencing pain is the cornerstone to optimal pain management. The gate theory opened a psychological approach to be used for pain management. This theory led to nonmedication treatment for pain. The pain management strategy and its applications will be able to test the concepts of the gate-control theory of pain in humans (Nathan & Rudge 1974).

Learning how the body responds to pain can help people understand recommended treatments and develop strategies to minimize chronic pain (Deardorff, 2017). This author stated that the key element of the theory is the concept of a gate that allows pain signals to reach the brain when it is open, and blocks the signals when it is closed. This author noted that closing the gate resulted in less pain. Once the pain signal is allowed through the spinal gate the brain can amplify it, decrease it, or ignore it altogether. Various cognitive (thoughts) and emotional (depression, anxiety, etc.) factors will determine what happen to the pain signal. Deardorff (2017) emphasized how the gate control theory has influenced our perception of pain and explained why certain pain treatments are effective. Concepts outlined in the gate control theory are often used to explain and develop pain relief treatments, such as: electrical, spinal cord, and peripheral nerve field stimulation. Deardorff explains how music therapy and auditory interventions tap the power of distraction, allowing the brain to send a signal down the spinal cord to close the pain gate while also minimizing the pain signal arriving to the brain itself.

Deardorff concluded stating that an awareness of ways to moderate pain by opening or closing pain gates can be applied to daily life. Sensory, cognitive, and emotional factors that can close spinal nerves gates can all be used for chronic pain management. A mix of sensory, cognitive and emotional chronic pain management strategies should be part of everyday life for anyone who suffers from chronic pain.

Biopsychosocial Model

The biopsychosocial model (Engel, 1980) was proposed by Gatchel et al. (2007) and focused primarily on the construal of the biological or the pathophysiological component of pain. Dating back to the 17th century, disease and illness were described pristinely as mechanistic biological processes. It was conceived that the experience of pain was conveyed directly to the brain from the skin, without a psychosocial interplay (Gatchel et al., 2007). Gatchel et al. (2007) emphasized the significant role that psychosocial factors potentially play in the perception of pain. The *biopsychosocial paradigm* is technical term for the concept of the "mind-body" connection. This is a general model or approach stating that biological, psychological (thoughts, emotions, and behaviors) and social (cultural, socio-economical, socio environmental) factors all play a significant role in human function in the context of illness. The concept of the "mind-body" connection is used in psychology and clinical psychology.

The clinical application of the Biopsychosocial Model (Engel, 1980) focuses on how physicians approach patients and the problems they present is influenced by the conceptual models around which their knowledge is organized. The author focused on a medical rather than a psychiatric patient to emphasize the unity of medicine and to help

define the place of psychiatrists in the education of physicians of the future. The author states that the biopsychosocial model is a scientific model constructed to take into account the missing dimensions of the biomedical model. To the extent that it succeeds it also serves to define the educational tasks of medicine and particularly the task and roles of psychiatrists in the education of physicians of the future. The author examines how the physicians approach clinical problems from the perspective of the systems-oriented biopsychosocial model. In consideration of the model, the physician's first source of information is the patient himself. The clinical study begins at the person level and takes place with a two-person system, the doctor-patient relationship. The data consist of reported inner experience (feelings, sensations, thoughts, opinion, and memories) and reported behavior. The clinical approach considers all information in terms of the system to find a diagnosis for a single disease. The author then reconstructs in systems terms the sequence of events comprising the acute phase of the illness. The patient experiences something toward or exhibits some behavior or appearance that is interpreted as indicating illness. The central nervous system is the integration and regulation of the patient's inner experiences and behavior and the physiological adjustments occurring in response to the processes originating from the illness. The biopsychosocial model provides a conceptual framework and a way of thinking that enables the physicians to act rationally in areas now excluded from a rational approach. It motivates the physician to become more informed and skillful in the psychosocial areas, and the model serves to counteract the wasteful reductionist pursuit of what often prove to be trivial rather than crucial determinants of illness.

Currently, Novy and Aigner (2014) emphasized the biopsychosocial model in cancer pain as a helpful way to comprehensively approach the conceptualizing and treatment of pain in cancer patients at all stages of the disease process. Recent reviews contain articles dated from 2012-2014, which advance the authors understanding of biopsychosocial factors related to the cancer pain experience and the psychosocial treatment for cancer pain. Recent publications have advanced the authors understanding of psychosocial interventions for cancer pain and symptom management. In the last few years, several reviews have emerged, which have found modest effect sizes for psychosocial intervention in cancer management. The authors stated that an established base of research on the importance of biopsychosocial model in cancer pain. The ability to treat patients with cancer pain effectively will improve as a better understanding of which treatment works for which patients.

Literature Review Related to Key Variables and/or Concepts

The current literature describes studies related to the construct of interest and chosen methodology and methods that are consistent with the scope of the study. The current literature describes ways researchers have approached the problems and the strength and weakness inherent in their approaches. Mohamad, Eslam, Ahmad, and Muayyad, (2018) assessed the effectiveness of VR distraction technology in reducing pain and anxiety among female patients with cancer. The authors randomized a controlled trial design used with a sample of 80 female patients with cancer at a specialized cancer center in Jordan. Participants were randomly assigned into intervention and comparison groups. The results of their findings showed that one session

of the immersive VR plus morphine made a significant reduction in pain and anxiety from self-reported scores, compared with morphine alone in cancer patients. The authors concluded that immersive VR is an effective distraction intervention for managing pain and anxiety among cancer patients using immersive VR as an intervention is more effective than morphine alone in relieving pain and anxiety. The authors concluded that using immersive VR as an intervention is more effective than using morphine alone in relieving pain and anxiety in cancer patients and that VR is a safer intervention than pharmacological treatment (Mohamad et al., 2018).

Cancer Pain Management

Greco, Roberto, Corli, and Deandrea (2014) updated a systematic review published in 2008, which showed that according to the pain management index (PMI), 43.4% of patients with cancer were under treated. The authors discuss adequately in treating cancer pain need to be identified, assessed, classified, and managed as part of a multidimensional approach. Pain assessment and classification implies awareness of the existence and importance of the problem and acknowledgement of its intrinsic subjective nature (pain). Pain is always affected by cultural, emotional, spiritual, and behavioral factors related to the host or to the macro and microenvironments. Valid and reliable tools are also essential assessing pain using a numeric rating scale is preferred. The authors state that new and more effective therapies are evidence-based guidelines that have become available in recent years providing both the framework and tools to treat cancer pain properly. But more accurate and better quality treatments cannot be automatically expected. Reliable estimates based on evidence are needed from systematic

reviews and meta-analysis. The review included observational and experimental studies reporting negative PMI scores for adults with cancer and pain published from 2007 to 2013 and retrieved through MEDLINE, and Google Scholar. A systematic review covering 26 studies from 1994 up to 2007 that adopted the Pain Management Index (PMI) to assess the adequacy of pharmacologic pain therapy reported the rate of potentially undertreated patient cases from 8% to 82%, with a weighted mean of 43%. More recent studies seem to suggest lower levels of inappropriate analgesic care. Therefore, the authors expected that in the last few years, the quality of cancer pain management has improved. However, because differences in study design and setting do not permit any solid conclusion, a formal evidence synthesis process is recommended to investigate any possible time trend. The authors updated the previously systematic review to assess whether any change could be detected in the quality of pain management in adults with cancer, in terms of adequacy of analgesic prescription. In this article, the authors describe the studies published after 2007, comparing the under treatment estimates before and after 2007. The authors assessed the temporal trends from 1944 to 2013 in the whole sample of studies, and identified variables associated with under treatment using a set of potential determinants. The MEDLINE search from November 2007 to September 2013 produced 2806 citations, and five additional cases were identified through Google Scholar or from experts in the field. After removing duplicates, 2697 records remained. Of these, 2670 were discarded, because after reviewing the abstracts they did not meet the inclusion criteria. The full text of the remaining 27 was examined, and seven articles were excluded as not regarding cancer pain. The 20 studies

that met the inclusion criteria were included in the current analysis of under treatment of cancer pain.

Applications of morphine for chronic pain management in cancer patients. Morphine is considered the standard opiate and the drug of first choice in the treatment of moderate to severe cancer pain. The *Pharmaceutical Journal* (2013) states that morphine remains a popular opioid analgesic for cancer-related pain. Numerous reports have documented morphine as an effective analgesic for cancer patients. The published research covered in this review will pertain to specific applications in which morphine was used to alleviate pain in cancer patients.

One of the earliest studies involving morphine use during cancer care is oral morphine for chronic cancer patients (Walsh, 1984). The study provides a brief discussion of opiates during the last decade in controlling advanced cancer. The author indicated that the use of morphine at St. Christopher's Hospice since 1977, was the oral opiate for more than 1700 patients for several chronic pains. The continuing care of terminal cancer patients in 1979 clinical assessment confirms that 85-90% of patients with advance cancer tolerated oral morphine and up to 95% get excellent pain control (Mount, 1979 as cited by Walsh, 1984).

Schmitz (1985) describes morphine was first discovered in 1804 Paderborn, Germany by Friedrich Serturner. Morphine is one of the oldest drug in existence for relieving severe pain and suffering in patients. Morphine acts directly on the central nervous system (CNS) to decrease the feeling of pain. It can be taken for both acute pain and chronic pain (The American Society of Health-System Pharmacists, 2015).

Wiffen, Wee, and Moore (2016) determined the efficacy of oral morphine in relieving cancer pain, and assessed the incidence and severity of adverse events. The authors stated that this is the third updated version of a Cochrane review first published in issue 4, 2003 of The Cochrane Library and the first update in 2007. Morphine has been used for many years to relieve pain. Oral morphine in either immediate release or modified release form remains the analgesic of choice for moderate or severe cancer pain. The main results, seven new studies were identified in this update. The authors excluded six, and one study is ongoing so also not included in this update. This review contains a total of 62 included studies, with 4241 participants. Thirty-two studies used cross-over design ranging from one to 15 days, with the greatest number (1) foe seven days for each arm of the trial. Overall, the authors judged the included studies to be at high risk of bias because the methods of randomization and dislocation concealment were poorly. The primary outcomes for this review were participant reported pain and pain relief. The authors concluded that morphine is an effective analgesic for cancer pain. Pain relief did not differ between Mm/r and MIR. The author's conclusions have not changed for this update. The effectiveness of oral morphine has stood the test of time. The new studies added to the review for the previous update reinforced the view that it is possible to use modified release morphine to titrate to analgesic effect.

Winiarczyk and Knetki-Wroblewska (2016) addresses break through pain as a brief episode of severe pain occurring in patients undergoing analgesic procedures in the course of cancer. It affects about 70% of patients and significantly influences their quality of life. It is important to identify specific types of pain and inducing factors. Treatment is

based on modification of pain management including use of immediate release drug formulations. The authors state that pain treatment is an integral part of management in patients with cancer. Despite active treatment, in some patients pain control remains unsatisfactory, which also applies to breakthrough pain. A lack of unambiguous definition as well as a validated tool for assessment of pain still significantly implies the diagnostics and treatment of break through pain. Management is based on modification of the treatment of baseline pain, considering opioid drugs of immediate release, used in 1/6 of baseline drugs daily dose. Transmuscosal opioids ensure faster analgesic effect then other oral formulations, and intranasal aerosol seems to be currently the most beneficial route of administration.

Applications of morphine for chronic pain management in hospice patients.

Zeppelella, Davies, Eijgelshoven, and Jansen (2013) investigated the use of opioid analgesics for the management of breakthrough cancer pain (BTCP). In this study, a systematic literature search (2007-2010) resulted in ARBTCP morphine sulfate immediate release, were synthesized using a network meta-analyses. The authors identify many medications available for the management of breakthrough cancer pain (BTCP). Physicians may require additional guidance in selecting an appropriate medication to suit an individual patient's needs. The authors identify all the evidence and assess the relative clinical value of currently approach BTCP medications. The authors literature search (2007-2010) resulted in 10 randomized controlled trails investigating the effects of BTCP medications (intranasal fentanyl spray [INFS], fentanyl pectin nasal spray, fentanyl sublingual tablets, fentanyl buccal soluble film, fentanyl buccal tablets, oral transmucosal

fentanyl citrate, and morphine sulfate immediate release) were synthesized using a network meta-analysis. The main outcome was pain intensity difference (PID) relative to placebo up to 60 minutes often the intake of medication. The results were that INFS, fentanyl pectin nasal spray, fentanyl buccal tablet, and oral transmucosal fentanyl citrate showed greater PIDs relative to placebo than other BTCP medications 15 minutes after intake. All other medications showed greater PIDs relative to placebo at 30 minutes, except morphine sulfate immediate release, which did not show efficacy over placebo until 45 minutes. Only INFS produced clinically meaningful pain relief at 15 minutes. The conclusion from evidence was that all BTCP medications provided pain relief within the time frame assessed.

Groninger and Vijayan (2014) describe options to improve analgesia and quality of life for patients experiencing deliberating pain at the end of life. Pain assessment using a validated tool helps tailor treatment plans and The World Health Organization (WHO) pain ladder offers a guideline for approaching pain management. However, for the many patients that are terminally ill, strong opioids are necessary for efficient and effective analgesia. The authors explained that many persons experience significant pain in the final months of life. Despite advances in understanding pain physiology and available pharmacotherapies, many patients with terminal illness; such as cancer, report untreated and undertreated pain. The authors also describe the pain assessment procedure. Assessment of pain should include the patient's pain intensities and the physical signs of pain. Pain intensity can provide essential information about the effectiveness of current interventions. Pain should be assessed regularly using a pain scale. There are several pain

scales; such as, A Likert-type scale (rating pain from 0 to 10), the Wong-Baker FACES Pain Rating Scale, and a visual Analog Scale. The author explained that clinicians should begin with non-opioid analgesics should be used first and gradually progress to a more potent analgesic until pain is relieved. For patients with terminal illness, opioid therapies provide greatest analgesic relief. However, concerns about addiction and respiratory depression inappropriately limit use of opioids in these patients. Another option is the use of alternative opioid formulations and routes of administration to enhance pain management. Patients may benefit from concentrated opioid elixirs, morphine, hydro-morphine, oxycodone and methadone.

Prommer and Ficek (2012) provide an overview of the analgesic considerations for elderly patients at the end of life. The authors state that pain is one of the symptoms most frequently encountered in elderly patients at the end of life. The management of pain in the elderly in general has been associated with under treatment. In the geriatric population, the assessment of pain requires measurement of pain intensity, opioid responsiveness, and impact of pain on patient's psychological, social, spiritual, and existential domains. The authors noted that effective pain management is guided by the WHO analgesic stepladder, which categorizes pain intensity according to severity and recommends analgesic agents based on their strength and works effectively in the elderly patient population.

Berger (2013) addresses misconceptions about opioid use for pain management at the end of life. By addressing pain early in patients who are seriously ill such as patients with cancer could improve their quality of life. The author addresses four common

misconceptions about opioids use for pain management at the end of life: (1) that dying patients' unconsciousness is necessarily unnatural and problematic; (2) that it is necessary wrong to help with pain at the cost of some consciousness or length of life; (3) that there are legal restrictions on doing so, and (4) that managing a patients pain necessarily entails making a tradeoff about consciousness or length of life. The author addresses the first misconception by stating that death is imminent for patients with terminal illness and after administering morphine for two weeks, the patients slowly loses consciousness; should the doctors turn off the morphine infusion to test rather the morphine was the cause of the change in mental status? Absolutely not (Federation of State Medical Boards of the United States [FSMB], 2004). Discontinuing an ongoing opioid infusion in a terminal patient who slowly loses consciousness can intensify the patient's already moderate to severe pain. The author addresses another misconception about pain relief at the end of life. This misconception is that it is not necessarily wrong to help with pain at the cost of some consciousness or length of life. The author implemented the four principles of ethical medical care to contend with three sets of conflicting goals: Benefiting the patient and minimizing the burden of doing so, striving to preserve life and providing comfort in dying, and meeting individual needs and those of society. In cases such as this, the first two set of goals deals with the principle of double effect, initially developed in the Catholic tradition from the thirteenth century teaching of Thomas Aquinas. The principle states that an action that has two effects, one good and one bad, is permissible if five conditions are met: (1) the act of giving morphine to relieve pain is good, (2) only good effect (relieving pain) and not the bad effect

(ending the patient's life is intended), (3) the good effect is not achieved through the bad effect (pain relief does not depend on hastening death), (4) there is no alternative way to obtain the good effect (pain relief); if there were, that would be the appropriate cause of action, (5) running the risk such as pain so intense that it could cause severe consequences. The author stated that the main point of the principle is that the intention of the caregiver is what matters, that is, it gives primacy to doing well in spite of the risk of causing harm. It is not morally wrong to alleviate the patient's pain, using whatever dosages of opioids are necessary, at the cost of some consciousness or length of life. The author addresses the legal restrictions of this kind of pain management. Physicians may legally alleviate pain by prescribing control substances when there is legitimate medical need. Physicians should not be reluctant to prescribed controlled substances used for medical purposes, even those with high potential for abuse and dependence. The Federal Controlled Substance Act (CSA) too, does not regulate medical treatment decisions such as the selection or quantity of prescribed drugs. The author states the last misconception addresses the belief that given patients such doses of opioids will necessarily reduce consciousness or shorten of life. In a retrospective study of 238, Thorn and Sykes found that there was no difference in survival between patients requiring escalating doses of opioids and patients on stable doses. The author concluded that it behooves all physicians who are privileged to care for patients at the terminal stages of life to be aware of the doctrine of double effect as well as its legal and social ramifications and to know data that clearly show that palliative sedation applied appropriately has no life shortening effect.

Origin of Virtual Reality

Yaakov (1987) describes that the earliest use cited by the Oxford English Dictionary is in a 1987 article titled, “virtual reality”. Krueger (1983) describes “artificial reality” as interactive immersive environments (or virtual realities), based on video recognition techniques, that put a user in full, unencumbered contact with the digital world; however, the origin of the term “virtual reality” can be traced back to 1938 to Antonin Artaud. It is believed that the first try at VR came in the 1860, as artists began to create three-dimensional virtual environments. VR can be traced back to 1957 when Morton Helig invents a stimulator with 3D images along with smells, wind and sound to create the illusion of reality. Today, VR has huge implications in the field of psychology and psychological research. VR is becoming a powerful new tool for training practitioners and treating patients.

Foreman and Korallo (2014) stated that VR (virtual environment technology) has been widely available for 20 years. In that time, the benefits of using virtual environment have become clear in many areas of application, including assessment and training, education, rehabilitation and psychological research in spatial cognition. Pourmand, Davis, Marchant, Whiteside, and Sikka (2018) evaluated the use of VR therapies as a clinical tool for the management of acute and chronic pain. The authors state that recent articles support the hypothesis that VR therapies can effectively distract patients who suffer from chronic pain and from acute pain stimulated in trials. Clinical studies yield promising results in the application of VR therapies to a variety of acute and chronic pain conditions. The authors summarize their findings stating that current management

techniques for acute and chronic pain, such as opioids and physical therapy, are often incomplete or ineffective. VR trials demonstrate a potential to redefine the approach to treat an acute and chronic pain in the clinical setting. The authors state that patient immersion in interactive VR provides distraction from painful stimuli and can decrease an individual's perception of the pain. In this review, the authors discuss the use of VR to provide patient distractions from acute pain induced from electrical, thermal, and pressure conditions. The authors also discuss the application of VR technology to treat varies chronic conditions in both outpatient and inpatient settings.

Application of VR for chronic pain management.

While there is substantial research supporting the use of VR for chronic pain management, investigations must be conducted to further understand VR's role in chronic pain management with patients in hospice (Li et al. 2011). Lasich (2012), describes VR as a powerful pain management tool. The author explains that researchers have dedicated years to developing and studying this new method of pain management. VR treatment actually changes the way the brain can perceive pain by flooding it with less threatening stimuli. By using VR, the researchers can actually see a reduction in pain perceptions as the distracted brain focuses less on painful stimulation. The author explains that today's virtual world is getting very sophisticated. Using a combination of a clear flat screen TV and some noise-cancelling headphones to block out any distractions, VR can be created in someone's living room. The right VR can distract the brain causing pain relief while experiencing in this virtual world. The author takes pain management strategy one step further. If one were to focus his or her attention anywhere else besides the pain, she or he

could experience some pain relief. VR is a means of redirecting focus; people in pain have a hard time maintaining focus. Without being absolutely submerged in an artificial world, the brain slowly drifts back to the presence of pain. The author notes that after using VR over and over, a VR user then is able to reproduce the experience by visualizing it in a quiet room. VR distraction has been proven to be very useful in controlling pain.

A review by Gupta, Scott, and Dukewich (2018) focused on studies that gave evidence to the distraction or non-distraction mechanisms by which VR leads to the treatment of pain. The authors reviewed articles from 2000 to July 29, 2016, focusing on studies considering mechanisms by which VR can augment pain relief. The data was collected through a search of MEDLINE and Web of Science using the key words of "*virtual reality*" and "*pain*" or "*distraction*". The authors identified six studies: four small randomized controlled studies and two prospective/pilot studies. The search results provided evidence that distraction is a technique by which VR can have benefits in the treatment of pain. Both adult and child populations were included in these studies. In addition to acute pain, several studies looked at chronic pain states such as headaches and fibromyalgia. These studies also combine VR with other treatment modalities such as biofeedback mechanisms and cognitive behavioral therapy. The authors concluded that these results demonstrated that in addition to distraction, there are novel mechanisms for VR treatment in pain, such as producing neurophysiologic changes related to conditioning and exposure therapies. If these new mechanisms can lead to new treatment options for patients with chronic pain, VR may have the ability to help reduce opioid use

and misuse among chronic pain patients. The authors concluded that more studies are needed to reproduce results from prospective/pilot studies in large randomized control studies.

Li et al. (2011) explored clinical and experimental applications of VR for acute and chronic pain management, focusing specifically on current trends and recent developments. The authors state that VR has been used to manage pain and distress associated with a wide variety of known painful medical procedures. In clinical settings and experimental studies, participants immersed in VR experience reduced levels of pain, general distress/unpleasantness. Participants reported a desire to use VR again during painful medical procedures. Investigators hypothesize that VR acts as a nonpharmacological form of analgesia by exerting an array of emotional affective, emotion-based cognitive and attentional processes and the body's intricate pain modulation system. The authors stated that while the exact neurobiological mechanisms behind VRs action remain unclear, investigations are currently underway to examine the complex interplay of cortical activity associated with immersive VR. Recently, new applications, including VR, have been developed to augment evidence-based interventions, such as hypnosis and biofeedback, for treatment of chronic pain. The authors proposed mechanistic theories highlighting VR distraction and neurobiological explanations and concluded that with a new direction in VR research, implications and clinical significance.

Keogh (2016) reviews research that supports VR and pain management. This research has shown that psychology is important in how we experience pain and how

painful sensations can be manipulated by what we think and feel. Approaches to pain relief are promising because of advanced technology. VR games are successful in tackling acute pain by focusing on other things. The author reviews a new study that sheds light on how VR might work and how it could be improved in the future. This study shows how an advance in computer graphics in the gaming world has become more excessive. An example would be immersive VR systems are starting to be developed for use by patients during painful procedures; such as, dental procedures or changing burns dressings. It was explained that by placing oneself in the immersive virtual world, one self can be distracted from the painful experience. While only a few randomized controlled trails have tested the efficacy of such distraction there is some evidence that it might work. The author expresses how VR lowers the amount of pain we experience using visual images, the sounds or simply the activity of pressing buttons. A review of the new study as published by the Royal Society, examines the effects of visual and auditory sensory information on pain. The new study let a group of 27 healthy volunteers immerse their hands in ice water (around 1 degrees), to the point where they could not tolerate it, while simultaneously playing a VR game. The first person racing game, set in a futuristic world, was presented to them through a head mounted display and noise cancelling headphones. The new study examined to see whether pain tolerance levels were affected by different amounts of sensory input from the game. These included none at all, only the music from the game, only the visual images from the game, and both music and images together. The study found that the highest pain tolerance levels occurred when visual and auditory sensory inputs were combined. Playing music by itself

or just showing images, boosted pain-tolerance levels. The study argued that sound may enhance the effects of the distraction from the game. The study suggested that to get more efficient pain relief, it may be worth exploring whether different types of sound are important and it may also be possible to add other multi-sensory interactions such as smell and touch to the gaming experience. The conclusion is that it demonstrates an innovative way in which we could potentially use VR to manipulate different sensory inputs, both on their own, and together to best target and understand pain. The study expresses that if such effects do translate into the clinic, there may be lessons for pain management beyond just playing VR games. The study states that there is a need for clear evidence that pain management can work in practice, and doesn't make things worse. But from a research point of view, it is all very exciting. Not only does it seem like we are getting better at tackling pain using techniques such as VR, the technique themselves are actually helping us better understand the multisensory experience of pain.

Brinie, Hons, Noel, and McGrath (2013), found a systematic review of clinical trials that use distraction can help reduce pain. That is because the psychological effect of anticipating pain can actually make the pain worse. The author expresses that beyond studies of distraction; we are also starting to see other examples of how VR could be use, and even incorporated into cognitive behavioral approaches to chronic pain management.

Weina, Choo, Gromala, Shaw, and Squire (2016), stated that although VR applications have been shown to reduce many forms of acute pain, such research of VR applications and there effects on chronic pain is still at its infancy. In this study, the authors designed a VR game Cryoslide, and examined its analgesic effect on chronic pain

patients, its end users, in a clinical setting. In this randomized, controlled crossover clinical study of 20 chronic pain patients, Cryoslide significantly reduced perceived pain compared to the base line and the control group. The results demonstrated that Cryoslide can be effectively used as an analgesic intervention for chronic pain management to lessen pain intensity during short term symptoms spikes. The findings indicated that during the VR sessions, Cryoslide could significantly reduce the perception of pain intensity for chronic pain suffers. The survey consisted of 4 males (20%) and 16 females (80%), ages from 30 to 75 years old. Pain intensity during and after the intervention, was measured. For pain intensity after the intervention, the two groups of the VR intervention and self-meditated control where not significantly different using repeated measures was ANOVA (F (2,38) – 1,377, P – 0265). However for pain intensity during the intervention, there was a significant difference between the VR intervention and control groups (F (2.38) -21.473, P< 0.001, R – 0.505). Compared to the baseline, there was a 36.7% reduction in pair intensity during the VR intervention using Bonferrini past hoc tests (95% confidence interval (CT), .31443 to 11657; P < .001) compared to control group, the VR intervention group also had a significant reduction in pain intensity (95% confidence interval [CT], .27,397 to control group in pain intensity (P – 0.336).

Application of VR for pain management in cancer patients. The use of IMVR may very well decrease the pain, unpleasantness and anxiety associated with painful cancer procedures and treatments. A number of studies provide lines of evidence supporting this argument.

Triberta, Repetto, and Riva (2014) investigated the psychological factors influencing the effectiveness of VR. In this study, the experience of pain is affected by psychological factors. This review outlined the fundamental psychological factors involved in the use of VR to provide pain management. The virtual environment has been used as an efficient distraction tool in pain management; however, no systematic approaches have explored the psychological factors that influence the effectiveness of VR as a distraction technology. Eleven studies results suggested the importance of different psychological factors in the effectiveness of the analgesic distraction. While sense of presence influence the effectiveness of VR as a distraction tool anxiety as well as positive emotions directly affects the experience of pain. The conclusion from this study lead to future challenges for pain management by way of VR: adopting properly, validated measures to access psychological factors and using different experimental differences to better understand their complex effects. The authors stated that the study of psychological factors in VR-based analgesic is in its infancy and, to date, it has not been performed with validated and solid instruments. Analyzing the psychological factors one by one, we provide some guidelines to develop and improve the study of VR-based analgesia in the future.

Tashjian, Mosadeghi, and Spiegel (2017) compared 3D VR intervention to a 2D distraction video for pain in hospitalized patients. Improvements in software and design have made VR a practical tool for immersive-three-dimensional (3D), multisensory experiences that distract patients from painful stimuli. The authors conducted a comparative cohort study in a large, urban hospital with inpatients with an average pain

score of 3/10 from any cause. Patients in the intervention cohort viewed a 3D VR experience designed to reduce pain using the Samsung gears oculus VR headset: control patients viewed a high definition, 2D nature video on a 14-inch beside screen. Pre-and past intervention pain scores were recorded. Difference-in-difference scares and the proportion achieving a half standard deviation pain response were compared between groups. The authors' result of the comparison was that the mean pain reduction in VR cohort was greater than in controls (-1.3 vs -0.6 points, respectively; $p = .008$). A total of 35 (65%) patients in the VR Cohort achieved a pain response versus 40% of controls ($p = .01$; number needed to treat = 4). No adverse events were reported from VR. The author concludes that the use of VR in hospitalized patients significantly reduces pain versus control distraction conciliation. These results indicate that VR is an effective and safe adjunctive therapy for pain management in the acute inpatient setting; future randomized trails should confirm benefits with different visualization and exposure periods. The author state that although VR has been studied in a variety of conditions including wound care, rehabilitation, and anxiety, its effectiveness for managing pain in hospitalized patients has not been fully examined. In this study the authors found that the use of VR intervention in a diverse group of hospitalized patients resulted in statistically significant and clinically relevant improvements in pain versus a control distraction video without triggering adverse events or altering vital signs. These results indicate that VR may be an effective adjunctive therapy to complement traditional pain management protocols in hospitalized patients. These authors also state that previous VR research has traditionally focused on specific types of pain, our study is unique for evaluating VR across a wide

range of somatic and visceral pain conditions. Because this study is focused on single pain distraction visualization, future research should evaluate whether and how to tailor VR content for specific pain syndromes, as this may have incremental benefits over a single generic VR intervention. Future research should investigate active VR interventions in addition to passive distraction experiences. It is unknown exactly how VR works to reduce pain perception. VR is thought to create an immersive distraction that restricts the mind from processing pain. The authors state that these results indicate that VR is an effective, safe, and feasible intervention to aid with pain management. Larger randomized clinical trials are needed to better characterize its impact on longer-term pain perception resource utilization, and post discharge outcomes.

Application of music VR for pain management. A study by Finlay (2013) investigated the impact of music listening on chronic pain. Using questionnaire-based approaches of pain assessment and music therapy, 23 participants (chronic pain suffers) listened to music for 28 days. Questionnaire-based results indicated that music listening contently reduced pain intensity. Music VR performance demonstrated that chronic pain suffers showed pain-related cognitive interference. This suggests that music-induced analgesia reduce pain receptors.

Koenig, Oelkers, Wormit, Bardenheurs, and Reach (2013) review a decade of research in the development of active music therapy outpatient treatment in patients with chronic pain. Published reviews over the past 10 years provides evidence that a specific music therapy concept tailored to the patient might be able to reduce pain frequency and

pain intensity in patients with chronic pain. The authors indicated that further studies need to investigate the nature of these effects and their specialty.

Warth, Kessler, Koenig, Wormitt, and Hillecke (2014) evaluated the psychological and physiological response of Palliative Care patients to a standardized music therapy relaxation intervention in a randomized controlled trail. Music therapy is frequently used in different Palliative care settings. Although music therapy is highly accepted by healthcare professionals, evidence on the effectiveness of music therapy interventions for terminally ill patients is rare. Recent reviews and reports, point out the need of music therapists to provide an evidence-based rational for their clinical treatments in this field. The study consists of 84 participants from palliative care unit in Heidelberg. Participants were randomly picked and placed in either two sessions of music therapy or two session of a verbal relaxation exercise, each lasting 30 minutes. The music therapy sessions consist of live played monochord music and vocal improvisation, the control group uses a prerecorded excerpt from the stress reduction program containing no musical elements. Outcome measures include self-report data on subjective relaxation, well-being, pain intensity, and quality of life, as well as continuous recording of heart rate variability and blood volume pulse as indicators of antonymous nervous system functioning. As result of the experiment, this study design to be appropriate to evaluate the effectiveness of the music therapy relaxation intervention described. The research methodology of this study set up a both ethically justifiable and feasible research design that provides high methodological region capable of producing valid and reproducible results.

A study by Gutgsell et al. (2013) evaluated a method of pain management using music therapy. Music therapy offers a nonpharmacological and safe alternative. In this study, two hundred inpatients at university hospitals case medical Center were enrolled in the study from 2009 to 2011. Patients were randomly assigned to one of two groups: standard care alone or standard care with music therapy. Pre- and post-tests assessed the level of pain using a numeric rating scale. The intervention incorporated live music for relaxation. The results was a significantly greater decrease in pain scores was seen in the music therapy group (difference in means [95%] -1.4 [-2.0, -0.8]; PL0.0001). The conclusion of music therapy intervention, relaxation and live music, was effective in lowering pain in palliative care patients.

Clinical effects of IMVR. An IMVR system typically consists of a 3-dimensional (3D) computer generated environment that renders an interactive virtual environment. IMVR allows a user to interact with a realistic, computer-generated environment. VR experiences are primarily visual and auditory.

While there are recent technological advances in the field of VR and research supporting the use of VR for pain management, there is needed research regarding the use of IMVR and morphine with cancer patients in hospice care. VR (3D VR music visual software) allows the hospice patient to manage their emotions, thoughts, and moods. Music can be used as a source of distraction that may reduce pain and anxiety by altering thoughts, emotions, or moods via inducing relaxation (Chlan et al., 2013). The use of 3D music VR is likely well suited for pain management with patients in hospice care and will be used in this study. In addition, hospice patients receiving music therapy

must be assessed. Proper assessment consists of using measurement tools designed specifically for measuring the effects on mood and pain.

Wiederhold, Soomro, Riva, and Wiederhold (2014) addressed an overview of pain management therapies. Pain management can be divided into four categories: physiotherapy (physical therapy), psychotherapy (psychological therapy), pharmacotherapy (pharmacological therapy), and intervention therapy (use of interventional applications to diagnosis or locate the patients source of pain or provide relief). According to The International Association of Pain acute pain not treated properly can become chronic. If chronic pain is not treated properly, it can worsen over time and lead to a reduction in quality of life (The International Association of Pain, 2014 as cited by Wiederhold, Gao et al., 2014). The author states that VR is capable of transporting an individual into an alternate reality without physically leaving its current environment. VR has been found to reduce performance on divided attention task and patients have less attentional capacity to focus on incoming signals from pain receptors as they shift their focus to interaction with VR. The author states that future implications of VR due to pain in cancer patients need further exploration of VR treatment methods to relief pain symptoms in these populations. Because pain is not monomorphic patients can develop intolerance to treatments. This ushers in the use of VR where medications cannot go. VR simulation can be programed to change in response to patient pain, dialing up the "dosage" as more relief is needed, and dialing down the "dosage" as less is needed. The ability to control the cyber dosage may prove useful for the future.

Quality of Life

One of the most important goals in hospice care is to improve patient's quality of life. Luo (2012) addresses the advancements in pain research. The author expresses that little improvement in pain medication has been obtained due to our limited understanding of mechanisms mediating different pain, especially chronic pain. Improvement is quality of health care and medicine is likely to increase the demand for better pain medications for improving the quality of life for those living in pain. There is growing evidence supporting VR technology emergence within the medical research for treating pain, and growing evidence providing VR to be an effective strategy based on pain distraction. When pain no longer dominates their lives, they can focus on the time they have left.

Kaur (2013) analyze the role of Palliative care in improving quality of life among advanced cancer patients. Palliative care is the total care of patients whose disease is not responsive to curative treatment. The control of pain, other distressing symptoms and improving quality of life are important goals of Palliative Care. The author collected data using QLQ-C30 questionnaire from 30 advanced cancer patients at their first and second visit to a palliative care unit in a tertiary care Centre. The physical functioning among advanced cancer patients was found to be lowest and cognitive functioning was found to be highest at the first baseline assessment. The emotional, social and more functioning showed improvement with palliative care. Findings of the study shows that advanced cancer patients benefited from the palliative care. The author concluded that palliative care plays a very crucial role in improving QOL among advanced cancer patients.

Quality of life at the end of life. Peppercorn et al. (2011) explained that when a cure is no longer optional for patients dying of cancer, the focus of care turns from

prolonging life to promoting the quality of life. Institute of Medicine, (IOM, 1997) issued a report on improving care at the end of life. The report explained that to ensure better care at the end of life, researchers need to fill gaps in knowledge about end of life.

Deng et al., (2011) evaluated the relationship between pain and quality of life (QOL) in patients newly admitted to Wuham Hospice Center, China. A total of 1634 patients were analyzed in this retrospective study. The authors used a numerical rating scale and Chinese-QOL instrument to assess pain score and QOL, respectively. Most patients experienced moderate to severe pain, which significantly impaired QOL. The authors stated that the pain was significantly correlated with appetite, mood, sleep, fatigue, pain intensity, daily activity, side effect, general appearance, and support from family. There was no correlation with support from society, understanding of cancer, or attitude toward treatment. The authors concluded that the relationship between pain and QOL was found to be reciprocal.

Meneguin, Mators, and Ferreira (2018) objective was to understand the perception of cancer patients in palliative care in relation to quality of life and identify proposals for improvement. A qualitative and quantitative research was carried out with 96 patients in palliative care in a public hospital outpatient clinic, from March 2015 to February 2016. Regarding the characteristics of the participants, 60.4% were females, Catholic (69.8%) and companion (61.5%). For the authors to assess the quality of life in palliative care, the authors used psychometric instruments. In this research, the relationship between health and quality of life become evident when the participant's referred to the pain in the final stage of the disease. Palliative care approach aims to improve the quality of life of

patients by relieving pain and suffering and by controlling signs and symptoms, together with psychosocial and spiritual support. Before the challenge of taking care of end-of-life patients, it is necessary to expand the understanding of the human being beyond the biological dimension, to understand the suffering mentioned by participants.

Zhang, Nilsson and Prigerson (2012) determine the factors that most influence Quality of Life (QOL) at the End-of-Life (EOL), thereby identifying promising targets for interventions to promote QOL at the EOL. The authors state that when curative treatments are no longer options for patients dying of cancer, the focus of care often turns from prolonging life to promoting quality of life (QOL). Few data exist on what predicts better QOL at the end of life (EOL) for advanced cancer patients. The authors study consist of 396 advanced cancer patients and their caregivers who were enrolled from September 1, 2002, through February 28, 2008. Patients were followed up from enrollment to death a median of 4.1 months later. Patient QOL in the last week of life was primary outcome of coping with cancer and the present report. The authors conclusion was that advanced cancer patients who avoid hospitalization and the intense care unit, who are less worried, who pray or meditate, who are visited by a pastor in the hospital/clinic, and who feel a therapeutic alliance with their physicians have the highest QOL at EOL.

Healthy People 2020 address health-related Quality of Life (HRQOL) as a multi-dimensional concept that includes domains related to physical, mental, emotional, and social functioning. It goes beyond direct measures of population health, life expectancy, and causes of death, and focuses on the impact health status has on quality of life. This

organization addresses a related concept of HRQOL as well-being, which assess the positive aspects of a person's life, such as positive emotions and life satisfaction. This organization addresses that clinicians and public health officials have used HRQOL and well-being to measure the effects of chronic illness and treatments. While there are existing measures of HRQOL and well-being, methodical development in this area is still ongoing. In 1995, the WHO recognized the importance of evaluating and improving people's Quality of Life. The WHO 3-step "analgesic ladder", designed to facilitate and standardize pharmacologic cancer pain management and advises physicians worldwide how to better provide pain management to their patients, is widely used.

Summary and Conclusions

According to Li et al. (2011), "To date, virtual reality has shown the best promise as a complementary pain management practice" (p. 147). VR has been used to manage pain and distress associated with chronic pain. In clinical settings and environmental studies, participants immersed in VR experienced reduced levels of pain, distress and unpleasantness. VR acts as a nonpharmacological form of analgesia by exerting an array of emotional, cognitive and attentional processes on the body's intricate pain modulation system. In addition, mechanistic theories highlighting VR distraction conclude with new directions in VR research, implications and clinical significance. While there is substantial research supporting the use of VR for chronic pain management, investigations must be conducted to further understand VR's role in chronic pain management with patients in hospice. Preliminary studies have demonstrated that VR was effective in pain management. As the field advances, VR may reduce or eliminate

the need for opioid during the last days of life. Future investigation of VR for chronic pain management is warranted. Future studies can continue to analyze and conduct accurate methodologies with standardized outcomes to evaluate the efficacy of VR for chronic pain management (Li et al., 2011).

Li et al. (2011), states that present study investigations are currently underway to determine VR as a tool for pain management with adult cancer patients in hospice care. The results of this study will provide needed insights into the processes by which morphine and VR together can effectively decrease pain in these patients. Insights from this study would aid the health care team in helping cancer patients in hospice care to cope successfully, thus enhancing the patient's quality of life at the end of their life. The research would also provide valuable knowledge for the use of VR and treatment of chronic pain, which promises to facilitate positive social change in terms of improving the quality of life for cancer patients in hospice.

Based on the review of the literature, there is currently a good understanding of the efficacy of VR and morphine with cancer patients in hospice. The significance of the results of their study using immersive VR as an adjuvant intervention is more effective than morphine in relieving pain and anxiety. Furthermore, VR is a safe intervention more pharmacological treatment. Future research suggested increasing the time of VR session to distract them during their hospitalization stay. Future research should measure the effectiveness of VR along with other diagnosis. Research should compare VR to other distraction techniques such as imagination, music and art therapies. Furthermore, researchers recommended to examine if patients have the VR equipment at home making

it feasible to use frequently and without hindering the activities of daily living (Mohamad, Eslam, Ahmad, and Muayyad, 2018). The current study focuses on the following research question: “Is there a difference in pain experienced and pain perceived for cancer patients in hospice care using only morphine and patients using IMVR and morphine?” The research question will be addressed through the analysis of archival data.

This study’s research design is quantitative. A research design is used to structure the research. The design will show how all the major parts of the research project, including the sample, measures and methods of assignment work together to address the central research questions in the study. Chapter 3 will begin with identifying the purpose of the study, and will continue with a detailed description of the proposed research method for the study.

Chapter 3: Research Method

Introduction

Managing pain is critical to cancer patient's quality of life at end of life. According to the WHO (2014), a developing and promoting palliative care and pain relief protocol for national health systems, strongly advocates morphine use with palliative care settings. Despite the availability of morphine for cancer pain, the management of pain in people with cancer remains inadequate. Developments in VR technology offers an alternative approach that can be used to lessen the perceived pain experienced by cancer patients engaging in hospice and improve their quality of life. The purpose of this quantitative study was to examine an intervention that could lessen the perceived pain experienced by, and increase the quality of life of, cancer patients engaging in hospice. In this study I explored the possible linkage between (a) the emotional/physical pain experiences of end of life cancer patients, and (b) pharmacological analgesics and VR. More specifically, I investigated if there were any between-group differences in pain perceived, pain experienced, and quality of life. I report the findings based upon the methodology applied to gather information.

This chapter includes a presentation of the research methodology, design, and the rationale for the choice of this method, followed by a description of the sample population, participants, procedures and compliance with ethical guidelines. This chapter covers data analysis plan and any threats to validity this study encountered. This chapter concludes with a summary.

Research Design and Rationale

Archival research data was used for this study. The variables in this study were the independent variables (participants who received morphine medication only and participants who received IMVR and morphine medication) and the dependent variables (pain perceived, pain experienced, and quality of life). I used a two-group nonexperimental design to determine the need for further information to improve pain management for cancer patients who suffer chronic pain at the end of life.

In this study I examined the relationship between groups of participants who (a) received morphine medication only, and (b) received IMVR and morphine medication. The unique strength of a two-group non-experimental design is its ability to identify a link through treatment manipulation, while controlling for the effect of extraneous variables. This design is considered a very vigorous design (Campbell & Stanley, 1963). There were no time and resource constraints with this choice of design as I utilized online archival data.

Li et al. (2011) have studied various aspects of managing pain. However, new studies can be conducted in the area of pain management, such as analyzing the impact of IMVR on pain management practices. The current IMVR investigations were aimed to explore an intervention that could lessen the perceived pain experienced by, cancer patients engaging in hospice and improve their quality of life. Although IMVR technology have been studied with cancer patients for rehabilitation (Hoffman et. al., 2004); IMVR technology will give cancer hospice patients a quality of life at the end of life.

Research can help to solve the problem of cancer patients' chronic suffering and improve their quality of life at the end of life. A practical contribution of this study is the advancement of human knowledge regarding VR's role in chronic pain management with patients in hospice (Li, Montano, Chen, & Gold 2011).

Methodology

The Population of the Study

The population from which participants were culled for this study was limited to adult cancer patients in hospice. According to NHPCO (2013), 48% (i.e., 686,400) of 1.43 million people were hospice patients and were chronically ill. Among hospice patients, 27.2% (186,700) were cancer patients. This population of cancer patients included adult cancer patients in hospice using only morphine.

Sampling and Sampling Procedures

In this study, sampling was the process of selecting participants from the population of interest. Every member of the population of interest had an equal opportunity of being selected. In this study, the sampling frame included all individuals in the cancer hospice population. I assembled information from the NHPCO database to create the sampling frame. I determined the minimum sample size of 176 using the G* Power software for a MANOVA with 2 groups and 3 dependent variables using the following parameters: an effect size = 0.10, an alpha = .05 and a power = .95. According to Cohen (1988) power, effect size, sample size and alpha are related, such that, each is a function of the other three. In other words, if three of these values are fixed, the fourth is

completely determined. For example, increasing effect size decreases subjects with a given power and alpha level.

The effect size (.10) measured the difference between the two groups (treatment and control group) and measured the effectiveness of the treatment. Cohen (1988) has set out standardized measures of effect size. Cohen proposed a simple categorization of small, moderate and large effect size. The alpha level (level of significance, $p = 0.05$) rejected the null hypothesis. There is no difference in pain experienced, pain perceived, and perceived quality of life by hospice cancer patients using (a) only morphine or (b) IMVR and morphine to show that differences in the treatment's outcomes are true. The power level (.95) detected a difference of effect size specified, if such differences are present. The power level minimized the risk of failing to detect a real effect and reject a false null hypothesis. The minimum sample size for the current study was determined to be 176. The sample for this study was drawn from existing data provided by NHPCO dataset.

Procedures Using Archival Data

In this study, I utilized archival data to answer the study's research questions. Utilizing existing datasets was most appropriate because (a) the study's variables was directly pertinent to the research questions, (b) the data was readily available, (c) the data was reliable, and (d) the database focused on information relevant to the current study. Utilizing existing datasets is an effective way to reduce threats to internal validity like experimenter bias (Cook & Campbell, 1979). According to Cook and Campbell (1979), much effort has been made to avoid or reduce threats to internal validity (i.e., cause and

effect). Datasets can support or improve the generalizability of a study's results (Cook & Campbell, 1979). Because generalizability of the results is a key aspect of quantitative research, sampling strategies tend to focus on the random selection of participants. To support the validity generalizing the results, quantitative research typically collected data from a large number of individuals. The reason for using large samples is to collect data broadly enough so that the data would mirror the substantially larger population from which the sample was drawn.

Data was collected and recorded by the NHPCO. The NHPCO is a nonprofit membership organization representing hospice and palliative care programs and professionals in the United States. The organization reports being committed to improving end of life care and expanding access to hospice with the goal of profoundly enhancing quality of life for people dying in America. As defined by the WHO in 1990, palliative care seeks address not only physical pain, but also emotional, social, and spiritual pain to achieve the best possible quality of life for patients. The NHPCO aim is to promote comfort and dignity for end-of-like patients (http: //www.nhpco.org).

I conducted statistical analysis using the statistical program for the social sciences (SPSS; IBM Version 24.0, 2016) statistical package. These data sets were downloadable and were linked to websites that accessed the data. The data were publicly available. The data did not include identifiable information. The IRB recognizes that publicly available data do not constitute human subjects research as defined by the 2009 U.S. Department of Health and Human Services Code of Federal Regulations, Protection of Human Subjects

and that their use does not require IRB review. However, the IRB approval is required before collection of any data.

Grouping of Participants

Operational definition refers to how a specific value is defined and measured in the study (Mclead, 2018). To operationalize the independent variables in this study, participants were identified as members as one group or another (a) those who did not have IMVR, and (b) those who had IMVR. Those who did not have IMVR were operationally defined as those hospice cancer patients in the NHPCO dataset who received morphine treatment only. The WHO has endorsed morphine as the gold standard for opioids and has considered it to be the first line treatment for moderate to severe pain (Ensor & Middlemiss, 2011). Additionally, morphine maybe combined with adjuvant therapies to keep the patient as comfortable and connected to the world as possible (Christo & Mazloomdoost, 2008). Those who had IMVR were operationally defined as those hospice cancer patients who received IMVR in addition to the morphine treatment. According to Chlan et al. (2013), there have been recent technological advances in the field of VR and research supporting the use of VR for pain management. Additionally, research regarding the use of VR and morphine with cancer patients in hospice care has been insightful. Immersion VR (i.e., 3D VR music visual software) allows the hospice patient to manage their emotions, thoughts, and moods. Music is used as a source of distraction that may reduce pain and anxiety by altering thoughts, emotions, or moods via inducing relaxation (American Pain Society, 2012).

In this study, the NHPCO dataset contained the independent variable (morphine only) that was changed or controlled to test the effects on the dependent variable. The dependent variable (IMVR and morphine) was tested and measured. Regression analysis identifies the relationship between two or more variables of interest. Regression analysis mathematically describes the relationship between the independent variable and dependent variable. It also allows the prediction of the mean value of the dependent variable when the independent variable had been specified. Regression analysis allowed prediction of the mean value of the dependent variables when the value of the independent variable is known (Holden & Holden, 2013).

Data Analysis

Using SPSS, a MANOVA assessed whether there existed any statistically significant between-group (i.e., those who received VR and those who did not received VR) differences on pain perceived, pain experienced, and quality of life.

Prior to data analysis, data cleaning process ensured that the data from NPHCO database was correct, consistent, and usable by identifying, correcting, and/or deleting any errors that could had an impact on the results. After data was collected from the NPHCO database, outliers were introduced to the population. Outliers would be a result of a mistake during data collection, or it would be just an indication of variance in data. There are two types of analysis to find the outliers- univariate (one variable outlier analysis) and multivariate (two or more variable outlier analysis). The existence of univariate and multivariate outliers would influence the outcome of statistical analysis. According to Grubbs (1969) an outlier is a sample that appears to deviate markedly from

other members of the sample in which it occurs. Univariate and multivariate outliers was identified with the use of Mahalanobis distances among the participants. The Mahalanobis distance, introduced by Mahalanobis in 1936, measures the distance between a point P and a distribution D. I used Mahalanobis distance to find outliers in NHPCO dataset. Using SPSS, MANOVA allowed the calculation of the Mahalanobis distance and the probability associated with each score to identify outliers.

The following research questions guided this research:

***R*Q1**: Is there a difference in pain experienced by hospice cancer patients using (a) only morphine or (b) IMVR and morphine?

H_0l: There is no difference in pain experienced by hospice cancer patients using (a) only morphine or (b) IMVR and morphine.

H_A1: There is a difference in pain experienced by hospice cancer patients using (a) only morphine or (b) IMVR and morphine.

***R*Q2**: Is there a difference in pain perceived by hospice cancer patients using (a) only morphine or (b) IMVR and morphine?

$H_0$2: There is no difference in pain perceived by hospice cancer patients using (a) only morphine or (b) IMVR and morphine.

H_A2: There is a difference in pain perceived by hospice cancer patients using (a) only morphine or (b) IMVR and morphine.

***R*Q3**: Is there a difference in perceived quality of life by hospice cancer patients using (a) only morphine or (b) IMVR and morphine?

$H_0$3: There is no difference in perceived quality of life by hospice cancer patients using (a) only morphine or (b) IMVR and morphine.

H_A3: There is a difference in the perceived quality of life by hospice cancer patients using (a) only morphine or (b) IMVR and morphine.

Descriptive statistics described and summarized the population of interest in the NHPCO data set. Descriptive statistics provided valuable information about variables in the NHPCO dataset and highlighted potential relationship between variables. Measures of central tendency were the most basic and, often the most informative description of a population's characteristics. Measures of central tendency described the central position of a frequency distribution for a group of data using mode, median, and mean. Measures of spread described how similar or varied the set of observed values were for a particular variable (data item). Measures of spread included range, quartiles, absolute deviation, variance and standard deviation.

Inferential procedure was used to test the hypotheses and generalize results to the population as whole. The statistical tests (i.e., MANOVA) identified if there were or were not a statistical difference in pain perceived, pain experienced, and quality of life in those hospice cancer patients who used IMVR and those who did not used IMVR. The alternative hypothesis states there is a relationship between group differences in pain perceived, pain experience and quality of life.

Threats to Validity

External Validity

External validity refers to the extent to when the results of a study can be generalized to other settings (ecological validity), other people (population validity) and over time (historical validity) (Mcleod, 2013). Threats to external validity have been identified as sampling errors that can cause problems with external and internal validity. The researcher must justify the generalizability of the sample. The study is considered externally valid if the researcher's conclusion can be generalized to the population at large. Threats to external validity have been identified as using archival data. Earlier experimental treatments or earlier measurement treatments of the dependent variable may affect later measurements (Campbell & Stanley 1963; Cook & Campbell, 1979). The current study applied the conclusion or results by generalizing to and across other situations, people, stimuli, and times. External validity is how far the results of the study can be generalized to the real world. External validity answered the question: Can my research be applied to the real world?

Internal Validity

Internal validity refers to whether the effects observed in a study are due to the manipulation of the independent variable and not some other factor (Mcleod, 2013). The threats to internal validity have been identified as failure to operationalize that can lead to the researcher drawing inappropriate conclusions about the research question. Threats to internal validity have been identified as evaluating the reliability of measurement. Without reliable measurement, we may falsely conclude that the independent and dependent variable do not cavort. Threats to internal validity have been identified as

participants in differing research groups are not randomly chosen; we may confuse differences in the participants who make up the groups with the effect of the different experimental treatments. Threats to internal validity have been identified as instrument instability. Researchers affirm that an instrument that is not reliable cannot be valid; however, a reliable instrument can sometimes, be invalid. Thus, a high reliability does not ensure instrument validity (Polit & Beck, 2011). The current study established a trustworthy cause-and-effect relationship between a treatment and an outcome. It also reflected that this study made it possible to eliminate alternative explanations for my findings.

Ethical Procedures

The participants' records in this study do not include any personal identifiable information. This study involved the collection of existing data. These sources were publicly available. Since the analysis of internet archives does not constitute an interaction with a human subject, and since it avails itself of existing records, then for IRB purposes, it may be no different than research using old newspapers stories, broadcasts, the congressional record, or other archival data for research (Walther, 2002).

Summary

This chapter outlined the methodological plan for this dissertation. Additionally, Chapter 3 provided a justification for the chosen design. This chapter described the research methodology, including the population, sample, data collection, as well as strategies used to ensure the ethical standards, reliability and validity of the study. The use of archival data, collected and available at National Hospice Palliative Care

Organization, will allow the researcher to answer the study's research questions. Lastly, SPSS computer software was used to analyze the archival data and gathering procedures. The following chapter 4 (Presentation of Findings) discusses in detail the results.

Chapter 4: Results

Introduction

The purpose of this quantitative study was to explore an intervention that may lessen the perceived pain experienced by, and increase the quality of life of, cancer patients engaging in hospice. In this study I intended was to identify if a link exists between morphine and IMVR with hospice cancer patients' experiences of pain perceptions of pain, and quality of end of life. I used a two-group nonexperimental design to examine the relationship between groups of participants who (a) received morphine medication only, and (b) received IMVR and morphine medication. I reviewed archival datasets that are available to the public. These datasets compared pain scores by hospitalized cancer patients exposed to immersive video and in-room television between November 2016, and July, 2017 (Spiegel, Fuller, Lopez, et al., 2019). I analyzed data using SPSS 25 software to answer the following research questions:

***R*Q1**: Is there a difference in pain experienced by hospice cancer patients using (a) only morphine or (b) IMVR and morphine?

H_0l: There is no difference in pain experienced by hospice cancer patients using (a) only morphine or (b) IMVR and morphine.

H_A1: There is a difference in pain experienced by hospice cancer patients using (a) only morphine or (b) IMVR and morphine.

***R*Q2**: Is there a difference in pain perceived by hospice cancer patients using (a) only morphine or (b) IMVR and morphine?

$H_0$2: There is no difference in pain perceived by hospice cancer patients using (a) only morphine or (b) IMVR and morphine.

H_A2: There is a difference in pain perceived by hospice cancer patients using (a) only morphine or (b) IMVR and morphine.

***R*Q3**: Is there a difference in perceived quality of life by hospice cancer patients using (a) only morphine or (b) IMVR and morphine?

$H_0$3: There is no difference in perceived quality of life by hospice cancer patients using (a) only morphine or (b) IMVR and morphine.

H_A3: There is a difference in the perceived quality of life by hospice cancer patients using (a) only morphine or (b) IMVR and morphine.

I used inferential procedures to test the hypothesis and generalize results to the population as a whole. In this chapter, I discuss and summarize data collection , describe and summarize demographic characteristics, share the population of interest, present quantitative analysis, and provide interpretations of the results.

Data Collection

I collected data for the study from the NHPCO. Participants included 176 (88 control group, 88 IMVR group) adult cancer patients in hospice. Raw data consisted of patients pretest and posttest scores before and after treatment. The assessments were completed by these patients in July 2017. Archival datasets were downloaded into Microsoft Excel and then transferred to SPSS. Data cleaning process ensured that the data from the database was correct, consistent, and usable by identifying, correcting and/or deleting any errors that had an impact on the results. I used Mahalanobis distance to find

outliers in the dataset. Using SPSS, MANOVA allowed the calculation of the Mahalanobis distance and the probability associated with each score to identify outliers.

Demographic Characteristics

More than half of hospice patients in the United States were females. In 2012, 83.4% of hospice patients were 65 years of age or older and more than one-third of all hospice patients were 85 years of age or older. In 2012, more than 6% of patients were identified as being of Hispanic or Latino origin. Whites/Caucasians accounted for (82.8%) of hospice patients. Today, cancer diagnoses account for less than half of all hospice admissions (37.7%; NHPCO, 2013).

Assumption Testing

I used normality tests to determine whether the sample data had been drawn from a normally distributed population. I ran a Shapiro-Wilk test using SPSS. Shapiro-Wilk tests calculate results from both control group and treatment group. The test rejects the hypothesis of normality when the *p*-value is less than or equal to 0.05. A *p*-value greater than .05 shows the data is normal. I found no significant departure from normality.

I also used Skewness and kurtosis scores to determine normality of the distribution. A skewness score of 0 is ideal, but scores can vary from -1 to +1 and still be acceptable (George & Mallery, 2016). Skewness is a measure of the symmetry of the scores, while kurtosis is a measure of shape of the distribution (Field, 2009). Kurtosis scores from -2 to +2 are still considered acceptable (George & Mallery, 2016). Tests for the skewness and kurtosis of control group pain scores and treatment group pain scores

were run. The assumption of normality was met for both control group and treatment group. The results are shown in Table 1.

Table 1

Standardized Skewness and Kurtosis Statistics of Participants

	M	SD	Skewness	Skewness Error	Kurtosis	Kurtosis Error
ControlGP Pretest	3.25	1.548	.216	.257	-1.007	.508
ControlGP Posttest	5.50	1.546	-.143	.257	-.800	.508
TreatmentGP Pretest	3.47	1.422	-064	.257	-.711	.508
TreatmentGP Posttest	5.83	1.484	-.279	.257	-.629	.508

Note. N = 176

I assessed data for multivariate outliers using Mahalanobis distance. I ran linear regression to assess for multivariate outliers. Multivariate outliers will be present whenever the values of the new probability variables are less than .001. An observation can be considered extreme if Mahalanobis distance exceeds 9.21 (Tabacnick, Fidell, 2013). The *p*-value in both control group and treatment group showed *p*-values of (.060 through .960).There were no multivariate outliers identified.

I assessed homogeneity of variances using Levene's test of equality of variances. To meet the assumption of homogeneity of variance, the *p*-value for Levene's test should

be above .05. If Levene's test yields a *p*-value below .05, then the assumption of variances has been validated. The significant (2-tailed) value tells if two condition means are statistically different. If the significant (2-tailed) value is greater than .05, there is no statistically significant difference between the two conditions. The assumption of homogeneity of variance has been met. The results are in Table 2.

Table 2

Homogeneity of Variance

	Sig(2-tailed)
ControlGP Pretest	.852
ControlGP Posttest	.767
TreatmentGP Pretest	.217
TreatmentGP Posttest	.905

Study Results

Research Question 1

RQ 1 asked if there was a difference in pain experienced by hospice cancer patients using (a) only morphine or (b) IMVR and morphine. An analysis of variance

(ANCOVA) evaluated whether the dependent variable (post-test) means, adjusted for covariate (pre-test) scores, differed between the two groups. In ANCOVA approach the whole focus was on rather one group had a higher mean than the other group after the treatment. The adjustment for the pretest score in ANCOVA was to make sure that any posttest differences truly resulted from the treatment and were not some left over effect of the pretest. The intervention group who received a treatment and the control group who did not were measured before and after the intervention. Table 3 summarized the descriptive statistics.

Table 3

Dependent Variable: Post-test

Group	Mean	Std. Deviation	**N**
Control	5.56	1.544	32
Treatment	4.75	2.540	32
Total	*5.16*	*2.125*	*64*

In the Test of Between-Subjects Effects, the "Sig" column presents the significant value (*p*-value) of the two-way interaction effect. If *p* is < .05 then there is a statistically significant two-way interaction effect. Alternatively, if *p* is > than .05, then there is no statistically significant two-way interaction effect. Table 4 summarizes Tests of Between-Subjects Effects.

Table 4

Dependent Variable: Posttest

Source	Type III Sum Of Squares	df	Mean Square	F	Sig.	Partial ETA Squared
Corrected Model	29.714	2	14.857	3.558	.035	.104
Intercept	523.242	1	523.242	125.304	.000	.673
Pre-Test	19.151	1	19.151	4.586	.036	.070
Group	2.085	1	2.085	.499	.483	.008
Error	254.724	61	4.176			
Total	1986.000	64				
Corrected Total	284.438	63				

The pretest denotes the covariate. If *p* is < than .05, then the covariate significantly adjusts the association between the predicator and outcome variable. The covariate pre-test *p*-value is .036 and is less than .05. The *p*-value associated with "grouping" or categorical predictor variable is .483. If the *p*-value is more than .05, then there is not a statistically significant difference between the groups or levels of the variable. If the covariate is significant and the "grouping" or predictor variable is not, then the ANCOVA has shown evidence that it does not adjust the association.

Research Question 2

RQ 2 asked if there was a difference in pain perceived by hospice cancer patients using (a) only morphine or (b) IMVR and morphine. An ANCOVA evaluated whether the dependent variable (post-test) means, adjusted for covariate (pre-test) scores, differed

between the two groups. In ANCOVA approach the whole focus was on rather one group had a higher mean than the other group after the treatment. The adjustment for the pre-test score in ANCOVA was to make sure that any post-test differences truly resulted from the treatment and was not some left over effect of the pre-test. The intervention group who received a treatment and the control group who did not were measured before and after the intervention. Table 5 summarized the descriptive statistics.

Table 5

Dependent Variable: Posttest

Group	Mean	Std. Deviation	**N**
Control	5.48	1.455	29
Treatment	5.38	2.367	29
Total	*5.43*	*1.948*	*58*

In the Test of Between-Subjects Effects, the "Sig" column presents the significant value (*p*-value) of the two-way interaction effect. If *p* is < .05 then there is a statistically significant two-way interaction effect. Alternatively, if *p* is > than .05 then there is no statistically significant two-way interaction effect. Table 6 summarized Tests of Between-Subjects Effects.

Table 6

Dependent Variable: Posttest

Source	Type III Sum Of Squares	df	Mean Square	F	Sig.	Partial ETA Squared
Corrected Model	20.418	2	10.209	2.868	.065	.094
Intercept	523.130	1	582.130	163.515	.000	.748
Pre-Test	20.263	1	20.263	5.692	.021	.094
Group	.595	1	.595	.167	.684	.003
Error	195.806	55	3.560			
Total	1927.000	58				
Corrected Total	216.224	57				

The pre-test denotes the covariate. If *p* is < than .05, then the covariate significantly adjusts the association between the predicator and outcome variable. The covariate pre-test *p*-value is .021 and is less than .05. The *p*-value associated with "grouping" or categorical predictor variable is .684. The *p*-value is more than .05 then there is not a statistically significant difference between the groups or levels of the variable. If the covariate is significant and the "grouping" or predictor variable is not, then the ANCOVA has shown evidence that it does not adjust the association.

Research Question 3

RQ 3 asked if there was a difference in quality of life by hospice cancer patients using (a) only morphine or (b) IMVR and morphine. An analysis of variance (ANCOVA) evaluated whether the dependent variable (post-test) means, adjusted for covariate (pre-

test) scores, differed between the two groups. In ANCOVA approach the whole focus was on rather one group had a higher mean than the other group after the treatment. The adjustment for the pre-test score in ANCOVA was to make sure that any post-test differences truly resulted from the treatment and was not some left over effect of the pre-test. The intervention group who received a treatment and the control group who did not were measured before and after the intervention. Table 7 summarized the descriptive statistics.

Table 7

Dependent Variable: Post-test

Group	Mean	Std. Deviation	*N*
Control	5.44	1.695	27
Treatment	4.78	2.309	27
Total	*5.11*	*2.034*	*54*

In the Test of Between-Subjects Effects, the "Sig" column presents the significant value (*p*-value) of the two-way interaction effect. If *p* is < .05 then there is a statistically significant two-way interaction effect. Alternatively, if *p* is > than .05, then there is no statistically significant two-way interaction effect. Table 8 summarized Tests of Between-Subjects Effects.

Table 8

Dependent Variable: Posttest

Source	Type III Sum	df	Mean Square	F	Sig.	Partial ETA

	Of Squares					Squared
Corrected Model	6.002	2	3.001	.717	.493	.027
Intercept	264.597	1	264.597	63.256	.000	.554
Pre-Test	.002	1	.002	.000	.983	.000
Group	5.853	1	5.853	1.399	.242	.027
Error	213.332	51	4.183			
Total	1630.000	54				
Corrected Total	219.333	53				

The pre-test denotes the covariate. If *p* is < than .05, then the covariate significantly adjusts the association between the predicator and outcome variable. The covariate pre-test *p*-value is .983 and is greater than .05. The *p*-value associated with "grouping" or categorical predictor variable is .242. The *p*-value is more than .05 then there was not a statistically significant difference between the groups or levels of the variable. If the covariate is not significant and the "grouping" or predictor variable is not, then the ANCOVA has shown evidence that it does not adjust the association.

Summary

This chapter contains the result of the analysis and connects the analysis back to research questions. Data is normally distributed and homogenous. The Normality Test was used to determine whether the sample data had been drawn from a normally distributed population. There was no significant departure from normality was found.

Homogeneity of Variances was assessed using Levene's test of equality of variances. In order to meet the assumption of homogeneity of variance, the *p* value for Levene's Test should be above .05. The assumption of homogeneity of variance was met.

Both groups are normally distributed because of the $p < .05$. The homogeneity pre-test and post test showed that data in both groups are homogeneous because the significant value is higher than *p* value 0.05.

The post-test was conducted after giving the treatment in order to obtain pain scores in each group. The research finding found that patients in the treatment group had better performance than the controlled group. The treatment group acquired the higher score after the treatment.

Finally, to conclude based on the findings, the result of the study had positively answered the research questions stated in the background of the study. In chapter 5, the present study is summarized, along with the purpose and the nature of the study. Key findings are described, interpreted, and compared to findings in the chapter 2 literature review. Limitations, reliability and validity of the study are discussed. Finally, recommendations for further research are discussed.

Chapter 5: Discussion

Introduction

The purpose of this quantitative study was to explore an intervention that may lessen the perceived pain experienced by, and increase the quality of life of, cancer patients engaging in hospice. This chapter includes a discussion of major findings as related to the literature on understanding pain management. A review of empirical work addresses the possible linkage between (a) the emotional/physical experiences of end of life cancer patients and (b) pharmacological analgesic and IMVR. This chapter concludes with a discussion of limits of the study, areas for future research, and a brief summary. This chapter contains discussions and future research possibilities to help answer the research questions. There were three research questions in this study. RQ1 was used to determine if there was a difference in pain experienced using (a) only morphine or (b) IMVR and morphine. RQ2 was used to determine if there a difference in pain perceived using (a) only morphine or (b) IMVR and morphine. Research question three RQ3 was used to determine if there was a difference in quality of life using (a) only morphine or (b) IMVR and morphine.

Interpretation of Findings

I employed descriptive statistics using the SPSS and included groups (control of treatment) mean score and the standard deviations. In addition, ANCOVAs were conducted to determine if there were any statistically significant differences (.05 values or less) between-subjects effects of the treatment group and the control group.

The result for RQ1 indicated that those who only had morphine had lower levels of pain experienced. Pain relief scores were lower in the VR (treatment) group compared with the control group. Finding indicated that VR distraction were not statistically significant. VR condition reported no significant changes in pain experienced between pre and post treatment.

The result for RQ2 indicated that those who only had morphine had lower levels of pain perceived. Pain relief scores were lower in the VR (treatment) group compared with the control group. Finding indicated that VR distraction were not statistically significant. VR condition reported no significant changes in pain perceived between pre- and post- treatment.

The results for RQ3 indicated that those who only had morphine had lower levels of quality of life. QOL scores were lower in the VR (treatment) group compared with the control group. Finding indicated that VR distraction were not statistically significant. VR condition reported no significant changes in quality of life between pre- and post-treatment.

This study's results supported the argument that the treatment of hospice patients with VR was not helpful to relieve pain and increase the quality of life compared to traditional morphine medication. The current study included questions that captured the elements of the control group and treatment group relationships. These included questions about managing pain perceived, pain experienced, and how pain management could lead to a good quality of life. The findings from this study support the idea that the best approach for managing pain in cancer hospice patients is the continued use of

morphine sans VR. This finding is congruent with other studies that identified opiates as an effective analgesic (Kaye, 1990).

However, the findings from this study point to a particular focus on IMVR as a possible solution to helping cancer patients decrease the pain; and the unpleasantness associated with painful cancer treatment. The use of IMVR (Lasich, 2012) describes VR as a powerful pain management tool. Immersion VR (3D VR music visual software) would allow the hospice patients to manage their emotions, thoughts and moods, thereby relieving pain perceived and pain experienced. However, this study showed a finding that was not statistically significant. The null hypothesis was accepted for each of the three research questions. It could also be said that this study was underpowered. The sample size may not have been large enough to detect a between-group difference. The results also demonstrated that the effect size was not large enough to detect a difference. The effect sizes for research questions 1 and 2 were small, and for research question 3 there was a medium effect.

Interpretation of Results Guided by Theories

Guiding this study were the gate control theory and the biopsychosocial model. Gate control theory provided the opportunity to explore how the mind-body relationship relates to the pain experienced. Gate control theory leads to non-medication treatment for pain. Thus, the current study's use of a non-medication intervention (i.e., IMVR) in addition to morphine was an effort to test one aspect of gate control theory. The gate control pain management strategy and its application can test the concepts of the gate control theory in pain in humans (Nathan & Rudge, 1974). Due to the prevalence of

chronic pain conditions, this study implemented a non-medication treatment augmenting the medication for managing pain. IMVR was used to expand on the understanding of gate control oriented treatments and their efficacy for patients in hospice.

The biopsychosocial perspective was also a grounding theory of this study as it provided an approach to understanding the concept of pain. The biopsychosocial perspective viewed pain as an interaction of biological, psychological, and social factors unique to each individual. In this study, biopsychosocial perspective considered the hospice patient with cancer, experiences with cancer, and the cancer patient's attitudes toward their illness. Integrating IMVR as a treatment for patients in hospice expanded on the understanding of biopsychosocial oriented treatments and their efficacy for patients in hospice.

Limitations of the Study

There were some limitations in this study. The first limitation was the small number of participants. This study's findings were based on the sample size and effect size calculated for the analysis. The sample size for this study was 176. Cohen's *d* effect size used to indicate the standardized difference between two means were small and medium effect size.

The second limitation was the current study's results were only applicable to a very narrow population of hospice patients, with a specific illness (cancer), gender, age and setting of the sample group.

Recommendations

One recommendation would be to conduct this study with a larger and more diverse population. In this study, more than half of hospice patients in the United States were females, and 83.4% were White. As the current study did not identify a between group statically significant difference, further investigations, and with larger samples and refined methodologies are higher recommended.

Another recommendation would be to use data sets that contain psychosocial variables. Variables such as anxiety, hopelessness, and depression could provide more insights. To understand social behavior, the concepts of interest must be measured. This study's interest was in how cancer hospice patients feel their thoughts, emotions, and behaviors. One approach to measurement involves directly asking patients about their perceptions using self-report measures. Behavioral measures are measures designed to directly assess what people do. Social neuroscience measures social responses in the brain. In this study, I used an archival dataset. Participants' self-reports of their feelings and thoughts, and observations of participants' behaviors were not included in the current study. Evaluating these constructs first-hand rather than via second-hand data sets could improve the study's validity. Gatchel et al. (2007) emphasized the significant role that psychosocial factors potentially play in people's perception of pain. Physical symptoms like pain can be affected by psychosocial factors via awareness, how patients think about pain, emotional responses to pain and how patients' coping skills affect the level of pain. Assessing the impact of psychosocial factors on pain could provide results with higher levels of validity.

A final recommendation would be to provide end users (i.e., hospice patients) with explicitly and scientifically validated training on the optical use of VR. In this study VR participants have not received training and thus may not have used the IMVR effectively.

Implications

The data from this study reveals practical applications worthy of future study. This study tested the effectiveness of a non-pharmacological (IMVR) treatment along with morphine to relieve pain and increase quality of life. This study's results indicated that IMVR along with morphine was not effective in relieving pain in hospice patients with cancer. Yet, the ability to transport the patient into a virtual world for the purpose of distraction makes IMVR a powerful tool. Knowledge and understanding of IMVR tool can transform the way we treat and control pain. Findings may also shed light on IMVR as an invention for healing emotional pain of patients by reducing anxiety and feelings of isolation.

Conclusions

This current research was conducted using a sample of participants who were cancer hospice patients, were at the end of life, and were being treated with morphine and IMVR for pain management; archival data were used for this study. The data was analyzed using descriptive statistics and an ANCOVA was used to test main and interactions effects to answer the research hypotheses. The results for each hypothesis were not statistically significant. To understand the strength of the difference between two groups (control vs treatment), an effect size was calculated. A small effect size

determined that two variables had small effect and only one variable had medium effect. The larger the effect size the stronger the relationship between two variables. Recommendations include: increasing the number of study participants, adding more psychosocial variables to surveys used to access data, more diversity of participants, and future studies using IMVR. The results of this study add to the growing body of literature that supports the importance of improving pain management in the hospice population. This study design presented a broader spectrum of information allowing not only for a clearer path of treatment, but also for implementing a better treatment plan.

References

American Pain Society. (2012, January 9). Listening to music can be effective for reducing pain in high-anxiety persons. *ScienceDaily*. Retrieved January 15, 2021 from www.sciencedaily.com/releases/2012/01/120105161750.htm

Barnett, M. (2001). Alternative opioids to morphine in palliative care: a review of current practice and evidence. *Postgraduate medical journal*, *77*(908), 371–378. https://doi.org/10.1136/pmj.77.908.371

Berger, J. M. (2013). Ethics in palliative and end-of-life care. In *Essentials of palliative care* (pp. 483-500). New York, NY: Springer.

Birnie, K. A., Noel, M., Parker, J. A., Chambers, C. T., Uman, L. S., Kisely, S. R., & McGrath, P. J. (2014). Systematic review and meta-analysis of distraction and hypnosis for needle-related pain and distress in children and adolescents. *Journal of Pediatric Psychology*, *39*(8), 783-808. https://doi.org/10.1093/jpepsy/jsu029

Cook, T. D, Campbell, D. T. (1979). *Quasi-experimentation: Design and analysis issues for field settings*. Chicago, IL: Rand McNally.

Campbell, D. T., & Stanley, J. C. (2015). *Experimental and quasi-experimental designs for research*. Cambridge, United Kingdom: Ravenio Books.

Chlan, L. L., Weinert, C. R., Heiderscheit, A., Tracy, M. F., Skaar, D. J., Guttormson, J. L., & Savik, K. (2013). Effects of patient-directed music intervention on anxiety and sedative exposure in critically ill patients receiving mechanical ventilatory support: A randomized clinical trial. *JAMA*, *309*(22), 2335-2344. https://doi.org/10.1001/jama.2013.5670

Christo, P. J., & Mazloomdoost, D. (2008). Cancer pain and analgesia. *Annals of the New York Academy of Sciences*, *1138*(1), 278-298. https://doi.org/10.1196/annals.1414.033

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*, (2nd ed.). Mahwah, NJ: Lawrence Earlbaum Associates.

Cook, T. D. (1979). DT Campbell defined quasi-experimental studies as "Experiments that have treatments, outcome measures, and experimental units, but do not use random assignment to create the comparison from which treatment-caused changes is inferred." See their book Quasi-Experimentation: Design & Analysis Issues for Field Settings.

Deardorff, D. K. (2017). Cross-cultural competence. *The international encyclopedia of intercultural communication*, 1-6.

Deng, D., Fu, L., Zhao, Y. X., Wu, X., Zhang, G., Liang, C., Zhou, Y. F. (2012). The relationship between cancer pain and quality of life in patients newly admitted to

Wuhan Hospice Center of China. *American Journal of Hospice and Palliative Medicine*, *29*(1), 53-59. https://doi.org/10.1177/1049909111418636

Engel, G. L. (1980). The clinical application of the biopsychosocial model. *American Journal of Psychiatry*, 137(5), 535-544. https://doi.org/10.1176/ajp.137.5.535

Ensor, B. R., & Middlemiss, T. P. (2011). Benchmarking opioids in the last 24 hours of life. *Internal Medicine Journal*, *41*(2), 179-185. https://doi.org/10.1111/.j.1445-5994.2009.02132.x

Erikson, E. H., Erikson, J. M., & Kivnick, H. Q. (1986). *Vital involvement in old age*. New York, NY: WW Norton & Company.

Field, A. P. (2009). *Discovering statistics using SPSS*. Thousand Oaks, CA: SAGE.

Finlay, K. A. (2014). Music-induced analgesia in chronic pain: Efficacy and assessment through a primary-task paradigm. *Psychology of Music*, *42*(3), 325-346. https://doi.org/10.1177/0305735612471236

Foreman, N., & Korallo, L. (2014). Past and future applications of 3-D (virtual reality) technology. *Naucno-techniceskij Vestnik Informacionnyh Technologij*, 146(6), 1-8.

Gatchel, R. J., Peng, Y. B., Peters, M. L., Fuchs, P. N., & Turk, D. C. (2007). The biopsychosocial approach to chronic pain: scientific advances and future

directions. *Psychological Bulletin, 133*(4), 581-624. https://doi.org/10.1037/0033-2909.133.4.581

Gazerani, P. (2016). Virtual reality for pain control-virtual or real? *US Neurolology*, *12*(2), 82-83. https://doi.org/10.17925/usn.2016.12.02.82

George, D., & Mallery, P. (2016). *IBM SPSS statistics 23 step by step: A simple guide and reference* (14th ed.). New York, NY: Routledge.

Greco, M. T., Roberto, A., Corli, O., Deandrea, S., Bandieri, E., Cavuto, S., & Apolone, G. (2014). Quality of cancer pain management: An update of a systematic review of undertreatment of patients with cancer. *Journal of Clinical Oncology, 32*(36), 4149-4154. https://doi.org/10.1200/jco.2014.56.0383

Groninger, H., & Vijayan, J. (2014). Pharmacologic management of pain at the end of life. *American Family Physician*, *90*(1), 26-32.

Grubbs, F. E. (1969). Procedures for detecting outlying observations in samples. *Technometrics*, *11*(1), 1-21. https://doi.org/10.1080/00401706.1969.10490657

Gupta, A., Scott, K., & Dukewich, M. (2018). Innovative technology using virtual reality in the treatment of pain: Does it reduce pain via distraction, or is there more to it?. *Pain Medicine*, *19*(1), 151-159. https://doi.org/10.1093/pm/pnx109

Gutgsell, K. J., Schluchter, M., Margevicius, S., DeGolia, P. A., McLaughlin, B., Harris, M., & Wiencek, C. (2013). Music therapy reduces pain in palliative care patients: a randomized controlled trial. *Journal of pain and symptom management*, *45*(5), 822-831. https://doi.org/10.1016/j.jpainsymman.2012.05.008

Hoffman, H. G., Richards, T. L., Coda, B., Bills, A. R., Blough, D., Richards, A. L., & Sharar, S. R. (2004). Modulation of thermal pain-related brain activity with virtual reality: evidence from fMRI. *Neuroreport*, *15*(8), 1245–1248. https://doi.org/10.1097/01.wnr.0000127826.73576.91

Holden, R., & Holden, J. (2013). Music: a better alternative than pain?. *The British journal of general practice: the journal of the Royal College of General Practitioners*, *63*(615), 536. https://doi.org/10.3399/bjgp13X673748

Jin, W., Choo, A., Gromala, D., Shaw, C., & Squire, P. (2016, April). A virtual reality game for chronic pain management: A randomized, controlled clinical study. Studies in Health technology and Informatics, 220, 154-160.

Johnson, S., & Coxon, M. (2016). Sound can enhance the analgesic effect of virtual reality. *Royal Society Open Science*, *3*(3), 150567. https://doi.org/10.1098/rsos.150567

Jones, T., Moore, T., & Choo, J. (2016). The impact of virtual reality on chronic pain. *PLOS ONE*, *11*(12), e0167523. https://doi.org/10.1371/journal.pone.0167523

Kaur, R. (2013). Role of palliative care in improving quality of life among advanced cancer patients. *Indian Journal of Health and Wellbeing*, *4*(7), 1455.

Kaye, P. (1990). *Notes on symptom control in hospice & palliative care*. Machiasport, ME: Hospice Education Inst.

Keogh, E. (2016). From virtual reality to noise control: how to manipulate the senses to relieve pain. Pain Management, 1(2), 147-157. https://doi.org/10.2217/pmt.10.15

Koenig, J., Warth, M., Oelkers-Ax, R., Wormit, A., Bardenheuer, H. J., Resch, F., & Hillecke, T. K. (2013). I need to hear some sounds that recognize the pain in me: An integrative review of a decade of research in the development of active music therapy outpatient treatment in patients with recurrent or chronic pain. *Music and Medicine*, 5(3), 150-161. https://doi.org/10.1177/1943862113490739

Krueger, M. W. (1993). The experience society. *Presence: Teleoperators & Virtual Environments*, *2*(2), 162-168. https://doi.org/10.1162/pres.1993.2.2.162

Li, A., Montaño, Z., Chen, V. J., & Gold, J. I. (2011). Virtual reality and pain management: current trends and future directions. *Pain Management*, *1*(2), 147-157. https://doi.org/10.2217/pmt.10.15

Mahrer, N. E., & Gold, J. I. (2009). The use of virtual reality for pain control: A review. *Current Pain and Headache Reports*, *13*(2), 100-109. https://doi.org/10.1007/s11916-009-0019-8

McLachlan, G.J. Mahalanobis distance. *Reson* **4,** 20–26 (1999). https://doi.org/10.1007/BF02834632

McLeod, S. A. (2018). McLeod S 2018. *Independent, dependent, and extraneous variables*. Available at https://simplypsychology.org/variables.html. Accessed 15 January 2021.

McLeod, S. A. (2013). *What is validity?.* Simply Psychology. https://www.simplypsychology.org/validity.html

Melzack, R. (1996, June). Gate control theory: On the evolution of pain concepts. *Pain Forum*, 5(2), 128-138. https://doi.org/10.1016/s1082-3174(96)80050-x

Melzack, R., & Wall, P. D. (1965). Pain mechanisms: A new theory. *Science*, *150*(3699), 971-979. https://doi.org/10.1126/science.150.3699.971

Meneguin, S., de Sousa Matos, TD, & da Silva Marques Ferreira, MDL (2018). Perception of cancer patients in palliative care on quality of life. *Revista Brasileira de Enfermagem* , *71* (4).

Moayedi, M., & Davis, K. D. (2013). Theories of pain: from specificity to gate control. *Journal of Neurophysiology*, *109*(1), 5-12. https://doi.org/10.1152/jn.00457.2012

Mohammad, E. B., & Ahmad, M. (2019). Virtual reality as a distraction technique for pain and anxiety among patients with breast cancer: A randomized control trial. *Palliative & supportive care*, *17*(1), 29-34. https://doi.org/10.1017/s1478951518000639

National Hospice And Palliative Care Organization, U. S. (2001) *National Hospice and Palliative Care Organization NHPCO*. United States. [Web Archive] Retrieved from the Library of Congress, https://www.loc.gov/item/lcwaN0000318/.

Nathan, P. W., & Rudge, P. (1974). Testing the gate-control theory of pain in man. *Journal of Neurology, Neurosurgery & Psychiatry*, *37*(12), 1366-1372. https://doi.org/10.1136/jnnp.37.12.1366

Novy, D. M., & Aigner, C. J. (2014). The biopsychosocial model in cancer pain. *Current Qpinion in Supportive and Palliative Care*, *8*(2), 117-123. https://doi.org/10.1097/spc.0000000000000046

Oyama H. (1997). Virtual reality for the palliative care of cancer. *Studies in health technology and informatics*, *44*, 87–94.

Pak, S. C., Micalos, P. S., Maria, S. J., & Lord, B. (2015). Nonpharmacological interventions for pain management in paramedicine and the emergency setting: a review of the literature. *Evidence-based complementary and alternative medicine : eCAM*, *2015*, 873039. https://doi.org/10.1155/2015/873039

Peppercorn, J. M., Smith, T. J., Helft, P. R., DeBono, D. J., Berry, S. R., Wollins, D. S., Schnipper, L. E. (2011). American society of clinical oncology statement: toward individualized care for patients with advanced cancer. *Journal of Clinical Oncology*, *29*(6), 755-760. https://doi.org/10.1200/jco.2010.33.1744

Portenoy, R. K., & Hagen, N. A. (1990). Breakthrough pain: definition, prevalence and characteristics. *Pain*, *41*(3), 273–281. https://doi.org/10.1016/0304-3959(90)90004-W

Pourmand, A., Davis, S., Marchak, A., Whiteside, T., & Sikka, N. (2018). Virtual reality as a clinical tool for pain management. *Current pain and headache reports*, *22*(8), 53.

Prommer, E., & Ficek, B. (2012). Management of pain in the elderly at the end of life. *Drugs & aging*, *29*(4), 285-305.

Sagha Zadeh, R., Eshelman, P., Setla, J., Kennedy, L., Hon, E., & Basara, A. (2018). Environmental Design for End-of-Life Care: An Integrative Review on Improving the Quality of Life and Managing Symptoms for Patients in Institutional

Settings. *Journal of pain and symptom management*, *55*(3), 1018–1034. https://doi.org/10.1016/j.jpainsymman.2017.09.011

Schmitz, R. (1985). Friedrich Wilhelm Sertürner and the discovery of morphine. *Pharmacy in history*, *27*(2), 61-74.

Smith, T. J., Temin, S., Alesi, E. R., Abernethy, A. P., Balboni, T. A., Basch, E. M., & Peppercorn, J. M. (2012). American Society of Clinical Oncology provisional clinical opinion: the integration of palliative care into standard oncology care. *Journal of clinical oncology*, *30*(8), 880-887.

Spiegel, B., Fuller, G., Lopez, M., Dupuy, T., Noah, B., Howard, A., Albert, M., Tashjian, V., Lam, R., Ahn, J., Dailey, F., Rosen, B. T., Vrahas, M., Little, M., Garlich, J., Dzubur, E., IsHak, W., & Danovitch, I. (2019). Virtual reality for management of pain in hospitalized patients: A randomized comparative effectiveness trial. *PLOS ONE*, *14*(8), e0219115. https://doi.org/10.1371/journal.pone.0219115

Tashjian, V. C., Mosadeghi, S., Howard, A. R., Lopez, M., Dupuy, T., Reid, M., & Rosen, B. (2017). Virtual reality for management of pain in hospitalized patients: results of a controlled trial. *JMIR mental health*, *4*(1), e9.

Tidwell, L. C., & Walther, J. B. (2002). Computer-mediated communication effects on disclosure, impressions, and interpersonal evaluations: Getting to know one another a bit at a time. *Human communication research*, *28*(3), 317-348.

Triberti, S., Repetto, C., & Riva, G. (2014). Psychological factors influencing the effectiveness of virtual reality–based analgesia: A systematic review. *Cyberpsychology, Behavior, and Social Networking*, *17*(6), 335-345. https://doi.org/10.1089/cyber.2014.0054

Turk, D. C., & Flor, H. (1999). Chronic pain: A biobehavioral perspective. In R. J. Gatchel & D. C. Turk (Eds), *Psychosocial factors in pain: Critical Perspectives* (pp. 18-34). New York, NY: The Guilford Press. U.S. Department of Health and Human Services Code of Federal Regulations, Protection of Human Subjects, 45 CFR 46.102 (2009)

Walsh, T. D. (1984). Oral morphine in chronic cancer pain. *Pain*, *18*(1), 1-11. https://doi.org/10.1016/0304-3959(84)90121-0

Warth, M., Kessler, J., Koenig, J., Wormit, A. F., Hillecke, T. K., & Bardenheuer, H. J. (2014). Music therapy to promote psychological and physiological relaxation in palliative care patients: protocol of a randomized controlled trial. *BMC Palliative Care*, *13*(1), 60. https://doi.org/10.1186/1472-684x-13-60

Westerhoff D. M. (2017). End-of-life care. *Canadian family physician Medecin de famille canadien*, *63*(5), 351–352.

Wiederhold, B. K., Gao, K., Sulea, C., & Wiederhold, M. D. (2014). Virtual reality as a distraction technique in chronic pain patients. *Cyberpsychology, Behavior, and Social Networking*, *17*(6), 346-352. https://doi.org/10.1089/cyber.2014.0207

Wiederhold, B. K., Soomro, A., Riva, G., & Wiederhold, M. D. (2014). Future directions: Advances and implications of virtual environments designed for pain management. *Cyberpsychology, Behavior, and Social Networking*, 17(6), 414-422. https://doi.org/10.1089/cyber.2014.0197

Wiffen, P. J., Wee, B., & Moore, R. A. (2016). Oral morphine for cancer pain. *Cochrane Database of Systematic Reviews*, (4).

Winiarczyk, K., & Knetki-Wróblewska, M. (2016). Breakthrough pain in cancer patients. *Oncology in Clinical Practice*, *12*(1), 1-7.

Zeppetella, G., Davies, A., Eijgelshoven, I., & Jansen, J. P. (2014). A network meta-analysis of the efficacy of opioid analgesics for the management of breakthrough cancer pain episodes. *Journal of pain and symptom management*, *47*(4), 772-785.

Zhang, B., Nilsson, M. E., & Prigerson, H. G. (2012). Factors important to patients' quality of life at the end of life. *Archives of internal medicine*, *172*(15), 1133-1142.