THE EFFECTS OF SOOTHING MUSIC
ON NOISE INDUCED ANNOYANCE
IN ADULT INTENSIVE CARE UNIT PATIENTS

BY

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A Thesis/Practicum submitted to the Faculty of Graduate Studies of The University of Manitoba in partial fulfillment of the requirements of the degree

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DEDICATION

To my husband William Edward (Ted)
and my children Graham Andrew and Victoria Elizabeth
for their patience, understanding and sacrifices

To my father Robert Gordon Groff
who taught me determination and perseverance
and
my mother Mary Victoria Frances Groff
in whose footsteps I followed to become a nurse

To Donna and William Moorby
for their support and encouragement

and
To my Grandmother Victoria Ellen Lusty
whose fingers literally flew across the piano keys

ABSTRACT

Environmental noise in the Intensive Care Unit (ICU) setting is well documented as a variable that affects the physiologic and psychologic heath of patients. The ICU patient who is not able to escape from, or control the source, duration or intensity of the noise is placed at risk by the very environment that is meant to be therapeutic.

A convenience sample of 36 adult patients admitted to an ICU was used to determine if listening to 20 minutes of soothing music would significantly decrease noise induced annoyance as measured by a Visual Analogue Scale and a modification of Baker's Annoyance to ICU Noise Index. Sixteen females and 20 males with a mean age of 61.3 years (range 33-84 years) served as their own controls. A quasi-experimental design was used where participants completed the Visual Analogue Scale and a modification of Baker's Annoyance to ICU Noise Index following a 20 minute control interval and again after listening to 20 minutes of soothing classical or contemporary music. Sound levels were documented during both control and intervention phases.

A statistically significant decrease was noted in Visual Analogue Scale scores ($p<.0001$) and modified Baker's Annoyance to ICU Noise Index scores ($p<.0001$) following the intervention. A simple linear regression analysis revealed a high correlation (Rsq = .836, $p<.0001$) and moderately high correlation (Rsq = .733, $p<.0001$) between the intervention and the outcomes for the Visual Analogue Scale and modified Baker's Annoyance to ICU Noise Index respectively. There was no significant difference in sound levels between the control and intervention intervals.

The results of this study demonstrated that listening to 20 minutes of soothing music reduced noise induce annoyance in adult Intensive Care Unit patients but generalizability to wider Intensive Care Unit populations is limited to gender only.

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CHAPTER I

PURPOSE OF THE RESEARCH

Environmental noise in the Intensive Care Unit (ICU) setting is well documented as a variable that affects the psychologic and physiologic health of patients. While a certain amount of sound is inherent to the ICU setting, the presence of high sound levels may further jeopardize the health of the already compromised critically ill patient. Reduction of noise stimuli is important for the enhancement of ICU patient well-being.

The purpose of this study is to investigate the use of soothing music as a nursing intervention to reduce noise induced annoyance in ICU patients. The literature provides many suggestions to reduce noise levels in ICUs, however, many of the strategies cited in the literature are anecdotal in nature. Most of the studies that employed music as a noise reducing intervention were not specific to the adult Intensive Care Unit patient population. The majority of studies that utilized music as a therapeutic intervention examined variables other than annoyance. Only one study was located that used music as an intervention for noise induced annoyance in adult ICU patient populations. The limited number of studies specifically undertaken to investigate the use of music as an intervention to reduce noise induced annoyance in adult ICU patient populations indicates a need for further research in this area. The research question that guided this study was: will listening to 20 minutes of soothing music significantly decrease noise induced annoyance of adult Intensive Care patients as measured by changes on the visual analogue scale and a modified version of Baker's Annoyance to ICU Noise Index ?

STATEMENT OF THE PROBLEM

Patients admitted to the ICU encounter many stressors. Most commonly, physiologic and psychologic stressors are directly related to the critical nature of the patient's illness, but often, these stressors can be attributed to the critical care environment itself (Gast & Baker, 1989; Hansell, 1984; Hoffman, Donker & Hauser, 1990; Kenner, Guzzetta & Dossey, 1985; Thelan, Davie & Urden, 1990). Thelan et al. (1990) describe the critical care environment as one where an intense amount of alien unpleasant stimuli continually assault the five senses. They further assert that the greatest source of sensory stimulation is environmental noise.

Florence Nightingale is credited with delineating the domain of nursing as the nurse, the patient, the environment, and health. Historically, environmental factors were a prime focus for Nightingale; attention to controlling the environment continues well into the twentieth century (Newman, 1983). Nightingale charges the nurse to maintain "the proper use of .....quiet.... at the least expense of vital power to ensure the success of Nature's reparative process" (Nightingale, 1992 [1859], p. 6). When quiet is unattainable, nurses must intervene to modify the sounds that interfere with ICU patient well-being.

The presence of sound does not necessarily indicate the presence of noise. Noise is a common term that, while used in everyday language, possesses a variety of meanings. The term noise may be used as a noun, verb or adjective. When altered slightly by the addition of a suffix, the term noise may be changed into an adverb as well as an adjective. Noise is synonymous with the terms sound, cry, din, babble, racket, uproar, clamor, outcry, tumult, hubbub, bedlam, commotion, rumpus, and clatter (Webster, 1993).

As a noun, noise has three general meanings (Webster, 1973). The more common meaning is the description of noise as a loud, confused or senseless shouting or outcry. The second meaning refers to noise as sound, but is based on its qualities. Noise is described as a sound that lacks agreeable musical quality or is noticeably unpleasant; any sound that is undesired or interferes with one's hearing of something; an unwanted signal or a disturbance in an electronic communication system, or a disturbance interfering with the operation of a mechanical device or system; electromagnetic radiation that is composed of several frequencies and that involves random changes in frequency or amplitude; or, irrelevant or meaningless bits or words occurring along with desired information. The final meaning is less common, that being common talk, rumor or gossip. When used as a verb, noise means to make a noise or, to spread by rumor or report.

Social psychologists Glass and Singer (1972) define noise as any sound that is physiologically arousing and harmful, subjectively annoying, or disruptive to performance. Definitions in the nursing literature include: any unwanted sound (Griffin, 1992; Williams, 1989); an unwanted sound usually described subjectively as being unpleasant, harsh or discordant (Sommargren, 1995); an unwanted signal or disturbance (Hansell, 1984); sound levels above those recommended for hospitals and perceived by patients as undesirable (Hilton, 1985); and, a subjective experience of sound that is unpleasant or intolerable that can be characterized as an unwanted undesirable sound without agreeable musical quality (Williams & Murphy, 1991). The City of Winnipeg (1995) defines noise as any loud or bothersome sound whatsoever that is deemed to be annoying or disturbing and that endangers the comfort, repose, peace, safety or health of the person. As demonstrated in the definitions in the "common language dictionary", literature and legislative references, noise has both physical properties and signal properties.

Many sources in the literature define noise in relation to its physical properties. The properties of intensity or loudness, frequency or pitch, and reverberation time or duration have been used as descriptors of noise by researchers in the areas of nursing, respiratory therapy, and social psychology. The physical properties are of significance to acoustic/electronic engineers, musicians and government legislators as well.

The loudness or intensity of noise is measured in decibels on a logarithmic scale expressing a ratio between a particular sound pressure to a reference level of 0 decibel (dB). Mathematically (Pierce, 1992; Soutar & Wilson, 1986) a decibel is described as:

$$1 \text{ dB} = 20 \times \log_{10} \frac{\text{measured air pressure (Pa)}}{20 \ \mu\text{Pa (smallest air pressure perceived by 50\% of adults)}}$$

The A-weighted decibel characteristic responds primarily to frequencies in the 500-10,000 herz (Hz) range which is the area of greatest sensitivity of the human ear.

Loudness is the criteria used to differentiate between sound and noise (Baker, 1992; Mishoe, Worth-Brooks, Dennison, Hill & Frey, 1995). Subjectively, an increase of 10 dB makes a sound twice as loud. A sound of 90 dBA is ten times stronger than a sound of 80 dBA and a sound of 100 dBA is 100 times stronger than 80 dBA (McCarthy, Ouimet & Daun, 1991; Mishoe, et al., 1995; Pierce, 1992; Soutar & Wilson, 1986). Gast and Baker (1989) categorize sounds less than 55 dBA as quiet, and sounds greater than 55 dBA as noise.

The American Environmental Protection Agency (EPA) recommends guidelines for noise levels in hospitals, these being 35 dBA at night and 45 dBA during the day (EPA, 1974). Reference is made to the American Environmental Protection Agency guidelines for noise levels in hospitals throughout the nursing literature (Gast & Baker, 1989; Griffin, 1992; Hilton, 1985; McCarthy et al., 1991; Sommargren, 1995; Soutar and Wilson, 1986; Spies Pope, 1995; Topf, 1994, 1984; Topf & Davis, 1993; Topf & Dillon, 1988; Webster & Thompson, 1986). Hilton's (1985) definition refers specifically to the EPA guidelines . The Province of Manitoba Workplace Safety and Health Act (1988) equates noise with sound, but then goes on to discuss the sound levels where hearing conservation equipment is recommended or required. Those levels are 80 and 85 dBA respectively.

Frequency or pitch is the second physical property of noise that is referred to extensively in the literature. Sound waves are fluctuations in air pressure that can be traced as sinusoidal waves using a cathode-ray oscilloscope. The number of peaks or cycles per second is the frequency measured in Herz (Hz). Sounds with a low frequency have a lower pitch whereas sounds with a higher frequency have a higher pitch (Pierce, 1992). The human ear is sensitive to a frequency range of 20 - 20,000 Hz (Mishoe et al., 1995). Frequency, as noted in the nursing literature (Baker, 1993; Gast and Baker, 1989; Griffin, 1992; Sommargren, 1995) and social psychology literature (Cohen and Weinstein, 1982) determines the noisiness of a sound. Examples of high frequency sounds of equipment and monitoring alarms are provided in the critical care nursing and respiratory therapy literature and include cardiac monitor alarms, ventilator alarms and oxygen flowing (Mishoe et al., 1995; Woods & Falk, 1974).

Reverberation refers to the number of times that sound waves reflect off surfaces, or the length of time that the sound waves remain in the atmosphere. Acoustically, it is defined as the time it takes a sound to decrease to 60 dB below its initial intensity (Pierce, 1992). Pierce (1992) states that to a musician, sound absorbing walls in a concert hall decrease the reverberation time and diminish the richness of the sound. Conversely, prolonged reverberation time takes on an echo like quality that increases the perception of loudness to a patient in a barren room or incubator (Gast & Baker, 1989; Griffin, 1992; Mishoe et al., 1995; Williams, 1989) or a downtown city dweller (Cohen & Weinstein, 1982).

Although the physical properties of sound determine the quantitative determinants of noise, the signal properties or qualitative aspects of sound were referred to in the literature and legislation. Individuals perceive and interpret sound stimuli differently and it is the context within which the sound occurs and the meaning attached to the sound that determines whether it is considered noise.

The context within which the sound occurs received considerable discussion in the nursing and social psychology literature (Baker, 1993; 1992; Williams,1989). Topf (1994) discusses the person-environment compatibility as opposed to incongruence, and both Parker (1995) and Simpson-Wilson (1987) comment on the importance of the situation that persons find themselves in when the sound occurs. A number of authors (Gast & Baker, 1989; Hansell, 1984; Topf, 1994; 1992; 1988; Topf & Dillon, 1988) argue that the ability to escape from or control the sound source impacts upon the subjective noisiness of the sound. According to Williams (1989), ownership of the sound determines whether it is considered noise.

The information contained in or relayed by the sound is a determinant of its noisiness (Gast & Baker, 1989). This idea is shared by other nursing and social psychology researchers as well as legislators. Sounds may be interpreted as a threat or signal of impending harm to the individual (City of Winnipeg; 1995; McCarthy et al., 1991; Meredith & Edworthy, 1995; Simpson-Wilson, 1987). Sound, particularly that which is divorced of meaning, such as the sounds emitted from the ICU environment are considered noise to many patients (Spencely 1993; Webster & Thompson, 1986).

Not all sound should be construed as negative. Sounds from alarms in the ICU environment are a signal for action to the critical care nurse, alerting the nurse to a potential or actual problem and giving rise to an appropriate therapeutic intervention (Topf, 1988). Social psychologists Glass and Singer (1972) and musician Pierce (1992) provide the example of white noise such as the hum of an air conditioner or synthetic noise to demonstrate that some sounds are used to mask unwanted sounds.

The most common descriptor of noise identified in the literature is "unwanted", indicating that the sound is undesired, annoying, or a nuisance. Topf's

(1994, 1984) assertions that noise is an aversive stimulus implies that it is a noxious sound. The activity in which the person is engaged in at time of noise determines the level of unwantedness (Glass & Singer, 1972; Hansell, 1984). Glass and Singer (1972) state that noise is the most impertinent of all interruptions. The unwantedness attribute used to define noise is cited in a number of sources (Baker, 1992; Cohen & Weinstein, 1982; Griffin, 1992; Hansell, 1984; Hilton, 1985; Hoffman et al, 1978; Sommargren, 1995; Webster, 1973; Williams, 1989; Williams & Murphy,1991). Minckley (1968) supports the unwantedness factor by implying that noise distracts from the therapeutic purpose of the environment. The descriptor of noise as an annoyance or nuisance factor cited throughout the literature and legislation supports the notion that one attribute of noise is that it is an unwanted sound (Baker, 1993; City of Winnipeg, 1995; Cohen & Weinstein, 1982; Glass & Singer, 1972; Sommargren, 1995; Williams, 1989; Woods & Falk, 1974) .

Common characteristics of noise noted in the literature include: sound, unwantedness due to a lack of contextual congruence, and unwantedness perceived as or an actual threat to the well being of the individual. Sound refers to the physical properties, specifically intensity, frequency and reverberation. Unwantedness is a reflection of the signal properties or meaning of the sound to the individual. The context within which the sound occurs is a determining factor in the unwantedness attribute. Perception of or actual threat to the integrity of the individual aids in differentiating sound stimuli from noise.

Two antecedents are necessary for noise to occur. First, there must be a sound source. Noise cannot occur unless vibration from an object creates sound waves (Pierce, 1992; Sommargren, 1995). Second, there must be an intact sensoneural auditory system. The individual must have the ability to hear the sound that has been produced (Sommargren, 1995).

The consequences of noise are three-fold and include a negative alteration in physical, psychological and/or cognitive well-being. The physical impact of noise is directly related to the physical properties discussed previously and referred to in the nursing, respiratory and acoustic medicine journals as well as legislation. The physiologic impact of noise is due to the startle stimulation of the autonomic nervous system that regulates the stress response in humans (Baker, 1992; Hansell, 1984; Kryter, 1972; Sommargren, 1995; Williams, 1989). Autonomic stimulation may occur due to continuous noise to which some of the stress responses do not habituate. The literature supports a causal relationship between noise and disruption of restful restorative sleep (Evans & French, 1995; Parker, 1995; Soutar & Wilson, 1986; Topf, 1992; Topf & Davis, 1993; Webster & Thompson, 1986). Disruption of the sleep cycle due to noise also effects levels of cortisol and growth hormone required for wound repair (McCarthy et al, 1991).

The impact of noise on hearing acuity is well documented in the legislation and nursing, respiratory, and acoustic medicine literature. Sections 5 and 6 of the Workplace Safety and Health Act (R1988) require hearing conservation equipment for workers exposed to sound levels greater than 85 dBA. Mishoe et al. (1995) found that neonates were exposed to uncomfortable or unsafe levels of sound emanating from respiratory equipment used in and around incubators.

The psychological consequences of noise are related to both physical and signal properties. The study conducted by Gast and Baker (1989) demonstrates a causal relationship between noise and anxiety. Glass and Singer (1972) and Kryter (1972) discuss the prevalence of mental disorders associated with prolonged exposure to air traffic noise. They further assert that noise elicits distress or anger causing people to "fly off the handle". Additional support for the emotional impact of noise on humans is discussed by Hansell (1984) who reports that persons in closely confined quarters displayed more aggressive behavior when noise was introduced than when the room was quiet.

Cognitive impairment due to noise has been studied by Glass and Singer (1972) who state specifically that randomly varying noises and intensities produce greater impairment on mental tasks than does steady state noise. Impairment of performance or task function due to noise exposure was found by Hansell (1984), Kryter (1972), and Weinstein (1978) who researched college dormitory residents. Numerous studies have linked noise or sensory overload to the syndrome of ICU psychosis (Evans & French, 1995; Griffin, 1992; Hansell, 1984; Hutton & Rea, 1994; Simpson-Wilson, 1987).

All patients are unique in how they perceive, interpret and respond to sounds. Some patients seem to be oblivious to environmental sounds and therefore noise elicits no reaction; others may react negatively. Negative reaction to noise ranges from minor irritation to annoyance and finally to extreme anxiety or psychosis. It is well known that psychologic stress, even that which is seemingly minor, can exacerbate physiologic problems in the already compromised critically ill patient (Barry, Selwyn & Nabel, 1988; Gast & Baker, 1989; Hansell, 1984; Helton, Gordon and Nunner, 1980; Hoffman et al., 1978; McCarthy et al., 1991; Webster & Thompson, 1986). Reduction of noise stimulation in the ICU seems important if the physiologic and psychologic well-being of the patients is to be optimized.

A certain amount of noise is inherent to the ICU setting. Although it is recognized that reduction of noise stimulation is important to enhance the physiologic and psychologic well-being of the patients in the Intensive Care setting, nurses are limited in the interventions that they may employ to reduce noise induced annoyance. Strategies that have been used include the use of earplugs and/or the administration of anxiolytics. It is the experience of this writer that patients often decline the use of earplugs, finding them intrusive, uncomfortable or ill fitting. Anxiolytics may induce relaxation but do not reduce sensory input. Furthermore, the use of anxiolytics is contraindicated for some patients particularly those with respiratory or central nervous system depression, and may cause adverse reactions in others.

Increasing staff awareness of the noisiness of the ICU may reduce noise levels but it is not known whether the reduction would be long lasting. Decreasing the volume of alarms has been suggested as a method to reduce noise emanating from health care equipment but nursing staff are generally reluctant to do so due to the risk of not hearing an alarm. Furthermore, many of the alarms do not have a mechanism to control the volume.

The ideal method to reduce noise involves the redesign of existing ICUs, including the addition of acoustic tiling, carpeted floors, use of non-reverberant surfaces, private rooms and sound proof barriers. In this current health care climate of budget reduction, the renovation of ICUs is not considered a fiscal priority.

None of the aforementioned interventions are ideal or financially feasible when addressing the phenomenon of noise induced annoyance in ICU patients. The ICU patient, unable to control the source of the noise or escape from the noisy environment, is being placed at risk by the same environment that is meant to be therapeutic. An alternative method to reduce noise induced annoyance must be examined. This method needs to be acceptable to the patient, easy and practical for staff to implement, and financially responsible and achievable.

CONCEPTUAL FRAMEWORK

Martha Rogers' Science of Unitary Human Beings has been chosen to guide this researcher's study. A brief overview of Rogers' theory will be followed by a description of the application of the framework to the research question, assumptions underlying the research problem and generation of the hypothesis statement.

In Martha E. Rogers' (1994) Science of Unitary Human Beings, the unitary human being is the center of focus, with human beings and their environment viewed as irreducible, pan-dimensional energy fields which are integral with one another. Each environmental field is specific to its given human field. Figure 1 in Appendix A (page 103) provides a schemata of Rogers' Science of Unitary Human Beings.

Energy fields are identified by their pattern and organization. Each human field pattern is unique and is integral with its own environmental field. Pattern is the distinguishing characteristic of the field and is perceived as an ever changing single wave. Although patterns cannot be directly observed, manifestations of the pattern are observable. Manifestations of pattern refer to the behaviors, qualities and characteristics of the field. Clusters of pattern manifestation are referred to as pattern profiles. Rogers' conceptual system is concerned with those patterns of the human and environmental energy fields that are associated with maximum well being.

Cowling (1990) suggests that since energy fields are identified by pattern and pattern cannot be perceived directly, manifestations of field pattern are important assessment devices in nursing practice. Assessment of the human field pattern encompasses the environmental field assessment as the two cannot be separated.

Barrett (1990 a) proposes two phases for nursing practice: pattern manifestation appraisal and deliberative mutual patterning. Appraisal of pattern manifestation focuses on identifying manifestations of the human and environmental fields that relate to current health events. Deliberative mutual patterning is the continuous process whereby the nurse with the client patterns the environmental field to promote harmony related to the health events.

Rogers (1986) has proposed three principles of homeodynamics derived from the conceptual systems that help to describe, explain and predict the nature of human and environmental change. These principles are stated as:

> Principle of Resonancy: The continuous change from lower to higher frequency wave patterns in human and environmental fields.
>
> Principle of Helicy: The continuous, innovative. probabilistic, increasing diversity of human and environmental field patterns characterized by non-repeating rhythmicities.
>
> Principle of Integrality: The continuous, mutual human field and environmental field process.

Validity of the principle of integrality will be tested by examining the nature of change in field pattern manifestations.

Application of the Conceptual Framework to the Clinical Area

Barrett (1990b) asserts that practice modalities based on motion, sound and light are especially useful in Rogerian practice. The purpose of healing in Rogerian science is to tune into that basic harmony of a specific human experience relative to a larger contextual pattern of environmental change. Healing is motion and the intent of health is to facilitate motion toward harmony of the human and environmental fields. It is proposed that altering the pattern of the environmental energy field through the use of soothing music will, due to its integral nature, alter the human energy field pattern thereby actualizing the potential for well being and promoting integrality. Refer to Figure 2 in Appendix B (page 104) for a schemata of the concept interaction.

STUDY HYPOTHESIS

In the context of Unitary Human Beings, it can be postulated that the ICU patient and the ICU are not separate entities, but energy fields that are in constant interaction with one another. These energy fields have unique patterns. It can be deduced that sound in the ICU environment energy field displays a pattern manifestation of noise, and annoyance is the human field pattern manifestation of the ICU noise related to the human-environment field interaction. A testable theorem deriving from this proposition is that alteration of the environmental energy field pattern through the use of soothing music will alter the human energy field pattern manifestation of annoyance. The effect of ICU noise on annoyance can be measured using a Visual Analogue Scale and an adaptation of Baker's Annoyance to ICU Noise Index (Gast and Baker, 1989). The Visual Analogue Scale and the modified Annoyance to ICU Noise Index can provide a measure of the efficacy of music as a mutual deliberative pattern alteration and the modified Annoyance to ICU Noise Index can provide a descriptor of the efficacy of music as mutual deliberative pattern alteration. The hypothesis for this study is:

> Twenty minutes of soothing music will significantly reduce noise induced annoyance of adult ICU patients as measured by a Visual Analogue Scale and Baker's Annoyance to ICU Noise Index (modified).

ASSUMPTIONS

The following assumptions underlie this study:

1. The ICU patient and the ICU are energy fields that are in continual mutual process.

2. Human field pattern is appraised through manifestations of the pattern in the form of experience, perception and expression.

3. Noise is an environmental field pattern manifestation of the ICU.

4. Annoyance is the human field pattern manifestation of the ICU related to the human-environmental field interaction.

5. Soothing music is a mutual deliberative environmental field pattern alteration.

6. Alteration of the environmental field pattern by virtue of mutual process, alters the human field pattern, validating the homeostatic principle of integrality.

The strengths of assumptions 3, 4, 5, and 6 are examined in this study.

DEFINITION OF TERMS

According to Polit and Hungler (1991) the variable to be studied must be clearly defined to specify the operations that the researcher must perform to collect the required information. Several theoretical and operational definitions of the variables are presented.

Soothing Music: a twenty minute audio tape of music that contains duple (double) or slow tempo triple rhythm between 60-80 beats per minute, predictive dynamics, harmonic consonance, recognizable timbre or tone and is nonlyrical (Chenoweth, 1972; Schuberg, 1981). Refer to Appendix C (page 105) for list of music selections.

Noise: Any sound which, in its present context, is perceived as unwanted and a threat to the physical, psychological or cognitive integrity of the individual. Operationally noise is defined as any sound that exceeds 50dB(A) on the Radio Shack Sound Level Meter 33-2055.

Annoyance to Intensive Care Unit Noise: the state of being or feeling disturbed or irritated by intermittent, repeated or sustained noise within the ICU environment. Operationally, annoyance to intensive care unit noise is defined as a self report measurement of participants perceived annoyance as measured with a 100 mm vertical Visual Analogue Scale and Baker's Annoyance to ICU Noise Index (modified).

Adult Intensive Care Unit Patient: a person who has attained the age of legal majority and is being cared for in the ICU setting. Operationally, this is defined as a person who is at least 18 years of age who has been admitted to the ICU, and consents to participate in the study.

SUMMARY

Patients admitted to ICUs encounter many stressors. Noise in the ICU environment is considered a stressor that manifests itself in psychologic and physiologic responses that may compromise the critically ill patient. ICU patients are neither able to escape from the noise nor control the source, intensity or duration of those sounds. Reduction of noise stimulation in the ICU is necessary to enhance the psychologic and physiologic well-being of critically ill patients.

ICU nurses are limited in their resources to reduce noise. Interventions which are acceptable and comfortable for the patient, easy to implement for the staff and financially affordable to the hospital are important to identify. Furthermore, many patients listen to personal tape or compact disc players during their stay in the ICU, yet only one study has been located that supports the effectiveness of this intervention. The purpose of this research is to determine whether listening to soothing music is an effective intervention for reducing noise induced annoyance in adult ICU patients.

CHAPTER II

LITERATURE REVIEW

The purpose of the literature search, according to Polit and Hungler (1991), is to orient the researcher and the reader to the body of knowledge that exists relative to the problem of interest. A search of the literature related to this study was conducted using computer indices such as Cumulative Index to Nursing and Allied Health Literature (CINAHL), Comprehensive Medline, and the Canadian Directory of Completed Masters Theses in Nursing (CAMN). An extensive manual search supplemented the computer search. Noise, noise pollution, sound, auditory stimulation, hospital environment, critical care/ intensive care/ coronary care environment, annoyance, and music therapy were the major descriptors used in the search.

Noise, an aversive sound stimulus, and the negative impact that noise has on human functioning have been studied extensively. Environmental noise has been measured in areas of high aircraft and automobile traffic, workplaces, entertainment venues, and hospitals, to name but a few. Much of this research has measured sound intensity or loudness as it relates to hearing conservation. Psychologic and other physiologic variables have been examined as well. Although numerous methods to reduce noise levels are discussed in the literature, Byers and Smyth (1997) and Pierce (1992) suggest masking an unwanted noxious sound with a more aesthetically pleasing sound such as music is an effective noise reduction strategy. Masking, according to Heddon (1980), occurs when two or more stimuli are present and when the frequency and/or intensity of one stimulus is of sufficient magnitude that an individual is not able to perceive that a second stimulus is present. It is postulated that soothing music may be used as a perceptual masking technique.

Two schools of music therapy are practiced in the hospital setting. "One school seeks to achieve a therapeutic effect by involving the client in communicative music making; the other seeks to achieve its effect by listening to vibrational sound" (Guzzettta, 1988, p. 266). Both schools have been fertile ground for research but it is the latter school of music therapy which is of interest to this writer. Within this subgroup of music therapy, a plethora of studies exist related to the use of music in a variety of heath care settings such as dental offices, birthing suites, pre-operative holding areas, operative suites, waiting rooms, critical/coronary care units, oncology units, palliative care units, geriatric care, and rehabilitative facilities.

The nursing and allied health literature abounds with studies relating to the various aspects of noise, its negative impact on humans, and the therapeutic use of music. As a result, criteria were selected to limit the scope of the literature review. Studies included in the review had to be related to the measurement of noise, the human psychologic and/or physiologic response to noise, and music therapy but were limited to the adult population in the acute care setting. In addition, studies had to be written in the English language. Exceptions to the selection criteria were made if a study enhanced understanding of the variables under examination (Mishoe, et al., 1995).

Studies located were subjected to a rigorous critique based on criteria defined by Polit and Hungler (1991, pp. 583-596) and Wilson (1987, pp. 283-305). Limitations of the studies retrieved included: use of laboratory setting or healthy individuals; small sample size; non-probability sampling; lack of power analysis, instrumentation accuracy and reliability testing, content validity for newly developed questionnaires, or true control group; and inter-rater reliability not reported in studies using more than one investigator or data collector. Internal and external validity of some of the studies were weakened as a result of these deficiencies.

Noise in the Critical Care Environment

Florence Nightingale is credited with delineating the domain of nursing as the nurse, the patient, the environment, and health. Historically, environmental factors were a prime focus for Nightingale, but attention to controlling the environment continues well into the twentieth century (Newman, 1983).

The environment of the hospital is described as the physical structure, objects and conditions that surround the patient and, according to Williams (1989), is comprised of the building and internal structures, space, light, sound, color, temperature, and atmospheric conditions. Rogers (1986) asserts that the environment and person are an inseparable unit. When faced with illness, injury or surgical intervention, the patient is thrust into this unfamiliar, often threatening environment.

When illness, injury or surgical intervention is of a critical or life threatening nature, the patient is admitted to the Intensive, Coronary or Critical Care Unit. " The critical care unit is a highly technological and specifically designated area within a hospital that is established for the care of critically ill patients" (Canadian Association of Critical Care Nurses, 1992, p. 4). Thelan et al. (1990) describe the critical care environment as one where an intense amount of alien and unpleasant stimuli continually assault the five senses.

Noise Levels in the Critical Care Environment

A number of researchers have asserted that the greatest source of sensory stimulation is environmental noise (Hutton & Rea, 1994; Spencely, 1994; Thelan et al., 1990; Zimmerman, Pierson & Marker, 1988).Currently, no standard exists for noise levels in Canadian hospitals but the internationally recognized American Environmental Protection Agency (1974) recommends that sound levels in hospitals not exceed 45 dB(A) during the day shift and 35 dB(A) during the night shift. The critical care environment has improved over the last two decades in response to research demonstrating the stressful nature of the environment. New and/or renovated ICUs are now designed with private or semi-private rooms rather than as an open concept or dormitory style. Incorporated into the design are acoustic tiling, less reverberant surfaces, sound barriers around high noise areas, and carpeting in high traffic areas. Unfortunately, recent studies continue to indicate that the patient is still bombarded with a multitude of environmental stresses while in the critical care unit (Spenceley, 1994).

Although sound levels above 45 dBA are considered noise, a number of studies demonstrated that ICU sound levels greatly exceed that level. The landmark study conducted by Woods and Falk (1974) assessed the intensity of noise stimuli from various sources in an open concept combined seven bed acute care unit and seventeen bed recovery room. Random interval sampling on noise levels over one to two hours were obtained between 0700 hours and 2100 hours. Using a Bruel and Kjaer Precision sound level meter type 2203 adjusted to the A weighted decibel scale with the microphone suspended from the ceiling in the center of the unit, mean background sound levels ranged from 55.4 - 55.6 dB(A) during the day shift, 56.8 - 60.8 dB(A) for the evening shift, and 53.4 - 59.3 dB(A) for the night shift. Impulse sounds greater than 70 dB(A) occurred on an average of once every nine minutes. Kendal's tau computation revealed a positive relationship between noise levels, number of patients and number of staff in the unit. These results support Minckley's (1968) earlier findings that reported recovery room sounds ranging between 60 - 70 dB with the lowest sound levels falling between 40-50 dB.

Support for the Wood and Falk (1974) findings is found in more recent studies conducted by Baker (1992), Gast and Baker (1989) and Topf (1992). Topf (1992) measured night shift (2230 - 0450 hours) noise levels over two nights using a Bruel and Kjaer 2230 sound level meter placed above patients' beds in an eight bed open concept design Cardiac Surgery Intensive Care Unit. Noise levels ranged between 50 - 86.8 dB(A). Minimum sound levels for both nights were 50 and 50.1 dB(A), maximum sound levels 86.8 and 86 dB(A), with averages being 56.3 and 56.1 dB(A) respectively. Similar results were found in Moorby's (1992) unpublished pilot study which revealed that ICU noise levels obtained during four separate 20 minute measurement time period ranged from 58 dB(A) to 78 dB(A) in an open concept ICU.

While unit design, open concept opposed to private room, appears to reduce noise levels, studies reveal that the sound levels of 45 dB(A) for day shift and 35 dB(A) for the night shift recommended by the Environmental Protection Agency (1974) are still exceeded. Gast and Baker (1989) measured noise levels in conjunction with anxiety and annoyance scores in an 18 bed, private room Coronary Care Unit. Sound levels were measured above each patient's bed using a Bruel and Kjaer 2203 sound level meter. Specific sound levels for background and impulse sounds were not described, but the mean sound levels were 50.0 - 58.9 dB(A) for what the staff nurses considered to be a noisy hour and 46.7 - 57.2 dB(A) for what was considered a quiet hour. Differences between the noisy and quiet hours were considered statistically significant ($t = 6.47$, $p < 0.0001$).

Similar results were found in Baker's (1992) study that examined the effects of noise level on the heart rate of 28 patients in a 14 bed, private room design, Surgical Intensive Care Unit. Sound levels were measured three feet above the patient's bed using a General Radio 1933 precision sound level meter. The mean sound level during the six hour data collection period was 60.5 - 62.3 dB(A) with the loudest hour corresponding with shift change. It was noted that 50% of the subjects were exposed to mean sound levels of 65-69 dB(A).

Sources of Sound

Research reveals that patients are subjected to a barrage of auditory stimuli of varying intensity, frequency and duration that exceeds the Environmental Protection Agency's recommended standards of 45 dB(A) for the day shift and 35dB(A) for the night shift. This auditory stimulation is classified as either continuous or impulse/intermittent sound and arises from an assortment of sources.

The technological advances in the critical care area unfortunately bring with them an increase in noise due to normal mechanical equipment operation and alarm systems. Cardiac monitoring alarms were measured at 60-61 dB(A), and, operation of an MA- 1 ventilator was 61-62 dB(A) with its alarm registering 66 dB(A) (Woods & Falk, 1974). An intravenous infusion pump alarm generated sound levels of 61 dB (Mishoe, 1995).

Even the seemingly innocuous types of equipment used in ICUs can create unacceptable sound levels. Woods & Falk (1974) measured an oxygen outlet and a wall suction outlet running at 48-50 dB(A) and 66-68 dB(A) respectively. Mishoe, et al. (1995) in their comparison of sound levels produced by nebulizers and humidifiers found that nebulizers and humidifiers used with oxygen hoods in the Neonatal Intensive Care Unit had mean sound levels of 62 d (B) and 43 d(B) respectively. Sound levels were significantly increased with higher oxygen flow as well as low water levels. Nebulizers and humidifiers are used extensively in the adult ICU patient population although not within the reverberant confines of an oxygen hood.

The explosion of technology used in the ICU is not the only source of noise. Devices used in the routine care of patients generate impulse sounds. A toilet flushing, water running, and operation of a bed scale measured 74 dB(A) and 68-72 dB(A) respectively (Woods & Falk, 1974). Suctioning a patients created noise between 66-68 dB(A) (Minckley, 1968).

The relatively close proximity of patients to each other and the nursing work stations greatly contributes to the intensity and frequency and duration of sounds. People-generated noise seems to be the highest with Baker (1992) reporting the loudest time period (62.4 dBA) when staff changed shifts and exchanged verbal report. Conversely, the quietest hour (60.5 dBA) occurred when visitors and physicians had left for the day. The loudest people-generated sounds occurred when nurses were encouraging patients to deep breath and cough, and achieving the cough which both registered 70 dB(A), and patients crying out which measured 80 dB(A) (Woods & Falk, 1974).

Impact of Noise on Patients

"Unnecessary noise, or noise that creates an expectation in the mind, is that which hurts a patient. It is rarely the loudness of the noise, the effect upon the organ of the ear itself, which appears to affect the sick....But intermittent noises, or sudden and sharp noise....affects far more than continuous noise...." (Nightingale, 1859 [1992], p. 25)

Environmental noise and its potential effect on healing and recovery has been a concern from the time of Florence Nightingale through to the present. The impact of increased noise levels on the critically ill patient is compounded by the effects of the critical care experience and the nature of the patient's illness.

Several factors may increase a patient's anxiety and stress in an ICU including the admission process, nature of the illness, environment, and interaction with staff. For those patients admitted with a diagnosis related to cardiac insufficiency, the physiologic risk is greater due to an already compromised myocardium (Leuders Bolwerk, 1990; White 1992). This barrage of sensory input occurs at a time when, according to Hutton and Rea (1994), the patient's physical and emotional resilience are already diminished. It can be well understood why Sommargren (1995) asserts that the ICU environment is a hazard to the health of patients.

The problem of noise is a complex one. The effect of sound on human beings is inextricably bound with the meaning of the sound and depends on the ability to perceive and interpret the source and meaning of the noise (Hansell, 1984; Williams, 1989). Hospital sounds are indeed unfamiliar to most people because they are emitted from devices that are not commonly found in the home or work place.

The response to noise varies not only from person to person.but may vary within the same individual as well. According to Parker (1995), the individual reaction to the noise is related to the noxious aspect of the sound source, the relative pleasure or displeasure the person is experiencing at the onset of the noise, the person's basic anxiety level and the individual's evaluation of their situation at the time the noise occurs. The meaning of the noise may also be altered because of the effects of pain, stress, medication and other physiologic problems.

All persons are unique in how they perceive, interpret and respond to sound. Some patients seem to be oblivious to environmental sounds and therefore noise elicits no reaction; others may react negatively. Negative reactions to noise range from minor irritation, to annoyance, to extreme anxiety or psychosis. A link between noise, sleep deprivation and ICU psychosis has been demonstrated by Helton, et al.(1980) and Hutton and Rea (1994). It is well known that psychological stress, even that which is seemingly minor, can exacerbate physiologic problems in the already compromised critically ill patient. Although these are difficult to separate, physiological and psychologic effects are described in the literature.

Physiologic Variables

The physiologic impact of noise is directly related to stimulation of the autonomic nervous system. The autonomic nervous system regulates the stress responses in humans. In response to noise, humans may elicit a startle reflex that will stimulate the sympathetic nervous system and catecholamine secretion leading to increased heart rate, blood pressure and metabolism (Hansell, 1984; Sommargren, 1995). This increased stress increases the cardiac work load and myocardial oxygen consumption, diminishes cardiac reserve and may lead to coronary insufficiency (McGreevy-Steelman, 1990). Sommargren (1995) further claims that hospital noise, sensory overload, sleep deprivation and increased pain perception are associated with an autonomic stress response. Important to note is Williams' (1989) assertions that certain responses do not appear to habituate or fade away on repeated exposure to noise. These include peripheral vasoconstriction, pupillary dilation, lengthening of the decay time of the galvanic skin response, and brief changes in skeletal muscle tension.

Heart Rate

Sympathetic nervous system stimulation occurs in response to the sudden, often startling aspect of impulse noise. This is referred to as the fight or flight responses. Release of catecholamines, particularly those in the beta and alpha adrenergic family cause an increase in the heart rate, and strength of myocardial contraction. Burke, Walsh, Oehler and Gingras (1995) demonstrated that even the unborn child responds to sound with an increase in heart rate.

Baker's (1992) descriptive one group design studied the effect of different levels and sources of hospital noises on the heart rate of 28 adult Surgical ICU patients. The heart rate was categorized as to whether it increased, decreased or remained the same in response to a 3-67 dBA increase in sound. Eighty-nine percent of the participants demonstrated increases in heart rate ranging from 2-12 beats per minute. Impulse noise was associated with a significant increase in heart rate ($p = 0.006$, $n = 18$). Baker observed that the greatest increase in heart rate occurred during staff talking inside the patients' rooms, followed by non-talking noise, and finally talking outside the room.

Sleep Pattern

The literature supports a correlation between noise and disruption of restful, restorative sleep. Webster and Thompson (1986, p. 450) state that "the auditory awakening threshold depends on the stage of sleep entered and the relevance of the noise to the sleeper". Hospital noise, being foreign to most people, is more likely to awaken a patient than would the same noise intensity in the home.

Soutar and Wilson (1986) measured overnight noise in several hospital wards and assessed the sleep patterns and attitudes of the patients on the morning following the measurements. Even though noise levels exceeded the recommended Environmental Protection Agency parameters, 28 of the 91 patients interviewed slept worse in the hospital and of those 28, only nine stated that it was due to noise.

Sleep efficacy in relation to coronary care unit noise was assessed by Topf (1992) on 108 healthy female volunteers to test an intervention for noise induced sleep disturbance. Night time Coronary Care Unit noises were audio taped and then played to the participants while sequestered in a sleep laboratory. Participants who were randomly assigned to enter the control group were exposed to the coronary care unit noise for one night. Sleep stage and efficacy were assessed using a polysomnograph and post-test questionnaire. Using multiple regression analysis, Topf reported that 19% of the variance in sleep efficiency defined as the time spent sleeping versus time spent in bed, and 38% of the variance in REM sleep was directly related to the objective Coronary Care Unit sounds.

Further study of sleep staging was conducted by Topf and Davis (1993). Seventy healthy female volunteers were randomly assigned to either an audio taped night time Coronary Care Unit noise group or a control group. One night was spent in a sleep laboratory with sleep staging measure by a polysomnograph. Although both groups demonstrated below the normal average for REM sleep, t-test results indicated a significantly poorer REM sleep in the Coronary Care Unit noise group in the first and second half of the night.

Healthy female volunteers were used in the two previously mentioned study, yet it can be assumed that noise is an external Critical Care Unit environmental factor that interrupts sleep. Coronary Care Unit patients, already stressed due to the nature of their illness, may attach different meanings to the sounds heard, perceiving them as a personal threat. Parker (1995) asserts that enhanced sympathetic activity in patients who are stressed will release increased amount of corticosteroids which can lead to catabolism, sleeplessness, and more anxiety.

Wound Repair

In a literature review conducted by McCarthy, et al. (1991), the impact of noise on wound healing was explored. Exposure to increased or novel environmental noises has been shown to elicit neuroendocrine changes indicative of the stress response. These endocrine changes are associated with alteration in the biological function of cells involved in wound healing. The key hormones affecting the constant balance between anabolic and catabolic processes are insulin, growth hormone, adrenaline and coritsol. The first two hormones promote protein synthesis and the last two hormones block it. Circulating levels of all four hormones are altered during the stress responses. Circulating levels of cortisol and growth hormone are directly affected by changes in the sleep cycle as well (McCarthy et al., 1991).

Interplay of Physical Discomfort and Psychological Effects of Noise

An incidental finding of Woods and Falk's (1974) study was what they referred to as a domino effect. "As one patient cried out, a chain reaction appeared to occur in which patients in adjacent beds in turn disturbed one another" (Woods & Falk, 1974, p. 148). This finding may be supportive of Minckley's (1968) earlier work that examined the relationship between Recovery Room noise and patient discomfort. Minckley (1968) determined that there was a statistically significant increase in the number of analgesics given when the noise levels were between 60 and 70 dB. Inferences made, though not verified with the patients include: the patient is sickened by the sound of vomiting, pained by the sound of another patient's cry, and resentful of the sound of laughter. It was inferred, but again not verified with the patients, that a lack of responses to the sound of a telephone or loud snoring indicated that such sounds do not denote human distress.

Psychologic Variables

Psychologic responses to noise identified in the literature include annoyance, anxiety, and altered thought processes. To many people, noise is considered an invasion of privacy and attaching meaning, or having control over or ownership of an sound will determine the psychologic reaction (Williams, 1989).

Annoyance, according to Baker (1993) refers to a feeling of displeasure or resentment associated with the physical presence of an unwanted stimulus or condition known to, or believed by an individual to be aversely affecting them. In general, noise is described by Griffin (1992) as being annoying when it is high pitched, intermittent, of long duration, impulsive in character, greater than 60 dBA, and increasing in level. It is not simply the physical nature of the sound but the emotional content as well that elicits a psychologic response. Frustration and annoyance with the sound may increase with the unwantedness of the sound, its potential for speech interference, activity disruption and the degree to which it disturbs rest.

Gast and Baker (1989) examined the relationship between noise, state anxiety and annoyance. The State Trait Anxiety Index and Baker's Annoyance to ICU Noise Index were used as measurement tools. Even though a small sample size was used, their findings revealed that state anxiety increased during noisy times yet annoyance increased during the quiet time. The increased annoyance was attributed to an interruption factor with equipment and people-generated noise found to be the most bothersome.

ICU psychosis, which is manifested as altered thought processes, is due to the patient's inability to perceive the environment correctly and /or sleep deprivation (Helton et al., 1980; Hutton & Rea, 1994). The common denominator which predisposes the patient to these sensory aberrations is noise.

In a study conducted by Simpson-Wilson (1987), extrapersonal and intrapersonal stressors were identified that may contribute to transient delirium in the Surgical ICU. Using the Adams Mental Status Examination, 22 of the 38 patients assessed were classified as having an impaired psychological response. A patients stressor scale developed by the author was administered to the patients when the psychologic response was considered normal. The impaired psychologic response group unidentified "too much noise " on the patient stressor scale as significantly more stressful than the normal responses groups ($p = 0.05$).

Interventions Related to Noise Reduction

Creation of a therapeutic milieu by manipulation of environmental factors that affect the patient's well-being is the responsibility of the nurse. Throughout the literature, numerous methods of reducing noise stimuli were found that related specifically to the environment or the personnel within that environment. Very few of the interventions, however, were supported by empirical data.

Staff Awareness

Increasing nursing staff awareness of noise levels has been demonstrated to decrease noise in Critical Care Units. In an early study conducted by Hoffman, et al. (1978), 50 patients recently transferred out of the Coronary Care Unit were asked to identify factors perceived by them as being stressful. Noise was considered a crucial factor. The interview results became the subject of a 30 minute inservice that was presented to the Coronary Care Unit staff. A further 50 patients completed the same interview when the inservice was completed. The post intervention noise score was lower than the pre-intervention score but statistical significance was not reported. Additional information would have been gleaned had repeated post interventions testing occurred to determine longevity of the effect.

Perceptual Masking

Perceptual masking is the replacing of an unwanted noxious sound with a pleasant sound. Two studies were located that utilized this technique. Topf (1992) randomly assigned 105 healthy women to one of three groups: instruction in personal control; no instruction in personal control; and quiet control groups. Sleep was subsequently measured in the laboratory using the polysomnograph and post-test questionnaires. Women not assigned to the quiet control group were exposed to audio taped Coronary Care Unit night time noise. The personal control group used a sound synthesizer to mask the uncomfortable Cardiac Care Unit sounds that interfered with relaxation and sleep. Sounds from the synthesizer included surf, rain on a tin roof and a waterfall. No significant difference between the three groups was observed.

Collins and Kuck (1991) used perceptual masking successfully in their evaluation of uterine sound combined with synthesized female singing as an intervention for neonatal stress related to noise. Seventeen intubated premature infants in a neonatal intensive care unit who displayed signs of agitation were observed and recorded for a 10 minute base-line period followed by 10 minutes of the intervention tape. Paired t-test analysis revealed significant improvement in oxygen saturation and decreased state of agitation, as well as significant decreases in mean blood pressure and heart rate during the intervention interval.

The Therapeutic Use of Music

"The power of music is so great that it draws every human being possessing a heart and open mind into its realm, enabling him to bear the hardest hours of his life" (Green, 1969, p. 76). The therapeutic use of music predates Biblical times. The 4th century BC writings of Plato laid down the framework for the study and use of music in ancient Greek society. He recognized that music could be used to influence character and behavior, stating in Book Three of The Republic "...rhythm and harmony penetrate deeply into the mind and have a most powerful effect on it..." (Plato, n.d./1955, p. 142). Biblical reference to therapeutic use of music is found in I Samuel 16:23 (Revised Standard Version) where David alleviated King Saul's suffering and melancholy by playing the harp. Popular magazines such as First for Women (Passero, 1996) espouse the use of music and its incredible power to alter mood, emotion and bring harmony to the soul.

Music therapy has been applied in a variety of clinical settings for its psychologic and physiologic effects. Frank (1995) notes that psychologically, music has the ability to affect mood because of its suggestive and persuasive elements, and physiologically, there is scarcely an organ in the body that does not experience the effects of music. It is postulated that the immediate influence of music therapy is on the mind state, which in turn influences the body state.

Psychologic Impact of Music

It has been suggested that the psychologic impact of music is related to its pitch, intensity and timbre that stimulate unconscious responses at the cerebral hemispheric levels and in the limbic system (Frank, 1995; Guzzetta, 1988; Speis-Pope, 1995). Soothing or sedative music was used exclusively throughout the studies critiqued.

Anxiety

Music as in intervention for anxiety has been studied in a variety of settings and has met with varying results. It is well known that patients undergoing surgery experience anxiety in the pre-operative period, peri-operative period when surgery is performed using local or regional blocks rather than general anaesthesia, as well as when the patient expects or experiences pain in the post operative period. The literature indicates that music therapy has seen varying degrees of success in reducing anxiety as measured by either the State Trait Anxiety Index or other self report measures.

Gaberson (1995) used a three group pre-test post-test design with a visual analogue scale self report of anxiety to compare the effects of a 20 minute of tranquil music distraction, 20 minutes of humor distraction, and no intervention in pre-operative ambulatory surgical patients. There was no significant difference in the reduction of anxiety across the three groups. McGreevy-Steelman (1990) found that listening to soothing music throughout the peri-operative period while undergoing regional block for hand/wrist surgery significantly reduced anxiety scores but there was no significant difference in anxiety scores when compared to the routine intervention group. In one study of 33 patients undergoing arthroscopic surgery, listening to 20 minutes of classical music produced a marginally significant reduction in state anxiety scores on the State Trait Anxiety Index over the control group,using a quasi-experimental pre-test post-test design study of 33 patients undergoing arthroscopic surgery (Kaempf & Amodei, 1989). Significance may have been achieved had a larger sample size been used.

In another study of arthroscopic surgery patients, conflicting results are seen in measurement of state anxiety using the State Trait Anxiety Index (Moss, 1988). Seventeen patients were randomly assigned to either the intervention or control group. The intervention group listened to music from the time that the pre-operative medication was administered until they reached the post anaesthesia recovery unit. A paired t-test was performed on the pre-operative and post-operative state anxiety scores for both groups, revealing a significant decrease for the music intervention group.

The critical nature of an acute illness or injury and admission to the ICU is in itself anxiety provoking. It seems well justified that music therapy has been examined as a method to reduce anxiety and promote relaxation. Once again, the impact of music on anxiety scores in this patient population is variable.

State anxiety scores on the State Trait Anxiety Index were found to be somewhat reduced while listening to soothing music in Elliot's (1994) comparison of classical music, muscle relaxation and uninterrupted rest period among patients admitted to the Cardiac Care Unit with the diagnosis of myocardial infarction. While there was a significant reduction within the classical music group, the between-group analysis revealed no significant difference. Study design and the recognition of incomplete data weakens the validity of this study. Zimmerman, et al. (1988) randomly assigned 75 Coronary Care Unit patients to one of three groups of music with relaxation suggestion, white noise with relaxation suggestion and a control group. The state section of the State Trait Anxiety Index was administered before and after the 30 minute intervention periods. ANCOVA revealed no significant difference in post State Trait Anxiety Index scores between the three groups but in the within-group analysis the music group demonstrated the greatest decreases in scores. Similar results were found by Barnason, Zimmerman and Nieveen (1995) for patients in the early post open heart surgery period. They compared 30 minutes of music, a music video and a rest period on two separate days. ANCOVA revealed no significant differences between post anxiety scores over time, $f(2, 89) = 0.51$, $p > 0.05$.

Contrary to the above mentioned studies, there were statistically significant decreases noted in the anxiety scores for myocardial infarction patients in the Coronary Care Unit by both Leuders-Bolwerk (1990) and White (1992). Participants in the Leuders-Bolwerk (1990) study were randomly assigned to either 22 minutes of relaxing classical music or a control group. There were three separate intervention periods. The between group comparison of mean anxiety scores revealed a statistical significance at the 0.007 level (t value of -2.87). White (1992) measured pre-test and post-test state anxiety scores for the 22 minute music intervention group and uninterrupted rest group which was considered the control. Both control and intervention groups demonstrated a statistically significant reduction in state anxiety score, but the degree of anxiety reduction was statistically greater in the music group than in the control group.

The effectiveness of a music intervention on relaxation and anxiety for patients receiving mechanical ventilation was studied by Chlan (1998). In this study, the 30 minute music session was found to significantly reduce anxiety and promote relaxation as measured by a six item state anxiety questionnaire and physiologic variables of heart rate and respiratory rate.

Mood and Emotion

Alteration in mood was measured using a numeric rating scale in an experimental and control group by Barnason et al. (1995). Perceived mood demonstrated no significant change on day two, but a significant group effect was seen on day three. The music-only intervention group had significantly higher mood rating than either the music video or rest groups.

The use of music therapy is ripe for qualitative analysis but only one qualitative study was located. Stevens (1990) conducted an ethnographically based descriptive study to determine the tangible aspects of the helpfulness of music as experienced by peri-operative patients undergoing spinal, epidural or regional anaesthesia. Twenty patients who listened to music throughout their surgical procedure were interviewed 20 hours post-operatively. Categories that arose indicated that music could be used as an aid for relaxation, distraction from the surgical procedure, escape to another mental realm by allowing them to fantasize, and assisting with pain relief. Some of the patients found that the music lulled them to sleep.

Many of the studies included patient comments that were either solicited or unsolicited. Phrases that were common throughout the literature included: helped pass the time, blocked out or masked background and unpleasant noises, diverted their minds from the procedure, felt peaceful, less tense, felt calm, satisfied and relaxed, stimulated imagination, brought back happy memories, and felt tranquil (Davis-Rollins & Cunningham, 1987; Eisenman & Cohen, 1995; Leuders-Bolwerk, 1990; McGreevy-Steelman, 1990; White, 1992;). This positive subjective aspect of music therapy indicates the need to elicit the patients' comments and not simply rely upon specific objective measurement tools.

Physiologic Impact of Music Therapy

The physiologic reactions elicited by music are the result of arousal of the autonomic nervous system. The autonomic nervous system is responsible for rhythms such as heart and respiratory rate, electrical conductivity, blood pressure, and endocrine function. Many of the studies that examined music as an intervention for anxiety or pain also examined the physiologic variables that are commonly associated with the stress response.

Cardiac

Heart rate and blood pressure were the most frequent physiologic parameters measured as a response to music therapy. While no significant heart rate reductions in response to music therapy were found by Barnason et al. (1995), Davis-Rollins and Cunningham (1987), Elliot (1994), Updike (1990), Whipple and Glynn (1992), and Zimmerman et al. (1988), statistically significant reductions in heart rates were reported by Burke et al. (1995), Byers and Smyth (1997), Chlan (1998), Guzzetta (1989), and White (1992). Clinical significance was not discussed by those investigators.

Similar discrepancies are found with blood pressure measurement. There was no significant decrease in blood pressure noted in studies conducted by Barnason et al. (1995), Elliot (1994), Whipple and Glynn (1992), and Zimmerman et al. (1988). Marginally significant changes in blood pressure were seen by Kaempf and Amodei (1989) with a statistically significant decrease in blood pressure reported by Byers and Smyth (1997), McGreevy-Steelman (1990), and Updike (1990). It must be noted that even though Barnason et al. (1995) found no significant differences between their control and intervention groups, a within-group significant time effect was detected. The relaxation response occurred within the first 10 minutes of the music intervention and continued throughout the remainder of the intervention time period.

Electrocardiogram (EKG) tracings were analyzed for cardiac arrhythmias in three studies. Davis-Rollins and Cunningham (1987) and Updike (1990) found no significant difference in the number and type of cardiac arrhythmias. Guzzetta (1989) reported that cardiac rhythm disturbances occurred only in the control group. It is interesting to note that of the studies located, EKG ST-segment deviation signifying cardiac ischemia as an indication of myocardial oxygenation supply and demand deficit, which may accompany the stress response, was not measured.

Respiratory

Respiratory status was reported as another indicator of the physiologic relaxation response. Davis-Rollins and Cunningham (1987) found no significant change in respiratory rate, while Chlan (1998), Kaempf and Amodei (1989) and White (1992) reported statistically significant reductions in the respiratory rate. Burke et al. (1995) noted an increase in blood oxygen saturation levels for the neonates enrolled in their study.

Skin Temperature

The final parameter measured to indicate psycho-physiologic relaxation was digital skin temperature. Neither Guzzetta (1989) or Zimmerman et al. (1988) reported a significant reduction in peripheral or galvanic skin temperature.

Music as an Intervention for Noise Induced Annoyance

Only one study was located that used a music intervention as a method to reduce noise induced annoyance in the ICU patient population. Byers and Smyth (1997) studied the effect of listening to 18 minutes of classical music with ocean waves on reported noise annoyance, heart rate and blood pressure in 40 cardiac surgery patients. Their findings on repeated measures revealed a significant ($p= .0001$) reduction in noise annoyance as measured on a visual analogue scale. The majority of their subjects were men (85%) and between the ages of 40 and 75 years therefore generalizability is restricted to those demographic variables.

SUMMATION

A summary of the literature reviewed reveals that environmental noise, a problem in ICU environments, may negatively impact on the well-being of patients. These negative effects are manifested in both psychological and physiological responses that may further compromise the critically ill patient's recovery. Very little empirical data is available to support many of the nursing interventions employed to reduce noise stimulation.

Music therapy study findings were variable but in some cases encouraging in determining the effectiveness of soothing or sedative music as an intervention for anxiety. A persistent within-group change was noted in music intervention groups but between-groups comparisons were rarely significant. While two studies were located that examined the use of music as a perceptual masking tool, only one study was found that used music therapy as an intervention to reduce noise induced annoyance in the adult ICU patient population. This study revealed a statistically significant decrease in reported noise annoyance in response to the music intervention.

CHAPTER III

STUDY DESIGN AND METHOD

In this chapter, the design and method used for this quantitative study will be delineated. The sample size, criteria for selection, setting, instruments, procedure and methods of data collection and analysis are discussed. The numerical data obtained from this study will be used to determine if there is a significant difference in the Visual Analogue Scale scores and the modified Baker's Annoyance to ICU Noise Index scores between the intervention and nonintervention groups. Numerical data obtained from the modified Baker's Annoyance to ICU Noise Index will be used to describe the noise sources that are amenable to masking by soothing music.

RESEARCH DESIGN

A quasi-experimental one group pretest post test design in which 36 adult ICU patients served as their own controls was used for this study. The dependent variable was annoyance to ICU noise as measured by a Visual Analogue Scale and modified Baker's Annoyance to ICU Noise Index. Descriptors of the noise annoyance sources were measured using the Baker's Annoyance to ICU Noise Index. The independent variable was the use of a 20 minute audio tape of soothing music. Measurements of annoyance to ICU noise and the descriptors of noise annoyance sources were taken twice, once following the 20 minute control interval and again following the intervention interval. Data was then analyzed to determine if the mean Visual Analogue Scale and Baker's Annoyance to ICU Noise Index (modified) scores are significantly lower following the intervention interval than following the control interval. Since noise source, frequency, duration and level vary in the ICU setting dependent upon the number and type of patients, the Modified Baker's Annoyance to ICU Noise Index questions will be analyzed to determine which specific determinants of ICU noise are affected by the intervention.

The Sample

The population studied were adult patients admitted to a community hospital, open concept (dormitory style), mixed census ICU. Mixed census refers to the type of patient admitted to the unit which, in this unit, includes medical, surgical and cardiac patients. A consecutive convenience sample of patients who satisfied the inclusion criteria, possessed none of the exclusion criteria, and provided informed consent were included in the study.

Consecutive convenience sampling was chosen with no attempt made to randomize. Consecutive convenience sampling was chosen as the population is accessible and there was no feasible alternative method for this patient population and study. Although convenience sampling is considered a weak form of sampling, the factors that influence the heterogeneity of the population were compared to those of the sample obtained. Demographic data obtained from the sample such as age, gender, and admitting diagnosis were compared to the patient census for the duration of the study recruitment time frame, as recorded in the ICU admission log book. This would determine representativeness of this sample to the ICU patient population.

The Manitoba Nursing Research Institute Statistical Consultation Services provided advice for determination of the sample size. To achieve a power of 90% with alpha set at 0.05 in one-tailed t-testing or Wilcoxon Signed Ranks test between the control interval and the intervention interval, it was calculated that the minimum sample size required was 36 participants. This would detect a large effect defined as 40% of the standard deviation.

The following criteria were required for inclusion in the study:

- 18 years of age or older
- patient in the ICU for a minimum of 24 hours
- hemodynamically stable (no inotropic or vasoactive medication intravenous infusions)
- able to speak, read, and write the English language
- able to hear the spoken word
- agreeable to signing the written consent
- situated in the open (dormitory style) area of the ICU

Patients who required the following assistive devices were excluded from the study:

- hearing assistive device such as a hearing aid
- external transcutaneous or transvenous or permanent pacemaker
- fast patch/hands off defibrillator
- endotracheal or tracheostomy tube

Patients who developed chest pain, potentially lethal cardiac arrhythmias or hemodynamic instability during the course of the study would be withdrawn from the study.

The Setting

A 220 bed community hospital in the Canadian Midwest was approached for permission to access their site and ICU patients. The setting for the study was an 8 bed, open concept, mixed census ICU. With the exception of one isolation room all patients admitted to this ICU share a communal dormitory style space. During the evening shift, night shift and throughout the weekend, a 2 bed post-operative recovery area is also located within the ICU. Census data for the past year revealed that the unit usually has an 80% occupancy rate. Refer to Figure 3 located in Appendix D (page 106) for schemata of the ICU.

Acoustical characteristics of this ICU include linoleum over cement flooring, painted plaster walls and ceiling, and five wood core doors. Two of the doors lead to the Operating Room corridor, the third door leads to an office, the fourth door enters into the staff lounge, while the final door connects to the Recovery Room. One door is usually open to the Operating Room corridor. A stainless steel nurse-server is located at the head of each bed and stretches the entire length of the ICU. Six feet and heavy fabric curtains separate one patient from another. The centrally located nursing station contains sound absorbing cloth matting on the exterior surfaces. The floor immediately above the ICU is a service floor within which is located piping for plumbing, electrical, communication and computer wiring, and a grid of metal cat-walks. Hospital and external service and maintenance employees frequently access the service floor area for repairs and renovations.

Noise within the ICU is generated from patient/visitor conversations or distress sounds, staff conversation, alarms, health care equipment, communication devices, cleaning equipment, plumbing and at times construction, renovations, routine maintenance or repairs.

Protection of Human Rights

The protection of human rights was maintained throughout the study. After receiving the attending physicians' access approval at the Acute Care Committee level, patients who met the inclusion criteria were determined by the bedside ICU nurse, and then approached by the ICU Communication Clerk or Volunteer and delivered an invitation to participate in the study (Appendix E, page 107). The Communication Clerks and Volunteers are not responsible for direct patient care and therefore were not in a position of direct power over the patient. Those patients who indicated an affirmative response received a written and verbal explanation (Appendix F, page 108) of the study from the investigator. Opportunity was provided to ask questions of the investigator. Participants were informed that the investigator would be taking all the measurements and collecting all the data. Participants were made aware that data collection would include accessing the hospital health record for information on their diagnosis, current medication regimen, and length of time in the ICU.

The investigator explained the purpose of the study and the procedures that would be undertaken to conduct the study as well as the time-frame involved for the patient. The patients were informed that they may or may not receive any direct benefit from their participation in the study. It was reinforced that their decision to participate was voluntary, that participation in the study would not affect their routine care in any way, and that they had the right to withdraw from the study at any time.

Confidentiality was stressed verbally and on the explanatory sheet. Participants were informed that their name would not appear on any of the data collection forms. Each participant is assigned a code number which was their only identification. Only the investigator was knowledgeable of the patient's identity. This information wil! be kept in a locked file separate from the data collection forms. The participants were informed that only the Thesis Committee and Statistician would have access to the coded data forms. The participants were informed that the data would be kept in locked file for ten years and then mechanically shredded. The possibility of publication of the results of the study was also discussed with the participants, ensuring that they were aware that their anonymity and confidentiality would be maintained.

Once it was ensured that the selection criteria are met, participants were asked to read and sign the written Explanatory Consent Form (Appendix G, page 110). A copy of explanation and consent was given to the participant. Patients who declined to participate in the study had their requests respected. Rationale for refusal was not sought as this could have been viewed as harassment or coercion. Rationale for non-participation that was not solicited was recorded and reported.

The collection of data involved no physical or psychological risk to the patient. During the 20 minute control interval nothing was required of the patient. There was no change in the routine care delivered by health care personnel or activities in which the patient participates with the exception of remaining in bed and not occluding their ears. The intervention interval involved listening to a 20 minute audio cassette of soothing music via head phones using a small portable tape player. The volume was initially set on low and then controlled by the participants according to their individual tastes and comfort. The total length of time commitment for participation was approximately 50-60 minutes for the control and intervention intervals, and completion of the questionnaires and surveys.

Variables Measured and Instrumentation

Dependent Variable

The dependent variable in the hypothesis was annoyance to ICU noise. Annoyance was defined as the state of being or feeling disturbed or irritated by intermittent, repeated or sustained noise within the ICU environment. Data to determine the participant's perceived annoyance to noise was collected using a vertical Visual Analogue Scale (Appendix H, page 112) and an adaptation of Baker's Annoyance to ICU Noise Index (Appendix I, page 113). The adaptation of Baker's

Annoyance to ICU Noise Index described the types of noises perceived by the patient as being annoying. Both are self report measures.

The vertical 100mm Visual Analogue Scale contained the anchor phrases " I am extremely annoyed by the noise" and "I am not annoyed by the noise at all". A vertical visual analogue scale was chosen as it produces sensitive subjective measures, requires minimal time to complete and is easy for subjects to use (Polit & Hungler, 1991). The Visual Analogue Scale provided a definitive measure for statistical analysis.

The adaptation of Baker's Annoyance to ICU Noise Index (Baker, 1989) is a 30 item 5 point Likert-type scale questionnaire that identified the source of noise and magnitude of annoyance. The modification involved removing questions related to nighttime noise as data collection for this study occurred during the day and early evening shift. Sources of noise specific to this Intensive Care Unit were added as well. The greater the score, the higher the level of annoyance (personal communication, Baker, March 6 1995). Alpha reliability of the original index was reported by Baker (1989) as 0.74 to 0.93. Data from this instrument would provide a definitive measurement for statistical analysis. Data would be analyzed question by question to determine whether the intervention was more beneficial for reducing noise from specific sources or categories of noise sources.

In choosing an instrument to suit this vulnerable population, certain difficulties present themselves. Two previous music therapy studies (Guzzetta, 1989; Leuders-Bolwerk, 1987) utilized the State-Trait Anxiety Index to demonstrate the subjective effects of music therapy. The State-Trait Anxiety Index is time-consuming for a critically ill patient to use repeatedly. Furthermore, repeated use of the test in a short timespan increases the risk of test sensitivity. Finally, because this study looks at annoyance, which Baker (1984) considers to be a precursor to anxiety, rather than anxiety, its was felt that the State-Trait Anxiety Index would be an inappropriate tool.

One previous music therapy study (Davis-Rollins & Cunningham, 1987) used a verbal self-report of tranquillity which did not lend itself to statistical analysis.

Other studies measured physiologic data such as heart rate and blood pressure. It is the experience of this investigator that the majority of patients admitted to this ICU are cardiac in nature and it is assumed that the majority of the subjects in this study would also be cardiac patients. It is currently standard medical practice that most cardiac patients are placed on Beta blocking medications. The action of this classification of medication includes blunting of the sympathetic nervous system stress response of increased heart rate and blood pressure. It was decided that measurement of heart rate and/or blood pressure would not occur in this study.

The Independent Variable

The independent variable tested was the intervention which consisted of a twenty minute audio tape of either soothing classical or contemporary music. Soothing music is that which has the following characteristics: duple (double) or slow tempo triple rhythm between 60-80 beats per minute, predictive dynamics, harmonic consonance, recognizable timbre or tone and is nonlyrical (Chenoweth, 1972; Schuberg, 1981). During the intervention interval, participants listened to one of two choices of audio tape, either classical or contemporary, via a Sony Walkman portable audio tape player equipped with a foam padded head set. Participants controlled the volume according to their personal preference.

Four of the previous music therapy studies offered a variety of music types to accommodate personal music preferences. Three used classical music. The remaining one used a combination of uterine sounds and synthesized female singing. Time frames for the music interventions ranged from 10 to 32 minutes.

Extraneous Variables

Extraneous variables, according to Polit and Hungler (1991), are those that confound the relationship between the dependent and independent variables. Several extraneous variables were measured and reported.

Noise Levels: Noise is defined as any sound which, in its present context, is perceived as unwanted and a threat to the physical, psychological or cognitive integrity of the individual. Operationally, noise is defined as any sound measured using the Radio Shack Precision Sound Level Meter 33-2055 emitted by any source that exceeds 45 dB which is the recommended Environmental Protection Agency limit for hospital day shift sounds (Webster & Thompson, 1986). Validity of the instrument was tested prior to and following the data collection period. Reliability was tested by the investigator prior to and following the data collection period. The sound level meter was calibrated to a constant sound (designated as a zero reference point) prior to each data collection phase.

Noise levels in the ICU were continuously monitored during the control and intervention intervals. Noise levels were measured at the participant's bedside with the sound level meter at the level of and within four feet of the participant's ear. Baseline noise levels were documented at one minute intervals on the Data Collection Record (Appendix J, page 116). Individual impulse noises that exceeded the baseline noise levels were documented on the data collection record.

Noise sensitivity: The participants sensitivity to noise was determined by using a 5 point Likert-type questionnaire with the anchors "extremely quiet" and "extremely noisy". This four item survey is a self report of the noise level in the participant's home and place of work, their expectation of the ICU noise level and noise levels encountered since admission. A quiet home and/or work environment and expectation of a quiet ICU environment has been demonstrated to predispose the patient to increased sensitivity to ICU environmental noise and annoyance (Baker, 1993). This information was documented on the Patient Questionnaire (Appendix K, page 117).

Previous exposure: Previous exposure to ICU noise levels may decrease the patient's sensitivity to noise through habituation. The number of previous ICU admissions was documented on the Patient Questionnaire. The length of time in hours of the current ICU admission was documented on the Data Collection Record.

Intensive Care Unit census: The number of patients in the ICU as well as the number of ventilated patients may impact on the noise levels generated within the unit. The number of patients in the ICU and the number of patients who were ventilated were counted and documented on the Data Collection Record during the time of data collection.

Demographic characteristics: Demographic data of the sample was obtained and recorded on the Patient Questionnaire. The information obtained included age, gender and occupation since any of these may have a connection with the results.

Medication history: The medications administered to the participant may impact on the annoyance response. Of particular interest are narcotics, sedatives and anxiolytics. The participants' health records were accessed to obtain the medication regimen which was then documunted on the Data Collection Record.

The Procedure

An outline of the protocol for this study is presented in Figure 4 (page 49). Approval of the study was sought from the Faculty of Nursing Ethical Review Committee at the University of Manitoba. Permission to access the community hospital ICU patient population was obtained from the facility. Permission was also sought from the facility to access the ICU census log book for comparison of the study population to the usual ICU patient population to see if the sample was

Figure 4: Study Protocol

invitation to participate

▼

explanation and consent

▼

calibration of sound level meter

▼

demographics questionnaire

▼

20 minutes control

▼

noise measurements during control interval

▼

completion of visual analogue scale

▼

completion of modified Baker's Annoyance to ICU Noise Index

▼

20 minutes soothing music (intervention)

▼

noise measurements during intervention interval

▼

completion of visual analogue scale

▼

completion of Baker's Annoyance to ICU Noise Index representative, permitting generalizability of the results to a wider population. Information sessions outlining the nature and purpose of the research were provided to the Acute Care Committee, the Department of Family Practice and the Critical Care Program Team at their regularly scheduled monthly or bimonthly meetings. A copy of the study results were offered to each committee.

Potential participant names were obtained daily from the patient roster located on ICU census board in the nurses station. Discussion with the nurse caring for the patients revealed whether the inclusion criteria were satisfied. The ICU Communication Clerk or Volunteer delivered a written invitation of participation to the patient. If the invitation to approach the patient was accepted, the investigator then approached the patient and provided a verbal and written explanation of the research. After questions were answered the patient was invited to participate in the study. If the invitation was accepted the patients was asked to read and sign the explanatory-consent form. A copy of the explanatory consent form was provided to the patient.

Data collection occurred at any time between the hours of 0700-2200 hours. Data was not collected between 1300 an 1400 hours as this is designated as a quiet rest time for all ICU patients. The time of data collection was mutually agreed upon between the participant and the investigator but took place on the same calendar day. The investigator was the exclusive data collector therefore potential interrater reliability limitations were eliminated.

The Radio Shack Sound Level Meter was calibrated to the zero reference. The slow response mode was chosen to capture background noise as well as impulse sounds. The Sound Level Meter was placed on the A weighted decibel scale. The A weighted decibel scale was chosen as it responds to frequencies that are of greatest sensitivity to the human ear.

The patient was asked to assume a comfortable position in bed. Ambulation was not permitted during the duration of the study. Ambulation does not allow for accurate measurement of the patients exposure to noise. The sound level meter was placed on top of a three inch foam pad on the bed side table. The foam pad was used to reduce vibration which may interfere with or alter the sound level readings. The microphone was positioned four feet from the patients right ear and pointed in the direction that the patient was facing. The height of the bed side table was adjusted to be level to the patient's ear. The investigator was seated behind and to the left the sound level meter and bedside the patient.

The Patient Questionnaire was then completed. The demographic data sought included gender, age, occupation, and number of previous admission to an ICU as well as the noise sensitivity survey. These data were used to describe the participants, determine generalizability and provide ease for replication of the study. Music selection was then made; the choice included a 20 minute audio cassette of either classical or contemporary music. The patient then participated in the control and intervention intervals of the study. The sequence of control and intervention intervals was not altered between participants. This reduced the possibility of cross-over effect.

The control interval consisted of a 20 minute time frame during which the participant was free to participate in any activity (i.e. reading, knitting visiting with relatives) provided that they remained in bed and did not occlude their ears. During the control interval, background sound levels were measured every minute and immediately recorded on the Data Collection Record. Impulse sounds that exceeded the background sounds levels were also measured and recorded on the Data Collection Record. Following the control interval, participants were asked to locate and mark their level of annoyance to ICU noise using the Visual Analogue Scale.

Participants were then asked to complete the modified Baker's Annoyance to ICU Noise Index.

The intervention interval consisted of a 20 minute time frame during which the participant listened to the selection of music. During the intervention interval, background sound levels were measured every minute and immediately recorded on the Data Collection Record. Impulse sounds that exceed the background sounds levels were measured and recorded on the Data Collection Record. Following the intervention interval the participants were asked to locate and mark their level of annoyance to ICU noise using the Visual Analogue Scale. The participants were then asked to complete the modified Baker's Annoyance to ICU Noise Index.

Additional data was entered on the Data Collection Record. This data included the patient census and number of ventilator supported patients obtained by counting those patients present in the ICU during data collection. The patient's diagnosis, current medication regimen and number of hours in the ICU was obtained from the hospital record. These data were used to describe the patients, determine generalizability and finally subjected to analysis to determine relationships between these data and the dependent variable.

Data collection continued using the above protocol on all subjects until a complete data set was obtained on 36 participants. The coded data was then entered into the SPSS 8.0 program and subjected to statistical analysis.

All data was recorded at the time of collection to ensure that none were accidentally omitted. Data were entered on the participants' coded Data Collection Record. During the time frame of data collection, additional demographic data was obtained from the ICU census log book. This data included the gender, admission diagnosis and age of all patients admitted to the ICU during the weeks of study recruitment and was used to determine homogeneity between the study participants and the actual ICU patient population.

Data Collection

Participants were provided with a code number to maintain anonymitiy. All data were collected by the investigator and recorded immediately on the data collection forms previously described in in this chapter. Data from the tests of validity and reliability of the Radio Shack Digital Sound Level Meter 33-2055 were recorded.

Data Analysis

The SPSS 8.0 statistal package was used to analyze data at the completion of the study. Alpha level was set at .05 to determine statisitical significance. Testing of the hypothesis was completed. The visual analogue scale control and experimental interval results were examined for a change in the position of the self report mark. An experimental mark that is less than the control mark indicated a decreased annoyance to noise. A Wilcoxon Signed Ranks test was performed to test the difference between the means between the control and intervention phases.

The Baker's Annoyance to ICU Noise Index control and experimental interval results were examined for a change in the total score. An experimental score that was less than the control score indicated a decreased annoyance to noise. A Wilcoxon Signed Ranks test was conducted to test the difference between the two scores.

This testing determined whether there was a significant decrease in noise induced annoyance following the 20 minute soothing music intervention as measured on the Visual Analogue Scale and Baker's Annoyance to ICU Noise Index. Simple linear regression analysis was conducted to determine the strength of the correlation between the music intervention and control-difference discrepencies.

Descriptive statistics were used to report demographic characteristics. These included: gender, age, admission diagnosis, previous admissions to an ICU, length of stay (in hours), and noise sensitivity.

SUMMATION

This chapter has outlined the research design for this study, rationale for instrumentation and well as reasoning for exclusion of measurements included in similar studies. A step by step procedure for the study was delineated and diagrammed. Protection of human rights was insured. The plan for statistical analysis was presented.

CHAPTER IV

RESULTS

Data collection began on May 28 1998 and continued, with the exception of a two week period in July, until August 26 1998. Thirty-eight subjects agreed to participate in the study. Two participants withdrew from the study prior to the commencement of data collection, therefore complete data sets were collected on the remaining 36. None of the remaining participants were eliminated, therefore final analysis was conducted on a sample size of 36.

The results of data collection and analysis of that data are presented in this chapter. Level of significance was set at 0.05. The accuracy and reliability of the Radio Shack Digital Sound Level Meter 33-2055 was examined. Information relating to the participants and non participants was well as the results of the Visual Analogue Scale and Baker's Annoyance to ICU Noise Index (modified) scores in the control and intervention intervals are reported. Testing of the hypothesis was undertaken to determine whether the intervention interval Visual Analogue Scale scores and the Modified Baker's Annoyance to ICU Noise Index scores were significantly lower than the control interval Visual Analogue Scale scores and Modified Baker's Annoyance to ICU Noise Index scores. Variables that may have affected the outcome were examined. Finally, relationships between other variables were explored.

Validity and Reliability of Instruments

Radio Shack Digital Sound Level Meter 33-2055

The same Radio Shack Digital Sound Level Meter 33-2055 was used for all participants in the study. Testing of the Radio Shack Digital Sound Level Meter

33-2055 for validity and reliability occurred prior to and at the completion of data collection. Accuracy of this instrument is reported by the manufacturer at +/-2 decibels up to 120 dB (InterTAN, 1996). Testing of this instrument against the community hospital's Audiology Department sound room setting of 70 A weighted decibels produced a decibel level of 72 dBA.

Reliability of the instrument was determined by conducting repeated measures at 5 minute intervals for a 40 minute time period using an electric alarm clock alarm at 73 A weighted decibels. The Radio Shack Digital Sound Level Meter 33-2055 remained reliable throughout the testing period.

The Radio Shack Digital Sound Level Meter 33-2055 was subjected to the above testing and determined to be both a valid and reliable instrument for sound level measurements. Refer to Tables 1 and 2 in Appendix L (page 118) for validity and reliability testing data.

Patient Demographics

Forty-six patients who met the study inclusion criteria were invited to participate in the study. Eight of these patients declined to participate. Two patients who consented to participate withdrew from the study prior to beginning data collection; one patient was discharged home and the other received visitors. Rationale for refusal to participate was not elicited from those patients who exercised that choice although one patient was overheard to say that he "didn't want to be anybody's guinea pig". No participants were eliminated from the study secondary to developing complications or discovering exclusion criteria.

Descriptive comparisons were conducted between the patients who participated in the study and ICU patient population during the study time frame to determine generalizability to a wider patient population.

The Sample

Demographic information related to the sample is listed in Table 3 (page 58). All subjects were patients in the open dormitory area of the eight bed ICU. As evidenced, the majority (n=20 or 56%) of subjects were men. The age of participants ranged from 33 years to 84 years with a mean age calculated as 61.3 years. The age ranges were as follows: 30 - 39 years, 3% ; 40 - 49 years, 19% ; 50-59 years, 22%; 60-69 years, 28%; 70-79 years, 22%; and 80-89 years, 6%.

Occupation of the subjects included retired (28%), homemaker (17%), sales/retail (11%), professional (11%), labour/construction (11%), secretary/clerical (11%), and other (11%).

The majority of patients (64%) had never been a patient in an ICU prior to this admission. Admission diagnoses included neurological, (6%); cardiovascular, (81%); respiratory, (6%); gastrointestinal, (3%), endocrine/diabetic ketoacidosis, (3%); and postoperative, (3%). Mean length of stay prior to data collection was 71.3 hours with a range of 26 to 276 hours.

Table 3: Patient Demographics

Variable	n	Percent	M	SD
Gender				
male	20	55.6		
female	16	44.4		
Age	36		61.3	13.0095
30-39	1	2.8		
40-49	7	19.4		
50-59	8	22.2		
60-69	10	27.8		
70-79	8	22.2		
80-89	2	5.6		
Occupation				
retired		27.8		
homemaker		16.7		
sales/retail		11.1		
professional		11.1		
labour		11.1		
clerical		11.1		
other		11.1		
Diagnosis				
neurological	2	5.6		
respiratory	2	5.6		
cardiovascular	29	80.6		
gastric	1	2.8		
endocrine	1	2.8		
post operative	1	2.8		
Prior ICU Inpatient				
yes		36.1		
no		63.9		
Length of Stay (hr)	36		71.3	48.7278

Comparison of Sample to the Intensive Care Unit Patient Population

The ICU census statistics for the duration of the study were examined to determine the representativeness of the sample to the population of patients admitted to the ICU. The percentage of male patients in the ICU was 55.7% while that of the sample was 55.6%. With regards to age ranges, there was no correlation. While the most common diagnosis was cardiac related in both the general ICU population (58.6%) and the sample (80.6%) there is a substantial difference in percentages. The only diagnosis that matched well was for endocrine disorders, where the ICU population was 2.9% and that of the sample was 2.8%. Refer to Table 4 for a comparison between the ICU population and the sample.

Table 4: Comparison between ICU population and Sample

	ICU Population n=140		Sample n=36	
Variable	Frequency	Percent	Frequency	Percent
Gender				
male	78	55.7	20	55.6
female	62	44.3	16	44.4
Age				
20-29	3	2.1	0	0
30-39	5	3.6	1	2.8
40-49	13	9.3	7	19.4
50-59	17	12.1	8	22.2
60-69	34	24.3	10	27.8
70-79	40	28.6	8	22.2
80-89	26	18.6	2	5.6
90-99	2	1.4	0	0
Diagnosis				
neurological	9	6.4	2	5.6
respiratory	19	13.6	2	5.6
cardiovascular	82	58.6	29	80.6
gastric	3	2.1	1	2.8
genitourinary	2	1.4	0	0
endocrine	4	2.9	1	2.8
postoperative	17	12.1	1	2.8
multiple organ	4	2.9	0	0

Visual Analogue Scale Scores During Control and Intervention Intervals

Each participant reported their annoyance to ICU noise on a 100 mm vertical Visual Analogue Scale immediately following the 20 minute control and 20 minute intervention intervals. The higher the score, the greater the annoyance to noise. Visual Analogue Scale scores in the control and intervention intervals ranged from 3mm to 98mm, and 0mm to 45mm respectively. Mean scores were 35.47mm (SD 26.10) and 9.77mm (SD 11.00) for control and intervention intervals. All subjects demonstrated a decrease in annoyance to ICU noise based on the lower visual analogue scale scores in the intervention phase.

Modified Baker's Annoyance to ICU Noise Index Scores During Control and Intervention Intervals

All participants completed the modified Baker's Annoyance to ICU Noise Index following the control and intervention intervals. This 30 item self report 5 point Lickert type questionnaire asked about level of noise annoyance to various sounds occurring in the ICU. The possible range of scores was from 30 to 150. The higher the score, the greater the level of annoyance to noise. A question by question analysis is presented in Appendix M (page 120). All participants scored lower following the intervention interval than following the control interval. The control interval scores ranged from 31 to 69 with a mean score of 39.52 (SD 7.00) while the intervention interval scores ranged from 30 to 49 with a mean of 31.55 (SD 3.6).

Question by question analysis reveals that subjects found the following sound sources to be annoying during the control interval: staff talking about other patients, staff talking to other patients, staff talking personal, loud talk/laughing/shouting, staff preparing to do a task, staff doing a task, other patients' sounds of distress, other patient sounds not distressed, moving a patient into/out of the ICU, visitors talking, movement sounds, alarms ringing constant, beeping alarms, oxygen running, equipment operating, objects dropped, equipment carts moving, telephones, televisions, computer sounds , moving furniture, public address system, toilets flushed, water running, doors opening/closing, squeaking wheels/hinges, heating/cooling system, other sounds people, other sounds non person. During the intervention interval the question by question analysis reveals that subjects found the following sound sources to be annoying: staff talking personal, loud talk/laughing/shouting, staff preparing to do a task, other patients' sounds of distress, other patient sounds not distressed, visitors talking, movement sounds, alarms ringing constant, beeping alarms, oxygen running, objects dropped, equipment carts moving, telephones, computer sounds , moving furniture, public address system, toilets flushed, water running, doors opening/closing, squeaking wheels/hinges, other sounds people, other sounds non person. None of the subjects reported annoyance to housekeeping/cleaning sounds in the control phase, or staff talking about or to other patients, staff performing a task, moving a patient into/out of the ICU, equipment operating, televisions, housekeeping/cleaning, or the heating/cooling system during the intervention phase.

Testing of the Hypothesis

Two instruments were used to test the hypothesis: a 100mm Vertical Visual Analogue Scale and the Modified Baker's Annoyance to ICU Noise Index.

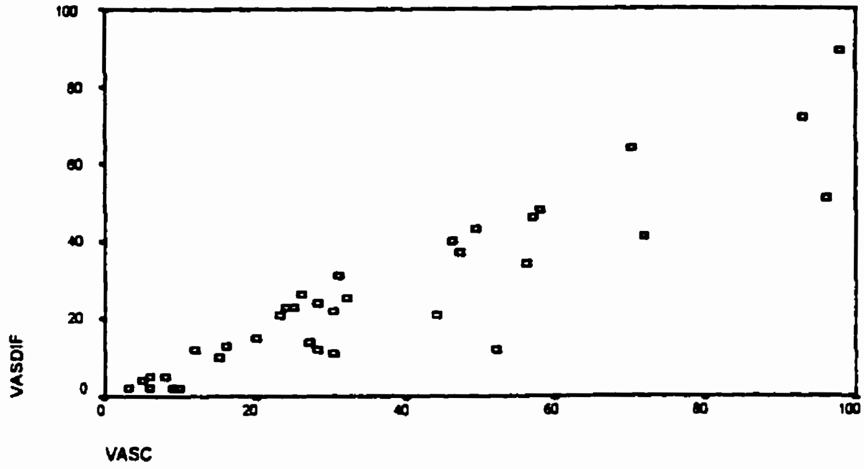
Data from the Visual Analogue Scale did not fall within a normal distribution therefore non parametric testing was chosen. A Wilcoxon Signed Ranks Test for non-parametric data revealed that the overall mean difference between the control and intervention visual analogue scores was significant ($n=36$, $Z = -5.233$, $p< 0.0001$). The hypothesis was supported.

Data from the Modified Baker's Annoyance to ICU Noise Index did not fall within a normal distribution therefore nonparametric testing was chosen. A Wilcoxon Signed Ranks Test for non-parametric data revealed that the overall mean difference between the control and intervention Modified Baker's Annoyance to ICU Noise Index was significant ($n=36$, $Z = -5.166$, $p< 0.0001$). Again, the hypothesis was upheld.

<u>Correlation Analysis</u>

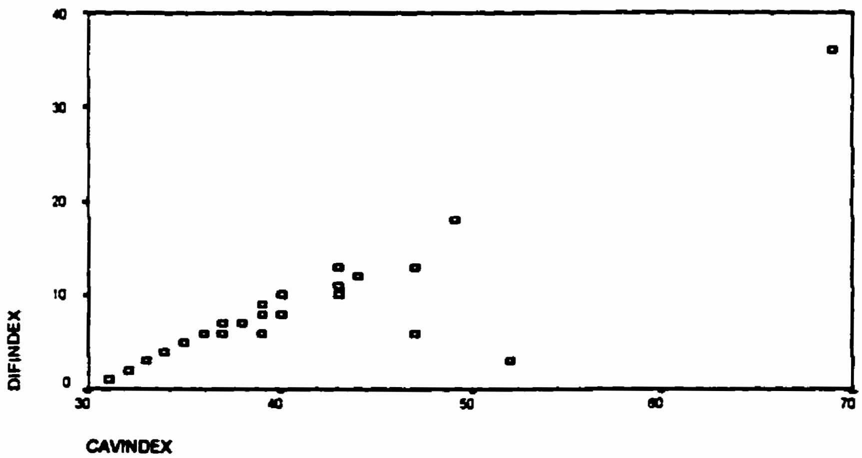
Simple Linear Regression analysis was conducted on the data from the Visual Analogue Scale as well as the Modified Baker's Annoyance to ICU Noise Index. The assumption that the music intervention would decrease annoyance to ICU noise was defended. Analysis revealed a high correlation between the Visual Analogue Scale control score and the difference between the Visual Analogue Scale control and intervention scores (Rsq = .836, $p<.0001$). Analysis revealed a moderately high correlation between the Modified Baker's Annoyance to ICU Noise Index control score and the difference between the Index control and intervention scores (Rsq = .733, $p<.0001$). Figures 5 and 6 (page 63) demonstrate the correlation.

Figure 5: Simple linear Regression analysis for Visual Analogue Scale



Rsquare = 0.8358
Legend
VASDIF = difference between control and intervention score on the Visual Analogue Scale
VASC = control score for Visual Analogue Scale

Figure 6: Simple linear regression analysis for Modified Baker's Annoyance to ICU Noise Index



Rsquare = 0.7327
Legend
DIFINDEX = difference between control and intervention score on the Baker's Annoyance to ICU Noise Index
CAVINDEX= control score for Baker's Annoyance to ICU Noise Index

Variables Possibly Affecting Noise Levels in the ICU

Numerous variables may affect the level of annoyance experienced and reported by participants. The primary variable is that of noise levels in the ICU during control and intervention intervals. Gender, age, prior exposure as an ICU patient, noise levels in the home and work environments as well as expectation of ICU sound levels and perceived ICU sound levels since admission are reported. Medication use in the previous 24 hours was not controlled for but was documented and is presented in Figure 7 located in Appendix N (page 121).

Sound Levels in the ICU

ICU noise levels were measured continuously during the control and intervention phases using the Radio Shack Digital Sound Level Meter 33-2055 placed on the slow response A weighted decibels scale. The sounds were documented as either background sound or intermittent sound.

Noise levels in the ICU varied depending on the patient census and number of ventilated patients at the time of data collection (Table 5, page 65). The lowest patient census was four while the highest was seven. At no time during data collection was the ICU fully occupied. The mean patient census was 5.7 . Seventeen (47.2%) of the subjects shared the common ICU space with at least one ventilated patient while 5 (13.9%) of the subjects shared the common ICU space with 2 ventilated patients. As can be expected, the noise level increased as the patient census increased. This held true for background sounds during the control and intervention periods as well as intermittent sounds during the control and intervention periods. While the background sound levels did not change during control and intervention intervals as the number of ventilators increased, the intermittent sound levels were higher when there were two ventilators as opposed to one.

Table 5: Sound Levels Related to Patient Census and Number of Ventilators

	Background Sound Level Control Mean	Background Sound Level Intervention Mean	Intermittent Sound Level Control Mean	Intermittent Sound Level Intervention Mean
Census				
4	53.93	54.67	61.15	62.12
5	57.25	56.63	63.86	63.21
6	56.74	56.94	63.34	63.61
7	58.45	57.18	64.20	63.21
Ventilators				
0	56.56	56.93	62.92	63.14
1	57.45	56.70	63.59	63.33
2	56.25	56.12	64.38	63.94

Noise levels in the ICU had a wide range. During the control interval, the background noise recorded ranged from 50 to 69 dBA with a mean of 56.93 dBA (SD = 2.13) while during the intervention interval the background noise ranged from 50 to 66 dBA with a mean of 56.71 dBA (SD 1.47). The intermittent noise levels ranged from 57 to 84 dBA with a mean of 63.44 dBA (SD 1.25) while during the intervention interval the background noise ranged from 56 to 70 dBA with a mean of 63.34 dBA (SD .93).

Differences in the sound levels in the control and intervention intervals may account for some of the change in the annoyance to ICU noise scores. It was necessary to determine whether there was a significant difference between the sound levels recorded during both the control and intervention phases of the study. The sound level data did not fall within a normal distribution. A Wilcoxon Signed Rank Test was conducted to determine whether there were significant differences in sound levels between the control and intervention intervals. Results of that testing revealed that the difference between the background sound levels in the control and intervention intervals was not significant (Z= -.975 p=0.330) and the difference between the intermittent sound levels in the control and intervention intervals was not significant (Z= -.418, p=0.676). Based on this information it is assumed that the sound levels in the control and intervention intervals did not impact on the change in Visual Analogue Scale and Bakers Annoyance to ICU Noise Index scores.

Variables Possibly Affecting Reported Noise Annoyance

Gender

Analysis was conducted to determine whether there was a relationship between gender and annoyance to noise and displayed in Table 6 (page 67). The mean Visual Analogue Scale control interval score for men was 29.30mm and for women 43.18mm. The mean Baker's Annoyance to ICU Noise Index control scores for males was 39.1 and for females 40.06. An analysis of variance was performed to determine whether the differences were significant. The Mann-Whitney Test revealed U = 107.000, Z= -1.688, p= .0455 indicating a significant difference in the Visual Analogue Scale scores, but no significant difference in the Annoyance to ICU Noise Index scores (U= 156.000, Z=-.128, p=.449).

Gender also appeared to impact on the difference in scores between the control and intervention phases. Men's scores decreased an average of 7.05mm on the Visual Analogue Scale while women's score decreased 9.18mm. As well, men decreased an average of 21.35 on the Annoyance to ICU Noise Index while women decreased an average of 31.12. A Mann-Whitney test was conducted on both sets of data to determine whether variances occurred. Differences were not significantly different for either Visual Analogue Scale (VAS) scores (U=130.500, Z= -.940, P= .1785) or Annoyance to ICU Noise Index Scores (U=129.000, Z= -.991, P=.160).

Table 6: Comparison Between Gender and Annoyance

	VAS Mean	Index Mean	Decrease VAS Mean	Decrease Index Mean
n= 36				
Men	29.30	39.10	7.05	21.35
Women	43.18	40.06	9.18	31.12
Significance	p=0.0445	p=0.449	p=0.1785	p=0.160

Age

Persons in the 80-89 years age range demonstrated the highest scores on the VAS and the Annoyance to ICU Noise Index. This age group also demonstrated the greatest mean decrease in both scores between the control and intervention intervals. Persons in the 50-59 year age group demonstrated the lowest mean scores on both the Visual Analogue Score and the Annoyance to ICU Noise Index. Refer to Table 7 for comparison between ages and annoyance.

Table 7: Comparison Between Age and Annoyance

	Mean VAS Score Control	Mean VAS Score Decrease	Mean Index Score Control	Mean Index Score Decrease
Age Range				
30-39	56	34	36	6
40-49	41.42	25.57	41.42	9.42
50-59	24.50	20.87	36.50	6.12
60-69	30.20	19.40	39.40	8.5
70-79	40.87	33.62	41.00	7.75
80-89	53.00	44.50	41.50	10.00

Prior Exposure to the ICU Environment

Prior exposure to the ICU was analyzed. Participants who had not been a patient in an ICU previously had a mean Visual Analogue Scale control score of 39.08 mm while those who had been in an ICU in the past scored 29.07mm. A

Mann-Whitney Test was conducted to determine the significance of this variation (U= 105.000, A= -1.466, P= .0715). The Annoyance to ICU Noise Index scores were the same at 39.5.

Noise Sensitivity

Participants were asked to complete a 4 item questionnaire to elicit information regarding their perception of noise levels in their home and work environments, their expectation of the noise level in the ICU, and their perception of the noise level of the ICU since their admission. Results are presented in Table 8 (page 70).

Home Environment

The home environment noise level was reported by most patients (58.3%) as being somewhat quiet. Nine (25%) reported their home environment to be extremely quiet while 6 (16.7%) reported a moderately noisy home. None of the participants reported that their home environments were very or extremely noisy. A comparison was made between home noise levels and reported noise levels in the control interval. Patients who reported an extremely quiet home reported a mean Visual Analogue Scale score of 45.66mm while patients who reported somewhat quiet and moderately noisy home environments scored lower. The same trend held true for the Baker's Annoyance to ICU Noise Index scores. The change in scores was greater for both instruments in those with extremely quiet homes than those in the other groups.

Work Environment

The reported noise level of the patients' work environment differed. Nine (25%) said that their work environment was extremely quiet, 13 (36.1%) very quiet, 5 (13.9%) somewhat noisy, 6 (16.7%) very noisy and 3 (8.3%) extremely noisy. Those who reported a somewhat noisy work environment had the highest mean Visual Analogue Scale and Baker's Annoyance to ICU Noise Index scores for the control phase as well as the largest difference for both instruments.

Expectation of Intensive Care Unit Noise Level

Expectation of the environment may factor into the annoyance level perceived by patients. More than half (n=19 or 52%) of the patients expected the ICU to be very quiet. Eight (22.2%) expected the ICU to be extremely quiet and another 8 (22.2%) expected the ICU to be somewhat noisy. Only one (2.8%) participant expected the ICU to be extremely noisy. Those participants who expected the ICU to be extremely quiet had reported mean Visual Analogue Scale and Baker's Annoyance to ICU Noise Index control scores higher than all other categories. As the expectation of noisiness increased the mean annoyance scores decreased for both instruments.

Perceived Intensive Care Unit Noise Level Since Admission

Participants were asked to rank their perception of the noise level experienced since their admission to the ICU. Twenty (55.6%) found the ICU to be very quiet, 14 (38.9%) found it somewhat noisy, 1 (2.8%) found it very noisy and another 1 (2.8%) found it to be extremely noisy. Actual noise levels of the ICU are reported below. As expected, participants who indicated that the unit was extremely noisy scored highest on the Visual Analogue Scale and Baker's Annoyance to ICU Noise Index control intervals. This group also demonstrated the greatest mean difference in both Visual Analogue Scale and Baker's Annoyance to ICU Noise Index scores.

Table 8: Noise Sensitivity

Score	1	2	3	4	5
Home	25% n=9	58.3% n=21	16.7% n=6	0% n=0	0% n=0
Work	25% n=9	36.% n=13	13.9% n=5	16.7% n=6	8.3% n=3
Expectation	22.2% n=8	52% n=19	22.2% n=8	0% n=0	2.8% n=1
Perceived	0% n=0	55.6% n=20	38.9% n=14	2.8% n=1	2.8% n=1

Verbal Reports from Participants

Comments were not elicited by the investigator, however, those comments that were volunteered by the participants were recorded and presented in Table 9 (page 71).

Table 9 : Music Selection and Comments/Observations

contemporary	helped pass the time
contemporary	didn't have to listen to some dude trying to die
contemporary	no comment
classical	this is beauty, when you lay here what you hear is not beauty
contemporary	shuts out the other stuff
contemporary	concentrate on the music not what's going on around me
contemporary	helped me to relax a little
contemporary	no comment
contemporary	you don't have to listen to the other shit
contemporary	no comment
contemporary	nice tape patient fell asleep during intervention
contemporary	fell asleep
contemporary	no comment
contemporary	you can shut your eyes and pretend you're someplace else
contemporary	no comment
contemporary	you can really relax with this
contemporary	fell asleep I need this at night can I keep it
contemporary	that was lovely
contemporary	sure helps pass the time when you're just lying here
contemporary	fell asleep
contemporary	it worked real good
contemporary	no comment
classical	very nice selection
contemporary	sure brings back memories
classical	helps somewhat but nothing can block out all the noise
contemporary	fell asleep
contemporary	took my mind off things
contemporary	no comment
contemporary	not exactly my kind of music but I liked it, it was a distraction
contemporary	no comment
contemporary	no comment
contemporary	you should give this to everyone, a temporary diversion
contemporary	blocked out the other sounds around me
contemporary	no comment
contemporary	if you concentrate on the music you don't hear the other sounds
contemporary	nice but a mellow jazz would be my first choice

SUMMARY

Thirty six subjects completed the study with the data analysis being performed on all participants' data. The typical participant was a retired, male, between the ages of 60 and 69, and admitted for cardiac reasons. For the majority of the participants, this admission was their first to an Intensive Care Unit.

The Radio Shack Digital Sound Level Meter 33-2055 was determined to be a valid and reliable instrument (+/- 2 dBA). Sound levels recorded using the Radio Shack Digital Sound Level Meter 33-2055 were not significantly different between the control and intervention intervals.

Analysis was conducted to test the hypothesis. All subjects reported lower annoyance to Intensive Care Unit noise during the intervention interval as compared to the control interval for both test instruments. The mean difference (decrease) between the control and intervention period as measured by the Visual Analogue Scale was statistically significant ($p<.0001$). The mean difference (decrease) between the control and intervention period as measured by the Modified Baker's Annoyance to ICU Noise Index was statistically significant at ($p<.0001$). The hypothesis was supported.

Strong to moderately strong correlations were demonstrated between the differences for Visual Analogue Scale (Rsq= .835) and the Modified Baker's Annoyance to ICU Noise Index (Rsq= .732), indicating a direct correlation between the intervention and the outcome.

Other variables were examined to explore the relationships between annoyance scores and gender, age, previous admission status, sound levels in the participants' home and work, and expected and perceived noise levels in the ICU.

CHAPTER 5

DISCUSSION, NURSING IMPLICATIONS AND RECOMMENDATIONS

The purpose of any nursing research endeavor is to add to the body of existing knowledge for a particular subject matter. The full implication of the results of a study cannot be conveyed unless the researcher elucidates those findings into practical and conceptual meaning. A discussion of the findings and limitations of this study as well as the implications for nursing practice, education and research are presented in this chapter.

Discussion of the Findings

Environmental noise in the ICU setting has been implicated as a variable that has an affect on the psychologic and physiologic health of patients. While a certain amount of sound is inherent to the ICU setting, the presence of high sound levels may further jeopardize the health of the already compromised critically ill patient. Reduction of noise stimuli is important to the enhancement of ICU patient well-being.

All patients are unique in how they perceive, interpret and respond to sounds. Some patients seem to be oblivious to environmental sounds and therefore noise elicits no reaction; others may react negatively. Negative reaction to noise ranges from minor irritation to annoyance and finally to extreme anxiety or psychosis. It is well known that psychologic stress, even that which is seemingly minor, can exacerbate physiologic problems in the already compromised critically ill patient (Barry, et al., 1988; Gast & Baker, 1989; Hansell, 1984; Helton, et al., 1980; Hoffman et al., 1978; McCarthy, et al., 1991; Webster & Thompson, 1986). While it has been recognized that reduction of noise stimulation in the ICU may enhance the physiologic and psychologic well-being of the patients, resources to achieve this objective have been limited. Research studies focusing on the reduction of ICU noise induced annoyance are also limited.

The purpose of this study was to add to the body of nursing knowledge regarding interventions to reduce noise induced annoyance by answering the question; does listening to 20 minutes of soothing music decrease the noise induced annoyance experienced by adult ICU patients? To determine this, a quasi-experimental design was used. Subjects served as their own controls. Annoyance to ICU noise was measured twice, once following a twenty minute period of exposure to the ICU noise and again following a twenty minute period of listening to soothing music using a Sanyo portable cassette tape player equipped with head phones. Two selections of music were available from which to choose: classical and contemporary. Environmental sound levels were measured during both control and intervention intervals and reported as either background or impulse/intermittent sounds.

Patient Characteristics

Thirty eight (82%) of the 46 of the patients invited to participate in this study utilizing soothing music as an intervention to reduce noise induced annoyance agreed to do so. It was anticipated that a higher number would agree to participate as the study was non-invasive and required minimal time to complete.

Demographic information for the 36 participants who were entered for data analysis was compared to the ICU population during the time period of the study. The distribution of male/female participants was almost identical to that of the ICU patient population. Comparison of age ranges and admission diagnoses demonstrated few similarities. Generalizability of this study's findings to the ICU population can be assumed only on the basis of gender.

Conceptual Framework and Existing Knowledge

Interpretation of the results has little meaning unless placed within the context of the conceptual framework and the existing body of knowledge. Rogers' Science of Unitary Human Beings was the theoretical framework that guided this study. In Rogers' Science of Unitary Human Beings, the unitary human being is the center of focus, with human beings and their environment viewed as irreducible, pan-dimensional energy fields which are integral with one another. Each environmental field is specific to its given human field.

Energy fields are identified by their pattern and organization. Each human field pattern is unique and is integral with its own environmental field. Pattern is the distinguishing characteristic of the field and is perceived as an ever changing single wave. Although patterns cannot be directly observed, manifestations of the pattern are observable. Manifestations of pattern refer to the behaviors, qualities and characteristics of the field. Clusters of pattern manifestation are referred to as pattern profiles. Rogers' conceptual system is concerned with those patterns of the human and environmental energy fields that are associated with maximum well being.

Cowling (1990) suggests that since energy fields are identified by pattern and pattern cannot be perceived directly, manifestations of field pattern are important assessment devices in nursing practice. Assessment of the human field pattern encompasses the environmental field assessment as the two cannot be separated.

Pattern Manifestation Appraisal

According to Barrett (1990 a), the first phase in nursing practice is pattern manifestation appraisal. Appraisal of pattern manifestation focuses on identifying manifestations of the human and environmental fields that relate to current health events.

Environmental Field Pattern Manifestation

In this study, it was assumed that noise is an environmental field pattern manifestation of the ICU. This assumption will now be explored.

Sound levels in the ICU were measured using the Radio Shack Digital Sound Level Meter 33-2055. The instrument demonstrated validity for monitoring the sound levels in the ICU environment. Reliability of the instrument was supported through repeated testing. The results of this testing support the claim of the manufacturer that the Radio Shack Digital Sound Level Meter 33-2055 is accurate within +/- 2 dBA (InterTAN, 1996). This specific instrument was not used by other researchers. Validity and reliability testing of the sound level meters used by Baker (1992), Gast and Baker (1989), Hilton (1985), Minckley (1968), Mishoe et al. (1995), Soutar and Wilson (1986), Topf (1992), Topf and Davis (1993), Woods and Falk (1978), was not reported in the literature, but pre-data collection calibration of the instruments was reported by Baker (1992), Gast and Baker (1989), and Hilton (1985).

Although there is no Canadian standard in existence for noise levels in hospitals, the American Environmental Protection Agency (1974) standards have been widely referred to in the literature. Sound levels greater than 45 dBA during the day shift are considered noise according to that EPA standard. This study demonstrated that acceptable sound levels were greatly exceeded. Sound levels in the ICU were measured during the control and intervention intervals and reported as either background or impulse sounds. Documented background sound levels in the

ICU ranged from 50-69 dBA M 56.93 and 50-66 dBA M 56.71 for control and intervention intervals while intermittent sound levels ranged from 57-84 dBA M 63.44 and 56-70 dBA M 63.34 respectively. Wilcoxon Signed Rank testing revealed that there was no significant difference between control and intervention sound level measurements for either background or impulse sound measurements. When one considers that subjectively, an increase of 10 dB makes a sound seem twice as loud, this ICU is indeed a noisy environment.

The findings of this study corroborate the claim of a number of researchers that environmental noise in the ICU is a great source of sensory stimulation (Hutton & Rea, 1994; Spencely, 1994; Thelan et al., 1990; Zimmerman et al., 1988). Studies conducted by Baker (1992), Gast and Baker (1989), Minckley (1968), Topf (1992), and Woods and Falk (1974) all revealed sound levels above the acceptable EPA standard. Patients occupying a private room versus those in an open concept dormitory style design of unit were still exposed to noise levels that were greater than the EPA acceptable limits (Gast and Baker, 1989). Patients occupying the single private room were not included in the current study.

The relatively close proximity of patients to one another and the nursing work station as well as mechanical equipment operation greatly contributes to the noise levels in the ICU. Noise levels in the Intensive Care Unit varied depending on the patient census and number of ventilated patients at the time of data collection. The lowest patient census was four while the highest was seven. At no time during data collection was the ICU at its full occupancy of eight patients. The mean patient census was 5.7 . Seventeen (47.2%) of the subjects shared the common ICU space with at least one ventilated patient while 5 (13.9%) of the subjects shared the common ICU space with 2 ventilated patients. It was assumed that the noise level would increase as the patient census increased. This assumption held true for background sounds during the control and intervention periods as well as intermittent sounds during the control and intervention periods. While the background sound levels did not change during control and intervention intervals as the number of ventilators increased, the intermittent sound levels were higher when there were two ventilators as opposed to one.

Other studies did not report noise levels in relation to the number of ventilators or patient census. Baker (1992; 1993) reported that as staff numbers increased so did the noise level. Baker (1992; 1993) found that noise levels increased, particularly at change of shift when there was double the usual numbers of staff for the purpose of exchanging verbal report. Number of staff present would have been a interesting variable to document in this current study.

Human Field Pattern Manifestation

All persons are unique in how they perceive, interpret and respond to sound. Some patients seem to be oblivious to environmental sounds and therefore noise elicits no reaction; others may react negatively. The negative reaction investigated in this study was annoyance. The assumption that annoyance is the human field pattern manifestation of the ICU related to the human-environmental field interaction was examined.

The response to noise varies from person to person. All participants in this study indicated some annoyance to the environmental noise although the range on the Visual Analogue Scare scores varied between 3mm and 95mm with a mean of 35.47mm. Items perceived as annoying on the Modified Baker's Annoyance to ICU Noise Index also varied from subject to subject. Sounds that were considered annoying to subjects in the Baker's Annoyance to ICU Noise Index were rank ordered and included: loud talk laughing and shouting, alarms ringing (constant), staff talking about other patients, alarm ringing (beeping), moving furniture, public address system/pagers, staff talking personal, staff talking to other patients, other patient sounds of distress, other sounds (people), other sounds (non person), visitors talking, televisions, telephones, squeaking wheels and hinges, staff doing a task, other patient sounds not distressed, movement sounds, equipment carts moving, staff preparing to do a task, moving a patient into or out of ICU, objects dropped, toilets flushed, water running, oxygen running, equipment operating, doors opening/closing, computer sounds, heating cooling system. None of the subjects reported annoyance to the sounds of housekeeping/cleaning.

These findings support those reported by Gast and Baker (1989) in their study examining the relationship between noise, state anxiety and annoyance. Their findings revealed that increased annoyance was attributed to an interruption factor with equipment and people generated noise reported as the most bothersome. Byers and Smyth (1997) reported that noise generated from staff, particularly laughing and inappropriate conversation, and equipment operation most annoying. Topf (1985) also reported that people generated sounds were the most disturbing to hospitalized post-operative male patients.

It has been reported that personal characteristics may have an impact on the perceived noisiness of a sound stimulus (Baker, 1994; Baker, 1993; Gast and Baker, 1989; Topf, 1985). The personal characteristics examined in this study included gender, age, previous admission to an ICU, length of stay, and noise sensitivity.

Differences between the perception of noise as an annoyance is noted between men and women who participated in this study. Female participants (n=16) scored significantly higher on the Visual Analogue Scale with a mean score of 43.1875 mm while male participants (n=20) reported a mean Visual Analogue Scale score of 29.30mm. Similar findings were demonstrated in scores from the Baker's Annoyance to ICU Noise Index with women having slightly higher scores than men. These findings contradict those of Snook (1964) who found that patients most annoyed by hospital noise were men. Gender differences were not reported by Baker

(1993), Gast and Baker (1989) or Byers and Smyth (1997). No significant differences between genders were found by Elliot (1994) in his study using a music intervention to reduce anxiety.

A tentative explanation for the observation that men seemed less annoyed by the noise than females may be related to the perception of control over the environment. Sherrod, Hage, Halpern and Moore (1977) in their study of the effects of personal causation and perceived control in response to an aversive environment found that those who believed that they could exert some control over their environment were less distracted during complex tasks than those who believed they were helpless. Lindquist, Jeffery, Johnson and Haus (1985) suggest that as perceptions of control increase, stress decreases and mental and physical adjustment may be enhanced. Men may believe that they have a degree of control whereas women may fall into the believed helplessness category. Further research into the area of perceived control and helplessness is required to support this assumption.

The relation between the age of the patient and the Visual Analogue Scale and Baker's Annoyance to ICU Noise Index scores was of interest. Rank ordering of the Visual Analogue Scale scores according to age range were 30-39, 80-89, 40-49,70-79, 60-69 and 50-59. Rank ordering of the Baker's Annoyance to ICU Noise Index scores according to age range were 80-89, 40-49, 70-79, 60-69,50-59, 30-39. With the exception of the 30-39 year age group, the annoyance scores on both Visual Analogue Scale and Baker's Annoyance to ICU Noise Index were related. Plausible explanations for the discrepancies between the Visual Analogue Scale and Baker's Annoyance to ICU Noise Index score in the 30-39 year old age group (n=1) could be either social desirability or being aware of a noise causing annoyance but being unable to identify the noise source. Participants in the oldest age group (80-89) tended to be the most annoyed by the ICU noise. Again this contradicts the findings of Snook (1964) who identified persons in the age range of 50-59 years as most annoyed by noise stimuli. Participants over the age of 75 years were excluded in Byers and Smyth's (1997) study due to a generalized assumption of decreasing hearing acuity in this age group, however subjects in the 80-89 year age group in this study were able to hear the spoken word without the benefit of hearing assistive devices and demonstrated the greatest annoyance to noise. No significant differences between age groups were reported by Elliot (1994) in his study using a music intervention to reduce anxiety.

It was demonstrated that exposure to ICU noise as a previous inpatient may determine the level of annoyance one perceives. Subjects who had never been a patient in an ICU (n=23) scored higher on the Visual Analogue Scale (39.0870mm) and Baker's Annoyance to ICU Noise Index (39.5652) than those who had been exposed to ICU noise in the past. Subjects who had prior exposure to ICU noise scored 29.0769mm on the Visual Analogue Scale and 39.4615 on the Baker's Annoyance to ICU Noise Index respectively. No other study reported the relationship between past internment in an ICU and noise annoyance although Byers and Smyth (1997) included prior ICU exposure in their patient demographics. A plausible explanation is that perhaps those patients with prior exposure to ICU noise had a more realistic expectation of the noise levels present in intensive care units. As well, the sounds are no longer divorced of meaning therefore decreasing the annoyance aspect.

It should be noted that this trend in the above mentioned findings did not stand true with length of stay in the ICU. Annoyance to ICU noise did not demonstrate a downward trend with increasing length of stay as might be expected had patients become habituated to sounds. No significant differences were found by Elliot (1994) in his study using a music intervention to reduce anxiety based on length of stay in the CCU.

Several researchers examined the relationship between sensitivity to noise and the variables under study. Participants in this study answered questions related to the sound levels in their home and work environments, their expectation of the noise level in the ICU and their overall perception of the noise level since their admission to the ICU. It was assumed that patients with quiet homes and workplaces and those who expected the ICU to be quiet would be more sensitive to the sounds and therefore more annoyed by the noise.

This study revealed that those patients who had quiet homes scored highest on the Visual Analogue Scale and Baker's Annoyance to ICU Noise Index. As well those who expected the ICU to be quiet were again most annoyed by the noise levels. These findings are supportive of Topf's assertion that those patients with reported high noise sensivity scores are more likely to react negatively to environmental noise.

Deliberative Mutual Patterning

Deliberative mutual patterning is the continuous process whereby the nurse with the client patterns the environmental field to promote harmony related to the health events. Listening to twenty minutes of soothing music is a mutual deliberative environmental field pattern alteration.

Subjects listened to a 20 minute music selection with a Sanyo portable cassette tape player equipped with head phones. Subjects controlled the volume according to their own preferences and comfort level. Two selections of music were available: classical and contemporary. Only three subjects, one man and two women, chose the classical music tape. Comments about the music selections were positive although two subjects stated that neither of the selections would have been their first choice. One would have chosen mellow jazz whereas the other did not specify the music selection of choice. Other researchers have commented that personal preference should be taken into consideration when designing a music therapy intervention (Chlan, 1998; Guzzetta, 1988).

Comments volunteered by the subjects revealed that the response to the music intervention was relaxing. While anecdotal in nature, these responses correspond with the findings of other researchers who noted increased relaxation while listening to music (Chlan, 1998; Cook, 1986; Davis-Rollins & Cunningham, 1987; Guzzetta, 1989; Leuders-Bolwerk, 1990; White, 1992). Guzzetta (1989) notes that one the elements in achieving relaxation is a quiet environment. On the other hand, Barnason, et al. (1995), Elliot (1994), and Zimmerman et al.(1988) did not find significant increases in relaxation. It should be noted that subjects were provided with only classical music in these three studies, which may not have been their personal preference.

Several of the participants commented that the music helped them to pass the time. This thought was shared by participants who listened to music during chemotherapy and radiation therapy and during operative procedures in studies reported by Cook (1986) and Eisenman and Cohen (1995) .

Other participants remarked that the music provided a pleasant experience for them by eliciting pleasant memories from their past, fantasizing about being elsewhere or concentrating on the "beauty" of the music itself . An altered perception of the ICU experience was found in comments from studies conducted by Cook (1986), Davis-Rollins and Cunningham (1987) and Guzzetta (1989).

The most common theme that emerged from the participant comments was that of the music intervention being a perceptual masking technique. While reports of blocking out other sounds and not hearing the other sounds were common, the most profound statement was from a subject who participated in the study while a cardiac arrest resuscitation was occurring in a neighbouring bed. His comment was "I didn't have to listen to some dude trying to die". The idea of music being a perceptual masking technique was also brought forth by patients exposed to the noise of Betatron radiation treatments (Cook, 1986) and patients undergoing surgery using local or regional anesthetic (Eisenman and Cohen,1995).

An interesting observation in this study was that four of the subjects, all men, were observed to fall asleep during the music intervention. This is, in itself, an important clinical finding. One patient stated that he needed the intervention at night and requested to keep the tape. Whether this phenomenon is due to the relaxing effect of the music or the perceptual masking is unknown at this time. Eisenman and Cohen (1995) also found that soothing music lulled some of their subjects to sleep during operative procedures using local or regional anesthetic.

The Study Hypothesis

In the context of Unitary Human Beings, it can be postulated that the ICU patient and the ICU are not separate entities, but energy fields that are in constant interaction with one another. These energy fields have unique patterns. It can be deduced that sound in the ICU environment energy field displays a pattern manifestation of noise, and annoyance is the human field pattern manifestation of the ICU noise related to the human-environment field interaction. A testable theorem derived from this proposition was that alteration of the environmental energy field pattern through the use of soothing music would alter the human energy field pattern manifestation of annoyance. The effect of ICU noise on annoyance was measured using a 100mm vertical Visual Analogue Scale and an adaptation of Baker's Annoyance to Intensive Care Unit Noise Index (Gast and Baker, 1989). The Visual Analogue Scale and the modified Baker's Annoyance to ICU Noise Index provided a measure of the annoyance to ICU noise and were utilized as instruments to test the efficacy of music as mutual deliberative pattern alteration. The hypothesis for this study was:

> Twenty minutes of soothing music will significantly reduce noise induced annoyance of adult intensive care unit patients as measured by a Visual Analogue Scale and the Modified Baker's Annoyance to ICU Noise Index.

Analysis of the data included: Wilcoxon Signed Ranks to test the hypothesis that annoyance to ICU noise was significantly decreased during the intervention phase as compared to the control phase, simple linear regression analysis to determine if the music intervention significantly affected the reported noise annoyance, and a Wilcoxon Signed Ranks to determine if there were significant differences in sound levels between the control and intervention intervals. Analysis of the data revealed the following: a significant decrease in annoyance to ICU noise following the music intervention as reported on the Visual Analogue Scale and Baker's Annoyance to ICU Noise Index, and a strong relationship between the intervention and the decreased annoyance to noise reported in the intervention phase. These findings strongly support that of Byers and Smyth (1997) who also reported a significant reduction in noise annoyance in cardiac surgery patients. There was no significant difference in the sound levels between the control and intervention intervals.

The assumption that alteration in the environmental field pattern by listening to 20 minutes of soothing music will, by virtue of mutual process, alter the human field pattern manifested by annoyance to ICU noise has been demonstrated. The homeostatic principle of integrality is validated.

Limitations

Despite the encouraging outcomes, limitations which may have inadvertently weakened the validity of the findings must be taken into consideration when viewing the results of this study. Several are listed in this section.

The inability of the researcher to obtain a sound measurement instrument that provided a continuous printout of the sound levels in the ICU may have led to inaccurate reporting of those sound levels. The researcher relied upon visualization of the digital read out on the Radio Shack Sound Level Meter and manually recorded the sound levels on the data collection record.

A second limitation related to the sound level measurements is based on this researcher's prior and prolonged exposure to ICU sounds. Working in the ICU environment for 18 years may have caused habituation to the ambient sounds, therefore errors in perception of the sounds both within and between subjects is recognized as a possible source of error. The use of a second investigator to verify sound level measurements would have added validity to the sound level data.

Reactivity to the testing may have occurred on the part of the subjects as well as ICU staff members working at the time of data collection. Subjects may have provided responses which they deemed to be acceptable to the researcher. Pre data collection testing for social desirability of the subjects may have reduced this limitation. Subjects may have been more heightened to or aware of the sounds when asked specifically about the sound sources during the intervention phase due to a carryover effect related to the study design. Sound levels may have been lower than in reality as ICU staff members were heard on several occasions to comment they should be quiet when the investigator was measuring sound levels.

Hearing acuity was not tested on each of the subjects prior to data collection. The observation that the subject could hear and respond appropriately to the spoken word was the criteria used by this researcher. Patients with a documented hearing loss or those using hearing assistive devices were not invited to participate.

The effect of medications on the response of the subjects was a variable for which there was no control. Several of the subjects received anxiolytics and/or narcotics prior to data collection. The effect of these medications may have reduced the response of the subjects to the sound stimulus.

Minor modifications were made to Bakers's Annoyance to ICU Noise Index that were specific to the time of day and this ICU within which the data were collected. Use of this instrument may have resulted in measurement error as testing for content validity and reliability of the modifications was not conducted.

Listening to the music selection with headphones is a limitation that must be taken into consideration. It is unknown whether the reduction in noise annoyance is due specifically to the music intervention or related to the ears being occluded by the headphones. Further investigation is required to alleviate this limitation.

Finally, the results of this study pertain to relatively stable non ventilated ICU patients in an open concept, 8 bed ICU during the day and evening shift. The results cannot be generalized to patients whose current condition is life threatening, are assisted with a ventilator, or who are located in an ICU that has private or semi-private rooms or cubicles.

Implications for Nursing Practice, Education, and Research

"One of the oft-repeated laments of nurse researchers is that research findings do not find their way into the clinical practice of nurses. The belief has been expressed that there is a gap between knowledge verified by research and its use by the practitioner" (Notter and Holt, 1988, p.23). Nursing educators should share the responsibility of bridging the gap between research and practice by promoting the use of evidence based knowledge in their clinical teaching. Exposure to, and evaluation and implementation of research findings often leads to further questions that may be answered through the research process. In this section the implications of this study for nursing practice, education and research will be discussed.

Nursing Practice

Nursing practice is based on the nursing process which contains four phases: assessment, planning, intervention and evaluation. The results of this study have implications for each of these elements.

Nurses admitting patients to the ICU complete an initial assessment prior to planning the care that they deliver. Included in the initial assessment should be an appraisal of the patients' noise sensitivity as well as their past exposure to the ICU environment. Results of this study suggest that patients with a high sensitivity to noise and first time patients in ICU are most annoyed by the ICU sounds.

Once the assessment is completed nursing staff may then determine what action may be taken to reduce the exposure to noise annoyance. Patients predisposed to noise annoyance may be placed in private rooms if the unit design allows, or away from ventilated patients, the central nursing/work stations or areas that generate high noise levels. Alternate strategies such as earplugs or the use of soothing music may be a component added to the nursing care plan.

Nurses working in ICUs are aware that noise is an element of that environment. With the exception of the use of earplugs and being conscious of the volume of voice and alarms nurses have had few resources at their disposal to reduce noise induced annoyance. The results of this study support the use of soothing music as an intervention to reduce noise induced annoyance in adult ICU patients. Of particular interest to nurses may be the use of music to block out the unpleasant and possibly anxiety producing sounds of cardiac resuscitation events that occur frequently in critically ill patient populations.

It was noted that four patients fell asleep during the music intervention which may have implications for nursing practice. Soothing music may be offered to patients as an adjuct to or instead of sedation or during the patients' rest period or at night.

Evaluation of these interventions is the final phase of the nursing process. Patients who do not respond to one selection of music may be offered a different style of music according to their own preferences, as the efficacy of the intervention is determined to a great extent by how well the individual relates to the music.

Nursing Education

Nurse educators at the basic level and those who teach in advanced critical care programs are in a position to instill in nurses an awareness of the negative impact that a highly technological environment may have on patients. The courage to use alternative, non traditional methods of treatment in the care of the critically ill patient can be encouraged.

Although nurses currently working in an ICU environment may be aware of the noise levels that general conversation produces, there may be a lack of awareness the content or context of conversation and not the sound level itself is most bothersome. Efforts of inservice or education instructors within institutions should focus on the effects of such sound levels on patient well-being.

Education instructors in institutions are in a position to disseminate information gleaned from and espouse the use of sound research findings in daily nursing practice. Development of a nursing protocol should be based on research presented in the literature.

Nursing Research

When conducting the literature search for this study, it was revealed that while music has been used as an intervention for a variety of patient populations and problems, only one study was located that specifically examined the use of soothing music as an intervention for noise induced annoyance in adult ICU patients. The limited number of studies and the limitations related to this present study's sample size and demographic characteristics indicate a need to confirm these findings with larger samples and more critically ill patient populations.

Several suggestions for research emerge from this study. It was observed that male subjects demonstrated less annoyance to noise than female subjects in the control phase, yet women demonstrated a greater decrease in the noise annoyance during the intervention phase. Such differences cannot be ignored. Exploration of the attributes possessed by male and female patient populations may provide cues as to the coping or control mechanisms practiced to reduce the annoyance factor.

The results of this study indicate that a single 20 minute music intervention was effective in reducing noise induced annoyance. The use of a music intervention over a longer periods of time or at repeated intervals should be studied to determine whether the annoyance scores would decrease further or if the music will itself become a noise stimulus.

The observation that four of the patients fell asleep during the music intervention indicates a need to further explore the use of soothing music as a non-pharmacologic adjunct to or replacement for sedative medications.

While the results of this study have been encouraging, it cannot be deduced that the music therapy alone contributed to the decrease in annoyance scores. Occluding the ears through the use of headphones may have in itself, effectively blocked the sound source. Studies comparing the use of music via head phones and earplugs need to be conducted.

Finally, the comments volunteered by patients after the music intervention are a rich source of data for qualitative research. The present quantitative study demonstrates that soothing music may be a promising intervention to reduce noise induced annoyance. The next logical step would be to explore how and why this intervention is effective.

CONCLUSION

The purpose of this study was to determine whether listening to 20 minutes of soothing music would decrease noise induced annoyance experienced by adult ICU patients measured using a visual analogue scale and a modification of Baker's Annoyance to ICU noise index. To demonstrate a decrease in noise induced annoyance, the intervention interval scores reported on the visual analogue and modification of Baker's Annoyance to ICU noise index would have to be consistently lower than the scores reported during the control interval. The findings from this study suggest that noise induced annoyance was decreased while listening to 20 minutes of soothing music. This conclusion is supported by the statistically significant differences in both Visual Analogue Scale scores and modified Baker's Annoyance to ICU Noise Index scores between control and intervention intervals, as well as high and moderately high correlations between the intervention and the outcome. The findings of this study support that of Byers and Smyth (1997) who determined that annoyance to ICU noise was decreased by listening to music in the post cardiac surgical intensive care unit patient population.

The results of this study, when viewed within the context of the limitations presented, reveal that the use of soothing music may be a promising intervention to reduce noise induced annoyance in the adult ICU patient population. The findings of this study cannot be generalized to non adult patient populations, intubated and ventilated patients or other ICU designs; further investigations are required to determine the appropriateness of the use of soothing music to reduce noise induced in these situations.

REFERENCES

References

Baker, C.F. (1992). Discomfort to environmental noise: Heart rate responses of SICU patients. Critical Care Nursing Quarterly, 15(2), 75-90.

Baker, C.F. (1993). Annoyance to ICU noise: A model of patient discomfort. Critical Care Nursing Quarterly, 16(2), 83-90.

Baker, C.F. (1984). Sensory overload and noise in the ICU: Sources of environmental stress. Critical Care Quarterly, 1984(March), 66-80.

Barnason, S., Zimmerman, L., & Nieveen, J. (1995). The effects of music intervention on anxiety in the patient after coronary artery bypass grafting. Heart & Lung, 24(2), 124-132.

Barrett, E.A.M. (1990 a). Rogers' science-based nursing practice. In E.A.M. Barrett (Ed.), Visions of Rogers' science-based nursing (pp. 31-44). New York: National League for Nursing.

Barrett, E.A.M. (1990 b). Rogerian patterns of scientific inquiry. In E.A.M. Barrett (Ed.), Visions of Rogers' science-based nursing (pp. 169-187). New York: National League for Nursing.

Barry, J. Selwyn, A.P. & Nabel, E.G. (1988). Frequency of ST segment depression produced by mental stress in stable angina patients from coronary artery disease. American Journal of Cardiology, 61, 989-993.

Burke, M., Walsh, J., Oehler, J., & Gingras, J. (1995). Music therapy following suctioning: Four case studies. Neonatal Network, 14(7), 41-49.

Byers, J & Smyth, K.A. (1997). Effect of a music intervention on noise annoyance, heart rate, and blood pressure in cardiac surgery patients. American Journal of Critical Care, 6,(3), 183-191.

Canadian Association of Critical Care Nurses (1997). Standards for critical care nursing practice.

Caunt, H. (1992). Preoperative nursing intervention to relieve stress. British Journal of Nursing, 1(4), 171-173.

Chenoweth, V. (1972). Melodic perception and analysis. Papua, New Guinea: Summer Institute of Linguisitics.

Chlan, L. (1998). Effectiveness of a music therapy intervention on relaxation and anxiety for patients receiving ventilatory assistance. Heart and Lung, 27(3), 169-176.

City of Winnipeg Municipal Bylaws Noise Nuisance 79-2480 Amended 1995

Cohen, S. & Weinstein, N. (1982) Nonauditory effects on noise on behavior and health in G.W. Evans (Ed.) Environmental Stress. New York: Cambridge University Press

Collins, S.K. & Kuck, K. (1991). Music therapy in the neonatal intensive care unit. Neonatal Network, 9(6), 23-26.

Cook, J.D. (1981). The therapeutic use of music: A literature review. Nursing Forum, 20 (3), 252-266.

Cook, J.D. (1986). Music as an intervention in the oncology setting. Cancer Nursing, 9(1), 23-28.

Cowling, W.R. (1990). A template for unitary pattern-based nursing practice. In E.A.M. Barrett (Ed.), Visions of Rogers' science-based nursing (pp. 45-66). New York: National League for Nursing.

Davis-Rollins, C. & Cunningham, S.G. (1987). Physiologic responses of coronary care patients to selected music. Heart & Lung, 16(4), 370-378.

Eisenman, A. & Cohen, B. (1995). Music therapy for patients undergoing regional anaesthesia. AORN, 62(6), 947-950.

Elliot, D. (1994). The effects of music an muscle relaxation on patient anxiety in a coronary care unit. Heart & Lung, 23(1), 27-35.

Environmental Protection Agency (1974). Information on levels of environmental noise requisite to protect public health and welfare with an adequate margin of safety. Washington DC: Environmental Protection Agency.

Evans, J.C. & French, D.G. (1995). Sleep and healing in intensive care settings. Dimensions of Critical Care Nursing, 14(4), p. 189-199.

Frank, J.M. (1995). The effects of music therapy and guided visual imagery on chemotherapy induced nausea and vomiting. Oncology Nursing Forum, 12(5), 47-52.

Gaberson, K.B. (1995). The effects of humorous and musical distraction on preoperative anxiety. AORN Journal, 62(5), 784-791.

Gast, P.L. & Baker, C.F. (1989). The CCU patient: Anxiety and annoyance to noise. Critical Care Nursing Quarterly, 12(3), pp. 39-54.

Glass, D.G. and Singer, J.E. (1972). Urban Stress: Experiments on Noise and Social Stressors. New York: Academic Press.

Green, G. (1969). The Artists of Terezin. New York: Hawthorn Books Inc.

Griffin, J.P. (1992). The impact of noise on critically ill people. Holistic Nursing Practice, 8(4), 53-56.

Guzzetta, C.E. (1988). Music therapy: Hearing the melody of the soul. In B. Montgomery Dossey, L. Keegan, C.E. Guzzetta, & L. Gooding Kolkmeier, Holistic nursing: A handbook for practice (pp. 263-288). Rockville, Md: Aspen Publishers Inc.

Guzzetta, C.E. (1989). Effects of relaxation and music therapy on patients in a coronary care unit with presumptive acute myocardial infarction. Heart & Lung, 18(6), 609-616.

Guzzetta, C.E. (1991). Music therapy: Nursing the music of the soul. in D. Campbell (Ed.), Music: Physician for Times to Come (pp. 146-166). London: Quest Books.

Hansell, H.N. (1984). The behavioural effects of noise on man: The patient with "intensive care unit psychosis". Heart & Lung, 13(1), 59-65.

Hedden, S.K. (1980). Psychoacoustical parameter of music. In D. A. Hodges (Ed.) Handbook of Music Psychology. Lawrence, Kansas: National Association for Music Therapy.

Helton, M.C., Gordon, S.H & Nunner, S.L. (1980). The correlation between sleep deprivation and he ICU syndrome. Heart & Lung, 9 (3), 464-468.

Henry, L.L. (1995). Music therapy: A nursing intervention for the control of pain and anxiety in the ICU: A review of the research literature. Dimensions of Critical Care Nursing, 14(6), 295-304.

Hilton, B.A. (1985) Noise in acute patient care areas. Research in Nursing and Health, (8), pp 283-291

Hoffman, M., Donker, S. & Hauser, M. (1978). The effect of nursing interventions on stress factors perceived by patients in a coronary care unit. Heart & Lung, 7(5), 804-809.

Holy Bible (Revised Standard Version, 1952). Toronto: Thomas Nelson and Sons.

Hutton, D. & Rea, E. (1994). Iatrogenic nursing: Critical care psychosis in the elderly client. Official Journal of CACCN, 5(1), 22-24.

InterTAN Inc. (1996). Owners Manual: Radio Shack Digital Sound Level Meter 33-2055

Kaempf, G. & Amodei, M.E. (1989). The effect of music on anxiety. AORN Journal, 50(1), 112-118.

Kenner, C.V., Guzzetta, C.E. & Dossey, B.M. (1985). Critical care nursing: Body, mind spirit (pp. 151-78). Toronto: Little, Brown and Company.

Kryter, K.D. (1972). Non-auditory effects of environmental noise. American Journal of Public Health, (March). pp 389-398.

Leonard, J.E. (1993). Music therapy: Fertile ground for application of research in practice. Neonatal Network, 12(2), 47-48.

Leuders Bolwerk, C.A. (1990). Effects of relaxing music on state anxiety in myocardial infarction patients. Critical Care Nursing Quarterly, 13(2), 63-72.

Lindquist, R.D., Jeffery, R.W., Johnson, C.A. and Haus, E. (1985). The stress of patient adjustment to the coronary care unit as related to perceptions of personal control and control preference. Heart and Lung, 14(3), 297-298.

McCarthy, D.O., Ouimet, M.E. & Daun, J.M. (1991). Shades of Florence Nightingale: Potential impact of noise stress on wound healing. Holistic Nursing Practice, 5(4), 39-48.

McGreevy Steelman, V. (1990). Intraoperative music therapy. AORN Journal, 52(5), 1026-1034.

Meredith, C. & Edworthy, J. (1995). Are there too many alarms in the intensive care unit? An overview of the problems. Journal of Advanced Nursing,(21), p. 15-20.

Minckley, B.B. (1968). A study of noise and its relationship to patient discomfort in the recovery room. Nursing Research, 17(3), 247-250.

Mishoe, S.C., Worth Brooks, C., Dennison, F.H., Hill, K.V. & Frey, T. (1995). Octave wave band analysis to determine sound frequencies and intensities produced by nebulizers and humidifiers used with hoods. Respiratory Care, 40(11), 1120-1124.

Mishoe, S.C. (1995). Quiet - hospital zone: Why we should reduce noise levels in the hospital. Respiratory Care, 40(11), 1116-1117.

Moorby, C.V. (1992). [Effects of soothing music on noise induced annoyance in CCU patients]. Unpublished pilot study.

Moss, V.A. (1988). Music and the surgical patient: the effect of music on anxiety. AORN Journal, 48(1), 64-69.

Newman, M. (1983). The continuing revolution: A history of nursing science. In N. Chaska The nursing profession: A time to speak (pp. 385-393). Toronto: McGraw-Hill.

Nightingale, F. (1992). Notes on nursing: What it is and what it is not (Commemorative ed.) Philadelphia: J.B. Lippincott. [Original work published 1859].

Notter, L.E. and Holt, J.R. (1988). Essentials of nursing research (4th ed). New York: Springer Publishing Company.

Parker, K.P. (1995). Promoting sleep and rest in critically ill patients. Critical Care Nursing Clinics of North America, 7(2), 337-349.

Passero, K. (1996). Songs that lift your spirits. First for Women, September 16, 1996, 26-27.

Pierce, J.R. (1992). The science of musical sound (rev. ed.). New York: W.H. Freeman and Company.

Plato (1955). The republic (H.D.P. Lee, Trans.). London: The Whitefriars Press Ltd. (Original work published n.d.)

Polit, D.F. & Hungler, B.P. (1991). Nursing research: Principles and methods (4th ed.)
Philadelphia: J.B. Lippincott Company.

Rogers, M.E. (1986) Science of unitary human beings. In V.M. Malinski (Ed.) Explorations on Martha Rogers' science of unitary human beings (pp. 3-8). Norwalk: Appleton-Century-Crofts.

Rogers, M.E. (1994). The theoretical basis of nursing. In V.M. Malinski & E.A.M. Barrett (Eds.), Martha Rogers: Her life and her work (pp. 220-224). Philadelphia: F.A. Davis Company.

Schuberg, C.H. (1981). The Music Therapy Source Book (pp.13-21). New York: Human Sciences Press.

Sherrod, D.R., Hage, J.N., Halpern, P.L. and Moore, B.S. (1977). Effects of personal causation and perceived control on responses to an aversive environment: The more control, the better. Journal of Experimental Social Psychology (13), 14-27.

Simpson-Wilson, V. (1987). Identification of stressors related to patients' psychologic responses to the surgical intensive care unit. Heart & Lung, 16(3), p. 267-273.

Snook, I. (1964). Noise that annoys. Nursing Outlook, 12 , 33-35.

Sommargren, C.E. (1995). Environmental hazards in the technological age. Critical Care Nursing Clinics of North America, 7(2), 287-295.

Soutar, R.L. & Wilson, J.A. (1986). Does hospital noise disturb patients. British Journal of Medicine, 292(6516), 305.

Spenceley, S.M. (1993). Sleep inquiry: A look with fresh eyes. Image: Journal of Nursing Scholarship, 25(3), 249-256.

Spies Pope, D. (1995). Music, noise and the human voice in the nurse-patient environment. Image: Journal of Nursing Scholarship 27(4), 291-296.

Stevens, K. (1990). Patients'' perceptions of music during surgery. Journal of Advanced nursing, (15), 1045 -1051.

Thelan, L.A., Davie, J.K. & Urden, L.D. (1990). The textbook of critical care nursing: Diagnosis and management. Toronto: C.V. Mosby Company.

Topf, M. (1994), Theoretical considerations for research on environmental stress and health. Image: The Journal of Nursing Scholarship, 26(4), p. 289-293.

Topf, M. (1992). Effects of personal control over hospital noise on sleep. Research in Nursing and Health, (15), 19-28.

Topf, M. (1988). Noise-induced occupational stress and health in critical care nurses. Hospital Topics 66(1), pp. 30-34

Topf, M. (1985). Personal and environmental predictors of patient disturbance due to hospital noise. Journal of Applied Psychology, 70(1) pp 22-28.

Topf, M. (1984). A framework for research on aversive physical aspects of the environment. Research in Nursing and Health, (7), pp 35-42

Topf, M. & Davis, J.E. (1993). Critical care unit noise and rapid eye movement (REM) sleep. Heart & Lung, 22(3), 252-258.

Topf, M. & Dillon, E. (1988). Noise induced stress as a predictor of burnout in critical care nurses. Heart & Lung, 17(5), pp 567-574.

Updike, P. (1990). Music therapy results for ICU patients. Dimensions of Critical Care Nursing, 9(1), 39-45.

Walker, L.O. & Avant, K.C. (1988). Strategies for Theory Construction in Nursing (2nd ed.). Norwalk: Appleton and Lange.

Webster's New Collegiate Dictionary (1973) Toronto: Thomas Allen and Son Limited.

Webster's Thesaurus (1993), Ashland Ohio: Landoll Inc.

Webster, R.A. & Thompson, D.R. (1986). Sleep in hospital. Journal of Advanced Nursing, (11), 447-457.

Weinstein, N.D. (1978). Individual differences in reactions to noise: A longitudinal study in a college dormitory. Journal of Applied Psychology, 63(4) pp 458-466

Whipple, B. & Glynn, N.J. (1992). Quantification of the effects listening to music as an noninvasive method of pain control. Scholarly Inquiry for Nursing Practice: An International Journal, 6(1), 43-58.

White, J.M. (1992). Music therapy: An intervention to reduce anxiety in the myocardial infarction patient. Clinical Nurse Specialist, 6(2), 58-63.

Williams, M.A. (1989). Physical environment of the intensive care unit and elderly patients. Critical Care Nursing Quarterly, 12(1), 52-60.

Williams, M. and Murphy, J.D. (1991). Noises in critical care units: A quality assurance approach. Journal of Nursing Care Quality, 6(1), p. 53-59.

Wilson, H. (1987). Introducing research in nursing. Don Mills, Ontario: Addison-Wesley Publishing Company.

Woods, N.F. & Falk, S.A. (1974). Noise stimuli in the acute care area. Nursing Research, 23(2), 144-150.

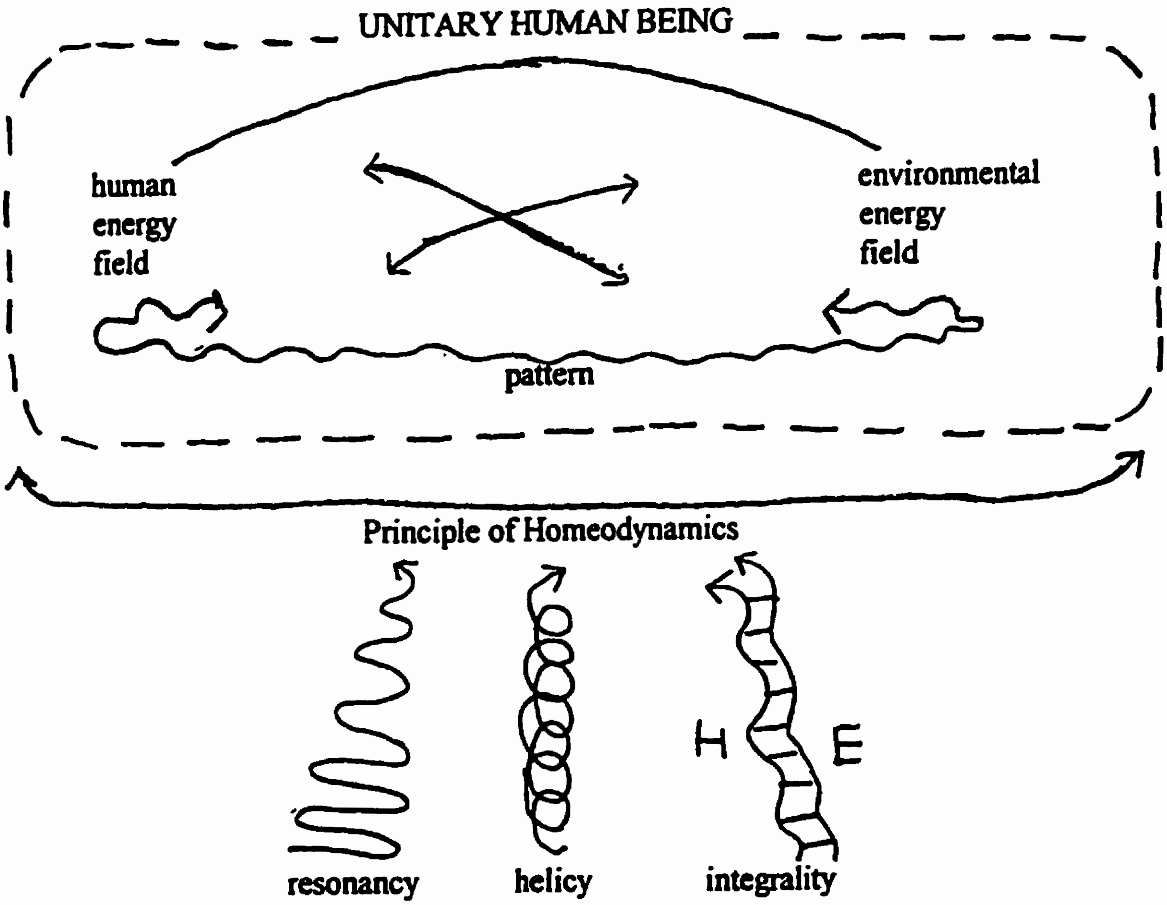
Workplace Safety and Health Act (C.C.S.M.c. W210), Manitoba regulation 103/88 R Respecting hearing conservation and noise control. January 29 1988. Queen's Printer for the Province of Manitoba

Zimmerman, L.M., Pierson, M.A. & Marker, J. (1988). Effects of music on patient anxiety coronary care units. Heart & Lung, 17 (5), 560-566.

APPENDICES

Appendix A

Figure 1: Schemata of Rogers' Science of Unitary Human Beings



Appendix B

Figure 2: Schemata of Concept and Construct Interaction

Mutual deliberative environmental patterning *Soothing music*	ICU enviromental pattern manifestation *Noise*
Repattern for Integrality *Decreased annoyance*	Human pattern manifestation *Annoyance*
Lower score on visual annalogue scale and modified Baker's Annoyance to ICU Noise Index	Higher score on visual annalogue scale and modified Baker's Annoyance to ICU Noise Index

Appendix C

Music Selections

Classical

Canon in D	Pachelbel
Moonlight Sonata, Opus 27, No. 2	Beethoven
Air in C on the G string	Bach
Traumerei	Schumann

Contemporary

Arranged and performed by Lorie Line

Theme from Prince of Tides

Theme from Robin Hood Prince of Thieves Everything I Do

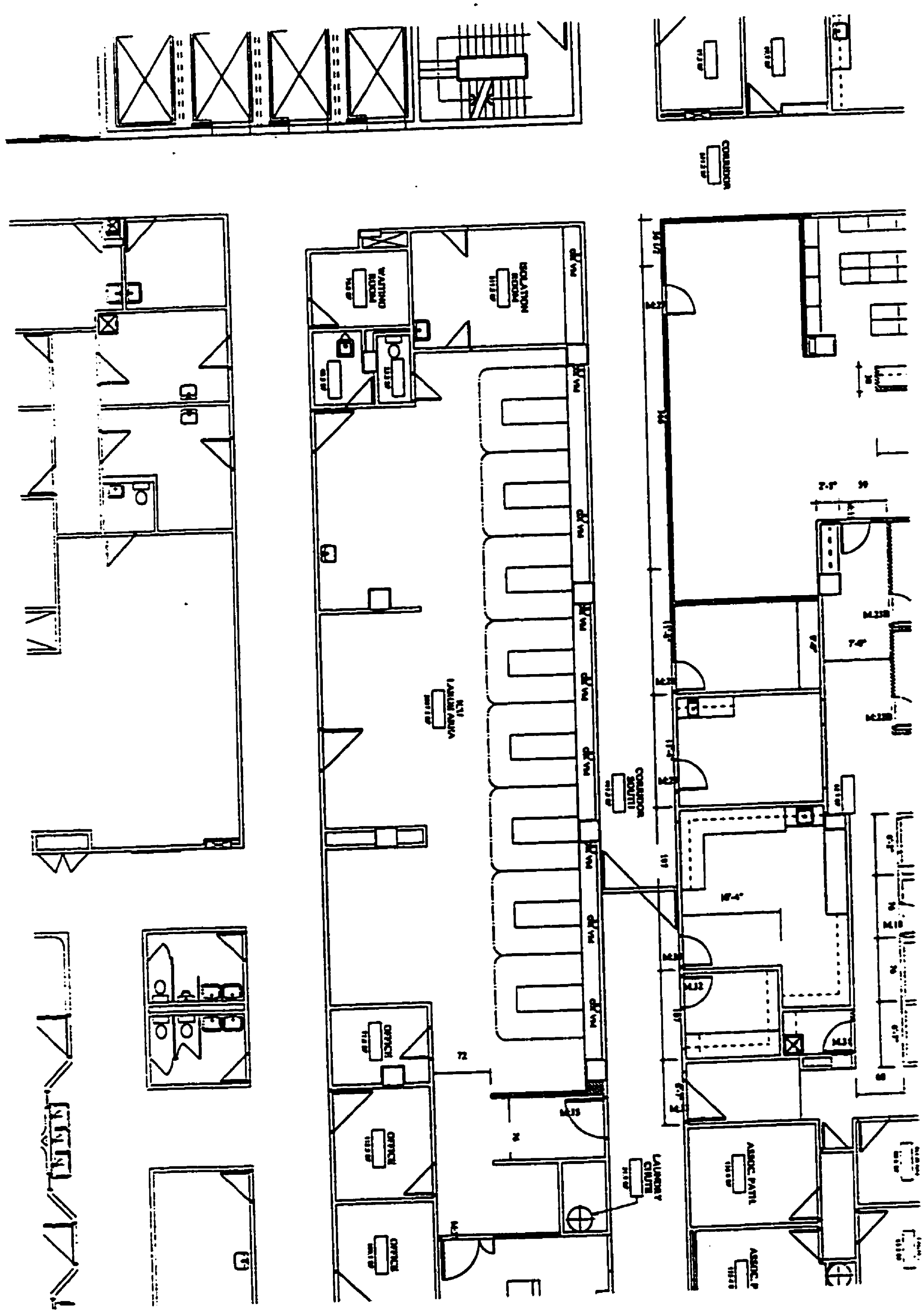
Theme from Ghost Unchained Melody

Hymne

Morning Has Broken

Appendix D

Figure 3: Schemata of the Intensive Care Unit



Appendix E

INVITATION TO PARTICIPATE

Effects of Soothing Music on Noise Induced Annoyance in Intensive Care Unit Patients

INVESTIGATOR: Cynthia Moorby RN BN CACE
Master of Nursing Student
University of Manitoba

You are being invited to take part in a research project being conducted by Cynthia Moorby, a Registered Nurse and Master of Nursing student at the University of Manitoba. The purpose of this study is to determine the impact of listening to 20 minutes of music on the noise annoyance that may be experienced by Intensive Care Unit patients. This research is being conducted as part of the requirements for her Master of Nursing degree.

If you would like to know more about this research project, Cynthia Moorby will provide you with a full explanation and answer any questions you may have. After the explanation you may decide whether or not you would like to take part in this research study.

I would like to know more about the research study

Please circle YES

NO

Please ring your call bell so the Communication Clerk can collect this form.

Thank you very much

Cynthia Moorby RN BN CACE
Master of Nursing Student
Faculty of Nursing
University of Manitoba

Appendix F

VERBAL EXPLANATION OF STUDY

Good morning (afternoon, evening) Mr./Mrs./ Ms. Patient. My name is Cynthia Moorby and I am a Registered Nurse and Master of Nursing student studying in the Faculty of Nursing at the University of Manitoba. Thank-you for expressing an interest in this study by accepting my invitation. The purpose of this study is to determine the impact of listening to 20 minutes of music on the noise annoyance that may be experienced by Intensive Care Unit patients. I am conducting this research study to complete the Thesis portion of my degree.

Please stop me at any time if you have any questions or do not understand what I am saying.

The entire study will take approximately 50-60 minutes while you are a patient in the Intensive Care Unit. You will be asked to find a comfortable position in bed and remain there during the study. You will then complete a short questionnaire that will provide me with information about your age, sex, occupation, and number of times you have been a patient in an Intensive Care Unit. You will also be asked to rate how noisy your usual home or work environment is. I will also look at your hospital record to see what medications you are taking, your diagnosis and how long you have been in the Intensive Care Unit.

There are two parts to the study. The first part of the study will last for 20 minutes. During this time you may do as you wish except get out of bed or cover your ears. The second part of the study will last for 20 minutes. During this time you will be given a small tape cassette player with a head set. You may chose from one of two selections of music, either classical or contemporary (modern). You will control the volume yourself. At the end of each twenty minute part you will be asked to complete a short questionnaire about the Intensive Care Unit Noise. You will also be asked to mark on a scale how annoyed you are by the noise. I will be sitting beside you measuring noise levels during the study.

I want to assure you that any information about you will be held strictly confidential. Your name will not appear on any of the questionnaires or information forms. Instead you will be assigned a code number. The consent form and the coded information sheets will be stored separately. No other person will know your identity. The statistician or statistics expert and the Thesis Committee will have access to the coded information. All information will be stored in a locked file for seven years then mechanically shredded. The results of this study may be published in a nursing related magazine or presented at conferences but you will not be identified in any way.

You may benefit from participating in this study by discovering a method of reducing the annoyance to the noise levels that you hear in the Intensive Care Unit. You may not receive any benefit from participating in this study but your participation may be of benefit to other Intensive Care Unit patients in the future. There is no risk to you by participation in this study. This study has received ethical approval from the Ethical Review Committee of the Faculty of Nursing at the University of Manitoba.

Your participation in this study is VOLUNTARY. Your decision to participate or not, WILL NOT AFFECT THE CARE THAT YOU WOULD NORMALLY RECEIVE while you are a patient in this hospital. You may WITHDRAW or DROP OUT of the study at any time you wish. You may do this by either telling your nurse before the study begins or me once the study has started.

If you wish, a summary of the results of the research study will be mailed to you. I will give you a written copy of what we have just discussed. If after reading the explanation, you decide to participate in the study please sign the bottom of the form.

Do you understand what is being asked of you in this study? (If the answer is no, provided further explanation until understanding is reached). Do you have any questions at this time? If you think of any questions later please feel free to call me Cynthia Moorby at 477-3388. Your nurse will give you the telephone.

Would you like to participate in this study? If the answer is yes provide patient with the written Explanation/Consent form. If the answer is no, the patient is thanked for their time and attention and the investigator retreats from the bed side.

Thank you Mr./Mrs./Ms. Patient for your time and attention and agreeing to participate in this study.

Appendix G

EXPLANATION AND CONSENT

Effects of Soothing Music on Noise Induced Annoyance in Intensive Care Unit Patients

INVESTIGATOR: Cynthia Moorby RN BN CACE
Master of Nursing Student
University of Manitoba

I have been told that the purpose of this study is to determine the impact of listening to 20 minutes of music on the noise annoyance that may be experienced by Intensive Care Unit patients.

I am aware that the entire study will take about 50-60 minutes while I am a patient in the Intensive Care Unit. I will be asked to find a comfortable position in bed and remain there during the study. I will then complete a short questionnaire that will provide the investigator with information about my age, sex, type of work that I do, number of times as a patient in an Intensive Care Unit and noise sensitivity. The investigator will also look at my hospital record to see what medications I am taking, my diagnosis and how long I have been in the Intensive Care Unit.

I understand that there are two parts to the study. The first part of the study will last for 20 minutes. During this time I may do as I wish except get out of bed or cover my ears. The second part of the study will last for 20 minutes. I may choose from one of two types of music, either classical or contemporary (modern). During this time I will be given a small tape cassette player with a head set. I will control the volume myself. At the end of each twenty minute part I will be asked to complete a short questionnaire about the Intensive Care Unit Noise. I will also be asked to mark on a scale how annoyed I am by the noise. The investigator will be sitting beside me during the study to measure noise levels.

My name will not appear on any of the questionnaires or information forms. I will be assigned a code number. I understand that the consent form and the coded information sheets will be stored separately. Only the investigator will have access to this information. The statistician (statistics expert) and the Thesis Committee may have access to the coded information. All information will be stored in a locked file for seven years then destroyed. The results of this study may be published or presented at conferences but I will not be identified in any way.

I am aware that I may benefit from being in this study by discovering a way to reduce the annoyance to the noise levels that I hear in the Intensive Care Unit. I also know that I may not receive any benefit from taking part in this study but my taking part may be of benefit to other Intensive Care Unit patients in the future. Participation in this study exposes me to no added risks.

My participation in this study is VOLUNTARY. My decision to take part or not, WILL NOT CHANGE THE CARE THAT I WOULD NORMALLY RECEIVE while I am a patient in this hospital. I may WITHDRAW or DROP OUT of the study at any time I wish. I may do this by either telling my nurse before the study begins or the Investigator once the study has started. I have been told that this study has received approval from the Ethics Review Committee of the Faculty of Nursing at the University of Manitoba. I will receive a photocopy of this explanation and consent form. I have also been offered a summary of the results of this study.

If I have any questions or concerns about the study, I may call either the Investigator Cynthia Moorby at 477-3388 or the Thesis Chairperson Dr. Erna Schilder at 474-9664. My nurse will provide me with the telephone.

CONSENT

I have read the explanation of the study and understand what has been asked of me. The investigator has also explained the study to me and given me the chance to ask questions.

I freely give my permission to take part in this study: The Effects of Soothing Music on Noise Induced Annoyance in Intensive Care Patients.

Patient Signature:__________________ Date:____________

Investigator Signature:______________
Cynthia Moorby RN BN CACE
477-3388

Appendix H

CODE NUMBER:

VISUAL ANALOGUE SCALE

Please place a mark on this line to show how the Intensive Care Unit noise made you feel during the last 20 minutes.

EXTREMELY ANNOYED

NOT ANNOYED AT ALL

Appendix I

Modified Bakers Annoyance to ICU Noise Index

ANNOYANCE TO ICU NOISE INDEX

Please circle the number that you think best describes how annoyed you were in the last 20 minutes by the different sounds in the Intensive Care Unit.

SOUND	NOT ANNOYED	A LITTLE ANNOYED	SOMEWHAT ANNOYED	VERY ANNOYED	EXTREMELY ANNOYED
Staff talking about other patients	1	2	3	4	5
Staff talking to other patients	1	2	3	4	5
Staff talking personal	1	2	3	4	5
Loud talk laughing shouting	1	2	3	4	5
Staff preparing to do a task	1	2	3	4	5
Staff doing a task	1	2	3	4	5
Other patient sounds of distress	1	2	3	4	5
Other patient sounds not distressed	1	2	3	4	5
Moving patient in/out of ICU	1	2	3	4	5
Visitors talking	1	2	3	4	5
Movement sounds	1	2	3	4	5
Alarms ringing constant	1	2	3	4	5
Beeping alarms	1	2	3	4	5

SOUND	NOT ANNOYED	A LITTLE ANNOYED	SOMEWHAT ANNOYED	VERY ANNOYED	EXTREMELY ANNOYED
Oxygen running	1	2	3	4	5
Equipment operating	1	2	3	4	5
Objects dropped	1	2	3	4	5
Equipment carts moving	1	2	3	4	5
Telephones	1	2	3	4	5
Televisions	1	2	3	4	5
Computer sounds	1	2	3	4	5
Moving furniture	1	2	3	4	5
Public address pagers	1	2	3	4	5
Housekeeping cleaning	1	2	3	4	5
Toilets flushed	1	2	3	4	5
Water running	1	2	3	4	5
Doors opening closing	1	2	3	4	5
Squeaking wheels/hinges	1	2	3	4	5
Heating/cooling system	1	2	3	4	5
Other sounds people	1	2	3	4	5
Other sounds non person	1	2	3	4	5

Appendix J

TIME	BACKGROUND SOUND LEVELS		IMPULSE SOUND LEVELS		CONTINUOUS SOUND LEVELS	
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

PATIENT CENSUS: __________ NUMBER OF VENTILATORS:________

DIAGNOSIS:________________ LENGTH OF STAY IN HOURS:______

MEDICATION	DOSE AND TIMES		LAST DOSE	

DATA COLLECTION RECORD
PATIENT CODE NUMBER:

Appendix K

CODE NUMBER:

PATIENT INFORMATION QUESTIONNAIRE

Please answer all of the following questions.

What is your sex? __________ How old are you? __________

What type of work do you do? ______________________________

Have you ever been a patient in any Intensive Care Unit before?
Please circle YES NO

If you answered yes, how many times? __________

NOISE SENSITIVITY

Circle the number that you think best describes your response to the next four statements.

1.My home is usually:

1 2 3 4 5

extremely quiet ... extremely noisy

2. My place of work is usually:

1 2 3 4 5

extremely quiet ... extremely noisy

3. I expect the Intensive Care Unit to be:

1 2 3 4 5

extremely quiet ... extremely noisy

4. Since coming to the Intensive Care Unit, I have found it to be:

1 2 3 4 5

extremely quiet ... extremely noisy

Appendix L

Testing of the Radio Shack Digital Sound Level Meter 33-2055

Validity Testing of Sound Level Meter Pre and Post Data Collection

Pre Data Collection = 72 dB(A)
Post Data Collection = 72 dB(A)

Reliability Testing of Sound Level Meter

Table 1: Results of Testing for Reliability Over 40 Minutes

Time	A Weighted Decibels
0	73
5	73
10	73
15	73
20	73
25	73
30	73
35	73
40	73

Table 2: Results of Testing of Sound Level Meter to "0" Reference

Subject #	A Weighted Decibels
1	73
2	73
3	73
4	73
5	73
6	73
7	73
8	73
9	73
10	73
11	73
12	73
13	73
14	73
15	73
16	73
17	73
18	73
19	73
20	73
21	73
22	73
23	73
24	73
25	73
26	73
27	73
28	73
29	73
30	73
31	73
32	73
33	73
34	73
35	73
36	73

Appendix M

Question by Question Analysis of Bakers Annoyance to ICU Noise Index

Number of Responses per Category
control (intervention)

Question	not	a little	somewhat	very	extremely
1	17 (36)	15 (0)	2 (0)	1 (0)	1 (0)
2	20 (36)	14 (0)	1 (0)	0 (0)	1 (0)
3	21 (35)	11 (1)	3 (0)	0 (0)	1 (0)
4	9 (27)	9 (9)	15 (0)	1 (0)	2 (0)
5	32 (35)	3 (1)	1 (0)	0 (0)	0 (0)
6	29 (36)	7 (0)	0 (0)	0 (0)	0 (0)
7	27 (35)	3 (1)	4 (0)	1 (0)	1 (0)
8	31 (34)	3 (2)	2 (0)	0 (0)	0 (0)
9	32 (36)	3 (0)	1 (0)	0 (0)	0 (0)
10	30 (34)	3 (2)	2 (0)	0 (0)	1 (0)
11	31 (35)	4 (1)	0 (0)	1 (0)	0 (0)
12	17 (32)	12 (4)	5 (0)	1 (0)	1 (0)
13	18 (33)	13 (2)	4 (1)	0 (0)	1 (0)
14	34 (35)	2 (1)	0 (0)	0 (0)	0 (0)
15	34 (36)	2 (0)	0 (0)	0 (0)	0 (0)
16	31 (35)	5 (1)	0 (0)	0 (0)	0 (0)
17	31 (34)	4 (2)	1 (0)	0 (0)	0 (0)
18	29 (35)	5 (1)	2 (0)	0 (0)	0 (0)
19	27 (36)	8 (0)	1 (0)	0 (0)	0 (0)
20	35 (35)	1 (1)	0 (0)	0 (0)	0 (0)
21	16 (33)	16 (3)	4 (0)	0 (0)	0 (0)
22	15 (32)	20 (4)	1 (0)	0 (0)	0 (0)
23	36 (36)	0 (0)	0 (0)	0 (0)	0 (0)
24	32 (35)	3 (1)	1 (0)	0 (0)	0 (0)
25	32 (34)	3 (2)	1 (0)	0 (0)	0 (0)
26	34 (35)	2 (1)	0 (0)	0 (0)	0 (0)
27	29 (35)	5 (0)	2 (1)	0 (0)	0 (0)
28	35 (36)	1 (0)	0 (0)	0 (0)	0 (0)
29	27 (33)	6 (3)	2 (0)	1 (0)	0 (0)
30	26 (33)	8 (3)	1 (0)	1 (0)	0 (0)

Appendix N

Figure 7: Participants' Medication Use in Previous 24 Hours