THE CAREGIVER EXPERIENCE: THE IMPACT OF ENVIRONMENTAL MUSIC THERAPY IN THE SURGICAL INTENSIVE CARE UNIT

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By

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Abstract

This study examines the effects of an Environmental Music Therapy (EMT) protocol on the caregiver experience in the Surgical Intensive Care Unit (SICU). For the purpose of this study, EMT may be understood as a music therapy intervention designed to implement live music that attunes to the sonic environment of a medical unit while gradually shifting to address psychological, physical, and contextual needs of caregivers. In this study, caregivers are defined as family members and loved ones, ages 18 an older, involved in active care of related patients within the SICU at Mount Sinai Beth Israel. An experimental design was implemented via examining one group's pre and post-intervention surveys. Results did not indicate statistically significant impact of an EMT protocol on caregiver experience in regards to interactions with staff, perceived pain of patients, or ability of music to mask/blend with noxious environmental sounds. However, without regard to statistical significance, results do indicate preliminary levels of impact of EMT on caregiver experience in the SICU. Small sample size may be accountable for lack of statistical significance given preliminary results. This research study, while unable to yield significant results, may point to a need for future research regarding the use of music therapy interventions within intensive care unit environments.

Keywords: music therapy, environmental music therapy, music and medicine, caregivers, noise, hospital, surgical intensive care unit, intensive care unit

The Caregiver Experience: The Impact of Environmental Music Therapy in the Surgical Intensive Care Unit

The surgical intensive care unit can be a high stress and hectic environment not just for patients and staff but for caregivers as well. Given the crucial role that caregivers play in a patient's psychological, physical, and overall health, it is surprising that research on the caregiver experience and mediating interventions to address needs are so scarce. Preliminary research points to the strain of a medical unit on a caregiver's mental state, with some studies even revealing incidents of post-traumatic stress disorder (Azoulay, et al., 2005). Noxious stimuli, including noise, have been cited as a factor in high stress levels among caregivers (Bush-Vishniac et al., 2005). Existing research has illuminated the role of noise in creation of a toxic sonic environment in the surgical intensive care unit (SICU) thus contributing to long-term effects of stress and anxiety among caregivers. Even with such research, there remains a lack of examination on possible interventions to ameliorate noise levels and thus stress levels in the ICU. An environmental music therapy intervention may provide a means to address the unique needs of caregivers exposed to noise within an intensive care unit environment. Music therapy has been proven an effective method for decreasing anxiety and promoting wellbeing within the hospital setting (Wong et al., 2001). An environmental music therapy protocol may be successful in addressing the unique health needs of caregivers in the intensive care unit by offering an innovative and relatively low-risk approach to changing the auditory environment of an intensive care unit. Environmental music therapy involves the use of live music provided by trained therapists to create a relaxing and modified experience within a health care unit (Canga et al., 2012). This study seeks to explore the impact of an environmental music therapy protocol on the caregiver experience in the SICU.

Literature Review

The Intensive Care Unit

The intensive care unit (ICU) was initially developed in the 1950s to treat patients in need of mechanical ventilation. Since that time, ICU's have expanded range of care to all critically ill patients thus developing into standard and necessary units in nearly every hospital around the world (Wenham & Pittard, 2009). Today there is a variety of specialty ICUs including those to treat newborn infants, burn patients, cardiac care, etc. (Donchin & Seagull, 2002). According to the Society of Critical Care Medicine (SCCM), more than five million patients are admitted into intensive care units within the United States annually (http://www.sccm.org/Communications/Pages/CriticalCareStats.aspx). The number of individuals treated within American ICUs has been steadily growing each year due to increased reliance on life-sustaining technologies. Despite such technologies, the ICU remains the leader in mortality rates among any unit within the hospital, with rates ranging from 8%-19% annually. These hundreds of thousands of deaths are due in part to the high risk of cases, the rate of medical error, and severity of illness among patients (http://healthpolicy.ucsf.edu/content/icu-outcomes). Research indicates strong correlations between ICU performance rates and overall hospital mortality rates. It is only logical that a hospital that has a well-run, effective ICU will contribute to a domino effect of a healthier hospital (http://healthpolicy.ucsf.edu/content/icu-outcomes).

Noise in the Intensive Care Unit

The ICU is arguably the highest stress, anxiety-provoking unit within any hospital (Donchin & Seagull, 2002). In addition to the complexity of the cases, the fragility of the patients, the environmental factors present within the ICU exacerbate stress levels, impede

healing, create traumatic experiences among caregivers and patients alike, and in some cases even causes ICU induced psychosis and delirium among patients (Wenham & Pittard, 2009). Environmental factors that impact stress levels among individuals within the ICU include noise, ambient light, social isolation, and overall ergonomics of the unit's design (Donchin & Seagull, 2002). Noise in the ICU is of particular concern as frequent alarms, foot traffic from staff, and sounds of electronic devices such as ventilators create a layer of background noise that can be distressing to patients and caregivers alike. Noise is consistently ranked as a top complaint among patients, visitors and staff within hospitals (Bush-Vishniac et al., 2005). Given the impact of noise on stress levels, sleep disruption, and effective healing, the World Health Organization has created parameters stating that average background noise in hospitals shall not exceed 30 A-weighted decibels [dBA] as well as peaks remaining below 40 dBA at night. Despite these parameters, research indicates that average noise levels in the ICU measure 60-70 dBA and reach peaks of over 90 dBA (Wenham & Pittard, 2009). Design of many ICUs involve open floor plans, thus allowing sound to travel openly from room to room contributing to greater noise levels throughout the unit. Additionally, due to the medical needs of the patients, doors to patient rooms are often left open further allowing for noise levels to reach each individual patient, and caregivers in an immediate manner. Improvements in technology have led to increased amount of medical equipment contributing to a steady rise in noise levels in care units since the 1960s (Salandin, Arnold & Kornadt, 2011). For safety reasons, nearly every medical device within a patient's room comes equipped with an alarm. A single patient's bed may be surrounded by at minimum a respirator, a monitor, and intravenous pools with up to ten automatic infusion pumps. Each of these devices creates noise (Donchin & Seagull, 2002). Non-vital alarms on medical devices are often louder than alarms on vital machines leading to confusion regarding alarm

identification (Salandin, Arnold, & Kornadt, 2011). Sound absorption is an issue in ICUs as walls and ceilings are frequently designed with highly sound-reflective materials resulting in a reverberation and buildup of noise (Salandin, Arnold, & Kornadt, 2011). Hospitals also frequently employ doors with large gaps between the door and floor allowing for sound to travel from unit to unit (Bush- Vishniac et al., 2005).

Noise impact on staff in hospitals. In non-ICU units nurses stations were shown to have the highest noise levels in comparison to patient rooms, and exam rooms (Bush-Vishniac et al., 2005). Given the open lay out of many ICUs, the nurses station is frequently at the center of the unit thus allowing for that highest noise level area to be exposed to everyone on the unit. Many hospital units also employ double glazed outside windows to reduce outside noise but because of the reflective surface, noise within the unit is amplified creating an "echo chamber" of sorts (Christensen, 2007). Individual sensitivities to this noise can produce discomforts resulting in factors such as the inability to control the noise, cultural and social factors, personal associations with the noise, and lack of stability as the noise may fluctuate between constant and intermittent (Wenham & Pittard, 2009). Sudden and disruptive noise (such as the sound of an alarm) can negatively impact heart rates, respiratory rates, breathing rates, and oxygen saturation rates (Salandin, Arnold, & Kornadt, 2011). Among surveyed doctors and nurses working in an ICU, 80% reported feeling disturbed due to noise within the unit. Those surveyed noted the cause of noise disruption as operation and alert sounds of medical devices, phones, and IT-equipment. Another study conducted in a Swedish ICU revealed that more than 90% of staff felt negatively impacted by noise at work. Noise has been shown to impact communication among staff as one study found that 83.3% of nurses reported dissatisfaction with noise's interference on verbal interactions with other health care providers. Additionally, in the same study 91.7% of nurses

reported dissatisfaction with ability to hear clinical conversations during medical rounds due to noise (Salandin, Arnold, & Kornadt, 2011). With such high stress work environments, fatigue, and workload, noise has a strong ability to exacerbate psychological stress and contribute to loss of concentration (Salandin, Arnold, & Kornadt, 2011). A study conducted in one Pediatric ICU (PICU) found for every 10 dBA increase in average sound level, on-unit nurses' heart rate increased by six beats per minute (Morrison et al., 2003). An analysis on tachycardia (abnormally rapid heart rate) among nurses in the same study revealed 20% more time in tachycardia for every 10 dBA increase in sound on the unit. Furthermore, the study displayed significant increase in stress levels and annoyance ratings related to increases in sound within the PICU (Morrison et al., 2003). Noise in the hospital setting has also found to contribute to higher staff burnout rates (Bush-Vishniac et al., 2005). A study done by Murthy et al. showed a decrease in mental acuity and short-term memory within the context of typical operating room noise for anesthetists. Additionally, the same study found significant impairments among communication techniques, specifically speech discrimination (Bush-Vishniac et al., 2005). Among numerous studies focusing on noise levels within hospital settings, not a single hospital complies with the World Health Organization guidelines for noise in hospitals (Bush-Vishniac et al., 2005). It is clear that problems with noise levels in hospitals are wide-ranging and common (Bush-Vishniac et al., 2005). A study conducted at John Hopkins Hospital in Baltimore, MD (a top ranked hospital in the United States for the last 14 years as noted by the US News and World Report) showed that among a variety of units within the hospital, noise levels consistently rated above the recommended World Health Organization guidelines by 20 dBA. Noise levels routinely exceeded communication levels between two individuals resulting in staff raising their voices in order to hear each other above the noise (Bush- Vishniac et al., 2005). Noise is of

particular concern among ICUs given the need of constant monitoring of patients by staff (Bush-Vishniac et al., 2005). There is increasing concern regarding noise levels impact on medical error and communication errors (Bush-Vishniac et al., 2005). Although noise levels have a strong impact on stress, anxiety, and communication levels among staff, research indicates a lack of knowledge and education among ICU staff, specifically nurses, in regards to noise's effects on psychological well-being, immune suppression, wound healing, stress hormone stimulation, and current guidelines regarding noise levels (Christensen, 2007).

Noise impact on patients in hospitals. Noise in the hospital setting has a profound impact on patients (Salandin, Arnold & Kornadt, 2011). Noise contributes to higher stress levels among patients, while interrupting a crucial need for peace and quiet (Salandin, Arnold & Kornadt, 2011). In addition to effecting stress levels, noise has also shown to have a negative impact on patient health. Sudden noise exceeding regular background noise by 30 dBA (approximately the level of an alarm activation) has been proven to increase patient heart rate, respiratory rate and oxygen requirements (Salandin, Arnold & Kornadt, 2011). Noise may lead to unwanted cardiovascular stimulation, hearing loss, increased gastric secretion, pituitary and adrenal glad stimulation, suppression of immune response to infection, and negative impact on female reproduction and fertility (Xie, Kang & Mills, 2009). Whereas healthy people may encounter sleep deprivation due to noise above 60 dBA, hospitalized individuals have an even higher likelihood of enduring sleep deterioration under such conditions (Salandin, Arnold & Kornadt, 2011). Research indicates that sound pressure levels must generally be below 40 dBA to enable sleep. Given that average noise levels in the ICU measure 60-70 dBA and reach peaks of over 90 dBA (Wenham & Pittard, 2009), sleep deprivation due to noise is a common occurrence. In fact, patients in the ICU report noise as the common cause of sleep disturbances.

Sleep is a critical element in healing and recovery from trauma (Wenham & Pittard, 2009). Patients in ICUs spend approximately 30-40% of sleeping time in an awake state. Sleep is a complex process that may be divided into two main types in terms of measurement of eye movement; rapid eye movement sleep (REM sleep) and non-rapid eye movement sleep (NREM sleep). Each type of sleep involves its own unique set of physiological, psychological and neurological functions (Xie, Kang & Mills, 2009). One research study confirmed correlations between sound peaks at over 80 dBA and electroencephalogram arousals from patient's sleep. The same study revealed increased level of arousals during loud periods based on noise peaks (Xie, Kang & Mills, 2009). Sepsis, a common occurrence in ICU patients, changes an individual's circadian patterns of adrenocorticotropic hormone and melatonin levels. In a healthy individual, peaks of adrenocorticotropic hormones occur at dawn with melatonin levels rising after midnight and peaking around 3am. For individuals with sepsis, this response is flattened thus leading to disturbances in sleep patterns while encouraging reduction of sleep at night and consequently increased sleep during the day (Xie, Kang & Mills, 2009). Sleep in the ICU is often fragmented and disturbed throughout the day and night resulting in reductions in rapid eye movement (REM) and slow wave sleep (Wenham & Pittard, 2009). Additionally, hallucinations may occur during transition from awake states into NREM and vice versa (Xie, Kang & Mills, 2009). Other sleep disturbances include state dissociation disorders manifesting as hallucinations and REM sleep behavioral disorders. State dissociation disorders stimulate delusional memories thus increasing the probability of PTSD (Xie, Kang & Mills, 2009). Sleep deprivation also contributes to overall mental changes, memory impairment, impaired immune function, and development of catabolic states, all which may compound delirium and psychosis among patients in the ICU (Wenham & Pittard, 2009). Drugs used in the hospital exacerbate levels and

timing of wakefulness and sleep while at times triggering rebound increase in REM sleep thus leading to nightmares, hypertension, tachycardia, and hypoventilation. Unsurprisingly, noise may aggravate this issue by precipitating transition from sleep towards wakefulness (Xie, Kang & Mills, 2009). It is not just general noise levels that may impact health and healing of patients but rather the impulsive, unfamiliar nature and character of noise disturbances within the hospital setting. The hospital setting is prone to sudden and frightening noise interruptions due to alarm activation and medical emergencies (Salandin, Arnold & Kornadt, 2011).

Psychological stressors are of critical concern for patients in an ICU environment and contribute to a syndrome known as ICU psychosis/delirium. ICU psychosis/delirium is characterized by a disturbance of consciousness developing over short periods of time. In cases of ICU psychosis/delirium inattention is compounded by changes in cognition and perceptual interruptions. Symptoms of ICU psychosis/delirium include acute disorientation, fluctuating mental status, disorganized thinking, and altered states of consciousness. ICU psychosis/delirium has been found to occur in up to 80% of critically ill ICU patients receiving mechanical ventilation (Bulic, Bennett & Shehabi, 2015). Risks associated with ICU psychosis/delirium include death, long-term cognitive impairment, poor functional status, and decreased quality of life in the case of survival. Research indicates increased incidences of post-traumatic stress disorder as well as depression, anxiety, and difficulty returning to work among survivors of ICU psychosis/delirium (Bulic, Bennett & Shehabi, 2015). Despite the high incident of ICU psychosis/delirium, the related risks, and studies revealing 92% of health care professionals reporting delirium as a significant and very serious problem in the ICU, the condition often is unrecognized by clinicians. In one study, 78% of health care professionals reported ICU psychosis/delirium as under diagnosed (Bulic, Bennett & Shehabi, 2015). Factors contributing to

ICU psychosis/delirium include the use of ICU sedatives, analgesic, and anticholinergic medication (Bulic, Bennett & Shehabi, 2015) as well as lack of sleep and sleep disturbances (Xie, Kang & Mills, 2009). Noise in particular, has been shown to increase the incidences of ICU psychosis/delirium (Wenham & Pittard, 2009).

Noise impact on caregivers in hospitals. Noise levels in the intensive care unit effect not only patients and staff, but caregivers as well (Meltzer, Davis & Mindell, 2012). Caregivers that spend time in the intensive care unit are exposed to high noise levels that impact cardiovascular, physiological and mental health (Konkami & Oakley, 2012). Noise levels aside, caregivers of loved ones in the ICU experience extremely high levels of stress and distress (Azoulay, et al., 2005). These high stress levels have shown to create common incidences of post-traumatic stress disorder (PTSD) among caregivers (Azoulay, et al., 2005). The fifth edition of the Diagnostic Statistics Manual states that the "Diagnostic criteria for PTSD include a history of exposure to a traumatic event that meets specific stipulations and symptoms from each of four symptom clusters: intrusion, avoidance, negative alterations in cognitions and mood, and alterations in arousal and reactivity" (http://www.ptsd.va.gov/professional/PTSD-overview/dsm5_criteria_ptsd.asp). Risk of re-experiencing trauma and experiencing PTSD is increased due to physiological triggers including noise (Kolk, 1994). Excessive noise in the ICU contributes not only to exacerbation of trauma response in caregivers, but also creates an environment of sleep disturbance for all exposed parties (Meltzer, Davis & Mindell, 2012). Just as noise in the ICU is of critical concern for patient sleep cycles, caregivers are at risk of interrupted sleep leading to poor immune function and increased stress response (Meltzer, Davis & Mindell, 2012). As family-centered care has become standard in hospitals around the country and more caregivers are permitted to spend extended hours, including overnights, at the bedside

of loved ones (Meltzer, Davis & Mindell, 2012). Parents of children in the ICU are frequently encouraged to remain present throughout the hospitalization of their child in order to decrease parent/child stress levels, and involve parents in the care of their child (Meltzer, Davis & Mindell, 2012). The benefits of caregiver presence in the ICU are clear but they are contrasted with compounded stress and anxiety levels among loved ones as they witness first-hand the impact of noise and other disturbances within the hospital environment (Meltzer, Davis & Mindell, 2012). In one study, researchers found that average total hours of sleep time among parents staying bedside of children in the hospital was approximately only 4.6 hours (McCann, 2008). A sleep period of 4.6 hours is equivalent to a sleep time classified as sleep deprivation, which can create mood disturbances and impact emotional well-being (Haack & Mullington, 2005). Parents reported machine noise, staff noise, environmental noise, and noise from other patients as a common factor in sleep disturbance (McCann, 2008). One variable that was shown to improve caregivers' sleep was the placement of the patient and caregiver in a private room with a closed door, thus suggesting that reduction of noise was of critical importance in improving sleep quality (Moore et al., 1998). Although this may be helpful in reducing the detrimental impact of environmental noise on caregivers, closing doors of patient's rooms limits staff ability to recognize alarm sounds, hear a patient in distress, and treat effectively (Meltzer, Davis & Mindell, 2012). Sleep deprivation among caregivers increases physical and emotional distress, creates long-term effects of daytime sleepiness and morning fatigue, all while leading to poor communication with staff and increased confusion regarding health status of loved ones (Meltzer, Davis & Mindell, 2012). Sleep is a vital need of caregivers in the ICU. Research shows that meeting the needs of caregivers leads to higher care satisfaction and increased feelings of wellbeing (Khalia, 2014). Sleep deprivation related to noise is not the only area of concern for

caregivers in the ICU. Other areas of concern include hearing damage, physiological and emotional stress response, altered communication patterns, and performance of caregiver duties. The environmental noise in the ICU serves as a stressor by triggering neuroendocrine mechanisms integrated in the hypothalamus and involving the autonomic nervous system, the anterior pituitary- adrenal axis, and vasopressin release. The stress response to noise among humans is designed for adaptation, but frequent and prolonged noise contributes to health issues due to elongated stress response (Thomas & Martin, 2000). Physiological response to noise among caregivers may include increased diastolic and mean blood pressure, vasoconstriction, hypertension, increased release of stress hormones such as cortisol, increased blood glucose levels, gastrointestinal issues, increased serum cholesterol, altered immune function, increased muscle tension, and as mention previously, disturbed sleep (Thomas & Martin, 2000). Uncontrollable noise has been found to increase stress-induced oxytocin in women leading to higher emotionality states (Thomas & Martin, 2000). For mothers of children in the ICU environment this is an important factor to consider. Sound has a profound effect on a variety of human responses outside of physiological factors. In a lab setting, determination of unpleasant vs. pleasant sound was dependent on frequency and volume and accurate sound source identification was found to impact emotional reaction (Thomas & Martin, 2000). In considering this, for a caregiver in a hospital setting, the unfamiliar sounds of medical machines may lead to a negative emotional reaction. Response to sound is indeed subjective with factors such as physical characteristics, emotional content, predictability of sound, ability to control sound, necessity of noise, and attitudes towards noise production, all playing a role in how the noise is interrupted (Thomas & Martin, 2000). One research study revealed that lack of control of sound created feelings of helplessness, lack of control, tension, unhappiness, anxiety, and depression among

subjects. These feelings may be even more compounded in the caregiver role as noise of machines and monitors indicate varying health statuses thus leading to a deeper response of loss of agency over the care of loved ones. Overall, noise plays a contributing factor to increased stress levels, compounding of PTSD symptoms, loss of sleep, and a lack of agency among caregivers of patients in the ICU.

Impact of Music Therapy on Health

Music therapy was established as a profession in the United States during the 1950s with the development of the National Association of Music Therapy (American Music Therapy Association, 2015). Music therapists practicing in the United States are board certified by the Certification Board of Music Therapists and undergo specialized training to work with individuals in a variety of settings. The American Music Therapy Association defines music therapy as "the clinical and evidence-based use of music interventions to accomplish individualized goals within a therapeutic relationship by a credentialed professional who has completed an approved music therapy program. Music Therapy is an established health profession in which music is used within a therapeutic relationship to address physical, emotional, cognitive, and social needs of individuals" (American Music Therapy Association, 2015). In the hospital setting, music therapy has been shown to decrease anxiety, promote health and wellbeing, while diminishing stress (Wong et al., 2001). Additionally, music may be implemented as a refocusing agent in order to redirect an individual's attention away from noxious stimuli, such as beeping alarms and loud machinery in an acute care environment (Wong et al., 2001). Music stimulates various areas of the brain via autonomic response in regions such as the hypothalamus, pituitary gland, and amygdala (Blood et al., 1999). Research confirms the notion that different types of music elicit different neural response. Given music's ability to tap

into memory processing within the parahippocampal gyrus and precuneus region of the brain, playing of familiar music has particular implications in prompting varying neurological, psychological, and emotional response (Blood et al., 1999). Live music in comparison to recorded music is significantly more effective in provoking emotional and physical change among hospitalized individuals (Bailey, 1983). One research study examining the effects of live versus recorded music among hospitalized cancer patients found that patients within the live music group reported lower anxiety levels, decreased tension, and increased wellness as compared to the recorded music group. Elements of live music that appear to be of particular importance include human creation of sound via body or voice. Physical presence of an individual playing music creates a feeling of contact between the patient and music therapist. This contact and sense of intimacy contributes to an element of togetherness and diminishment of isolation leading to overall mood improvements. Live music also has the ability to generate a sense of flow thus creating an energizing element that enlivens listeners and stimulates physical changes within the body. The flexibility of live music versus recorded music allows for subtle variations to take place from moment to moment within the musical communication thereby creating a rich atmosphere of communication between music therapist and patient (Bailey, 1983).

Music therapy has also been shown to be an effective method in reducing pain intensity and analgesic consumption in post-operative patients (Sin & Chow, 2015). The mechanism of pain reduction may be attributed to music therapy's ability to refocus an individual away from a pain experience and into a pleasant experience of participating in a musical interaction. Music therapy allows for the patient to break out of the cycle of focusing conscious attention on the pain, thus stimulating the pain response, and instead enter into the music world with the therapist (Nilsson, 2008). Patients who appear to be in a transitional state between sleep and awake still

maintain auditory senses and music therapy may provide relief for discomfort and sense of isolation within this state (Nilsson, 2008). Music therapy has also been shown to increase patient reported control and agency in relation to pain and discomfort within the hospital setting. Music therapy has the ability to not only refocus a patient away from the pain experience, but provide them with tools for much needed autonomy and ownership in regards to health and self-regulation (Nilsson, 2008). Research indicates music therapy's ability to provide interventions that reduce heart rates, improve oxygen saturation rates, decrease blood pressure, decrease respiratory rates, and increase skin temperature and cardiac output. Music therapy has been shown to be an effective method in reducing pre-operative and post-operative anxiety among pediatric and adult patients (Leardi, 2007). One study illuminated music therapy's ability to reduce stress hormones as indicated by lowered blood cortisol levels among patients treated by music therapists (Nilsson, 2008). Another study confirmed this finding in revealing decreased cortisol and natural killer lymphocytes (cells that increase during stress) levels among individuals who received music therapy during surgery as compared to those who did not. Cortisol and natural killer lymphocytes levels were further reduced among individuals who were able to choose patient preferred music, illuminating the importance of individualized and tailored music therapy interventions (Leardi, 2007).

Music therapy has also been proven as an effective means in addressing various mental health needs including depression (Erkkilä et al., 2011). Music therapy interventions such as improvised music making allow for free association, accessing of unconscious emotions and desires, and deepening of therapeutic relationship for individuals with depression. The act of creating and sharing music with another individual (the music therapist) allows for a uniquely intimate experience in which the client can experience being fully heard and validated within the

musical relationship. For individuals with mild, moderate to severe depression, music therapy in addition to standard care has been shown to significantly improve mood levels, decrease anxiety, and increase functioning. Music therapy as opposed to traditional therapies, allows for access to non-verbal communication, expression and interaction, which prove particularly helpful for individuals unable to describe inner experiences verbally. The offering of familiar and preferred music in a music therapy setting allows for triggering of emotional memories and imagery experiences thus allowing for access to deep and possibly repressed thoughts and feelings of the individual (Erkkilä et al., 2011). One research study examining the effects of music therapy on quality of life among patients with terminal cancer revealed music therapy's ability to improve self-reported quality of life in a statistically significant sample of hospice patients. In addition to self-reported scores of quality of life improving following initial music therapy sessions, scores continued to improve following subsequent sessions. As physical function declined among the hospice patients, quality of life scores within the music therapy group continued to maintain higher levels as compared to those in the non-music therapy group (Hilliard, 2003).

Within the hospital setting, music therapy has been shown to be effective in improving sleep quality among a range of populations from a variety of cultural backgrounds. The consistency in results indicating music's ability to improve quality of sleep in people from all over the world reveals music's fundamental role in human experience (Wang, Sun & Zang, 2013). Research indicates that musical characteristics such as slower tempos, stable rhythm, and lower-frequency tones may aid in improving sleep quality among hospitalized patients. Additionally, familiar music appears to be of particular importance in creating a sense of comfort for those suffering from lack of sleep while in the hospital (Wang, Sun & Zang, 2013). Sedative music is capable of reducing activity in the neuroendocrine and sympathetic nervous systems, as

well as reducing circulating noradrenaline, all of which are integral in the onset of sleep (Lai & Good, 2004). One research study examining the effects of a music therapy intervention on sleep among older adults revealed improved perceived sleep quality, sleep efficiency, sleep latency, and reductions in daytime dysfunction (Lai & Good,2004). As opposed to medications administered to combat sleeplessness, music therapy provides a low-risk, minimally invasive, and virtually side-effect free intervention proven to improve sleep quality among a range of individuals from pre-mature infants to older adults (Lai & Good, 2004, Arnon et al., 2006).

Environmental Music Therapy

Environmental music therapy (EMT) is a music therapy intervention initially designed to implement live music to address the physical, psychological and cultural needs of caregivers, staff, and patients within the outpatient areas of an urban cancer treatment center (Canga et al., 2012). EMT involves the music therapist clinician providing improvised music that matches and reflects the present environment through offering music that melds to the tonal environment of any given hospital unit. All aspects of the sonic environment including, but not limited to, noise from staff, beeping of machines, talking, movement through the unit, are all addressed through the music therapist's improvised music As the existing sound environment entrains with the improvised music, the music therapist may gradual shift into familiar songs that honor the musical preferences and needs of the caregivers, staff and patients (Canga et al., 2012). Environmental music therapy requires the music therapist to consider not just the musical environment, but rather the total sonic environment in which they are working. Environmental music therapy recognizes all aspects of the sonic environment as having the potential to shape and transform the live music experience provided by the therapist (Viega, 2016). Music therapists implementing EMT rely heavily on elements of improvisation, diversity, and

flexibility in order to meet the unique needs of varied environments. Therapists may employ a number of instruments to achieve a range of timbres and tones that best fit the existing sonic atmosphere. Musical instruments that imitate nature sounds such as rain sticks, chimes, and ocean disks are frequently utilized to encourage thematic elements and allow for organic levels of relaxation during exposure to familiar sounds. Music therapists create a musical arch or curve when practicing EMT in order to create a continuum for the music to fade in and out of the environment in a natural way with low levels of disturbances. The music may begin with simple and sparse sounds, and then gradually grow until a peak is reached before coming down and lessening musical complexities (Doherty & Zhang, 2014). A pilot study investigating the effect of EMT within a chemotherapy infusion suite illustrated changes in emotional states, and perception of noise levels. The initial research supports the belief that an EMT intervention with trained music therapists may contribute to creation of a relaxing atmosphere, and positively modified experience within the medical setting (Canga et al., 2012). Music therapist implementing EMT interventions in a hospital setting noted changes in overall sound environment, as well as shifts in affect, body movement, and social interactions among individuals on the medical unit. Such changes were represented in listeners engaging in the provided music through dancing, singing, and discussion of the music with others. One therapist noted a change in communication styles between hospital staff and patients during EMT interventions, including slower and softer speaking styles, increased smiling, and relaxed interactions (Doherty & Zhang, 2014). The existing research recognizes the need for continued EMT interventions within hospitals settings and continued research to bolster initial findings. Research studies have examined the effects of varying noise reduction and masking strategies within ICUs. When comparing interventions of earplugs, earmuffs, behavioral modification,

acoustic material, and sound masking, sound masking was shown to improve sleep significantly more. One study conducted in a public hospital in the USA found the use of sound masking using ocean sounds improved sleep by 37.5%. Compared to a similar study conducted in a neuro-critical care unit in the USA implementing behavioral modifications, which led to only a sleep improvement of 18.3%, it seems that sound masking is the more effective method (Salandin, Arnold & Kornadt, 2011).

Despite the initial research revealing the positive impact of EMT in hospitals, a lack of research exists pointing to a crucial need for further investigation focusing on the impact of an EMT protocol particularly within the critical care environment (Canga et al., 2012).

Method

The methodology of this research study was initially developed by music therapists and researchers at the Louis Armstrong Center for Music & Medicine as part of an existing, ongoing study examining the impact of an Environmental Music Therapy intervention on staff, patients and caregivers in the Surgical Intensive Care Unit at Mount Sinai Beth Israel in New York, NY. For the purpose of this study, I isolated existing data from 23 caregivers enrolled in the parent study to provide an analysis of effects of noise perception and the impact of environmental music therapy while offering an examination of the ongoing research study at large. Additionally, this research may further explicate how sound and noise is perceived by caregivers, and offer an evaluation of how an Environmental Music Therapy intervention might change these perceptions as well as the actual awareness of noise in the SICU.

EMT (Environmental Music Therapy) based on the pilot of Schneider & Stewart, (2000), Schneider, (2004), and Chestnut et al, (2004) was provided in the surgical intensive care environment. The music therapists provided a 30-minute EMT music intervention upon

enrollment of the patient, for sessions occurring either in the morning or in the afternoon. The total number of sessions for any participant varied based on length of stay, but on average consisted of 1-3 interventions. EMT involved the music therapists playing instruments, including the singing and playing of favorite genres and pieces or songs as requested by caregivers, staff, or the patients. Active participation for study subjects during the EMT session required only active listening to the musical intervention provided by the music therapists.

The impact of noise on the sound environment was determined by a survey that addressed the perceived needs of caregivers during the initial enrollment period. Surveys were conducted based on length of stay (LOS) of patients for whom caregivers are related. Surveys included questionnaires for the first 24-hour period within the SICU; then subsequent follow-up during their last 24-hour period. In cases where patients were based in the SICU for less than 24 hours, thus limiting the time of the caregiver within the unit, every attempt was made to survey within the first few and final few hours of habitation in the SICU. Caregivers enrolled had capacity to consent. Questionnaires were gathered in the morning and afternoon pre and post intervention.

All enrolled caregivers completed a survey provided by the researchers, which indicated their individual perception of noise and sound in the SICU. Data analysis was conducted based on guidelines initially designed by the team of researchers at the Louis Armstrong Center for Music & Medicine, yet executed and tailored by myself for analysis of this sample population of 23 caregivers. All statistical tests were done using a level of significance of 0.05. Averages of survey questions were calculated for the purpose of assessing the impact of environmental music therapy on stress, anxiety, and depression levels. Averages may reveal possible trends in response to the protocol. Averages of questions were compared pre and post-intervention to

examine level of change. Pre and post-test results were measured using a *t*-test to determine *P*-values thus revealing statistical significance.

Results

A total of 23 caregivers completed enrollment for participation, however only 22 completed pre and post intervention questionnaires. Participants answered a total of 22 pre and post survey questions to assess the impact of noise and subsequently music, on rest and sleep levels, pain, and level of care/involvement of staff. Examples of pre and post questionnaires may be found in Appendix A and Appendix B. These questionnaires were designed by researchers at the Louis Armstrong Center for Music & Medicine during initial development of the parent study. All data was analyzed separate from the parent study, and focusing solely on the isolated existing data of the 23 caregivers previously enrolled. Data was analyzed using Microsoft Excel (version 14.4 for Mac). Two-sample unequal variance (heteroscedastic) *t* tests were used to detect any possible significant difference in pre and post test response to questions. The level of significance was set at $P<.05$. Degrees of freedom (DF) for each question were calculated using the standard equation n-1.

Effect of noise vs. music on rest and sleep in the SICU

Data analyses[1] revealed no significant difference in the effects of noise vs. music on rest and sleep levels in the SICU among caregivers (t=.23, p>.05: t= .79, p>.05). On a 1-10 Likert scale, with 1 representing “not at all”, and 10 representing “completely pre-occupies me” the average score for the pre-test question, “Does noise in the SICU interfere with rest” was 5.6. Conversely, for the paired question in the post-test, “Does music affect rest in the SICU?” with *1* being “Never” and 10 being “Always”, the average score was 6.6 While there is a one-point

[1] See Table 1 for complete analysis

difference between the effects of noise vs. music on rest, such a minor change in mean is not enough to constitute statistical significance. Similarly, for the pre-test "Does noise in the SICU interfere with sleep?" the average score for participants was 5.7. The post-test equivalent, "Does music affect sleep in the SICU?" yielded an average score of 6. It is likely that with a larger population sample, the very minor change in results pre and post-test may have increased, indicating some statistical significance regarding the effects of noise vs. music on rest and sleep levels.

Effect of noise vs. music on impression of support interactions and interpretation of care

Data analyses[2] revealed no significant difference in the effects of noise vs. music on impression of support interactions and interpretation of care in the SICU among caregivers ($t= .02$, $p>.05$: $t=.01$, $p>.05$). On a 1-10 Likert scale, with 1 representing "Not at all" and 10 representing "Completely pre-occupies me", the average result to the question, "Does the noise interfere with family and other support interactions?" was 4.5 with a StD of 3.31. For the matching post-test question, "Does music affect family and other support interactions?" with 1 representing "never" and 10 representing "always", the average score was 6.5 with a StD of 3.54. There is a slightly higher response in the caregiver's impression of music vs. noise's effect on family and support interactions but not enough to constitute statistical significance. For the pre-test set of questions, "Does the noise in the unit impact your impression of: the care the patient receives, the general care, and the medical care?" average scores were 3.9, 3.6, and 3.5, respectively. For the matching post-test question, "Does the music in the unit impact your impression of: the care the patient receives, the general care, and the medical care?", results yielded averages of 7.0, 6.3, and 5.3 respectively. This change in average from pre to post-test

[2] See Table 2 for complete analysis

does indicate some effect of music vs. noise on perception of care, but not enough so to constitute significance.

Effect of music on masking/blending with environmental sounds in SICU

Data analyses[3] revealed that among surveyed caregivers there was no significant effect of music's ability to mask or blend with environmental sounds including the sound of IVACs, the sound of monitor alarms, the sound of voice noise, and the sound of adjacent patient noise (t=.5, p>.05: t= .6, p>.05: t=.26, p>.05: t=.45, p>.05:). On a 1-10 Likert scale, with 1 representing "Not at all" and 10 representing, "Completely", respondents had an average score of 3.0 for the question, "How bothered are you by the sound of vents?". Conversely, participants reported an average of 4.5 in response to the question, "How effective is music at masking/ blending with the sound of vents?". The average scores for the same pre-intervention questions referring to IVACs, monitor alarms, voice noise and adjacent patient noise were 5.3, 5.2, 3.6, and 3.3 respectively. For the matching post-intervention question regarding music's ability to mask/blend with IVACs, monitor alarms, voice noise and adjacent noise, mean results were 4.6, 4.6, 4.5, and 4.2. The change in pre and post-test show no statistical significance with noise displaying slightly higher levels of distraction as compared to music's ability to mask or blend with environmental sounds in the unit. It appears that noise's impact on caregivers was almost completely equivocal to music's ability to mask/blend with sounds in the unit.

Effect of noise vs. music on pain levels

Data analyses[4] revealed no significant change in caregiver's impression of the impact of noise vs. music on pain levels of patients in the SICU (t=.15, p>.05; t=.68, p>.05; t=.96, p>.05; t=.46, p>.05). On a 1-10 Likert scale, with 1 representing "Not at all" and 10 representing,

[3] See Table 3 for complete analysis
[4] See Table 4 for complete analysis

"Completely" the average score for participants to the question, "How much do you think noise impacts pain of minor procedures (intravenous lines and blood draws)?" was 4.5. For the matched post-test question, "How much do you think music impacts pain of minor procedures (intravenous lines and blood draws)?" using the same scale, the average response was 3.7. These averages demonstrate noise's slightly higher impact level on pain. However, this small change in averages is not enough to constitute statistical significance. The average scores for the same pre-intervention questions referring to central lines, chest tubes, and procedures involving staff were 4.6, 4.6, and 3.6 respectively. For the matching post-intervention question regarding music's impact on pain of procedures involving central lines, chest tubes, and staff, mean results were 4.3, 4.7, and 4.4. Clearly, average results for noise vs. music's impact on pain levels were nearly identical, demonstrating no significant difference in regards to music's ability vs. noise's ability to impact pain levels in patients in the SICU.

Discussion

Overall, data analyses revealed no significant difference between noise and music's impact on sleep & rest, impression of support interactions & care, the role in environmental ambience, and pain levels. Although in some cases, respondents reported on average slightly higher levels of impact in regards to music's ability to impact sleep and rest levels, as well as music's role in impacting support interactions with staff, these levels were not high enough to constitute statistical significance. Given the low sample size of caregivers, it is feasible to hypothesize that a larger amount of participants may yield significant results. In collecting existing data, I discovered numerous incomplete enrollments pointing to possible lack of follow-ups from researchers, or perhaps inability to complete surveys due to discharges of related patients. Furthermore, lack of significant results may point to the designed intervention's flaws.

For instance, perhaps an hour session as opposed to a 30-minute session of EMT would result in better outcomes. Additionally, more than the designed study's three sessions may have provided greater opportunity for impact of the intervention. In regards to the pre and post-test paired questions, it is arguable that differently designed survey questions would have resulted in statistically significant response. Finally, the Likert style scale could have been designed in a way that provide clearer choices for participants.

Environmental music therapy and rest/sleep

The researchers posed the questions, "Does noise in the SICU interfere with rest", "Does noise in the SICU interfere with sleep?" in order to establish if noise in the unit is a factor in rest and sleep levels among caregivers. Following exposure to the EMT intervention, researchers then asked participants, "Does music affect rest in the SICU?" and "Does music affect sleep in the SICU?" The perceived intention of these pre and post-questions is to ascertain if noise or music has a greater impact on rest and sleep levels among enrolled caregivers in the SICU. The designed questions seem to imply a negative impact of noise on rest and sleep levels through the use of the word "interfere". Conversely, the post-intervention questions seem to imply a more positive impact of music on rest and sleep through the use of the word "affect" as oppose to "interfere". It appears as though the designed question intended to reveal music's ability to mediate the affects of noise on sleep and rest levels. Implications for practice if such revelations were made may involve the use of EMT as a means to improve sleep and rest levels of caregivers, thus decreasing overall stress levels, anxiety levels, and negative experiences while in intensive care unit environments. However, researchers ask first about noise and then about music following the intervention as opposed to inquiring directly about the interventions ability to modify noise's impact on sleep. Noise has already been proven in a number of studies to act as

an element of interference in sleep and rest among caregivers, and if this research revealed similar results it would have served as a bolster to initial research and the need for solutions. As is the flaw with other questions designed for this research study, the question is posed as a "yes or no" yet participants are offered a 1-10 Likert scale for a closed response. This makes it impossible for data analysis to reveal levels of frequency and leads to a less detailed analysis on both noise's and music's impact on sleep.

Environmental music therapy and impression of support interactions/interpretation of care

The designed research study posed the questions, "Does noise interfere with family and other support interactions?", "Does noise in the unit impact your impression of: the care the patient receives, general care, and medical care?", and conversely, "Does music affect family and other support interactions?", "Does music affect your impression of: the care the patient receives, general care, and medical care?" The intent of such research questions appears to be to reveal whether noise or music plays a greater role in support interactions and interpretation of care among caregivers. As is the case with the majority of the designed research questions, there is an implied negativity and positivity to the pre and post-questions via the language of "interfere" vs. "affect". The researchers hoped to reveal EMT's ability to ameliorate noise's negative impact on support interactions and interpretation of care. However, flaws in the designed pre and post-questions include an inability to create a comparison between noise vs. music's impact on support and care due to a lack of correlating questions. The posed questions resulted in instead two sets of data that are difficult to measure against each other. The data shows the level at which noise interferes with interactions, and the level of music's effect on interactions, but not how noise and music interact with one another in regards to these interactions. The data is also difficult to analyze given that a 1-10 Likert scale was applied to a yes or no question. Instead of

having a frequency to determine the percentage of caregivers who feel noise interferes with support interactions and levels of care the data points only to the average level of interference as reported by enrolled participants. A more detailed analysis would involve percentage of frequency and level of interference, which could be used as evidence for the need of noise modification in order to improve caregiver interaction with staff. If research revealed noise as a significant negative factor in support interactions, clinicians could use such a research as evidence for increased training for staff and caregiver communication, improved design in sonic environments, as well as further research to determine effective means to curb noise during discussions of staff with caregivers. Furthermore, if the EMT intervention was found as an effective means to improve these communications, clinicians could point to such concrete data when formatting programming for music therapists in the hospital setting.

Environmental music therapy and masking/blending of environmental sounds in the SICU

In regards to masking and blending of environmental sounds in the SICU the researchers asked participants, "How bothered are you by the sound of: vents, IVACs, monitor alarms, voice noise, adjacent patient noise, and procedure noise?" Post-intervention, researchers asked participants to, "Choose a number from the scale below to rate music's ability to mask or blend the following sounds: the sounds of vents, the sound of IVACs, the sound of monitor alarms, the sound of voice noise, the sound of adjacent patient noise, and the sound of procedure noise." The researcher's intent in this set of questions was to measure the level of annoyance of various sounds in the unit and subsequently, EMT's ability to modify this level of annoyance via blending and masking. If results pointed to high incidences of participants reporting significant levels of being bothered, researchers could argue a need for techniques to lessen noise and/or modify the sonic environment. The post-intervention question aims to measure EMT's

effectiveness in acting as such a modifier in regards to noise in the medical unit. Statistically significant results could act as evidence for the increased need of music therapy programming in the hospital setting, specifically the intensive care unit, in order to improve caregiver experience. Furthermore, results revealing EMT's effectiveness as a modifier could serve as a basis for future research in regards to dissecting elements of EMT that are effective in masking/blending with environmental sounds, in order to improve levels of practice and understanding for music therapists.

Environmental music therapy and pain levels

Researchers asked enrolled caregivers prior to the EMT intervention, "How much do you think noise impacts pain of minor procedures", and "How much do you think noise impacts pain of the following major procedures: central lines, chest tubes, and procedures involving staff?" Following the intervention, caregivers were asked, "How much do you think music impacts pain of minor procedures?", and "How much do you think music impacts pain of the following major procedures: central lines, chest tubes, and procedures involving staff?" Researchers attempted to measure the level of noise impact on pain in order to assess the caregiver's perceived need of a sound-based intervention to modify patient pain. If pre-intervention response resulted in a significantly high level of noise impact on pain of minor or major procedures, researchers could argue for increased need of noise-modification in intensive care units to improve pain response to noise. The flaw in this particular research design is the impact of noise on pain was measured as amount and not frequency, thus making it impossible to determine significance in noise's impact on pain. If pain levels of minor and major procedures were compared in groups who were exposed to noise on the unit and those who were not, then the researchers could determine statistical significance. Instead, noise impact on pain was compared to music's impact on pain. It

appears that the researcher's intended to determine whether noise or music had a greater impact on pain. As was the case in the majority of the research questions, there is a presumed negative and positive impact of noise vs. music. This presumption further complicates data analysis given that even if results revealed music as having a statistically significant greater impact on pain, researchers are left wondering in what way.

Recommendations for Future Research

Moving forward, it is advisable that researchers implement longer, or perhaps more frequent Environmental Music Therapy interventions and better-designed pre and post-questions to yield more positive results. In the current study, the number of interventions that participants were exposed to varied from one to three. It is advisable that enrollees with exposure of less than three EMT sessions be unqualified for continued participation. When considering the amount of time caregivers were exposed to baseline noise levels in the SICU even within a 24-hour period, in contrast to a one time 30-minute exposure of EMT, it is only logical that such a limited amount of music therapy would limit impact among enrolled participants. For future research on the use of EMT in intensive care unit settings, researchers must be aware of this variable, and take more measures to ensure greater exposure to music therapy in order to balance exposure to baseline noise.

The lack of statistical significance in the current research may also point to flaws in the overall design of the survey style methodology. Future researchers may consider either forgoing the survey style, and/or designing clearer, and better matched pre and post-intervention questionnaires. Given that the questionnaires were designed and used for the first time in the present study, it is difficult for researchers to create reliability and validity for the one-time survey model (Nardi, 2015). Furthermore, the survey style may result in lack of detail and depth

in regards to particular research points. Surveys may result in increased focus on range of issues rather than focusing on specific elements pertinent to the research question (Kelley et al., 2003). These flaws can be seen in the existing research study questions regarding the impact of noise on caregiver's impression of care the patient received, general care, and medical care. The existing survey attempts to cover a range of elements of care, asking the participant to answer on a 1-10 scale how intensely noise impacts impressions of three varieties of care, all of which could be perceived as being the same from the eyes of the enrolled participants. A more effective research model to assess the impact of noise on perception of care may involve open-ended qualitative questions such as, "How does noise impact your perception of care?" Researchers may then look for themes in question response and may reveal trends that may not have been considered in design of survey questions.

The existing survey style research questions may have also contributed to confusion among participants. For instance, in question seven of the post-intervention questionnaire, the researcher asks, "Does the music affect your impression of the staff?" with the scale ranging from, "Has a strong effect" and "Cannot tolerate it". Given the similarity in perceived meaning between these two options at either end of a spectrum it is feasible that enrolled caregivers were unable to offer an answer that best represented their experience. Additionally, the use of the word "it" in the scale creates ambiguity in regards to what "it" refers to. "It" may be interpreted as the music, or the staff. For future research, it is recommended that when implementing survey questions, researchers design two sides of a Likert scale that provide clear opposing options and use concrete language that limits confusion and open interpretation for closed questionnaires.

The language of the designed questions presents possible issues not only for the participants, but for the data analysis as well. Some of the designed pre and post questions

include varied language making it difficult to provide accurate analysis. For example, for questions examining the effect of noise vs. music on pain levels, the pre-test question inquires, "How much do you think noise impacts pain of procedures?" with a matching post-test of, "How much do you think music impacts pain of procedures?" This set of questions may measure the impact of noise and music on pain but it makes it difficult to provide an accurate comparison of the two. A better-designed pre and post-intervention pair of questions may be worded such as, "How much does noise impact pain of procedures", followed by "How much does music mediate the impact of noise in pain response during procedures?" This would provide a clear means to assess level of change between pre and post-intervention conditions. In the current research study, the post-intervention questions seem to create an assumption that the impact of music is positive. For instance, question one asks participants "Does music affect rest in the SICU?", rather than "How does music affect rest in the SICU?" or, "Does music change the impact of noise on rest levels in the SICU?" When analyzing data of the existing research questions, it is impossible to ascertain the nature of impact if a participant answered, "10- always" to "Does music affect rest in the SICU". Overall, for future researchers interested in examining the impact of EMT on the caregiver experience in an intensive care unit environment, it is recommended that they take the time to implement higher levels of exposure to the designed intervention, a non-survey style design to yield more in-depth and detailed results, and clear and concrete language in research questions.

Conclusion

This is the first study to examine the use of an environmental music therapy protocol on the caregiver experience in the surgical intensive care unit. The purpose of this research was to explore the role of noise, and subsequently music, on the psychological health of caregivers in

hopes of revealing a possible intervention to address such needs. Researchers intended to illuminate a solution for noxious stimuli exposure by providing a creative and holistic means of relief for caregivers within the SICU setting.

This research implemented an experimental survey design to measure pre- and post-intervention interpretation of noise vs. music on factors such as rest & sleep, support interactions, environmental sounds, and pain response. Enrolled caregivers were surveyed before and after a 30-minute intervention of environmental music therapy provided by therapists. Data analysis revealed no statistical significance in pre and post-test response, indicating no substantial impact of the designed environmental music therapy protocol on caregiver response. Given the small sample size of caregivers, it is possible that higher levels of enrollment would have produced differing results. Additionally, increased exposure to the intervention, and better-designed survey questions may have resulted in greater levels of change. While unable to provide significant data to support the use of environmental music therapy to impact caregiver experience in the SICU, this research has revealed a need for continued exploration of negative auditory stimuli on psychological health of caregivers and subsequent solutions to such factors implicit in an intensive care unit setting. Furthermore, this study has exposed flaws in the existing research methodology present in the parent study, and has offered recommendations for future researchers undertaking related research initiatives.

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Tables

Table 1: Statistical Analysis of Noise vs. Music Impact on Rest & Sleep

Statistical Analysis	Noise Impact on Rest	Music Impact on Rest	Noise Impact on Sleep	Music Impact on Sleep
Mean	5.6	6.6	5.7	6
Median	5.5	8	7	7.5
Standard Dev.	2.6	4.2	3.4	2.8
T-Test		.23		.79

Table 2: Statistical Analysis of Noise vs. Music on Support and Interpretation of Care

Statistical Analysis	Noise Impact on Family & Support Interactions	Music Impact on Family & Support Interactions	Noise Impact on Care Received	Music Impact on Care Received	Noise Impact on General Care	Music Impact on General Care	Noise Impact on Medical Care	Music Impact on Medical Care
Mean	4.5	6.5	3.9	7.04	3.6	6.3	3.5	5.3
Median	5	7.5	1.5	7.5	2.5	6.5	2.5	6
Standard Dev.	3.3	3.5	3.4	.71	2.9	.71	2.8	1.41
T-Test		.02		.01		.01		.01

Table 3: Statistical Analysis of Music on Masking/Blending with Environmental Sounds

Statistical Analysis	Noise Impact: IVACs	Music Impact on IVACs	Noise Impact: Monitor Alarms	Music Impact on Monitor Alarms	Noise Impact: Voice Noise	Music Impact on Voice Noise	Noise Impact: Adjacent Patient Noise	Music Impact on Adjacent Patient Noise
Mean	5.3	4.6	5.2	4.6	3.6	4.5	2.2	4.2
Median	5.0	3.0	5.0	4.5	1.0	4.5	1.0	1.5
Standard Dev.	2.9	2.8	3.1	5.0	3.1	4.5	1.5	.7
T-Test		.5		.6		.3		.5

Table 4: Statistical Analysis of Noise vs. Music on Pain Levels

Statistical Analysis	Noise Impact: Minor Procedures	Music Impact: Minor Procedures	Noise Impact: Central Lines	Music Impact: Central Lines	Noise Impact: Chest Tubes	Music Impact: Chest Tubes	Noise Impact: Staff Procedures	Music Impact: Staff Procedures
Mean	4.5	3.7	4.6	4.3	4.6	4.7	3.6	4.4
Median	4.0	4.5	5.0	3.5	4.5	3.5	2.0	4.5
Standard Dev.	3.5	3.5	3.4	2.1	3.4	2.1	3.2	3.5
T-Test		.15		.7		1.0		.5

Appendix A

Personal Caregiver Questionnaire

Pre Intervention

Date:_____

Personal Caregiver's Name:_____

Circle response

1. Does noise in the SICU interfere with rest?

Not at all Somewhat Completely pre-occupies me

1 2 3 4 5 6 7 8 9 10

2. Does noise in the SICU interfere with sleep?

Not at all Somewhat Completely pre-occupies me

1 2 3 4 5 6 7 8 9 10

3. Does the noise interfere with family and other support interactions?

Not at all Somewhat Completely pre-occupies me

1 2 3 4 5 6 7 8 9 10

4. Does the noise in the unit impact your impression of:

a. ...the care the patient receives

Not at all Somewhat Completely pre-occupies me

1 2 3 4 5 6 7 8 9 10

b…of the general care?

Not at all Somewhat Completely pre-occupies me

1 2 3 4 5 6 7 8 9 10

c. ….of the medical care?

Not at all Somewhat Completely pre-occupies me

1 2 3 4 5 6 7 8 9 10

5. Are staff responsive to your requests to try and decrease noise?

Not at all Somewhat Extremely Attentive

1 2 3 4 5 6 7 8 9 10

6. Does the loudness of the noise affect your perception of staff?

Not at all Somewhat Definitely

1 2 3 4 5 6 7 8 9 10

Use the scale below to rate the following: (Circle from list below)

7. How bothered are you by:

a. …the sound of vents

Not at all Somewhat Completely

1 2 3 4 5 6 7 8 9 10

b. ..the sound of IVACS

Not at all Somewhat Completely

1 2 3 4 5 6 7 8 9 10

c. ..the sound of monitor alarms

Not at all Somewhat Completely

1 2 3 4 5 6 7 8 9 10

d. …the sound of voice noise

Not at all Somewhat Completely

1 2 3 4 5 6 7 8 9 10

e. …adjacent patient noise (voice, music, or tv)

Not at all Somewhat Completely

1 2 3 4 5 6 7 8 9 10

f. …the sound of procedure noise

Not at all Somewhat Completely

1 2 3 4 5 6 7 8 9 10

8. Has noise and consequent tiredness ever interfered with your willingness to sign a consent form for a procedure?

Not at all Somewhat Completely

1 2 3 4 5 6 7 8 9 10

9. How much do you think noise impacts pain of minor procedures (intravenous lines and blood draws)

Not at all Patient Cannot Tolerate It

1 2 3 4 5 6 7 8 9 10

10. How much do you think noise impacts pain of the following major procedures (central lines, chest tubes, or any procedure involving the staff sterile prepping and draping.)

a. Central lines

Not at all Patient Cannot Tolerate It

1 2 3 4 5 6 7 8 9 10

b. Chest tubes

Not at all Patient Cannot Tolerate It

1 2 3 4 5 6 7 8 9 10

c. Procedures involving the staff (sterile prepping and draping)

Not at all Patient Cannot Tolerate It

1 2 3 4 5 6 7 8 9 10

Appendix B

Personal Caregiver Questionnaire

Post Intervention

Date:_____

Personal Caregiver's Name:_____

Circle response

1. Does music affect rest in the SICU?

Never Always

1 2 3 4 5 6 7 8 9 10

2. Does music affect sleep in the SICU?

Never Always

1 2 3 4 5 6 7 8 9 10

3. Does music affect family and other support interactions?

Never Always

1 2 3 4 5 6 7 8 9 10

4. Does the music in the unit impact your impression of:

a. …the care the patient receives?

0 % 100 %

1 2 3 4 5 6 7 8 9 10

b. … the general care?

0 % 100 %

1 2 3 4 5 6 7 8 9 10

c. …the medical care?

0 % 100 %

1 2 3 4 5 6 7 8 9 10

6. Does the music impact staff's attempts to maintain a quieter environment?

Not at all Somewhat Extremely impacts

1 2 3 4 5 6 7 8 9 10

7. Does the music affect your perception of staff?

Has a strong effect Some effect Has no effect Cannot tolerate it

1 2 3 4 5 6 7 8 9 10

8. Does music affect tiredness or interfere with your willingness to sign a consent form for a procedure?

0 % 100 %

1 2 3 4 5 6 7 8 9 10

9. How much do you think music impacts pain of minor procedures (intravenous lines and blood draws)

Has a strong effect Some effect Has no effect Cannot tolerate it

1 2 3 4 5 6 7 8 9 10

10. How much does music impact pain of the following procedures:

a. Central lines

Has a strong effect Some effect Has no effect Cannot tolerate it

1 2 3 4 5 6 7 8 9 10

b. Chest tubes

Has a strong effect Some effect Has no effect Cannot tolerate it

1 2 3 4 5 6 7 8 9 10

c. Procedures involving the staff (sterile prepping and draping)

Has a strong effect Some effect Has no effect Cannot tolerate it

1 2 3 4 5 6 7 8 9 10

11. How did music impact any relaxation techniques during your SICU stay?

Has a strong effect Some effect Has no effect Cannot tolerate it

1 2 3 4 5 6 7 8 9 10