A Soundscape Healing Environment:

An Exploratory Study of the Relationship

Between Therapeutic Sound Frequency and Outcomes for Clinical Care Settings

by

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A Thesis Presented in Partial Fulfillment
of the Requirements for the Degree
Master of Science in Design

Approved April 2022 by the
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ARIZONA STATE UNIVERSITY

May 2022

ABSTRACT

The catalyst for this research was rooted in a patient satisfaction survey reported the need for an ambient quiet setting. This study used a descriptive comparative design augmented with qualitative data. The sample consisted of 54 participants came from one of three primary care clinics listened to 22 minutes of existing natural clinical sounds while the others listened to therapeutic sound hertz in a treatment room. The survey data correlated identify if an association existed or not to add therapeutic soundscape hertz back into a clinical ambient setting could affect the patient experience and wellness. Rather than, continue with abatement program efforts to remove unwanted sounds or mask the noise. Quantitative data were collected on mood states and biometric measures consisted of respiratory, heart, pulse systolic, and diastolic blood pressure rates. Qualitative data 5-Point Likert scale and open-ended questions determined participants' awareness of ambient sounds within the clinical setting. Data from participants were analyzed and compared separately for each clinic. The metrics were found to be statistically correlated ($p<0.05$) for the POMS-A survey and biometric measures using a Chi-square test. After the intervention, two clinics reported a 60%, and the third clinic an 80% mood state changes. Clinic 2-M reported the greatest significant mood state change. The t-Test validation biometric measures showed no significant evidence among the test and control groups for Clinic 1-L (396, 417, 444 Hz). Clinics 2-M (528, 639 Hz) and Clinic 3-H (714, 852 Hz) did share significant evidence to respiratory, heart, and systolic blood pressure rates. The respondents revealed 27% had a positive opinion of the therapeutic sound hertz perceived as silent or quiet, 59% had a negative opinion of unwanted sounds included communication as disruptive, and 16% felt the clinic’s

physical design was poor. As a whole, this study indicates exposing patients to therapeutic sound hertz had a positive impact on their biopsychosocial wellness states. The value and novelty of this study show by adding selective distinct therapeutic sound hertz levels back into the clinic setting have profound implications for future researchers to build upon how the quality soundscape performance effects on the patient.

DEDICATION

This thesis is dedicated to the glory of God Almighty, the ultimate Architect, that created the fullness of sound from the beginning of time, sound holds the power to transform lives and to shift atmospheric environments for the better.

On the personal note, I thank my parents role models within the African American society educators, deceased father, James Jones former Psychologist and Dean of Student Affairs for 22 years of our upbringing. My mother, Annie Jones PhD, who constantly encouraged me to finish a voice of strength and reason. My son, Aaron Michael, the light of my life, the fueled behind me to work hard to create a legacy for him, my dear brothers Travis Mitchell, and James Albert's children passed last year fought the bravest fight for life I have ever seen and his wife, Chichi. Many more thanks to my employer, AZ Army National Guard DEMA CFMO DPM, Aunt Joyce who was always there for my family. Finally, to countless beloved friends Sonya, Anne, Maxine, Christina, Mary Ann and Joy, Scott, Mrs. Forney, Alanna, Kevin, my church family, worship and prayer team lead Staci, Pastors Paul and Kim, Cindy, Phyllis, Pastor Bonnie Lloyd, Bonnie Fridenmaker, and Pastors Kouami and Esee.

ACKNOWLEDGMENTS

Hats off to Diane Bender PhD, my thesis chair for her poise and patience to help me finish what seemed to be countless starts and delays to not give up on this effort and work. John Takamura PhD for planting the seeds to pick a topic you will never get tired of truly appropriate for this work and his product development influence. Gerri Lamb PhD, RN, FAAN for keeping me grounded in research reality to scale back my work keep it concise. Gerri's healthcare experience and brilliance is admired, brainstorming, and who help pioneer the Healthcare and Healing Environment program. I want to thank Maja Racic, MD, PhD Mayo Clinic for cracking the whip to keep me on top of the ball and not falling off the edge. Mo Stein Principle HKS for his and staff graciousness to provide a place to study during the research discovery. Michael Tyrrell, worship leader, mastermind patent inventor of the WholeTone hertz levels, provided this study sound boxes, took time with me, his business partner, and shared journey. Lastly, Roger Call retired from Herman Miller Incorporated, Director of Healthcare Architecture and Design was always there for me, as a mentor throughout my academic career took a true interest in my career, and life direction I am grateful for. It is amazing to have this dedicated amazing, assembled team.

Special appreciation for special funding and sponsorship from P.E.O International Program for Continuing Education "Helping Women Reach for the Stars", Entrepreneur and Innovation "New Venture" summer program I-Corps grant award, ASU Summer Writing Camp, Herberger Art Institute for Design and the Arts special funding, shared Travel Fund Award from School of Design MSD and Edson College of Nursing and Health Innovation programs to help undergird my educational pursuits.

TABLE OF CONTENTS

Page

CHAPTER Page

LIST OF FIGURES

Figure Page

CHAPTER 1

INTRODUCTION

"An expanding body of knowledge has begun to link the physical environment with human physiological responses to a built space and the building to its environment, though there remains a largely unused body of rigorous biological research that describes the link between the environment and health, well-being, and performance. The translation of biomedical research now enables evidence-based design to look to the biological bases of human needs, relevant to all built settings and all people." – Edelstein (2008, pg. 54)

The United States Health Care Reform (HCR) policy has forever changed the landscape for healthcare. In 2010, the Institute for Health Improvement (IHI) developed an approach to optimize health system performance to simultaneously pursue three dimensions, called the Triple Aim. These dimensions are to improve the following: patient experience of care, health of populations, and reduce cost per capita of healthcare. This impact on the healthcare system has influenced the practice of healthcare design. Both practitioners of the design and the medical communities must recognize how to meet the new HCR quality standards. This requires a collaborative interdisciplinary design approach that recognizes the physical building as a

concrete influence on how patient care is delivered. In many cases, it is the opinion of the medical community that design decisions are a result of what has been

encased in steel, and these decisions create change in the practice environment and influence the patient and family experience (Porter-O'Grady & Malloch, 2010). It is widely understood that the hospital environment affects the patient's experience when admitted and treated in clinical spaces. At an ambulatory chemotherapy department, this study points out that personalized and targeted music interventions should go hand in hand with personalized medicine (Bro, Johansen, Vuust, Enggaard, Himmelstrup, Mourits-Andersen, Brown, D'Amore, Wreford, Abildgaard & Gram, 2019). Research on healthcare design and planning has highlighted strong relationships between environmental characteristics and human health (Monti, Agostini, Dellabartola, Neri, Bozicevic, & Pocecco, 2012).

Accordingly, a well-integrated patient-centered care model must focus on the hospital environment's ability to reduce negative effects of patient hospitalization. One element of the hospital environment is the sensory experience. The hospital soundscape ecosystem may have a direct impact on patient care. Sound is an environmental sensory characteristic often associated as a negative aspect within the healing space. It is worthwhile to consider how subjective responses to hospital sounds can be made more positive (Mackrill, Jennings & Cain, 2014). Although there can be negative health consequences of excessive sound within these spaces (Ulrich, 1992), there is potential for positive benefits in understanding and maintaining the soundscape of the patient-care environment (Mackrill et al., 2014). This suggests the ambience of space has an effect on the people within it (Schweitzer, Gilpin & Frampton, 2004).

This study will examine how manipulating the soundscape environment by utilizing therapeutic sound frequency intervention can improve the healing process at a biopsychosocial level for a well-integrated patient-care model. The architectural and design community have excelled to reduce and remove all types of sounds from hospital patient-care clinical spaces. Design practitioners have a responsibility to address the sound issues and present innovative solutions to not just remove from a hospital clinical setting, but to create a therapeutic clinical soundscape ecosystem for ambulatory centers, clinics of all types, and standalone health care patient facilities. Limited research has been done to investigate these design strategies and their impact on sound levels in patient care environments (Wang, Downs, Farell, Cook, Hourihan, McCreery, 2013). A disseminated therapeutic sound frequency may radically improve a patient's experience and perception of healing in a quieter environment during a clinical visit.

This chapter introduces the issue of hospital soundscapes and the necessity to add positive therapeutic sound frequency back into patient-care clinical spaces. The proposed dissemination of therapeutic sound into a healing space ultimately will satisfy the HCR Triple Aim to optimize the overall health system performance for the patient, the provider, and the community. Additionally, the significance, justification, scope, and delimitations of this study are discussed. Finally, the key operational terms and definitions are elucidated.

1.1 Background

Since 1960, there has been a consistent trend of rising levels of sound (Busch-Vishniac, West, Barnhill, Hunter, Orellana, & Chivukula, 2005). The driving factors for these rising levels of sound point to the advancement of technology, population growth, increased life expectancy, and medical advances. The utilization of sound interaction in the healthcare and healing environment can have either a positive or negative effect on people goes beyond the hospital landscape to ambulatory centers, clinics of all types, and standalone patient facilities. Routinely unwanted sounds, like operational noise and equipment, have been characterized as a top complaint of hospital patients, medical staff, and visitors (Bliefnick, Ryherd, & Jackson, 2019) Operational noise today is seen in various types of ambulatory centers and clinics of all types does not discriminate from noise issues just in hospitals only. The importance of unwanted sound in a healthcare and healing environment has been acknowledged for decades, as written in the 1859 book by the noteworthy founder of modern nursing, Florence Nightingale who stated, "Unnecessary noise, then, is the most cruel absence of care which can be inflicted either on the sick or the well." (Nightingale, 1860, pg. 63, 64). In a study of 4,115 patients in 32 Berlin hospitals, researchers found that chronic noise increased the risk of heart attacks by 50 percent for men and 75 percent for women (Willich, Wegscheider, Stallmann & Keil, 2006). In a hospital environment, where people are already ill and psychologically stressed, as Florence Nightingale stated, unnecessary noise can be very harmful. A clinical setting can be stressful like a surgical operating room a study reported some

patients receiving music intervention experienced clinically after surgery reduce use of analgesics and reduced pain (Kühlmann, De Rooij, Kroese, Van Dijk, Hunink & Jeekel, 2018). In contrast, excessive noise and poor sound environments can potentially reduce healing, create stress, contribute to poor communication, and lead to potential medical errors.

The health care medical clinics and hospital cacophony of sounds consists of a complexity of alarm systems designed to alert the medical team to patient needs. The overall noise levels often exceed World Health Organization (WHO) guidelines. The WHO guidelines on community noise (unwanted sounds) include noise as an important issue when addressing public health matters (World Health Organization, 1999). Many sounds are annoying, disturbing, and disquieting, but other sounds are pleasant, reassuring, relaxing, and even necessary, like exchange of the verbal information between patients and staff. In recent years, noise controls have emerged and taken on a more sophisticated approach. Soundscape strategies are complex sound environments, which embrace positive sounds as well as annoying ones (De Ruiter, 2015). Largely, the medical and design communities have addressed these sounds through the implementation of noise reduction or abatement programs to mask off unwanted and annoying sounds from the clinical care environments.

1.2 The Power of Sensory Stimuli

It is suggested to not just remove sound, but to add sound back into the environment to create a positive therapeutic place for patient biopsychosocial healing. To

the contrary, sound may also be carried in the space as a positive distractor. The interaction between stress and environmental stimuli such as light and sound are relevant to patients, visitors, and staff. For example, Ulrich's landmark (1984) study examined the sensory element of natural day light. Ulrich examined whether an assignment to a hospital room with a window view of a natural setting might have restorative influences over a room without a view. Twenty-three surgical patients assigned to rooms with windows looking out on a natural scene had shorter postoperative hospital stays, received fewer negative evaluative comments in nurses' notes, and took fewer potent analgesics than matched patients in similar rooms with windows facing a brick building wall (Ulrich, 1984). Likewise, sound included in the environment as a positive distractor, like the effects of ocean sounds on postoperative coronary artery patients, scored significantly higher on self-reported sleep (Williamson, 1992). Studies also confirm the value of music intervention, which appears to be useful in managing chronic pain and significantly reducing medication consumption (Guétin, Giniès, Siou, Didier & Picot, 2012; Kühlmann et al, 2018).

Music intervention for patients also have beneficial effects on environmental appraisals (Dijkstra, Pieterse & Pruyn, 2006). Although music is an environmental stimulus that can easily be applied to change the atmosphere of an environment, empirical evidence on the effects of music as being part of the shared healthcare environment is still limited (Dijkstra et al. 2006; Ulrich et al., 2004).

1.3 Sound Frequency Intervention

> *"Life is too short to live out of tune. Tune up, tune in, and release the sound of healing everywhere you go. The human body is no different. When the cells of the body are in tune with each other, the body functions flawlessly and resonates with life. When the body is in a state of disease, it is out of tune with itself and in need of cellular intonation."*
>
> *(Tyrrell, 2014, pg. 80, 88)*

Sound frequency interventions are defined sound frequency represents continuous and regular vibrations that can be heard as they? travels through the air to reach a person's ear. Sound frequency vibrations are found in musical tones. They resonate through the physical body to the cellular level. The human body is wired to be exquisitely sensitive to sound frequencies, as the body is largely composed of water. This enables the body to conduct sound at a rate approximately four times faster than air to "hear" the pressure waves of sound through one's skin (McRusick, 2016). For example, a medical treatment known as Vibroacoustic Sound Therapy (VST). VST incorporates both music therapy and sound frequencies arranged in such a way that the sound currents travel directly through the body (McRusick, 2016). A study with 33 patients who underwent knee replacements or revisions produced a 21 percent reduction of tension after patients received selective low frequency (SLF) physioacoustic treatment post surgically. The experimental group went home an average of one half-day earlier, used less pain medication, and expressed more satisfaction with the care they received than did control group subjects (Boyd-Brewer, 2003).

This study supports the notion that music has an environmental sound frequency pattern. The environmental effects sound has on the physiologic and emotions is a valid intervention to accelerate healing may significantly be beneficial to lower systolic blood pressure, arterial pressure, mood shifts, anxiety, depression, and pain experience (Schorr, 1993). The physical environment can contribute or aggravate the biopsychosocial problems. Healthcare design teams and stakeholders may closely examine the relationship between the dissemination of positive therapeutic sound frequency for a well-integrated patient-care clinical model. This chapter will provide a general overview of these topics discussed in the study as well as the importance of connecting the environment's sound frequency to explore the patient's biopsychosocial effects within a clinical setting. Thus, the health care design community can better translate evidence-based patient biomedical information to improve the application of design principles for the health care environments (Edlestein, 2008).

1.4 Significance

This section will explore the importance to add therapeutic sound frequency hertz levels back into a clinical setting. It will introduce the relationship between therapeutic sound frequency hertz, the patient experience, and the physical built environment.

Health care design practitioners have benefited from the 21st century emphasize on quality, patient centered care, and safety are just a few of the substantial improvements in the quality of health care over the past 10 years. The initiative to reduce the effects of unwanted sounds in clinical settings is a safety and quality performance issue in of improvement. The Institute of Medicine's (IOM) *Crossing the Quality Chasm*

(2001) focused on quality improvement to improving safety, quality, and patient care outcomes. These organizations analyzed the systems behind inadequate quality of care, may provide a new framework for healthcare design (Porter-O'Grady & Malloch, 2010). It is imperative to address the soundscape noise levels in health care is known to impact patients' ability to recover from the night noises, while the medical staff experience alarm fatigue can cause increased medical errors. Organizations like IOM have validated the design community to resolve the noise system issues related to care and building operations. This becomes a quality improvement strategic need to eradicate, if at all possible, such soundscapes of noise that can harm patient and its staff justifies the need to incorporate evidence-based solutions to add the positive distraction of sound hertz may prove to improve patient care and staff resilience just by manipulating the health care clinical soundscape.

Intensive care unit (ICU) psychosis or delirium has been directly linked to environmental stressors such as noise, sleep deprivation, and social isolation (Lorenz 2007). Noise is responsible for increased patient agitation, stress, followed by low pain thresholds due to illness. Unwanted sounds cause increased medication errors, longer lengths of stay, and other complications. Such environmental noise has been shown to significantly affect sleep and patient's perceptions of their ability to heal. In addition, Lorenz (2007) states that noise can alter the immune system, thereby impeding healing and recovery. Research supports that the rehospitalization rate is statistically significantly higher in settings with bad acoustics (Dijkstra, Pieterse & Pruyn, 2006). In 2018, medical

providers of 2,599 medical clinics faced readmissions penalties this year (Fontana, 2020). The significance to reducing noise in the clinical settings has direct financial impact on revenues.

Three key organizations, The World Health Organization (WHO), the International Noise Council (INC), and the Environmental Protection Agency (EPA), have set environmental noise standards (Konkani and Oakley, 2012). Research and evidence-based design indicates that excessive noise comes within and around the patient rooms, and overall noise levels often exceed World Health Organization (WHO) guidelines (Okcu, Ryherd, Zimring, & Samuels, 2011). Excessive noise and poor sound environments reduce healing, create stress, and contribute to poor communication and potential medical errors (Okcu, Ryherd, Zimring, & Samuels, 2011) is on the increase in standalone care facilities, outpatient care, and other ambulatory clinical settings. The impact of clinical ambient environment of unwanted sounds like noise has become a quality driven concern that of which we are seeing how policy leverages the opportunity for process improvement.

In 2013, HCR policy focused on the Triple Aim to improve issues like health coverage, safety, medical outcomes, delivery systems, and quality measures. Within the quality measures to control health care noise levels in hospitals and other medical clinics has become a main focus for many providers. The Center for Medicare and Medicaid Services (CMS) partnered with the Federal Department of Health and Human Services (HHS) to provide a standardized survey instrument and data collection methodology for

measuring patients' perspectives on hospital care. This survey is called the Hospital Consumer Assessment for Healthcare Providers and Systems (HCAHPS). To get this data, the HCAHPS survey was created and used by several federal agencies as a quality measure for Medicare reimbursements. The survey collects information and data focused on the patient experience taken from ten domains. One of the domains addresses the environmental factor of cleanliness and quietness (the absence of unwanted sound like noise or bustle). The question: How often do you experience quiet around your room at night? Consistently, this question receives the lowest hospital survey score depicting high levels of noise can impact satisfaction and may reduce the quality of patient care, and outcomes during a clinical visit or overnight stay. This is a problematic factor leads to medical errors, in turn, affecting patient safety (Dijkstra, Pieterse & Ad Pruyn, 2006). Therefore, the soundscape is a significant factor in determining a patient's overall satisfaction (Quan, Joseph & Ensign, 2012) within a clinical setting.

Nationally, the HCAHPS survey question on sound in and around patient rooms remains low, ranging between 51 to 75 percent. Figure 1 illustrates a summary of HCAHPS survey results. Figure 2 illustrates the mean results of 4,427 US healthcare providers results for all survey questions asked. Low satisfaction scores with healthcare services directly affects the reputation, patient loyalty, patient retention and attraction, operating revenue, and profit margin of a healthcare organizations (Quan, Joseph & Ensign, 2012).

State	Comm. with Nurses	Comm. with Doctors	Responsiveness of Hospital Staff	Comm. About Medicines	Cleanliness of Hosp. Env.	Quietness of Hosp. Env.	Discharge Information	Care Transition	Hospital Rating	Recommend the Hospital	Participating Hospitals*	Survey Response Rate**
AK	79	78	66	67	74	61	86	52	73	71	16	20%
AL	81	83	69	65	70	71	86	51	70	68	86	22%
AR	80	84	68	63	70	68	85	51	71	69	73	21%
AZ	76	76	63	60	68	58	85	49	68	69	74	24%
CA	76	76	61	60	71	53	85	48	69	69	320	21%
CO	81	81	69	66	74	68	89	54	77	75	82	25%
CT	79	79	61	60	72	54	88	50	69	71	26	24%
DC	72	78	54	59	66	57	84	48	62	61	7	17%
DE	79	79	67	59	69	58	88	49	70	69	7	22%
FL	76	76	60	59	69	60	83	48	67	68	176	21%
GA	78	80	62	60	69	66	84	51	69	69	128	18%
HI	79	80	65	63	77	58	86	50	70	69	16	24%
IA	83	84	72	66	78	69	88	55	79	76	113	32%
ID	84	85	77	69	79	65	89	54	78	77	43	28%
IL	79	80	65	62	73	64	87	52	71	69	176	24%
IN	80	80	67	62	74	62	87	52	74	72	107	27%
KS	83	84	73	65	78	69	87	57	78	78	130	30%
KY	82	82	68	64	74	65	86	52	72	70	92	21%
LA	83	86	71	68	76	74	87	58	76	75	100	21%
MA	81	80	64	63	71	52	89	52	71	73	57	25%
MD	75	77	58	57	67	57	86	48	66	66	45	19%
ME	85	84	73	69	78	59	89	56	76	77	34	26%
MI	82	79	71	63	72	61	88	53	73	71	127	29%
MN	83	84	74	66	76	70	89	57	77	76	119	34%
MO	80	80	65	61	71	63	87	51	72	69	104	26%
MS	82	85	71	64	73	73	84	53	72	71	81	19%
MT	82	85	74	66	71	63	84	52	71	72	53	31%
NC	80	82	65	64	71	64	87	53	72	69	106	20%
ND	84	86	76	69	74	70	85	58	77	77	42	35%
NE	84	87	74	69	79	72	89	56	81	78	85	36%
NH	81	80	68	64	76	58	89	54	74	74	26	24%
NJ	76	76	58	58	69	55	83	46	66	66	64	20%
NM	78	79	67	63	71	64	84	49	69	66	37	18%
NV	74	73	62	61	67	57	83	46	66	64	36	22%
NY	77	77	61	58	69	55	85	47	66	66	160	22%
OH	81	80	68	63	73	62	89	53	74	72	155	25%
OK	80	83	71	64	74	69	86	53	74	73	114	23%
OR	82	82	70	67	76	59	88	55	75	75	60	24%
PA	82	80	68	62	72	59	88	52	72	71	158	29%
PR	72	74	59	49	70	59	68	38	59	60	6	33%
RI	79	80	63	60	73	56	87	52	71	73	11	26%
SC	80	82	66	62	68	65	87	52	71	69	61	20%
SD	84	86	76	67	77	73	87	57	80	78	57	33%
TN	79	81	65	63	72	66	85	51	70	69	93	22%
TX	80	81	67	64	74	68	86	53	74	73	338	20%
UT	82	84	70	63	78	63	89	56	78	78	46	22%
VA	78	79	62	61	69	61	87	50	69	69	84	21%
VI	74	78	61	52	71	51	76	34	54	55	2	23%
VT	82	84	68	64	80	57	88	54	75	75	15	28%
WA	80	81	69	63	74	57	87	53	73	74	83	22%
WI	83	82	71	67	76	67	90	56	77	75	122	33%
WV	81	81	70	66	76	62	86	52	72	71	47	25%
WY	82	81	72	64	76	66	89	54	73	70	27	27%
US	**80**	**81**	**67**	**63**	**73**	**63**	**86**	**52**	**72**	**71**	**4427**	**24%**

Figure 1. Summary of HCAHPS results July 2020 to December 2020 Discharges, internet citation https://www.hcahpsonline.org

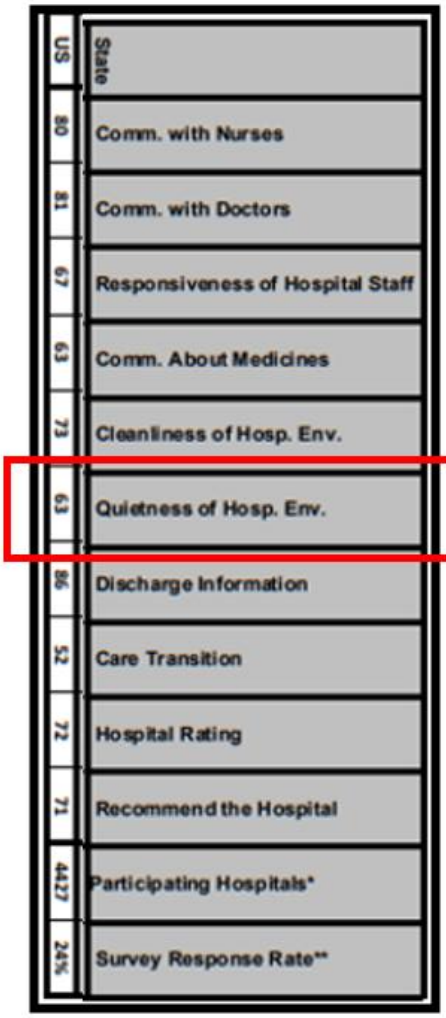

Figure 2. Summary of HCAHPS overall means results July 2020 to December 2020 Discharges, internet citation https://www.hcahpsonline.org

A growing body of evidence-based design indicates that the health care physical environment plays an important role in improving the experiences and satisfaction of patients (Quan, Joseph & Ensign, 2012). Patient satisfaction with healthcare service directly affects the hospital's reputation, patient loyalty, patient retention and attraction, operating revenue, and the profit margin of a healthcare organization (Quan, Joseph &

Ensign, 2012). With Medicare reimbursements, a driving factor tied directly to patient satisfaction scores, healthcare organizations have a strong financial motivation to improve patient satisfaction (Quan, Joseph & Ensign, 2012). The implication of this sound study may help contribute to the body of knowledge and design strategies in how to provide therapeutic sound hertz to reduce patient length of stay, improve patient experience, increase satisfaction scores, improve revenue inflow, reduce medical errors, and minimize pain relievers are just a few benefits.

1.5 Justification

This section will explore the importance of studying the issue of how therapeutic sound frequency hertz effects the patient, and its environment in a clinical setting. It is important to note limited research has been done to implement design strategies their ability to impact the sound levels in a patient care environment (Wang, Downs, Farell, Cook, Hourihan & McCreery, 2013). There is a gap in literature that measures conclusive evidence in how the therapeutic sound frequency hertz in music a key intervention may be to improve patient recovery, shorten lengths of stay, satisfaction scores, and medical outcomes. It is time for practitioners to understand how the environmental soundscape of frequencies, like the sensory of natural day light, will radically transform how people interact with the environment and will increase health outcomes and improve performance measures.

Therefore, there is demand for a study to establish design standards based for a positive therapeutic soundscape frequency hertz environment for a clinical setting. Any

potential impact of sound and music in a hospital space on the patient is a pertinent issue and should be further explored to create a greater understanding of this new paradigm (Iyendo, 2016).

The research question will explore the theory of health to expand consciousness that will provides a framework for understanding how sound frequency levels in music may become a pan-dimensional phenomenon and vehicle for medical transformation as an intervention for patient care no longer can be ignored (Schorr, 1993).

Primary RQ1: Do study participants mood state and/or physical vital signs change after listening to therapeutic sound frequency hertz during clinical treatment**?**

Secondary RQ2: Is there a relationship in how patients experience and the environmental soundscape in the clinical setting and their importance to them?

1.6 Operational Definitions

In this study there are several constructs. The following terms will be defined in this section for this research study.

1.4.1 Biopsychosocial

The contemporary view of health and illness is a biopsychosocial model, which addresses the role of biological, psychological, and social factors in the human body. This goes beyond a focus only on the physical (biological) aspects of health and illness (Davis et al., 2008).

1.4.2 The Patient Experience

The patient experience is viewed as the related measures of their technical quality of care. It is these measurements of the patient experience that captures the "responsiveness" of the healthcare system (Bleich, Ozaltin & Murray, 2009).

1.4.3 Patient Satisfaction.

Refers to people's satisfaction with the healthcare system from the perspective of the patient experience (Bleich, Ozaltin & Murray, 2009).

1.4.4 Evidence-Based Medicine

Evidence-based health care which is broader than medicine Evidence-Based Medicine (EBM) is the conscientious, explicit, and judicious use of current "best-evidence in making decisions about the care of individual patients. The practice of EBM means integrating individual clinical expertise with the best available evidence from systematic research"(Malone et al., 2008).

1.4.5 Health

Health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity (World Health Organization, 2010).

1.4.6 Healthcare

Healthcare refers to the system which delivers the care. Healthcare is needed first in order to have secondly, health care (Systemmd, 2015).

1.4.7 Therapeutic Therapy

Therapeutic therapy encompasses both the physical and psychological environments associated with treatment or healing; they are reputed to have an enduring reputation for achieving physical, mental, and spiritual healing" (Gesler, 1993, p. 171).

1.4.8 Music Therapy

The systematic application of music directed by the music therapist in a therapeutic environment to restore, maintain and improve mental and physical health (Davis et al., 2008).

1.4.9 Sound Healing

Sound healing refers to the more general field of therapeutic sound use, including signing, drumming, rattling, toning, and so on (McRusick, 2016).

1.5.0 Sound Therapy

The definition for sound therapy refers to aspects of the practice that are more clinical and structured. In alternative medicine, sound therapy is a sub-group of sound healing (McRusick, 2016).

1.5.1 Physioacoustic

The branch of psychology concerned with the perception of sound and its physiological effects (Ahonen, Deek & Kroeker, 2012).

1.6 The Physical & Built Environment

1.6.1 Clinical Setting

Clinics look after the main healthcare needs of populations in local communities. Sometimes the term clinic can refer to a department in a hospital as well. Clinics are typically smaller than hospitals and run by one or several general practitioners (CDPH, 2019).

1.6.2 Healing Environment

This field of research is characterized by the concept of healing environments, which implies that the physical environment of healthcare settings can make a difference in how quickly the patient recovers from or adapts to specific acute and chronic conditions (Stichler, 2001).

1.6.3 Optimal Healing Environment (OHE)

The elements of environmental design that either help or hinder healing by making an impact on health. An OHE influences the behaviors, actions, and interactions of patients and their families as well as the staff members who provide care (Schweitzer, Gilpin & Frampton, 2004).

1.6.4 Healing Space

The physical elements or ambiance of a space that has an effect on people using the space.

1.6.5 Positive Distraction

A working definition of positive distraction is an environmental-social condition which can improve mood and decrease stress (Ulrich, 2001). These positive

distractions can include views of nature, laughter, smiling faces, companion animals and music.

1.6.6 Sensory Environment

The sensory environment includes elements of smell, sound, noise, temperature, air quality, light, color, viewing and experiencing nature, art, aesthetic, entertainment, humor, music, and other positive distractions (Schweitzer, Gilpin & Frampton, 2004).

1.6.7 Soundscape

Soundscape is an umbrella term which relates to the complex sound environment, embracing positive sounds as well as annoying sounds (De Ruiter, 2015).

1.6.8 Ambiance

Another word for atmosphere in the sense of the mood a place or setting. The ambience of space influences the people using the space (Schweitzer, Gilpin & Frampton, 2004).

1.7 The Sound Mechanics

1.7.1 Music

Music is defined as a complex system of expressively organized sounds. It is composed of key elements, such as rhythm, pitch, harmony, and melody. Another definition is "the science or art of ordering tones or sounds in succession, in combination, and in temporal relationships to produce a composition having unity and continuity" (need a reference with a page number here).

1.7.2 Quiet

For better understanding, quiet is the absence of unwanted sound like noise or bustle. It is synonymous with silence, calm or the act of making little or no noise.

1.7.3 Noise

According to the Occupational Safety and Health Administration (OSHA), the definition of noise is "unwanted sound" (OSHA, 2011). The United State Environmental Protection Agency (2017) defines noise as "any sound that may produce an undesired physiological or psychological effect in an individual or group" (p. #). There is no way to measure noise empirically, as it must be assessed in relation to other factors in decibels (Greenberg, 2006). Noise that is experienced by people who did not produce it is called second hand-noise. Like second-hand smoke, second-hand noise can have negative impacts on people without their consent (NPC, 2001).

1.7.4 Operational Noise

Operational noises are permanent and existing unwanted sounds at various noise levels.

1.7.5 Decibels

Decibel (dB) is a sound intensity measure or units of sound pressure used to indicate how humans hear a given sound. As example, zero dBA is considered the point at which a person begins to hear sound. A soft whisper at 3 feet equals 30 dBA, a busy freeway at 50 feet is around 80 dBA, and a chain saw can reach 110 dBA or more at operating distance. The notation is implied any time a "sound

level" or "sound pressure level" are measured on a logarithmic scale: a small change indicates a huge change in the amount of noise and the potential damage to a person's hearing" (OSHA, 2011).

1.7.6 Hertz

The unit of measurement of frequency is called hertz (Hz) If a sound source vibrates slowly, it produces a low-frequency sound 20 Hz and if it vibrates quickly, a higher frequency sound is produced 4000 Hz (Davis, Gfeller & Thaut, 2008).

1.7.7 Frequency

The term frequency is used to describe the number of cycles per second at which a sound source (such as a voice or instrument) is vibrating (Davis, Gfeller & Thaut, 2008). A sound frequency is measured in units called hertz (Hz). One hertz is equivalent to one vibration per second.

1.7.8 Sound

Sound is a vibration that creates sound waves. These travel through mediums such as air, water, or solids to reach a human's ear (Davis, Gfeller & Thaut, 2008). Sound is vibration and vibration touch every part of the physical body. Therefore, sound is heard not only through a human's ears but through every cell in the body (Bissonnette, 2010).

1.7.9 Sound frequency

This study will define sound frequency as a measured point of vibration or energy. Everything possesses a resonant frequency. “Resonance is the phenomenon that occurs when a physical system is periodically disturbed at the same period of one of its natural frequencies” (Tyrell, 2015, p. 27-28).

1.8 The Vital Signs Biometrics

1.8.1 Respiratory Rate

Normal respiration rates for an adult person at rest range is from 12 to 16 breaths per minute.

1.8.2 Arterial oxygen saturation (SaO2)

Measurement the arterial oxygen saturation (SaO2) by pulse oximetry (SpO2), using a fingertip sensor is commonly used in the management of patients with pulmonary diseases.

1.8.3 Heart Beats

The normal pulse for healthy adults ranges from 60 to 100 beats per minute. The pulse rate may fluctuate and increase with exercise, illness, injury, and emotions.

Females ages 12 and older, in general, tend to have faster heart rates than do males.

1.8.4 Systolic blood pressure (SBP)

The systolic blood pressure (SBP) is the top number on your reading. It measures the force of blood against your artery walls while your ventricles the lower two chambers of your heart squeeze, pushing blood out to the rest of your body.

1.8.5 Diastolic blood pressure (DBP)

The diastolic blood pressure (DBP) and has a greater impact on blood pressure staging. A high diastolic reading (equal to or greater than 120 mmHg) is associated with an increased risk of stroke, heart attack, and other cardiovascular problems.

1.9 Evidence-Based Design

Evidence-Based Design (EBD) is a process for the conscientious, exposit and judicious use of current best evidence from research and practice in making critical decisions, together with an informed client, about the design of each individual and unique project (Malone et al., 2008).

1.9.1 There are four levels of EBD: 1) to keep up with the literature and the evidence to inform the designs; 2) to predict the outcomes expected from the design from a developed hypothesis and commit measurements that will confirm or disprove the prediction; 3) to commit to using measurements and to sharing the findings publicly; and 4) to increase rigor by publishing study results in peer-reviewed venues (Malone et al., 2008).

1.9.2 Design & Layout

Design and layout references to the plan or arrangement of physical space. The layout will address space allocation and the way patients, family, staff, and equipment move through the physical space.

1.10 Conclusion

This chapter discussed the significance and justification for the study and the clinical environment's soundscape necessary for patient clinical care. This chapter also discussed the scope, limitations, and the study's general framework. The next chapter will provide a literature review on this growing body of research that discusses the role of therapeutic sounds impact on patient care in a healthcare environment.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The soundscape of an environment is an umbrella term which relates to the complex sound environment, embracing positive sounds as well as annoying sounds (De Ruiter, 2015). The history of a soundscape environment has affected mankind since the beginning of time. Before Christ, the ancient Greeks understood the powerful influence of music on healing; based on this understanding, they worshiped Apollo as the god of both medicine and music. In the King James bible? when the *evil* spirit from God was upon Saul, David took a harp, and played with his hand. King Saul was refreshed, and was well, and the evil spirit departed from him now calmed. The illustrations above depict three accounts in how sound effects people and places is not a new discovery but has been an ancient practice. For the 21st century, the challenge today is to determine how sound may be used as a therapeutic agent within the clinical setting and its effects on patients deserves more research.

Through better facility design and evidence-based guidelines, the healthcare team faces the challenge to create a positive therapeutic soundscape experience for the patient. To the contrary of noise, sound may also be added in the environment as a positive distractor, like the effects of ocean sounds. Studies also confirm the value of music intervention, which appears to be useful in managing chronic pain and results in a significant reduction in medication consumption (Guétin, Giniès, Siou, Didier & Picot,

2012). For example, in a study on guar bean cellular growth, the musical sound had a significant effect on the number of seeds sprouted compared to noise, untreated control, and sound vibrations. Music can directly affect living biologic systems (Vanol & Vaidya, 2014). Likewise, music intervention for patients has been shown to have beneficial effects on environmental appraisals (Dijkstra, Pieterse & Pruyn, 2006). In terms of clinical practice, implementing music in the waiting room can be an accessible and effective way to improve patient and practitioner experience (Collins, Fitzpatrick, Kiernan, Moss & Harmon, 2021). The goal of this study has been to gather data that may contribute to future design standards to improve the canopy of the clinical soundscape through the intervention of therapeutic sound frequency hertz and its ability to positively alter the patient biopsychosocial states will provide a great quality provider benefit.

2.2 Background

The “ambiance” of a space has significant effect on people using the space itself. In recent years, design for health care environments has begun to include aesthetic enhancements to reduce stress and anxiety, increase patient satisfaction, and promote health and healing (Schwitzer, Gilpin & Frampton, 2004). Patients look to healthcare facilities as a place to get treatment in an environment that promotes healing. Over the decades, many discussions have uncovered how the physical environment plays and important role in the patient’s health and well-being. The provision and support of healthcare extends at as far back as 400 BC with Hippocrates to the 19th century with Florence Nightingale (Huisman et al, 2012). Nightingale strongly believed health could

be altered in such a manner as to improve conditions so that the natural laws would allow healing to occur. This grew out of her empirical observation poor or difficult environments led to poor health and disease. In 2010, Selanders stated Nightingale's definition of environment is anything that through manipulation, assist in putting the individual in the best possible condition for nature to act.

This literature review will focus on therapeutic sound frequency ability to support patient recovery within the physical built environment. There are sounds that are soothing and other sounds unwanted such as noise. The importance of noise in health care has been recognized for years, as evidenced by a statement in 1859 by Florence Nightingale "Unnecessary noise, then, is the most cruel absence of care which can be inflicted either on sick or well (Nightingale, 1859)." There is a growing and fascinating collection of studies that have examined the impact of noise in healthcare facilities, the patients, and medical staff safety and performance. There are only a handful of reports dealing with control of hospital noise, and these are almost entirely limited to administrative control measures such as closing doors and asking staff to speak softly.

The medical and architectural/design community have exceled at reducing operational and hospital equipment noise. There exists a gap in the architectural design and medical community miss understand to improve the ambient soundscape is not just abating unwanted sounds like noise, but the necessity to add correctly therapeutic sound frequency hertz back into the physical environment like clinical settings may have a positive effect on the patient. This gap of research can potentially report how therapeutic

sound frequency hertz may accelerate a patient's ability to recover, complete difficult treatments, and regain a sense of well-being and wellness during a visit. The objective of this research study explores how to improve the patient experience before, during, and after clinic visits through the dissemination of therapeutic sounds for a healing environment for this study we will focused on clinical settings. This study's aims to demonstrate how therapeutic sound frequency hertz just may be the one element that creates the perception of soundscape quietness.

2.3 Research Question

To understand the relationship of how sound impacts health outcomes the research questions will validate and inform the medical and architectural/design practitioners of the importance therapeutic sound frequency hertz may have for the healthcare design of facilities may have a direct impact on patient recovery and care. Based on the subsequent literature review, the following primary and secondary research questions are proposed for this study:

2.3.1 Primary RQ1: Do study participants mood state and/or physical vital signs change after listening to therapeutic sound frequency hertz during clinical treatment**?**

2.3.2 Secondary RQ2: Is there a relationship in how patients experience and the environmental soundscape in the clinical setting and their importance to them?

2.4 Global Topics

This section will cover the over-arching description of findings that encompass how sounds impact people and places in the field healthcare design its effect on the patient experience, patient satisfaction, and the patient ambient surroundings within the physical-built environment for clinical settings. This literature review cited articles that introduce soundscape's role in general for healthcare and its effects on the human body, soundscapes in clinical settings like hospital, primary care and other clinic delivery types, the reduction of harmful versus adoption of therapeutic sounds, and barriers to conduct these types of studies.

2.4.1 Patient Survey Influence on Ambient Soundscapes in Health Care

For those not familiar with evidence-based design (EBD) has become the theoretical concept for what are called healing environments. The healing environment has the role of sensory stimuli elements plays a major role to create a safe environment for the patient. Such sensory stimuli were leverage by Ulrich, who compared the positive effect of views of natural scenery on the recovery of patients from surgery to patients in similar conditions who were exposed to a view of a brick wall (Ulrich, 1982). Ulrich showed that in comparison with the wall-view group, the patients with the tree view had shorter postoperative hospital stays, had fewer negative evaluative comments from nurses, took fewer moderately strong and strong medication, and had slightly lower scores for minor postsurgical complications. Since then, the impact of the physical environment of the hospital on the well-being and health of the patient has received extensive academic attention (Huisman et al, 2012).

Consequently, this outcome for the creation of spaces became known as healing environments. Per several academic researchers, the definitions of a healing environment have been defined as: a place where the interaction between patient and staff produces positive health outcomes within the physical environment. Healing environments can be considered as "smart investments" because they save money, increase staff efficiency, and reduce the hospital stay of the patient by making the stay less stressful (Huisman et al, 2012). These quality most inpatient care metrics have now become the measuring stick in how to create the optimal healing environment.

The Health Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey instrument was birth forth to fulfill the need to improve medical outcomes, costs, and safety for patients by measuring their experience through satisfaction scores. This survey tool has become the leading indicator for quality, in addition to other patient satisfaction surveys that publicly report the patient experience, known as patient self-reported outcome (MacAllister Zimring & Ryherd, 2016). The survey question asked about the physical ambient environment upon discharge during this hospital stay is how often was the area around your room quiet at night? The survey results still hover and reports at a low satisfaction rank for quietness at a 63% for US hospitals.

The noise epidemic is not just in hospitals but also impacts other ambulatory care facilities like primary care clinics. It is evident, the HCAHPS survey remains to show any major quality improvement of ambient sound in health care remains seems to continue to

project alarming low metric results. For example, a clinical study of current noise standards for the neonatal intensive care unit (NICU) environment were established decades ago and have not been modified. Dosimeters were used to record the acoustic environment in open and private room settings. In 1974, the U.S. Environmental Protection Agency (EPA) recommended that indoor hospital areas maintain an average sound level of less than or equal to 45 decibels, A-weighted (dBA) during the day, and 35 dBA at night to maximize opportunity for patient recovery (Smith, Ortmann & Clark, 2018).

2.4.2 The Reduction of Harmful versus Adoption of Therapeutic Ambient Sounds

The sound environment is a vital part of the overall environmental ecosystem, and undesirable sound (usually referred to as noise) is one of the most significant environmental stressors currently found in the clinical environment (Lyendo, Uwajeh, & Ikenna, 2016). The literature presents a compelling case that noise levels in healthcare environments have a direct impact on the patient experience and satisfaction. Lorenz (2007) challenges the reader in "how does the environment promote healing and where is the evidence that it does?" It begs the question exactly what features truly promote healing, restorative health, maintenance of well-being, and allow for a therapeutic healing and caring environment (Lorenz, 2007). Additionally, another survey investigated noise in hospital intensive care units' article utilized noise reduction interventions that addressed the healthcare organization's behavioral using sound detection equipment,

implemented an educational noise reduction program, and low-cost alterations minimized noise levels for hospital rooms (Konkan and Oakley, 2012).

A growing body of evidence has shown that undesirable sound is a significant barrier to sleep for hospital patients, and sleep has been shown to be therapeutic for health, including healing and recovery (Lyendo et al, 2016). Several studies have documented research revealed that unwanted sound like noise, alarms, machinery, could have negative psychological and physiological effects on patients. Noise has been associated with annoyance, sleep disruption and awakening, decreased oxygen saturation, elevated blood pressure, increased heart, and respiration rate among neonatal intensive-care patients, induce higher incidence of re-hospitalization, increased perceived work pressure, emotional exhaustion, and burnout (Lyendo et al, 2016). There are study findings that noisy environments invoke negative emotions, whereas therapeutic intervention through music and a comfortable environment, promote more relaxed mind and well-being for patients recovering from illness and surgery (Lyendo et al, 2016).

On the contrary, a study Frumkin and Louv (2007) argued that people are closely attached to the natural world, which suggests that contact with nature is beneficial to health and wellbeing. For example, a survey conducted to investigate stress recovery during exposure to natural sounds and noisy urban environments indicated that the application of pleasant natural sounds of fountains and tweeting birds reduced psychological stress and facilitated fast physiological recovery of the sympathetic nervous system when matched with disagreeable city noises of road traffic (Lyendo et al,

2016). Similarly, another study concluded plots for difference in number of seeds germination viewed the difference in height and in the number of leaves grown clearly show a positive effect of silent classical musical. This outcome compared to rhythmic rock musical sound on the growth of the plants (Creath & Schwartz, 2004). Both the silent classical music and rhythmic rock music have given better results than the control. And the same; mixed and negative effect in traffic noise. This study is demonstrating how operational noise is not beneficial for biological growth. While seeking the right type of sound frequencies to promote cellular growth.

Similarly, another music project noted that when the cells of the body are in tune with each other, the body functions flawlessly and resonates with life. When the body is in a state of disease, it is out of tune with itself and in need of cellular intonation (Tyrrell, 2014). The study of intonation is simply the accuracy of pitch. From the creator, God at the beginning of time music has been given to mankind as a gift. Sound frequencies reflect the integrity of proper intonation and have been known to trigger spontaneous healing in the physiological and body. As an example, when you tune the instrument to a pitch and the intonation of a guitar is off, then the instrument will remain out of tune with itself. By calibrating the guitar correcting the intonation of the bridge, when tuned, the instrument is in tune with itself and resonates properly. Simply, the human body is no different. The integrity of proper intonation evidence has been shown to trigger spontaneous healing in the body eliminating cancerous tumors (Tyrell, 2014). The significance of these type of results are achieved by tuning from A 440 HZ to A 444 HZ

and more. There is a potential this would create an environment of healing everywhere with the dissemination of sound frequencies for clinical spaces.

Human beings perceive sound not just through the ear gates as well as musical vibrations through bone and skin; thus, our senses such as sight, smell, and touch allow us to perceive an even wider range of musical vibrations than those sensed by hearing alone (McCaffrey & Locsin, 2002). Our bodies are formed and function using vibrational energy causing our all our organs to vibrate to accomplish tasks necessary to continue the beat of life (McCaffrey & Locsin, 2002) in our bodies for physiological and psychological wellbeing for patients in clinical spaces. It observed sound included in the environment as a positive distraction has been shown to have a significant influence on patients' clinical and behavioral outcomes (Lyendo et al, 2016). Several studies have shown that music have healing effects. Pleasant music, when controlled, can promote relaxation, reduce anxiety or stress, improve coping with pain, affect sleep patterns, improve stroke patients' memories, and decrease the amount of sedative medication needed for some patients (Salonen, Lappalainen, Lahtinen, Knibbs, & Morawska, 2012).

2.4.3 Soundscapes Use for Clinical Studies

The United States Department of Defense and Veterans Health Administration used the vehicle of telehealth primary care delivery for medication management, physical, occupational, and speech-language therapies for their service members, vets, and dependents. Many veterans suffer from post-traumatic stress disorder (PTSD) and the prevalence of traumatic brain injury (TBI) has had devasting impacts on military

personnel and their families. The symptoms of these injuries often present cognitive, social, behavioral, occupational, and emotional health issues have resulted in the need for innovative treatments. Such treatments such as creative arts therapies have been integrated in the clinical realm aids in the rehabilitation process for military personnel (Vaudreuil, Langston, Magee, Betts, Kass & Levy, 2022). It has been found that telehealth is a platform can be used to implement therapies and promote community reintegration. The participants found to positively respond to music therapy engaged through telehealth, as a result reported decrease pain, anxiety, and depression. It was determined that music therapy intervention can be successfully adapted to accommodate remote facilitation and distance delivery of music through digital platforms can support participants on a clinic continuum (Vaudreuil et al, 2022).

Another review aimed to document the role of the physical environmental factors in clinical environments and their impact on patients and staff wellness in healthcare. This study reported on how the physical environmental factors into hospital design can facilitate better user satisfaction, efficiency, and organizational outcomes. Many of the design interventions convey positive distractions for patients and staff, in terms of views of pleasant outside vistas, soothing sound, artwork and music. Similarly, case studies have shown that substantial sound results are reported in clinical studies for rehabilitation centers for those with neurological care. Additional high-quality intervention studies, particularly large-scale trials have established music interventions are embedded into the clinical rehabilitation practice, would need to establish the efficacy and feasibility in real-

life settings of these approaches (Sihvonen, Särkämö, Leo, Tervaniemi, Altenmüller, & Soinila, 2017). Another case study focused music sound intervention for dental anxiety indicates music listening a non-pharmacological anxiety management intervention, are increasingly used in dental care. The dental clinics have harness individual music therapy interventions for the patient's presenting needs related to the degrees to manage their anxiety. Interventions may include active refocusing of attention, music-guided deep breathing, music-assisted relaxation, and music-guided imagery (Bradt & Teague, 2018). In addition, this study suggest music therapists could teach patients music-based anxiety management skills prior to dental treatments, offer them the opportunity to express emotions related to the upcoming procedure, and help them gain a sense of control and safety (Bradt & Teague, 2018).

2.4.4. Barriers to These Type of Studies

A key barrier in this type of research is to understand that perceptions seem to speaker louder than what may be really occurring relative to the patient’s perceptions of sound itself. This article reaches deeper into the underlying reasons why patients satisfaction scores have not improved related to hospital noise levels. This case conducted an ethnographic study of main events during hospitalization: perceptions of nurses and patients, suggest maintaining quality and patient satisfaction scores, hospitals will need to focus on the difference between the perceived care given and the perceived care received during main events (Coughlin, Long, Sheen, & Tolbert, 2012). The author points out how the patients’ identified issues in direct contrast to the nurses. Case point, hospital should

continue to focus on meeting the patients' perception of care and not hospital's expectation of care (Coughlin et al, 2012). This supports the importance asking the question do designers understand how to design a noise free patient room without asking the patient what noise means to them in during their inpatient or outpatient service treatment experience. These authors challenge how to address the future as number of patients and staff increase, so will noise levels increase (Konkan and Oakley, 2012).

Similarly, another study for neonatal intensive care unit (NICU) environment found it challenging to control the soundscape given the combined noise emitted from the necessary life support equipment, heating, ventilation, and air conditioning (HVAC) system, lights, and monitors does not meet standards even without additional noise introduced by staff, visitors, or maintenance, it would be futile to continue making efforts to meet the set agency standards as written today (Smith, Ortmann & Clark, 2018). Unique barriers came into play related to how providers would bill for the creation of an ambient soundscape environment through medical billing. The telehealth therapies to advance reimbursement, the efficacy and impact of creative arts therapies telehealth needs to be further researched (Vaudreuil et al, 2022). Currently there is limited research about telehealth overall, and more articles, such as this one, are needed to grow the evidence-base and advance the practice of telehealth. The dental study found limitations in the executions with lessons learned to optimize treatment impact, music interventions should start prior to the onset of the dental treatment and investigate the impact of music

intervention engagement with patients to self-management of their anxiety (Bradt & Teague, 2018).

2.5 Conclusion

In summary, there is evidence to recognize the relationship between sound frequencies environmental impact on physiological and psychological wellbeing and the ability to enhance the healing process for clinical settings. The review of these articles all point to the research question in how therapeutic sound can potentially effect the patient's biopsychosocial states within the physical environment of a clinical setting. The authors took different dimensions and approaches to how positive sounds and unwanted sounds may or not improve patient care and delivery for a clinical setting or hospital environment. All articles brought a different level of awareness whether the ambient soundscape could improve the patient experience, patient satisfaction, and the patient's physical-built surroundings.

Without a question, the soundscape impregnates the physical environment, and the right therapeutic sound can manipulate a clinical setting a place where a patient may recover. The design research community has identified how the patient experience with the physical environment has a significant factor in determining a patient's overall satisfaction. (Quan, Joseph & Ensign, 2012). Provider organizations and clinics have a strong financial motivation to improve patient satisfaction (Quan, Joseph & Ensign, 2012). This is significant as unwanted noise in the patient environment impacts patient ability to complete treatments and realized improved health outcomes.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter includes a description of the research design, the sample, the steps associated with data collection tools, procedures, and the data analysis plan. This research uses descriptive comparative design to evaluate changes in patient mood and biometric levels after listening to sound frequencies in a clinical setting during a primary care visit.

The research includes a qualitative and quantitative component to answer the two reason questions. The techniques used were chosen to ensure thoroughness and to build a rich robust understanding of how environmental sounds during a patient's treatment may affect the patient satisfaction and perceptions of their ability to heal (Quan, Joseph & Ensign 2012; Lorenz, 2007).

3.2 Research Questions

This research uses a descriptive comparative design to evaluate changes in patient mood state and physical vital signs during primary care visits after listening to therapeutic sound hertz. This research also includes a qualitative component to explore how patients describe environmental sound in the clinical setting and their importance.

3.2.1 Primary Research Question (RQ1)

Do study participants mood state and/or physical vital signs change after listening to therapeutic sound frequency hertz during clinical treatment**?**

3.2.2 Secondary Question (RQ2)

Is there a relationship in how patients experience and the environmental soundscape in the clinical setting and their importance to them?

3.3 Main Setting Study

The clinical setting is in three primary care physician clinics in the Balkan states of southeast Europe in Bosnia-Herzegovina and Croatia. The primary care clinics feature intervention rooms for acute patients to receive treatments in private. The research was conducted in these countries due to the access provided by the head of the department of family medicine for the primary care in Bosnia-Herzegovina. The three clinics' patient annual throughput ranged between 2000 to 2500 patients, with approximately 30 to 45 patients per day per family care clinic.

3.4 Data Collection

Data collection occurred during the weeks of October 4 and October 11, 2021, between the hours of eight in the morning and five in the evening. Data collection occurred over a 14-day period.

3.5 Sample

The convenience sampling for this study, the clinician selected the subjects that are were readily accessible from a data base of patients with chronic illnesses, such as hypertension, diabetes, and asthma. These are long-developing conditions that require medical treatments conducted in the intervention/therapeutic room in the family primary

care clinic. Inclusion criteria were: 1) one or more chronic conditions as determined by the primary care provider seeing the patient; 2) age 18 or older; 3) able to read and spoke Croatian. The English documents translated into Croatian included the long consent form, the Master Participant List, and the questionnaire. The questionnaire had both languages with Croatia translations and English subtitles (see Appendix D).

The intervention protocol required the participants to listen to the WholeTones to Go sound box through earplugs this tool provided the sound frequency hertz musical sounds, for example would be no difference than listening to Sony CD player with earplugs.

3.6 Instruments and Tools

The data collection instruments consisted of a four-part self-administered questionnaire both control and test groups completed. Only the test group listened to the *WholeTones To Go* portable sound frequency sound box.

3.6.1 The Sound Frequency Hertz Box Study Tool

The *WholeTones To Go* study tool was used to deliver the therapeutic sounds through for the test group participants. The *WholeTones To Go* is a portable sound box that releases seven therapeutic sound hertz levels found within the select songs. The box administers seven pre-loaded songs of hertz frequencies that ranged from 396 Hz to 852 Hz. The sound box had a 3.5mm headphone line out to connect disposable ear plugs to achieve sound control and private listening. Figure 3 illustrates the *WholeTones To Go*

sound box. Each selected song played for 22 minutes in length. The sound box can expect to play four to six hours when fully charged. The box is controlled by basic buttons for power, volume increase and decrease, mode, and next/previous song selection. The simplistic sound box was selected for its landmark research project called the healing frequency music project (Tyrrell, 2015). The therapeutic sound hertz songs the three clinics each had one box and assigned a specific sound hertz level for the control group to listen to during the treatment process. One clinic was assigned the low therapeutic hertz sound level at 396 Hz, 417 Hz, and 444 Hz (clinic 1-L, low). The second clinic was assigned the medium therapeutic hertz sound level at 528 Hz and 639 Hz (clinic 2-M, medium). The third clinic was assigned the therapeutic high hertz songs at 741 Hz and 852 Hz (clinic 3-H, high).

Figure 3. The sound frequency hertz box *WholeTones To Go*

To make sure each clinic understood how to use the *WholeTones To Go* sound boxes, three ZOOM training sessions were conducted. The first training was to introduce the research team review the study protocols, instruments, and sound tool. The *WholeTones To Go* sound box was played over the ZOOM virtual meeting and how to use it involved a power button to turn on the box, a forward and backward button located the correct hertz levels as shown in figure 3. A second ZOOM meeting was conducted after the *WholeTones To Go* sound box were shipped along with disposable earplugs. Again, the clinicians during this next meeting practice operating the sound box and found it user friendly and the tool easy to use. To achieve clicking on the correct sound hertz level instructions were indicated the song selection number and the clinician just would click through to where the hertz level song started. As example, like a Sony CD player if a person wanted to listen to song 3, then the player would allow you to click on the forward button to the third click for that specific song selection. This was how the *WholeTone To Go* box therapeutic sound hertz were selected.

3.6.2 The Self-Administered Five Part Questionnaire

This study utilized a questionnaire that offered an objective means of collecting information about people's moods, beliefs, attitudes, and physical response to the WholeTones songs from the sound frequency hertz box. Figure 3.1 illustrates a table of the combined sections as described next in section 3.5.3 the data analysis plan. The complete questionnaire in English and Croatian is in (see Appendix D).

3.6.3 Combined Instrument Consisted of Five Sections:

Section one of five is the demographic profile. Providers filled in the patient gender (male or female), age, the date, and time they arrived for the study participation. Demographic data was collected for the study for gender and age profiles.

Section two of five consisted of a series of three qualitative open-ended questions to solicit patient feelings toward sound in the clinical setting. The goal is to come up with a way to measure where the respondents are on the continuum and which items had higher medians indicate a more favorable attitude towards the concept (O'Learly, 2014, p. 210). These open-ended questions asked about how comfortable or bothersome were the clinic's soundscape, and what changes could be made in the environment.

Section three of five is the profile of mood states (POMS-A) survey (Terry, Lane & Fogarty, 2003). The POMS-A measures mood states for six subscales for anger, depression, confusion, fatigue, tension, and vigor. For each subscale had four descriptive mood states associated with each subscale name. It consists of a total of 24 number of items measured on a 5-Point Likert scale with 1 not at all, 2 = a little, 3 = moderately, 4 = quite a bit, and 5 = extremely. The POMS-A instrument has six subscales: one positive subscale (called vigor), consisted of four items and four negative subscales (called anger, confusion, depression, and fatigue) contains four mood state items each per subscale. In previous research, the reliability of the POMS-A 24-item study confirmatory factor analysis provided support for the validity of the instrument A POMS-A survey total score across all items related to positive and negative mood states was calculated for each study

participant and each clinical setting. The study participants were asked to complete the POMS instrument two times pre-post, prior to listening to therapeutic sound hertz at the beginning of the treatment and again after listening to the therapeutic sound hertz.

The data relationships between POMS-A scores and previously validated measures, were initially consistent with theoretical predictions, supported criterion validity (Terry, Lane, & Fogarty, 2003). It is important to note, evidence was found in support of the psychometric integrity of the POMS-A when extended from POMS-A adolescent to adult populations (Terry, Lane, & Fogarty, 2003). The participants self-selected the described mood state before, during, and after the treatment began and then again immediately after the intervention occurred during the treatment session.

Section four of five includes a vital sign biometric data collection system. In the control group, study participant physical attributes were measured before and after 22 minutes listening to the clinic's natural and operational sounds. The target group listened to the clinic's sound box of therapeutic sound hertz levels (i.e., low 396, 417, 444; medium 528, 639; high 741, 852). The vital measures consisted of respiratory rate, oxygen saturation (SaO2), heart rate, systolic blood pressure, and diastolic blood pressure. These measures were collected the assigned clinician physicians and data collected was provided to the research team.

Section five of five will provide a 5-Point Likert survey with five pointed questions to better understand the study groups opinions regarding sound perceptions. This 5-Point Likert scale will range from 1= strongly disagree, 2 = disagree, 3 = neutral,

4 = agree, and 5= strongly agree. The research will map out the responses answers to gain insight about what the participants value.

3.7 The Data Analysis Plan

The data analysis table summarizes the narrative describing the methods and instruments used.

Topic/Research Question	Data Collection	Instrument Analysis
Do study participants mood state and/or physical vital signs change after listening to therapeutic sound hertz during a primary care?	To determine if the therapeutic sounds had a positive/negative emotional and physical impact during a treatment process	A quantitative comparison of the POMS-A Scale validation of the mood state by a Chi Square test and vital sign biometric by a t-Test to compare the 2 variables, for each of the 4 groups we compared the control group with each of the intervention groups. the control and target groups. A change report of the mood state shift when listening to the therapeutic sound hertz levels for low, medium, high.
Is there a relationship in how patients experience and the environmental soundscape in the clinical setting and their importance to them?	To determine whether the clinical soundscape environment was comfortable or bothersome to the patient experience. To determine how patients would listen to therapeutic sound hertz in a clinical setting or not	Qualitative opened-ended question answer approach validated through the Thematic Coding approach to validate like group and word arrangements, create themes, and framework.
	To determine the respondent sound perception opinion ranking.	Qualitative 5-Point Likert scale determines best method to design the use of therapeutic sound hertz application for a clinical setting and rank
Experiment hypothesis inquiry	To determine the rigor cause and effect of the independent variable = sound hertz impact on the dependent variable = patient and clinical setting	The triangulation method only increases potential study validation through the number of instruments used to set forth an unbiased data outcome.

Figure 3.1 Methods Matrix

3.8 Data Collection Protocol

The research team was not present while the subjects completed the survey instruments. Due to the global pandemic, the research team was invited to ship the instruments to the three Balkan state family care clinicians. Each family care clinic maintains a registry of their chronic disease patients scheduled appointments.

3.9 Recruitment

The recruitment contact was managed by the clinician's registry nurse who invited and followed up with interested participants. Each clinic was provided a recruitment script that explained the purpose of the study. The registry nurse contacted patients using the recruitment script that had prior appointments. Patients were convenience selected by the clinician with ten subjects for the control group and ten for the experimental targeted group until each clinic reached no more than twenty people. The typical treatments with the primary provider reported the range is from 40-60 minutes. The average clinic visits during the data collection reported by the technician averaged 45 minutes. The range of each appointment was documented on the Master Participant List. Participation in this study was optional and confidential for each participant. Participation took place during one treatment session and not required to repeat or come back for any additional follow-up.

3.10 The study was executed in two steps for patients who agreed to participate

3.10.1 At the time of the scheduled appointment, the clinician instructed the participant to fill out a questionnaire and survey about their mood and feelings. Next, each person listened either the ambient sound in the clinic or to therapeutic sound frequencies during their treatment session. The therapeutic sound frequencies were played through the *WholeTone To Go* sound box attached to the disposable headphones. Both control and experimental groups listened to assigned or natural clinical sounds for 22 minutes. Then the participants were asked to fill out the same questionnaire and survey again at the end of their treatment session.

3.10.2 Nurse practitioners collected biometric readings before and after the intervention. Do you know if they used the same data collection instruments before and after?

3.11 Data Management

The research team was given each clinic's study data to review through a secured electronic transmission with all original hard copy documents mailed back to the research team. The subject's name was not associated with the participant's questionnaire/survey answers or biometric data, as each person was assigned a study subject ID number. The data was collected and managed using a 'Master List' with each ID number **(**see Appendix D). The collected data shall be stored securely on campus or on an ASU server that can be accessed remotely. The 'Master List' will be stored separately from the consent and other collected study data.

3.12 Institutional Review Board

The researcher applied to the Institutional Review Board (IRB) at Arizona State University (see Appendix A). The research study was approved in September 2022 by the Croatia and Bosnia-Herzegovina family care clinics adopted ASU approved IRB.

3.13 Conclusion

The methodology for this study was described in this chapter. This chapter discussed the research questions, data collection strategies, and analysis plan. The following chapter provides the data analysis and findings from the research study.

CHAPTER 4

ANALYSIS

4.1 Introduction

The first part of the chapter describes the study participants as a whole and then by each of the 4 groups. This is followed by a description of the results of the POMS-A instruments and biometric findings. Results of tests for each research question are presented. Finally, the results of the thematic analysis of the qualitative question are described. A Thematic Framework was developed to gain interpretative phenomenological analysis (IPA) of the participants conceptual understanding if there is a relationship of the how sounds impact their biopsychosocial outcomes within the clinical setting.

4.2 Study Demographics

54 individuals participated in the study 18 (33%) men and 36 (66%) women participated in the study. Their average age was xx with a range of x to y. The demographic characteristics of the participants in the 3 clinics are shown in Figure 4.2. The shortened version POMS-A was administered to 54 participants from four samples: adult patients from the control group (n=26), adult patients target group listened to low sound hertz (n=10), adult patients target group listened to medium sound hertz (n=10), and adult patients target group listened to high sound hertz (n=7) see Figure 4.0 shows clinic sound hertz level distribution.

Clinic Distributions	Clinic 1-L (n = 10) (396, 417, 444 Hz range)	Clinic 2-M (n = 10) (528, 639 Hz range)	Clinic 3-H (n =7) (714, 851 Hz range)

Figure 4.0 Clinic therapeutic sound hertz level distribution

The survey was distributed, and biometric data was collected during the patient scheduled appointments by clinicians from a total of 54 patients from three independent clinical sites, with 20 study participants from two clinics and 14 participants from the third clinical location. The study participants were self-selected to participate in this study as a volunteer. The study sites were divided into three experimental and control groups based on low (L), medium (M), and high (H) hertz levels of sounds. Clinical site 1-L test participants listened to low sound frequencies from 396, 417, and 444 hertz. Clinical site 2-M participants listened to medium sound frequencies from 528 and 639 hertz. Clinical site 3-H participants listened to high (H) sound frequencies from 791 and 852 hertz.

The clinic hertz level distributions among the three clinics for low, medium, and high hertz. Demographic data requested from participants included age and gender. The average participant was 52 years of age, 66% were female and 33% were male. The range of ages were from 24 to 81 years. Figure 4.1 documents the summary of the demographic data.

Gender	Frequency	Percent
Female	36	66.67%
Male	18	33.33%
Age	**Frequency**	**Percent**
18-30	6	11.11%
31-50	13	24.07%
51-70	30	55.56%
71-80	4	07.41%
81-90	1	01.85%

Figure 4.1 Depicts the demographics

The clinic hertz level distributions among the three clinics for low, medium, and high hertz. Demographic data requested from participants included age and gender. The average participant was 52 years of age, 66% were female and 33% were male. The range of ages were from 24 to 81 years. Figure 4.1 documents the summary of the demographic data.

4.3 Research Question 1

Describe each of your quant instruments first followed by analysis of research question 1

4.3.1 Quantitative Profile of Mood States (POMS-A) Survey Results

The factors of the POMS-A are described in the following way, Anger is expressed by feelings that vary from mild annoyance to fury. Confusion is proposed to

express bewilderment to uncertainty, failure to control attention. Depression is characterized by negative self-evaluation such as hopelessness to self-blame. Fatigue is associated with mental exhaustion to physical tiredness. It is important to note, the Depression factor through the translation of the POMS-A form clinician translator changed the subscale for Depression to a subscale for Calm typified by five not four items to depict a mood state that ranged from hopefulness to joyfulness. This limitation has been noted and was uncovered during the data analysis process outside the investigators direct control. Tension is characterized by feelings of nervousness to anxiety. Vigor is associated with excitement and physical energy (Terry et al., 2003).

A multi-sample approach was adopted to test the invariance six factor structure of the POMS-A among three disparate clinic 1-L, clinic 2-M, and clinic 3-H. The central purpose of the study was to test whether the factor structure demonstrated a relationship that would remain the same before and after listening to therapeutic sound frequency hertz among the control and test groups. The results of the data will determine how this supports the primary and secondary research questions.

This study also wanted to know if the results remained the same between clinic 1-L, clinic 2-M, and clinic 3-H. Sample clinic 1-L comprised of 20 adult patients 4 males, 16 females; age ranged 30 to 66. Sample 2 clinic 2-M comprised of 20 adult patients 6 males, 14 females, age ranged 28 to 81. Sample 3 clinic 3-H comprised of 14 adult patients 4 males, 10 females, age ranged 25 to 73.

The procedures to investigate of mood responses among the clinic patients were addressed within the control and test groups for each clinic. Groups conducted the survey

before starting treatment and then again during the treatment afterwards. The test group received the therapeutic sound frequency hertz during the treatment session. The control group listened to existing clinical sounds during their treatment session. Afterwards, the participants were asked to complete the same survey after the listening and intervention time. The multi-sample analysis was tested on the three clinical samples within a 10-day period. The test group listened to the therapeutic sound frequency hertz for 22 minutes during the treatment session in exam intervention rooms. The control group listened to the natural clinical soundscape for 22 minutes during the treatment session in the exam intervention rooms. The entire session averaged for each patient a time frame of 45 minutes.

Each participant rated their mood state using a 5-point scale, from 1 (not at all) to 5 (extremely) to assess the markers of a positive and negative effect. The data collected from the PANAS scale was then analyzed in the IBM SPSS statistics data editor from each clinic. For this study, the primary analyzed data set will determine if the mood state relationship remain the same among the control and test groups. Each clinic was analyzed independently of the other three clinics for the low, medium, and high hertz levels. A Chi Square test calculated the significance level and results for the POMS-A 25 mood state items.

The Chi Square test compares two variables. The two variables were the control group that listened to existing clinical soundscape and the test group that listened to the intervention of therapeutic sound frequency hertz. For example. the Chi Square test compared the Anger factor of the control group variables to that of the Anger factor of

the test group variables. This was completed for each of the six categories for: Anger, Confusion, Calm, Fatigue, Tension, and Vigor. An asymptotic significance (2-sided) < 0.05 is required to show any significance of how the therapeutic sounds effected the mood states.

The respondents reported a significant change after the intervention of the therapeutic frequency hertz for the following mood states. The level of statistical significance *p*-value between 0 and 1 shows the greatest significance for the mood state of bad tempered greatly improved after therapeutic sound intervention. Fifteen out of 25, 60% mood states were altered after the intervention demonstrated significant evidence as reported from clinic 1-L (396, 417, 444 hertz) when listening to the low frequency sound hertz the respondent mood did not remain the same. Twenty out of 25, 80% mood states were altered after the intervention demonstrated significant evidence as reported from clinic 1-M (528, 639) hertz) when listening to the low frequency sound hertz the respondent mood did not remain the same. Fifteen out of 25, 60% mood states were altered after the intervention demonstrated significant evidence as reported from clinic 1-H (714, 852 hertz) when listening to the low frequency sound hertz the respondent mood did not remain the same. Figure 4.2 illustrates clinics 1-L, 2-M, 3-H calculations using statistical software and reported to be statistically significant evidence of mood state changes as shown in Figures 4.2.1, 4.2.2 and 4.2.3.

CLINIC 1-LOW 396, 417, 444

Fatigue

Exhausted

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	11.800[a]	6	.067

Sleepy

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	16.889[a]	12	.154

Tired

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	24.000[a]	12	.020

< 0.05

Worn-out

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	13.333[a]	9	.148

CLINIC 2-MEDIUM 528, 639

Fatigue

Exhausted

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	29.500[a]	20	.078

Sleepy

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	37.209[a]	20	.011

Tired

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	34.333[a]	20	.024

Worn-Out

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	28.750[a]	16	.026

CLINIC 3-HIGH 714, 852

Fatigue

Exhausted

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	26.000[a]	15	.038

Sleepy

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	35.520[a]	20	.018

Tired

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	25.048[a]	15	.049

Worn-Out

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	26.714[a]	12	.012

Figure 4.2 Clinic Chi square tests for POMS-A fatigue mood state element

Angry *P* = .018, Chi Square Test	Annoyed *P* = .018, Chi Square Test	Bad Tempered *P* = .005, Chi Square Test	Bitter *P* = .018, Chi Square Test	Alert *P* = .042 Chi Square Test
Confused *P* = .046, Chi Square Test	Muddled *P* = .018, Chi Square Test	Mixed Up *P* = .042, Chi Square Test	Uncertain *P* = .046, Chi Square Test	Energetic *P* = .042, Chi Square Test
Peaceful *P* = .050, Chi Square Test	Tired *P* = .020, Chi Square Test	Anxious *P* = .018, Chi Square Test	Nervous *P* = .018, Chi Square Test	Lively *P* = .044, Chi Square Test

Figure 4.2.1 Clinic 1-L reported an asymptotic significance (2-sided) p-value ≤ 0.05

Angry *P* = .050, Chi Square Test	Annoyed *P* = .003, Chi Square Test	Bad Tempered *P* = .024, Chi Square Test	Bitter *P* = .049, Chi Square Test	Alert *P* = .001 Chi Square Test
Confused *P* = .011, Chi Square Test	Sleepy *P* = .011, Chi Square Test	Mixed Up *P* = .042, Chi Square Test	Uncertain *P* = .046, Chi Square Test	Joyful *P* = .034, Chi Square Test
Peaceful *P* = .050, Chi Square Test	Tired *P* = .024, Chi Square Test	Anxious *P* = .007, Chi Square Test	Nervous *P* = .011, Chi Square Test	Lively *P* = .030, Chi Square Test
Active *P* = .039, Chi Square Test	Peaceful *P* = .025 Chi Square Test	Panicky *P* = .025 Chi Square Test	Calm *P* = .007 Chi Square Test	Hopeful *P* = .018 Chi Square Test

Figure 4.2.2 Clinic 2-M reported an asymptotic significance (2-sided) p-value ≤ 0.05

Angry *P* = .037, Chi Square Test	Annoyed *P* = .048, Chi Square Test	Bad Tempered *P* = .029, Chi Square Test	Bitter *P* = .046, Chi Square Test	Alert *P* = .042 Chi Square Test
Confused *P* = .028, Chi Square Test	Muddled *P* = .019, Chi Square Test	Mixed Up *P* = .016, Chi Square Test	Uncertain *P* = .019, Chi Square Test	Energetic *P* = .048, Chi Square Test
Hopeful *P* = .043, Chi Square Test	Tired *P* = .042, Chi Square Test	Anxious *P* = .026, Chi Square Test	Nervous *P* = .017, Chi Square Test	Lively *P* = .038, Chi Square Test

Figure 4.2.3 Clinic 3-H reported an asymptotic significance (2-sided) p-value ≤ 0.05

4.4 Quantitative Biometric Measures

Respondents' vital signs were taken to determine if the intervention had any impact on the physical body. The vital signs were taken and measured before the treatment process and after the intervention of the therapeutic sound frequency hertz. The control group listened to the existing natural clinic soundscape during the regular treatment time. The investigators want to determine if the vital signs remained the same before and after the intervention of the therapeutic sound frequency hertz dissemination through the headset sound application. For this study, a statistical T-test was performed to discover if there would be any strong evidence of significance between the control group who listened to the existing natural clinical sounds from that of the experimental group who were provided intervention for clinic 1-L, clinic 2-M, and clinic 3-H.

The biometric readings were focused on five key vital signs for: respiration rates, arterial oxygen saturation (SaO2), normal heart pulse, systolic blood pressure (SBP), and diastolic blood pressure (DBP). The five vital sign definitions are as follows:

1. RespRate is the normal respiration rates for an adult person at rest range from 12 to 16 breaths per minute.
2. SaO2 is taking the measurement of the arterial oxygen saturation (SaO2) by pulse oximetry (SaO2), using a fingertip sensor is commonly used in the management of patients with pulmonary diseases.
3. Heart rate is the normal pulse for healthy adults' ranges from 60 to 100 beats per minute.
    a. The pulse rate may fluctuate and increase with exercise, illness, injury, and emotions.
    b. For example, females ages 12 and older, in general, tend to have faster heart rates than do males.
4. Systolic blood pressure (SBP) is the top number on the reading; it measures the force of blood against the artery walls while the ventricles of the lower two chambers of the heart squeeze, pushing blood out to the rest of the body.
5. Diastolic blood pressure (DBP) has a greater impact on blood pressure staging. A high diastolic reading (equal to or greater than 120 mmHg) is associated with an increased risk of stroke, heart attack, and other cardiovascular problems.

The data collected was analyzed using a T-test to address if there is any relationship between having had the therapeutic sound frequency hertz intervention for group 1 (test) and group 2 (control).

t-Test Results | Clinic 1-Low Frequency & Control Group

RespRate	SaO2	Heart Rate	SBP	DBP
P = 0.360, t-Test	P = 0.0896, t-Test	P = 0.429, t-Test	P = 0.253, t-Test	P = 0.475, t-test
No significant evidence shown.				

t-Test Results | Clinic 2-Medium Frequency & Control Group Results

RespRate	SaO2	Heart Rate	SBP	DBP
P = 0.006, t-Test	P = 0.122., t-Test	P = 0.0249, t-Test	P = 0.021, t-Test	P = 0.093, t-Test
Significance evidence shown for respiratory, heart, and systolic blood pressure.				

t-Test | Clinic 3-Medium Frequency & Control Group Results

RespRate	SaO2	Heart Rate	SBP	DBP
P = 0. 298, t-Test	P = 0.0896, t-Test	P = 0.255, t-Test	P = 0.05, t-Test	P = 0. 175, t-Test
Significance evidence shown for systolic blood pressure.				

Figure 4.4 Methods Matrix Chart

4.5 Qualitative Opened-Ended Questions

The results from the qualitative opened-ended responses were photocopied and translated from English to Croatia and collected from each clinic. The questions were presented to the respondents prior to the sound intervention at the beginning of the

respondent's scheduled appointment. Using an excel worksheet, each answer was sorted into like word groups to identify a common recurring pattern across a data set clustered around a central organizing concept. The research team chose to use a descriptive combined with thematic word code analysis. Braun and Clarke (2015) state thematic analysis is a method for identifying, analyzing, and reporting patterns (themes) within data with the aims to discover themes and concepts embedded throughout qualitative data process. The research team took a deductive approach to derive concepts from the respondent answers those informed codes, theme development, and a framework. Figure 4.5 illustrates the summary of the opened-ended questions, coding, themes, and framework. Figures 4.6 and 4.7 take a look at the data displayed in a pie and bar chart demonstrates the strength of opinions these findings.

Word Groups	silence	quiet	music	communi-cation	noise sounds	aware of effects	physical clinic	satisfied w/clinic
Participant Responses	10%	5%	12%	13%	23%	23%	14%	2%

Figure 4.5 Thematic repetitive affinity word groups

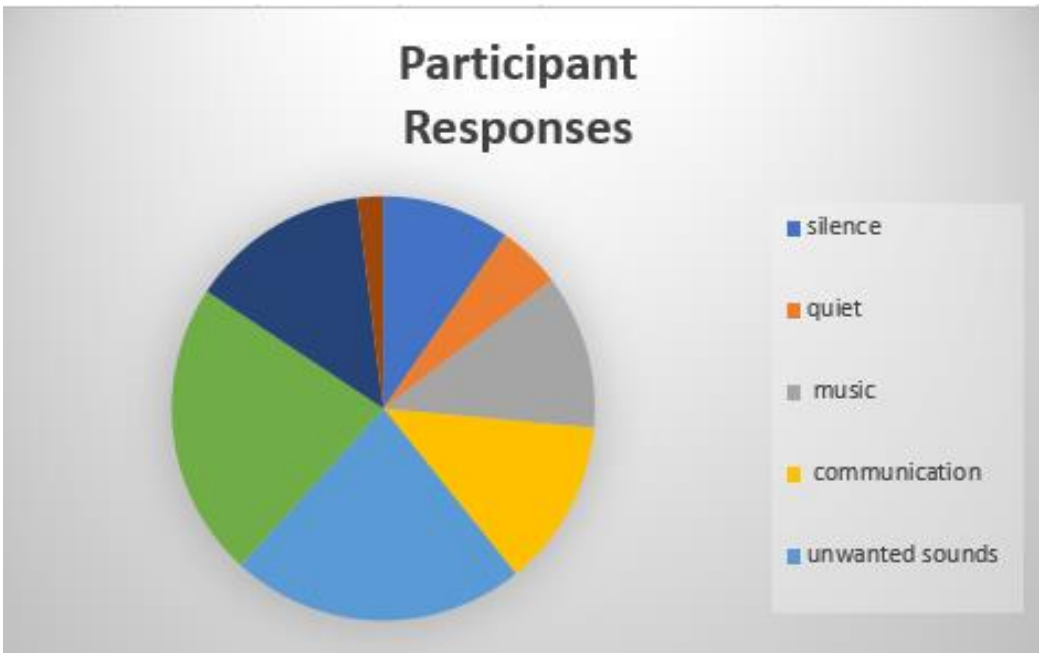

Figure 4.6 Participant Responses Pie Chart

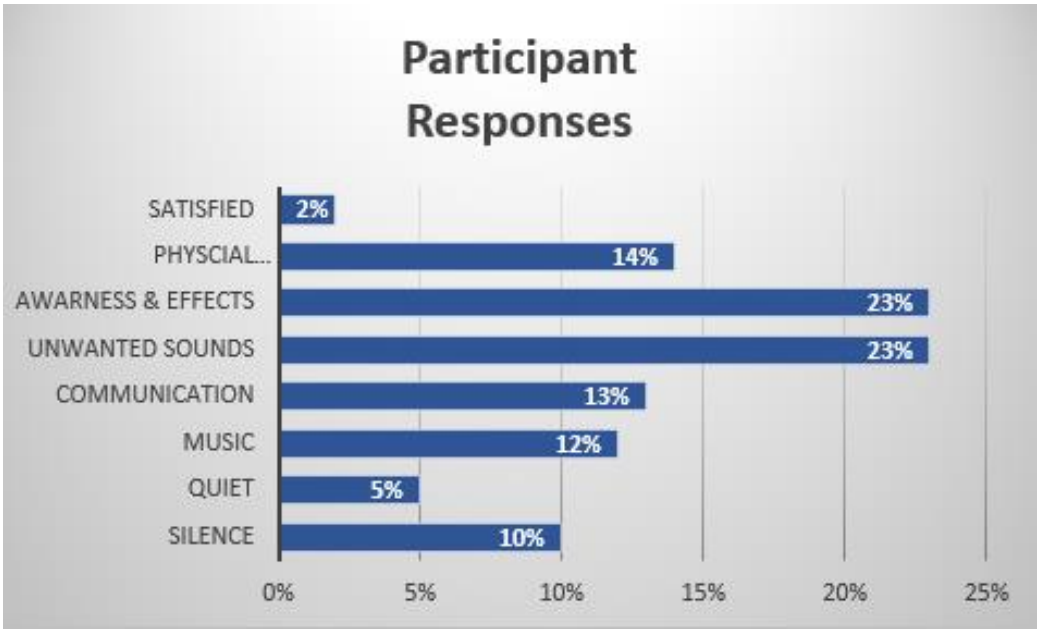

Figure 4.7 Participant Responses Bar Chart

The identified coding was grouped then the themes emerged from the opened-ended questions. Figure 4.8 depicts the three themes were identified and supported by the list of patient comments. The group coding of words, and phrases drove the final thematic framework. The framework deducted the respondents' answers about how clinical soundscape awareness to obstacles and barriers that have a direct internal and external patient effect. The patient effect seemed to influence an internal physical and determined the well-being of the patient at the start of their scheduled appointment. Figure 4.5 illustrates the framework also identified external patient effects that were derived from the clinics' physical building soundscape.

Theme 1	Ways to improve the clinical environment
Clinic 1, L	"Everything which I would want to change is impossible"
Clinic 2, M	"Some slow, quiet music she never liked the noise"
Clinic 3, H	"Minimum number of people in the waiting room would suit me, clearly defined order."
Theme 2	What distracts from the clinical environment?
Clinic 1, L	"Noise, racket, talking"
Clinic 2, M	"Loud talking, banging of doors"
Clinic 3, H	"Loud sounds of banging, creaking, and sounds of quarreling bother me. I feel disturbed and nervous in that environment."
Theme 3	Participants raised awareness of the barriers and benefits of sound
Clinic 1, L	"Peace, calm"
Clinic 1, L	"Silence because of concentration"
Clinic 2, M	"The racket and noise bother her"
Clinic 2, M	"Beautiful music in physical therapy"
Clinic 3, H	"Loud banging and talking, all of which produces unknown sounds which evoke fear."
Clinic 3, H	"Silence, quiet speech. I experience it as peace and relaxation."

Figure 4.8 Themes & Respondent Comments

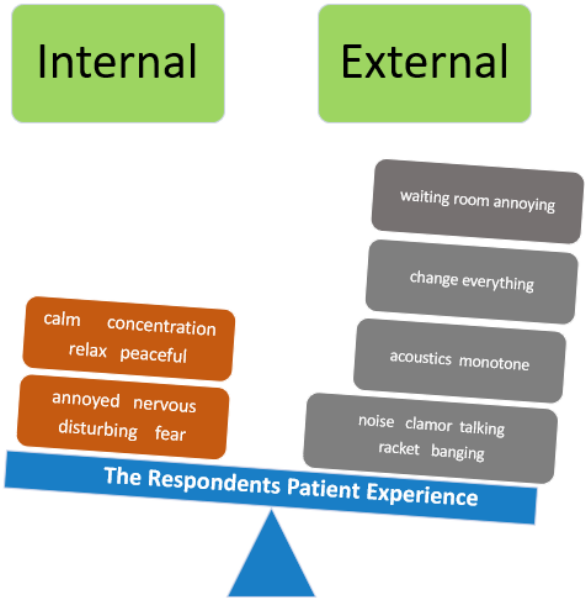

Figure 4.9 Thematic Framework Soundscape Effects

The analysis of the thematic data required the research team to go beyond the surface level of the thematic coding. The primary goal was to identify through the study participants their conceptual understanding of how they see the world related to sound effects during each patient's scheduled treatment. Patients reported on the sound awareness and its effects on them followed by unwanted sounds like noise and clamor, according to 46% of the responses is almost half of the study group.

4.6 5-Point Likert Scale

The respondents were asked to complete a 5-point Likert five question sound perception survey. The results from this scale will determine the participant's opinion about the application of how sound should be delivered into the clinical setting. Interpretation and

discussion of the study results will occur in the next chapter. The data collected reveals the following opinions regarding sound perception.

1) I prefer to listen to no addition missing sounds during my treatment session.				
1- Strongly Disagree	2 -Disagree	3 - Neutral	4 -Agree	5 - Strongly Agree
4	8	24	10	6

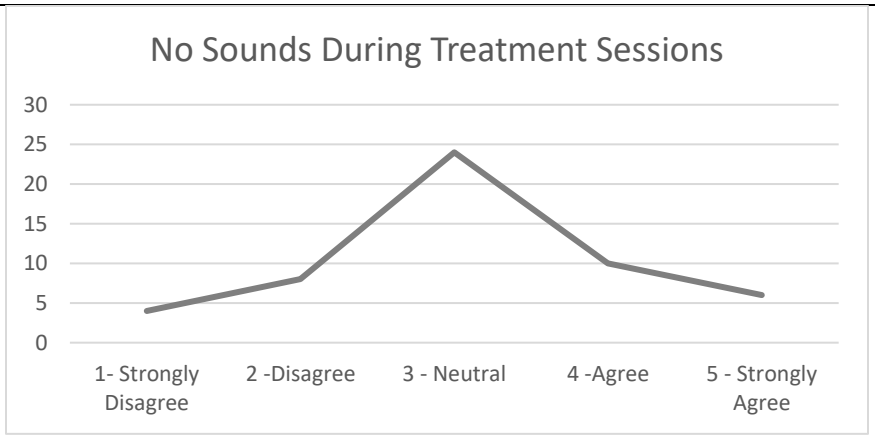

Figure 4.10 Soundscape Perception Survey, QA1

2) I would consider using headphones to listen to sounds during my treatment session.				
1- Strongly Disagree	2 -Disagree	3 - Neutral	4 -Agree	5 - Strongly Agree
3	7	22	12	7

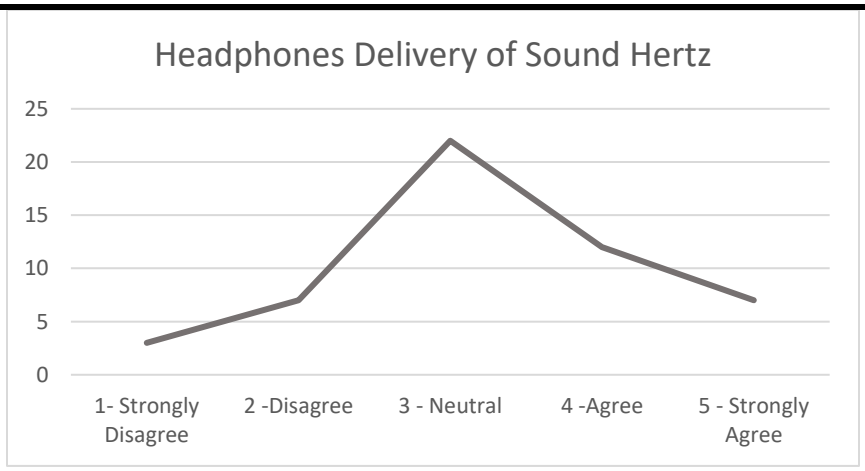

Figure 4.11 Soundscape Perception Survey, QA2

3) I prefer sounds be distributed through a speaker within the treatment area during my treatment session.				
1- Strongly Disagree	2 -Disagree	3 - Neutral	4 -Agree	5 - Strongly Agree
3	6	19	13	13

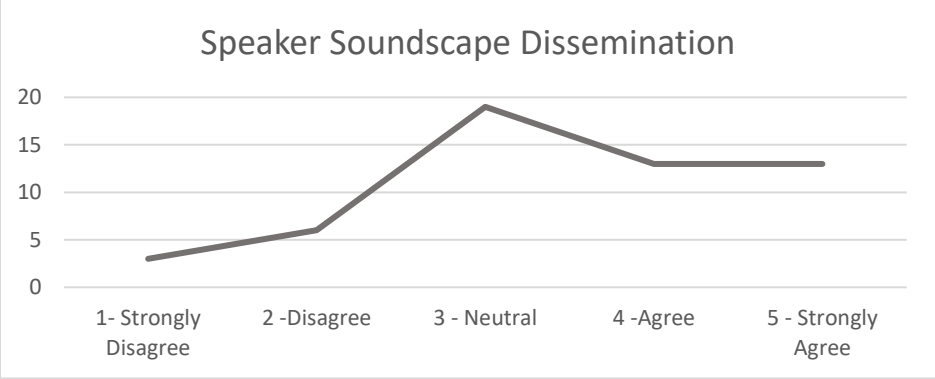

Figure 4.12 Soundscape Perception Survey, QA3

4) I prefer sounds be distributed through a speaker built into furniture, seat or bed pad, and a pillow during my session.				
1- Strongly Disagree	2 -Disagree	3 - Neutral	4 -Agree	5 - Strongly Agree
20	8	18	2	3

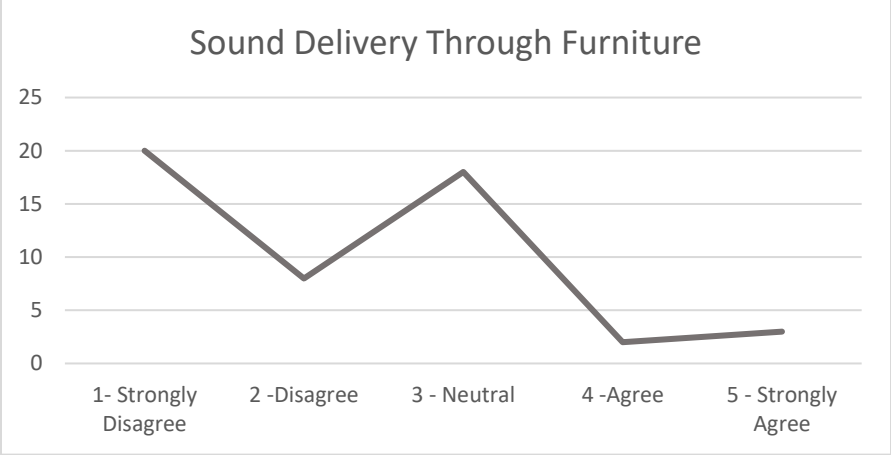

Figure 4.13 Soundscape Perception Survey, QA4

5) I believe each user should have a choice and selection of sounds available to choose from during your session.				
1- Strongly Disagree	2 -Disagree	3 - Neutral	4 -Agree	5 - Strongly Agree
1	6	20	5	18

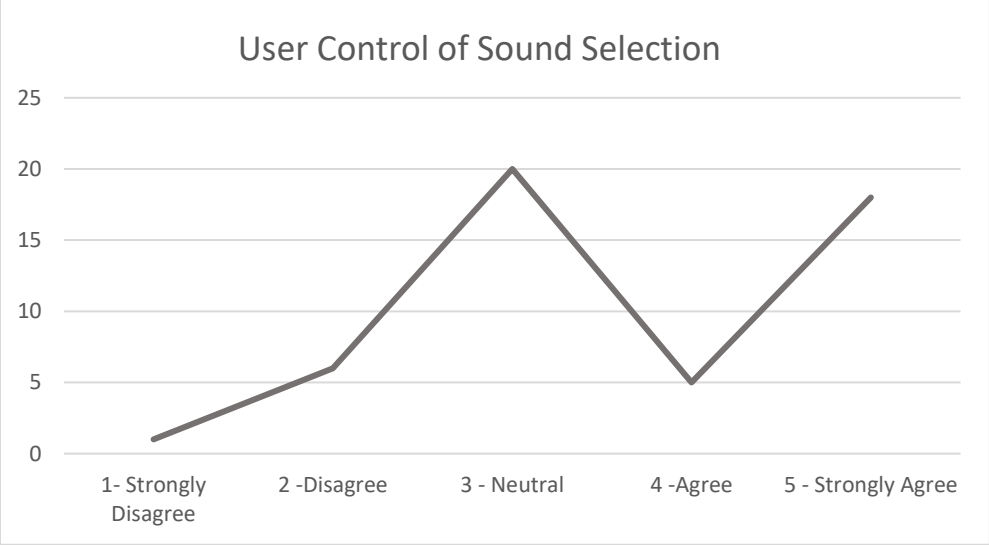

Figure 4.14 Soundscape Perception Survey, QA5

4.7 Conclusion

In summary, the results of the tests in order of significance start with the qualitative opened-ended questions. Three themes developed from the thematic coding that addressed sound barriers, distractions, its benefits, and improvement for a clinical setting. The framework clearly identified from this the respondents had internal and external awareness of the sound effects. The POMS-A mood state Chi Square test result had a P value of .05 reported a significant difference after the listening intervention between the test and control groups. As an example, clinic 1-low 396, 417, 444 hertz 60% of the 25 itemized mood states

showed evidence of changed. The vital signs biometric measures t-Test, P(T<=t) one-tail result had a P value of .05 showed a difference for clinic 2-medium 528, 639, and clinic 3-high 791, 852 hertz level shifts for the respiratory rate, heart rate, and systolic blood pressure. The 5-point Likert scale respondents reported a neutral opinion about listening to therapeutic sounds through either a headphone or speaker system. There was a strong opinion to adopt user-control to select the therapeutic sound choices with a low interest to have furniture disseminate these sounds. As an example, therapeutic sound frequency hertz through a lounge chair or a pillow. The cumulative effort of the study was combined in the support of the primary and secondary research questions. These results will be discussed furthered in depth in Chapter Five.

CHAPTER 5

DISCUSSION

5.1 Introduction

This chapter will discuss the limitations and results of the study and how the findings relate to the primary and secondary research questions and methods. The chapter will also discuss how the results relate to the therapeutic sound frequency hertz as a sensory design element to potentially improve the quality of care, the patient experience, and 'evidence-based' design standards for the healthcare and healing environment for clinical settings.

5.2 Limitations

There were limitations to this research. This chapter will begin with the discussion of shortcomings of the study that influenced the results found in the analysis of the research question that will follow. The chapter will help to inform the design and medical community to what should be improved in future studies of this kind. The section will discuss the instruments, study setting, and sample.

5.2.1 Instrument Limitations

Chief among the limitations was the difficult, if not impossible task of translating the study content and instrument instructions from English to the Croatia language. It is important to note, the study participants reacted to the instructions and questions they were given in Croatian. So, we had to report their responses even if it was not quite what was intended, such as the English word *alert* translated to *alarm* in Croatia, which

potentially could have a different interpretation of what was implied. The POMS-A instrument was altered during the instrument translation. One of the six sub-factors was replaced with a non-valid factor named *calm* which included five items that being joyful, hopeful, peaceful, relief, and calm. The changes in the study instructions does raise an eyebrow to why this occurred. Perhaps, the chosen Croatian translator was unclear of the importance not to change any of the approved instruments supported by the cited evidence; of course, this weakens the integrity and validity of the instrument used to collect the research data. It is apparent the research was loose and inaccurate as the translators' interpretation became more than a language barrier for the study instructions and instruments.

5.2.2 Setting Limitations

Also perceived as a limitation to the accuracy of the research, the respondents did not all experience the same controlled interior room layout. This situation was difficult, if not impossible to control. The studies clinical interior setting for all respondent rooms could not be the same for each clinic. It was confirmed that the Bosnia clinic 1-L and clinic 2-M had the same interior treatment intervention room layout as both were part of the same healthcare system. The Bosnian clinics were like that of a typical American clinical exam room. From the opened-ended questionnaire answers, it became apparent that clinic 3-H conducted part of the research from the participants answers seemingly partially occurred in or near the patient waiting room inferred by the thematic code

analysis. This presents some bias to the research results, as the treatment intervention room clinical setting consistency did not exist among the three clinics.

5.2.3 Sample Limitations

The clinician office assistant asked patients to participate in the study prior to their next scheduled appointment. The patient freely self-selected if they wanted to volunteer for this study. The pool of participants was taken from the clinician's database for patients with chronic illnesses. The clinician office assistant was given a script to follow when recruiting for study volunteers. It is unclear as to whether the script was followed verbatim at each clinic location for study consistency. The recruitment process may have been biased towards contacting patients who were more acutely ill over another patient. This may have resulted in not an unbiased sample. An unbiased selection of the sample is important in quantitative research which has a concern for generalization; while an unbiased sampling technique are the ones which are random (Delice, 2010). This study's sampling techniques, except simple random sampling, cannot be considered totally unbiased even if they are random (Delice, 2010). It is possible the patients who agreed to participate in the study may have had a preconceived understanding about sounds prior to the listening for 22 minutes during the treatment intervention session.

Potentially, this may have caused the patient to hyper-impose their mood states prior to the intervention. The knowledge of the study aim would have been discussed during the initial contact and consent agreement and may have caused the patients to become more aware of the clinic's soundscape than normal. The 5-point Likert survey

seemed to indicate that the patients wanted user-control of the therapeutic sound frequency hertz through the headphones but not necessarily added sound to the clinic's physical environment. This begs the question as a patient potentially limited in the ability to control one's illness having user-control over their built environment provides a sense of normalcy if one has the choice over what is heard during one's treatment session.

5.3 Discussion of Results

This research study was conducted to explore and examine if a relationship exists between offering a therapeutic soundscape intervention and its ability to manipulate the healing process within a well-integrated clinical patient-care model. Design practitioners have a responsibility to address the unwanted sounds and present innovative solutions to not just remove, but to create a therapeutic hospital soundscape ecosystem. Limited research has been done to investigate these design strategies and their impact on sound levels in patient care environments (Wang et al, 2013).

The study's design approach used a triangulation method to increase the credibility and validity of research findings (Noble & Heale, 2019). The collected data rendered from the POMS-A instrument found the calm subscale with its five items the Chi Square test analysis deemed to be invalid as it replaced the depression subscale. Despite the POMS-A validity evidence found in the literature review, if the subscale depression with its four items had been kept the data collected in this subscale could have worked. As mentioned in the previous section 4.3.2, although the clinicians were all trained in how to conduct the research, most likely, the disconnect was a result of the

clinician misinterpretation of how not to alter the POMS-A depression subscale. By choosing to triangulate the methods used, combining of the other methods such as the qualitative opened-ended thematic code responses, the quantitative POMS-A the other correct five subscales (anger, confusion, fatigue, tension and vigor) and Chi Square test data set results, the quantitative vital sign biometric measures and t-Test results, and followed by the qualitative 5-point Likert scale ensured that fundamental biases that could have arisen from the use of a single method were overcome (Noble & Heale, 2019).

The combined triangulation of methods allows for enriched research as it offers a variety of datasets to explain differing aspects of the phenomenon of interest, to address if the therapeutic sound frequency hertz had any relationship with the patients in their clinical settings. Two research questions framed this inquiry. The healthcare context primarily engaged three family practice clinics (two located in Bosnia and one located in Croatia), the chronically ill patients, and clinician staff.

5.3.1 Primary Research Question

RQ1: Do study participants mood state and/or physical vital signs change after listening to therapeutic sound frequency hertz during clinical treatment?

In reviewing the findings from the study, the answer to this question is possibly identified by examining the opened-ended responses, selected mood states, and vital sign biometric measures before the therapeutic sound frequency hertz intervention. Then to examine the data collected and compare results after the intervention of the participants

mood states, vital sign biometric measures, and sound perceptions. This study primarily compared the post intervention therapeutic sound frequency hertz level relationship between the control and test groups.

For this study, the POMS-A mood states comprised of the following six subscales and 25 mood items are categorized as shown in Figure 5.0:

POMS-A, Six Subscales and 25 Items					
Anger	Confusion	Calm	Fatigue	Tension	Vigor
angry	confused	calm	exhausted	anxious	active
annoyed	mixed-up	hopeful	sleepy	worried	alert
Bad-tempered	muddled	peaceful	tired	panicky	energetic
bitter	uncertain	joyful	warn-out	nervous	lively
NA	NA	relief	NA	NA	NA

Figure 5.0. POMS-A Subscales and Items Survey

There were noticeable mood shifts after the intervention that correlated with the test group findings for subscales anger and confusion, as participants were 8% more agitated and 14% more confused after listening to sounds at the 791 and 852 hertz levels. All three clinics experienced subscale improvement of 6% more calm and 8.5% less fatigue than the control group. A remarkable mood shift was observed at clinic 1-Low where 396, 417, and 444 hertz participants seemed less tense by 39%. This trend continued for all three clinics averaged at a 26% tension reduction. At clinic 2-Medium

528 and 639 hertz levels, participants experienced a 26% increase in vigor. This trend continued for all three clinics averaged at a 16% vigor improvement.

To summarize, mood shifts were conclusive after the therapeutic sound hertz intervention were positive for reducing tension when listening to low hertz 396, 417, 444; increasing vigor when listening to medium hertz 528 and 639; and a negative impact for increasing agitation coupled with confusion when listening to the high 791 and 852 hertz. More research will be needed to ensure full understanding of the impact of the positive and negative participant hertz levels responses.

The thematic coding analysis of opened-ended responses also supports RQ1. The research found the participants were aware of the clinical soundscape; it had a direct positive and negative internal effect on the people's health and welfare. The respondents had positive internal effects of calm, peace, relaxation, beautiful, concentration, and positive distraction. The negative internal effects were evoked fear, annoyed, disruptive, disturbed, nervous, improper behavior, and disturbance. Some environmental elements in themselves may foster or hinder the healing impact on health by influencing the behaviors, actions, and interactions of patients, the staff, and their families (Salonen, Lappalainen, Lahtinen, Knibbs, & Morawska, 2012).

The physical vital signs concluded the participants experienced biometric shifts after the 22-minute clinical intervention when comparing the test and control groups. The therapeutic sound frequency hertz interventions were for the five vital signs for the respiratory rate, arterial oxygen saturation (SaO2), heart pulse, systolic blood pressure (SBP), and diastolic blood pressure (DBP). The t-Test data analysis of the vital signs for

clinic 1-Low hertz levels 396, 417, 444 had no significant findings. Clinic 2-Medium hertz levels 528 and 639 significant evidence illustrated with an alpha of .050, the *P*-value equaled .006 for respiratory rate while the heart pulse and systolic blood pressure *P*-value equaled .020 were remarkable results. Clinic 3-High hertz levels 791 and 852 had significant evidence for the systolic blood pressure *P*-value which equaled .050. The biometric measure outcomes may suggest the medium and high therapeutic sound frequency hertz useful for patient restorative effects during treatments and recovery.

It appears the three study methods used addressed RQ1: the opened-ended questions, POMS-A, and vital sign biometric measures were effective to capture the therapeutic mood states and/or physical vital sign changes after listening to therapeutic sound frequency hertz during clinical treatment.

5.3.2 Secondary Research Question

RQ2: Is there a relationship in how patients experience and the environmental soundscape in the clinical setting and their importance to them?

The RQ2 through the thematic code analysis found many of the patients experienced the environmental soundscape was negative for most. A recurring theme of unwanted sounds were reported loud talking, racket, clamor, quarreling, and banging made some respondents nervous, disturbed, fearful, and concentration were impacted. These respondents also reported the need to change everything about the environment seemed impossible.

The 5-point Likert survey asked the study participants at the end of the study to provide an opinion about if therapeutic sound frequency hertz should be disseminated into the environmental clinical settings. It seems for the most part 20% of the respondents were neutral in opinion about even having therapeutic sounds released in their clinical setting. Another 18% to 20% were indifferent about listening to the therapeutic sound frequency hertz with headphones for speakers like a surround sound system. Opposite opinions demonstrated that 40% of the respondents were either indifferent or did not want therapeutic sounds installed into furniture. The same split findings were true that 40% of the respondents were indifferent or strongly agreed to have user control over the selection process to choose the therapeutic sound frequency hertz listening levels. The respondents for the most part was indifferent about how such therapeutic sounds would disseminate into a clinical setting. The researcher attributes the respondent's indifference perhaps from patients not recognizing they can have user-control to choose listening to therapeutic sounds and to recognize the role it plays in the healing process. This may be a new concept for the patient and clinicians and should be considered as an area for future research.

5.4 Areas of Future Research

This study is useful as a starting point for design practitioners to identify what within the realm of therapeutic sound frequency hertz levels should be considered when designing health care facility settings. The evidence collected in this study suggests a next step would be to clearly define and establish how listening to therapeutic sound

frequency hertz becomes a relational catalyst to impact wellness for a patient going through treatment within a clinical setting. It is important to distinguish among the different types of therapeutic sound modalities already used for health care settings. The results seem to suggest that some hertz levels had a greater significant effect on the patient's biopsychosocial outcomes. It is important to clarify how therapeutic sound frequency hertz set in music for listening is an intervention and does not conflict with the need for other professionals who use music. Music therapists use music as a systematic application to assist in the treatment of the physiologic and psychological aspects of illness or disability (McCaffrey & Locsin, 2002). Trained music therapists have skills in composing and in identifying music for specific therapeutic outcomes (McCaffrey & Locsin, 2002).

Expanded research is needed to understand for the design and medical practitioners, in their daily interactions with patients, can sound frequency hertz listening provide an environment to facilitate healing and wellbeing that goes beyond the sounds of waterfalls, crickets chirping, or classical tones.

The practitioner must identify what hertz levels set in music can be listened to rather it be at a low, medium, or high level. This chief intervention can provide a positive distraction from the array of unwanted noises, alarms, and machines in and around the patient's environment. Future research should locate the hertz levels that individual patients can listen to and aid in recovery in a clinical setting that is perceived to be peaceful, safe, and welcoming, one that enables the healing process despite facing difficult therapies, treatment plans, and exams during scheduled visits. To isolate the

ideal hertz level opens new avenues for patient delivery of care, clinical design, and product solutions. In nursing practice settings where patterns of care are developed based on evidence, the use of music as an effective intervention becomes an integral part of the plan for patient care (McCaffrey & Locsin, 2002) and for building noise reduction programs.

5.5 Suggested Design Changes

This study was valuable for the three clinics to better recognize how the soundscape can affect its patient population during clinical visits. Clinic 3-H expressed the desire to learn if this study could have a positive impact for those patients who suffered from covid-19 and isolation syndrome. In fact, based on the study results, one can infer the usefulness in disseminating therapeutic sound frequency hertz into the clinical settings for future treatment intervention exam room remodels. The thematic coding suggests the statements about sound perception, caused the participants to open their eyes to look at the entire physical space and its layout. It seemed a third of the participants were also impacted by how the clinic's layout must "change everything, define order, create smaller wait areas, less people, and racket" answered some of the comments expressed.

As it relates to creating new design sound strategy changes, it is important to understand the noise guidelines for healthcare facilities. In the U.S., the current noise standards for the hospital environment were established decades ago and have not been modified. In 1974, the U.S. Environmental Protection Agency (EPA) recommended that

indoor hospital areas maintain an average sound level of less than or equal to 45 decibels, A-weighted (dBA) during the day, and 35 dBA at night to maximize opportunity for patient recovery (Smith, Ortmann, & Clark, 2018). Over the following decades, several research groups have made additional or updated recommendations to re-evaluate the EPA standards. New recommendations regarding the presence of transient sounds in the environment (i.e., doors slamming) were issued, with the maximum level for transient sounds (L_{max} averaged over 1 s) being either 65 or 70 dBA (Smith, Ortmann, & Clark, 2018).

Due to alarms, medical equipment, and the continuous activity within units, the hospital soundscapes can be difficult environments to assess acoustically. Routinely, patients perceive these soundscapes to be poor when rating their hospital experience on HCAHPS (Hospital Consumer Assessment of Healthcare Providers and Systems) surveys administered after discharge (Bliefnick, Ryherd & Jackson, 2019). In 2022, the HCAHPS surveys continue to show a low overall quality performance for environmental quietness around the patient's hospital clinical stay. The October 2021 reports the U.S. hospitals quality performance for quietness remains the second lowest of the ten dimensions measured ranked a score of 63%.

There is room to expand design changes, to incorporate non-invasive therapeutic sound frequency hertz for clinical settings. The design community has a responsibility and impact on the health, safety, and welfare of the public within the physical built environment. Other research suggests continuation of the hospital noise abatement

programs have worked, like silent zones or quiet time hours. Yet there is more that can be done to improve the overall soundscape for patient wellness. As this study suggests, creating design standards that will incorporate listening to therapeutic sound frequency hertz in clinical settings may indicate a trend towards a positive and pleasant effect on the patient mood states and physical vital signs. This suggests that therapeutic sound frequency hertz can become a non-invasive intervention as part of the soundscape environment and patient care delivery.

Hospitals and clinical setting can adopt noise abatement programs as a design standard. The therapeutic sound frequency hertz, music listening can assist clinicians to create a healing environment to promote health and well-being (McCaffrey & Locsin, 2002) by adding hertz into the soundscape for clinical settings. This design change allows for the design and medical teams to practice patterns that are evidence based, the use of music listening; like that of therapeutic sound frequency hertz, could become an integral nursing intervention (McCaffrey & Locsin, 2002). As this study begins to suggest, music demonstrates an effectiveness to decrease anxiety, increase relaxation as well as to distract persons from the unpleasant sensations and other unwanted annoying sounds in a clinical space. This study has added to the body of knowledge in how to improve the soundscape for clinical spaces. As future research explores the non-invasive uses of therapeutic sound frequency hertz on the people and the environment, the perception of a quieter clinical setting can increase the patient experience and satisfaction scores beyond that of what is today ranked at 63%.

5.6 Study Conclusions

This study identified some correlations of the therapeutic sound frequency hertz had on the mood states and physical vital signs. The study also verified the relationship in how patients experience an environmental soundscape in the clinical setting. With a third of the study participants desiring to “change everything” in the clinical setting, this is a statement worth investigating to gain a deeper understanding of the underpinning of this need. The POMS-A results were non-validated but still proved to be useful to understand how the mood states were impacted from the sound intervention.

Overall, the study did provide helpful direction for future research to inform the interior design practice. What is interesting about this study is its ability to provide information about therapeutic sound frequency hertz as a potential intervention in a clinical setting. This requires more research to expand such findings, as the existing knowledge reported by the literature reviews were minimal to none.

Interior designers can educate themselves and the medical practitioner teams on the value to move beyond sound abatement programs to understand the properties of how sound frequency hertz can become a therapeutic agent in the healing process at the same time can create a perception of quietness, calm and wellbeing. This intervention can become a valid positive distraction against other annoying healthcare sounds.

Future research would also benefit from better research training and oversight throughout the study execution, to minimize mishaps experienced with the study tools and processes. A controlled setting for all three clinics perhaps may have yielded better

results and a stronger connection to understand the physical environment effects on the study participants.

In conclusion, the study did report positive mood state and vital sign changes using therapeutic sound frequency hertz were met with a theme of peacefulness, relaxing, calm, pleasing, and beautiful attributes to describe the soundscape. The incorporation of this as an intervention is new and should contribute to the current body of knowledge for an optimal healing environment (Sakallaris, McAllister, Voss, Smith & Jonas, 2015). This brings to light the early nursing work of Florence Nightingale, who used music listening as a nursing intervention "auditory modality" and viewed this as part of the environment (McCaffrey & Locsin, 2002). Nightingale felt that it was the responsibility of nursing to control the environment to put the patient in the best place for healing to occur. As design practitioners, work in healing environments must continue.

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APPENDIX A

UNIVERSITY IRB APPROVAL

ASU Knowledge Enterprise Development

APPROVAL:CONTINUATION

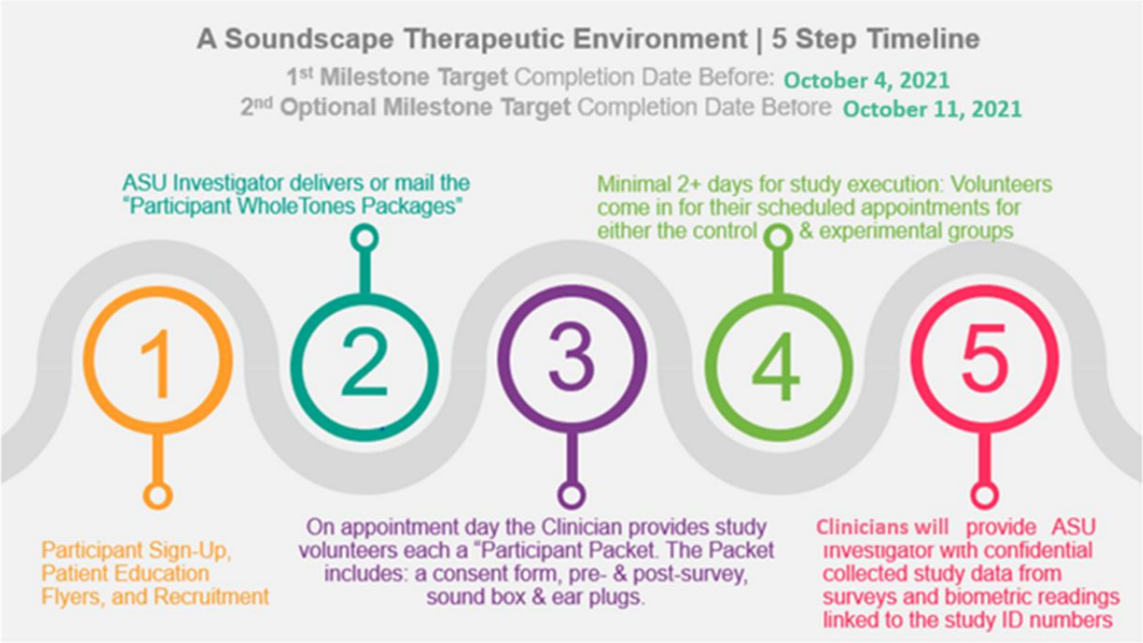
Type of Review:	Continuing Review
Title:	A Soundscape Healing Environment: An Exploratory Study of the Relationship between Therapeutic Sound Frequency and Biopsychosocial Outcomes in a Clinical Care Setting
Investigator:	Diane Bender
IRB ID:	STUDY00008429
Category of review:	
Funding:	Name: HIDA: Administrative Units; Name: HIDA: Administrative Units
Grant Title:	None
Grant ID:	None
Documents Reviewed:	• APPENDIX A HRP-503b-TEMPLATE_PROTOCOL_Bioscience 08152018.docx, Category: IRB Protocol; • APPENDIX J PRE-RECRUITMENT FLYERS.pdf, Category: Recruitment Materials; • Long Consent Form, Category: Consent Form; • APPENDIX K Recruitment Contact List.pdf, Category: Recruitment Materials; • APPENDIX I Post Recruitment Script 8-2-2018.pdf, Category: Recruitment Materials; • APPENDIX H Participant Master List.pdf, Category: Other; • APPENDIX G - Potential Setting.pdf, Category: Other;
	Off-site authorizations (school permission, other IRB approvals, Tribal permission etc); • APPENDIX E Study Questionnaire 08082018.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions); • APPENDIX D POMS Standardized.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions); • APPENDIX B The Study Timeline.pdf, Category: Other; • Rec letter for Angela Tate Scholarship (1).pdf, Category: Sponsor Attachment; • HIDA Thesis Research Funding.docx, Category: Sponsor Attachment;

The IRB approved the protocol from 8/18/2021 to 8/17/2022 inclusive. Three weeks before 8/17/2022 you are to submit a completed Continuing Review application and required attachments to request continuing approval or closure.

APPENDIX B

THE STUDY TIMELINE – OCTOBER 4 TO OCTOBER 11

APPENDIX B – THE STUDY TIMELINE



APPENDIX C

BIOSCIENCE CONSENT FORM OVERVIEW

Title of research study:

A Soundscape Healing Environment: An Exploratory Study of the Relationship between Therapeutic Sound Frequency and Biopsychosocial Outcomes in a Clinical Care Setting

Investigator:

I am Angela Diane Tate, a graduate student under the direction of Associate Professor Dr. Diane Bender in The Design School at Arizona State University.

IRB #: _____

Principal Investigator: Diane Bender, PhD

Co-Investigator: Angela Tate, PMP

Date _____

Introduction

Why am I being invited to take part in a research study?

We invite you to take part in a research study during your regularly scheduled medical treatment time. The study is about sound within the environment and its impact on your well-being. You are asked to participate in a research study about the relationships between patient biopsychosocial wellness, the clinical setting environment, and the ability of sound to influence the healing process.

As a patient of the _____ Center, we ask that you participate in this study while you wait on your doctor or practitioner before, during the treatment session, and just after the appointment.

Through recruitment flyers and/or contact by the clinician or investigator will invite and follow up with interested participants. All names will be documented on a recruitment contact list to be used for the study follow up instructions for participants.

Why is this research being done?

The purpose of this study is to help groups of people who have a need for inpatient care, rehabilitation, or other outpatient clinical treatment needs. Because these treatments require an extended length of time, positive sounds in the physical setting may help patients feel more at ease. This study is looking at non-invasive therapeutic sound frequencies as part of the healing process for clinical settings. When the sound frequencies are released, patients may have benefits like: increased relaxation, pain reduction, accelerated recovery,

reduced length of stay, emotional relief, and physical rest. Basic biometric readings and a questionnaire will be taken before and after the dissemination of the therapeutic sound frequencies. Once we review the biometric functionality and psychological responses, we can then analyze the gathered data to determine if a relationship exists between therapeutic sound frequencies and biopsychosocial healing.

How long will the research last?

We anticipate one (1) treatment time, ranging from 60 to 240 minutes per subject. The length of time depends on the type of therapy the patient receives for their schedule treatment session during the patient stay.

If you agree to participate, you will be asked to complete 2 surveys, which will take about 10 to 15 minutes each. In order to assure confidentiality, the surveys will not collect your identity but will be assigned an ID number not connected to your name. The standard biometric readings for pre/post readings will be collected and given to the research team for review. To protect your identity when data is received and reviewed, the biometric readings will be confidential linked to the ID number *only* not participant name.

How many people will be studied?

20-60 adults, age range 18 to 85 years old, male and female

What happens if I say yes, I want to be in this research?

It is up to you to decide whether or not to participate. If you choose to be part of this study, there are two steps:

The first step, you will fill out a questionnaire and survey about how you feel. You will then listen to sound frequencies during your treatment session. The sound frequencies will be played in the environment through recorded or live music, or through disposable head phones attached to a portable music box.

After listening to the sound frequencies, you will be asked to fill out the same questionnaire and survey about how you feel. This will be after your treatment session ends.

The second step, we will receive your basic biometric readings from the nurse practitioner. These non-invasive biometric readings include: blood pressure cuff, finger oximeter to measure oxygen and heart beats per minute, and bio/brain Vintanya signal assessment (by a non-invasive hand-touch ball method).

We will review the data to determine if any changes have occurred in your perceived mood and/or your physiological state. Participation in this study is optional and confidential. We are asking for one (1) session of your time, as part of your scheduled appointment. You will interact with the lead and assistant investigator who will monitor the process. You can end your participation at any time and your information will not be used in the study.

Please see the description exhibit 1: The Study Time Line -

- The study shall be conducted in 2 steps during 1 visit.
- No drugs or biologics will be given to the participant.

- All devices that will be used include: Vitanya equipment, sound level meter, WholeTone CD box, headphones, Sony CD player, stethoscope, oximeter, and blood pressure cuff.
- The length and duration of visits and procedures ranges from 60 to 240 minutes.
- No blood will be drawn.
- The lead and assistant investigator interacts with the participant to explain the directions. The clinic practitioner will administer biometric readings.
- The research will be done at the clinic where the patient's appointment occurs.
- The research is completed the same day for that subject.
- There will be only the listening to music through the CD players: WholeTones and/or Sony equipment through the use of head phones or sounds released in the open environment (i.e., harp).
- The procedures will be performed during the scheduled appointment. There will be no follow up visits for the subject.
- There is no need for the participant to be contacted for future research.

What happens if I say yes, but I change my mind later?

You can change your mind anytime during the study and your information will be deleted from the study. There are no penalties to withdraw your participation. Your participation or lack of participation has no impact on your treatment being received today.

Is there any way being in this study could be bad for me?

There are no foreseeable risks or discomforts to your participation nor any known risks to you from taking part in this research study. This study will not make your health better. It is for the benefit of research and will help to inform the reliability of the instruments, and to inform design decisions for the potential evidence-based design decisions and guidelines for clinical settings.

Your name will not be associated with the questionnaire, survey or master list. The questionnaire nor survey are not intended to ask questions that cause harm or discomfort. The biometric measurements received from the clinician will be recorded on the same questionnaire/survey sheet and will be used only to determine if sound frequencies have a biopsychosocial effect. If any discomfort arises, you can stop your participation at any time.

Please understand your participation is voluntary and you have the right to withdraw your consent or discontinue participation at any time without penalty. Specifically, your current or future medical care at _____Center will not be jeopardized if you choose not to participate.

Will being in this study help me anyway?

There are likely no direct benefits from your participation in this study. However, you may have a heightened awareness of the health and wellness setting after participation.

What happens to the information collected for the research?

We treat your privacy with the utmost importance in this study. This study is confidential. Your name is not associated with your questionnaire/survey answers or biometric data, as you will be assigned a study subject ID number. Here is how the data will be collected and managed: a 'Master List' is required to collect, compare, and contrast taken from the study data associated with each ID number. The data that will be stored has no identifiable information contained in it, as your name will not be recorded or associated with the collected data. The collected data shall be stored securely on campus or on an ASU server that can be accessed remotely. The 'Master List' will need be stored separate from the consent and other collected study data.

The data that will be stored has no identifiable information contained in it, as your name will not be recorded or associated with the collected data. The questionnaires/surveys, contact and master lists will be transcribed into electronic files and placed in a secured locked area. The data will be stored for 3 years on laptop computers with password-protected encryption. The files themselves will also be password protected. All electronic files, lists, data, and questionnaires/surveys will be carried in a locked messenger bag during the course of the study.

What else do I need to know?

This research is being partially funded by Arizona State University's Herberger Institute for Design and the Arts. The researcher is also pursuing a degree in The Design School's Healthcare Healing Environment program.

Who can I talk to?

If you have questions, concerns, or complaints, or think the research has hurt you, talk to the research team at:

Arizona State University

Names: Angela Diane Tate, Lead Investigator and Dr. Diane Bender, Associate Professor

Email: Adtate2@asu.edu and Diane.Bender@asu.edu

Phone: 001-602-680-0082 *or* 001-480-965-4367

This research has been reviewed and approved by the Bioscience IRB ("IRB"). You may talk to them at 001-480-965-6788 or research.integrity@asu.edu if:

Your questions, concerns, or complaints are not being answered by the research team.

- You cannot reach the research team.
- You want to talk to someone besides the research team.
- You have questions about your rights as a research participant.
- You want to get information or provide input about this research.

Signature Block for Capable Adult

Your signature documents your permission to take part in this research.

Signature of participant	Date
Printed name of participant	
Signature of person obtaining consent	Date
Printed name of person obtaining consent	

Title of research study: A Soundscape Healing Environment

Okruženje za ozdravljenje zvučnim pejzažom: Eksplorativna studija o odnosu između frekvencije terapijskog zvuka i biopsihosocijalnih ishoda u okruženju kliničke njege

Istraživač:

Angela Diane Tate, master student pod mentorstvom Dr. Diane Bender u Školi dizajna na Arizona State University.

IRB #: 00006249

Glavni Istraživač: Diane Bender, PhD

Istraživač: Angela Tate, PMP

Datum _____

ZAŠTO SAM POZVAN DA UČESTVUJEM U OVOM ISTRAŽIVANJU?

Mi Vas pozivamoda učestvujete u ovom istraživanju tokom Vaše redovne posjete zdravstvenoj ustanovi.Istraživanje se odnosi na zvukove u Vašoj sredini I o njegovom uticaju na Vaše zdravlje.Pozvani ste da učestvujete u ovom istraživanju o vezi između Vaše biopsihosocijalne dobrobiti I mogućnosti uticaja zvuka različite jačine na Vaš process izliječenja.

Kao pacijent Doma zdravlja Bijeljina ,molimo Vas da učestvujete u ovom istraživanju dok čekate na redovan pregled kod Vašeg ljekara ,tokom same posjete ili odmah nakon završene posjete kod Vašeg ljekara.Kroz flajere sa objašnjenjima ili kontaktom preko zdravstvenih radnika medicinske sestre ili ljekara pozvaćemo I pratiti učesnike koji su zainteresovani da učestvuju u ovom istraživanju. Sve će biti dokumenovano I detaljno će Vam biti date instrukcije I savjeti kao učesniku ovog istraživanja.

ZAŠTO SE RADI OVO ISTRAŽIVANJE?

Svrha ovog istraživanja je da pomogne grupi ljudi koji imaju potrebu za liječenjem,za rehabilitacijom ili drugom vrstom tretmana,kao I za vanbolničke pacijente .Istraživanje je usmjereno na pozitivne zvukove u okruženju koji mogu uticati da se pacijenti lakše osjećaju .Ovo istraživanje je usmjereno ka neinvazivnim terapeutskim frekvencama kao dio procesa izliječenja za kliničko okruženje.Kada se puste zvukovi određene frekvence pacijent može imati koristi kao što su : povećana relaksacija,redukcija bola,ubrzanioporavak,emocionalno olakšanje I fizički odmor. Osnovna biometrijska mjerenja kao I popunjavanje upitnika biće obavljeni prije I nakon slušanja terapeutskog zvuka .Kada sagledamo biometrijske parameter I psihološke odgovore ,tada možemo

analizirati sakupljene podatke da utvrdimo postoji li veza između terapeutskog zvuka I biopsihosocijalnog izliječenja.

KOLIKO DUGO ĆE OVO ISTRAŽIVANJE TRAJATI?

Ovo istraživanje bi prema procjeni trebalo da traje po jednom tretmanu između 60-240minuta po osobi, Vrijeme trajanja zavisi od toga koliko uobičajeno traje Vaša posjeta Vasem ljekaru ,tj,uobičajenom boravku u Vašem zdravstvenom centru.Ukoliko pristanete da učestvujete zamolićemo Vas da ispunite 2 upitnika ,a za to će trebati otprilike 10-15 minuta po upitniku,U nastojanju da osiguramo povjerenje neće biti otkriven Vaš identitet I bićete potpisani ID (identifikacionim brojem) koji neće ni u jednom momentu biti potpisan Vašim imenom .Standardni biometrijski parametric (krvni pritisak,saturacija kiseonikom, broj respiracija, puls) prije I poslije očitavanja biće sakupljeni i dati istraživačkom timu na ocjenu.Da bi smo u potpunosti zaštitili Vaš identitet Vaši podaci biće povezani samo sa Vašim ID brojem, a ne imenom učesnika.

KOLIKO LJUDI ĆE UČESTVOVATI?

U istraživanju će učestvovati 20-40 odraslih osoba, starosti od 18-85 godina, muškarci i žene.

ŠTA ĆE SE DESITI UKOLIKO PRISTANEM NA ISTRAŽIVANJE?

Vaša je odluka da li ćete pristati da učestvujete u ovom istraživanju.Ukoliko pristanete dva su koraka:

1.Ispunićete upitnik o tome kako se osjećate, potom ćemo Vam dat slušalice I muzičku kutiju preko kojega ćete slušati zvuk tokom trajanja tretmana.Nakon što odslušate bićete zamoljeni da ispunite isti upitnik I da se izjasnite kako se osjećate nakon slušanja terapeutskog zvuka.

2.Mi ćemo propratiti Vaše biometrijske parametre koji uključuju mjerenje krvnog pritiska,saturacija kiseonikom, broj respiracija, puls. Kad sakupimo te parametre pregledaćemo ih i ocjeniti da li ima ikakvih promijena u Vašem raspoloženju i/ili u Vašem psihološkom status. Ono što Vas mi molimo jeste da odvojite jedan dio Vašeg vremena tokom uobičajene posjete .Svo vrijeme bićete u kontaktu sa ispitivačima i asitentima koji nadgledaju cijeli process. Ono što je važno napomenuti jeste da u bilo kom trenutku možete prekinuti istraživanje i informacije o Vama neće biti korištene u istraživanju.Takođe napominjemo da se tokom istraživanja ne koriste ijekovi niti bilo kakve druge supstance. Instrumenti koji se koriste su muzička kutija (blu tut zvučnik) slušalice za jednokratnu upotrebu ,pulsni oksimetar,stetoskop,apparat za mjerenje krvnog pritiska. Dužina posjete varira od 60 minuta ,Tokom istraživanja neće biti

uzimani uzorci krvi. Svim učesnicima će biti detaljno opisan postupak. Zdravstveni radnik će vršiti mjerenje biometrijskih parametara.Istraživanje će biti obavljeno u prostorijama Doma zdravlja Bijeljina. Istraživanje se završava isti dan za tog učesnika.Muzika će se slušati samo preko CD playera,muzičke kutije ,slušalica ili zvuka u otvorenom prostoru. Sve se obavlja pri jednoj posjeti neće biti potrebni ponovni dolazak učesnika.

ŠTA ĆE SE DESITI AKO PRISTANEM NA ISTRAŽIVANJE,ALI SE POSLE PREDOMISLIM ?

Možete se predomisliti u bilo koje vrijeme tokom istraživanjai Vaše informacije će biti izbrisane. Ne postoje nikakve kazne niti posledice ukoliko se predomislite. Ovo istraživanje neće poboljšati Vaše zdravstveno stanje. Napominjemo da Vaše ime neće biti povezano sa upitnikom.Pitanja Vam neće izazvati neugodnosti. Ukoliko se pojavi neki osjećaj nelagode možete zaistaviti učešće u bilo kom trenutku.Molimo Vas da razumijete da je Vaše učešće dobrovoljno i možete povući pristanak u bilo kom trenutku.Vaši dalji dolasci u ovaj zdravstveni centar neće biti ugroženi I u slučaj da se odlučite da ne učestvujete.

HOĆE LI MI OVA STUDIJA IKAKO POMOĆI?

Nema direktne koristi od Vašeg učešća. Ipak možda ćete imati povećanu svijest o Vašem zdravlju nakon učešća.

ŠTA SE DEŠAVA SA INFORMACIJAMA PRIKUPJENIM TOKOM ISTRAŽIVANJA?

U ovoj studiji tretiramo vašu privatnost od najveće važnosti. Ova studija je povjerljiva. Vaše ime nije povezano s vašim upitnikom/odgovorima na anketu ili biometrijskim podacima, jer će vam biti dodijeljen identifikacijski broj ispitanika. Evo kako će se podaci prikupljati i upravljati njima: "Glavni popis" potreban je za prikupljanje, usporedbu i usporedbu preuzetih iz podataka studije povezanih sa svakim ID brojem. Podaci koji će biti pohranjeni ne sadrže identifikacijske podatke jer vaše ime neće biti zabilježeno niti povezano sa prikupljenim podacima. Prikupljeni podaci čuvaju se na sigurnom mjestu u kampusu ili na ASU poslužitelju kojem se može pristupiti daljinski. "Glavni popis" morat će se pohraniti odvojeno od pristanka i drugih prikupljenih podataka studije.

Podaci koji će biti pohranjeni ne sadrže identifikacijske podatke jer vaše ime neće biti zabilježeno niti povezano sa prikupljenim podacima. Upitnici/ankete, popisi kontakata i glavne liste bit će prepisani u elektroničke datoteke i smješteni u zaštićeno zaključano područje. Podaci će se čuvati 3 godine na prijenosnim računalima s enkripcijom zaštićenom lozinkom. I same datoteke bit će zaštićene lozinkom. Sve elektroničke

datoteke, popisi, podaci i upitnici/ankete bit će nošeni u zaključanoj torbi za glasnike tijekom studija.

ŠTO JOŠ MORAM ZNATI?

Ovo istraživanje djelomično financira Herberger Institut za dizajn i umjetnost Državnog sveučilišta Arizona. Istraživač također diplomira u programu Zdravstvene iscjeliteljske okoline Skole za dizajn.

S kim mogu razgovarati?

Ako imate pitanja, nedoumice ili pritužbe ili mislite da vas je istraživanje povrijedilo, razgovarajte s istraživačkim timom na:

Državno sveučilište Arizona

Imena: Angela Diane Tate, vodeća istražiteljica i dr. Diane Bender, izvanredna profesorica

E -pošta: Adtate2@asu.edu i Diane.Bender@asu.edu

Telefon: Angela, 001-602-859-2521 i dr. Bender, 001-480-965-4367, 001-480-748-9417

Ovo istraživanje pregledao je i odobrio Bioscience IRB ("IRB"). Možete razgovarati s njima na 100-480-965-6788 ili research.integrity@asu.edu ako:

Istraživački tim ne odgovara na vaša pitanja, nedoumice ili pritužbe.

- Ne možete doći do istraživačkog tima.
- Zelite razgovarati s nekim osim istraživačkog tima.
- Imate pitanja o svojim pravima kao sudionika istraživanja.
- Zelite dobiti informacije ili dati doprinos o ovom istraživanju.

Potpis (Signature Block for Capable Adult)

Vaš potpis dokumentuje da ste dali saglasnost za učešće u ovom istraživanju (Your signature documents your permission to take part in this research).

Potpis učesnika (Signature of participant)

Ime učesnika (Printed name of participant) Datum (Date)

Potpis osobe koja je tražila pristanak
(Signature of person obtaining consent)

Ime osobe koja je tražila pristanak
(Printed name of person obtaining consent) Datum (date)

APPENDIX D

MAIN STUDY INSTRUMENTS

PROFILE OF MOOD STATES EVALUATION FORM

Profile of Mood States: Questionnaire					
Script Instructions:	The assistant explains the test protocol to the subject: Read each word/statement below, decide how you have been feeling, in respect to the word/statement, for today, and select the appropriate statement "Not at All", "A Little", "Moderately", "Quite a Lot" or "Extremely" to indicate your feeling. The subject responds to the 24 words/statements on the questionnaire below - no time limit. The investigator shall determine and records the subject's mood state scores.				
POMS SCHEDULE ITEM	Not at All	A Little	Moderately	Quite a Bit	Extremely
Lively					
Bad-tempered					
Alert					
Annoyed					
Confused					
Exhausted					
Tired					
Energetic					
Nervous					
Worried					
Muddled					
Worn-out					
Panicky					
Angry					
Mixed-up					
Active					
Sleepy					
Bitter					
Uncertain					
Anxious					

Pre-Survey of Sound Perception
Study ID #: _____ Today's Date: _____ Time:
Are you Male or Female (please circle)? M or F What is your age?
1. Please identify what sounds in the clinical setting comfort you. Why are they comforting?
2. Please identify what sounds in the clinical setting bother you. Why are they bothersome?
3. What in the environment would you like changed?

Instructions:	How are you feeling right now? Place an 'X' in the column of the statement that most accurately reflects your present mood in relation to the word in the left column.				
Mood States	Not at All	A Little	Moderately	Quite a Bit	Extremely
Lively					
Bad-tempered					
Alert					
Annoyed					
Confused					
Exhausted					
Tired					
Energetic					
Nervous					
Worried					
Muddled					
Worn-out					
Panicky					
Angry					
Mixed-up					
Active					
Sleepy					
Bitter					
Uncertain					
Anxious					

PRE-VITAL MEASURES	Respiratory Rate	SaO2	Heart Rate	Systolic B.P.	Diastolic B.P.
HERTZ:	LOW: 396, 417 or 444	MEDIUM:	528 or 639	HIGH:	791 or 852

Post-Survey of Sound Perception		
Study ID #:	Today's Date:	Time:

POST-VITAL MEASURES	Respiratory Rate	SaO2	Heart Rate	Systolic B.P.	Diastolic B.P.

Instructions:	How are you feeling right now? Place an 'X' in the column of the statement that most accurately reflects your present mood in relation to the word in the left column.				
Mood States	Not at All	A Little	Moderately	Quite a Bit	Extremely
Lively					
Bad-tempered					
Alert					
Annoyed					
Confused					
Exhausted					
Tired					
Energetic					
Nervous					
Worried					
Muddled					
Worn-out					
Panicky					
Angry					
Mixed-up					
Active					
Sleepy					
Bitter					
Uncertain					
Anxious					

PRE & POST SELF DIRECTED REFLECTION QUESTIONNAIRES
VITAL BIOMETRIC MEASURES

Post-survey of Sound Perception		
Study ID #: _____	Today's Date: _____	Time: _____

Instructions: Please circle the number next to the statement that best represents your level of agreement with each statement.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I prefer to listen to no additional sounds during my treatment session.	1	2	3	4	5
2. I would consider using headphones to listen to sounds during my treatment session.	1	2	3	4	5
3. I prefer sounds be distributed through a speaker within the treatment area during my treatment session.	1	2	3	4	5
4. I prefer sounds be distributed through a speaker built into furniture, seat or bed pad, and a pillow during my session.	1	2	3	4	5
5. I believe each user should have a choice and selection of sounds available to choose from during your session.	1	2	3	4	5

Additional Comments Related to Sound:

_____

_____

_____

_____

_____

_____

Thank you for your participation in this study!

Percepcija zvuka prije istraživanja (Pre-Survey Questionnaire of Sound Perception)		
No Studije #: Study ID#	Datum: Today 's date	Vrijeme: Time
Jeste li muškog ili ženskog pola (Molim zaokružiti)? Are you Male or Female (please circle)?	M ili Ž M or F	
Navedite Vaše godine? What is your age?		
1. Molim Vas navedite koji Vam zvukovi u kliničkom okruženju odgovaraju. Zašto Vam odgovaraju? (Please identify what sounds in the clinical setting comfort you. Why are they comforting?		
2. Molim Vas navedite koji Vam zvukovi u kliničkom okruženju odgovaraju smetaju. Zašto Vam smetaju? (Please identify what sounds in the clinical setting bother you. Why are they bothersome?		
3. Šta bi ste voljeli promijeniti u okruženju? What in the environment would you like to change?		

Instrukcije: Instructions:	Kako se trenutno osjećate? Stavite „X„ u kolonu izjave koja najtačnije opisuje Vaše trenutno raspoloženje, a koja je u vezi sa riječi u lijevoj strani kolone ? How are you feeling right now? Place an 'X' in the column of the statement that most accurately reflects your present mood in relation to the word in the left column.				
Stanja raspoloženja Mood States	Uopšte ne Not at all	Malo A Little	Osrednje Moderately	Poprilično Quite a Bit	Extremno Extremely
Živahno (Lively)					
Loše naravi (Bad-tempered)					
Alarmirano (Alert)					

Iznervirano (Annoyed)					
Zbunjeno (Confused)					
Iscrpljeno (Exhausted)					
Umorno (Tired)					
Energično (Energetic)					
Nervozno (Nervous)					
Zabrinuto (Worried)					
Zbunjeno (Muddled)					
Istrošeno (Worn-out)					
Panično (Panicky)					
Ljuto (Angry)					
Neodređeno (Mixed-up)					
Aktivno (Active)					
Pospano (Sleepy)					
Ogorčeno (Bitter)					
Nedefinisano (Uncertain)					
Anksiozno (Anxious)					
Smiren (calm)					
Radosno (joyful)					
Olakšanje (relief)					
Pun nade (hopeful)					
Miran (peaceful)					

Vitalni znakovi prije PRE-VITAL MEASURES	Respiratorna frekvencija Respiratory Rate	SaO2	Srčana frekvencija Heart Rate	Sistolni pritisak Systolic B.P.	Dijastolni pritisak Diastolic B.P.
HERTZ LEVELS	LOW: 396 417 444	MEDIUM: 528 639		HIGH: 791 852	

Percepcija zvuka poslije istraživanja

(Post-Survey Questionnaire of Sound Perception)

Vitalni znakovi poslije POST-VITAL MEASURES	Respiratorna frekvencija Respiratory Rate	SaO2	Srčana frekvencija Heart Rate	Sistolni pritisak Systolic B.P.	Dijastolni pritisak Diastolic B.P.

Instrukcije: instructions:	Kako se trenutno osjećate? Stavite „X„ u kolonu izjave koja najtačnije opisuje Vaše trenutno raspoloženje, a koja je u vezi sa riječi u lijevoj strani kolone ? How are you feeling right now? Place an 'X' in the column of the statement that most accurately reflects your present mood in relation to the word in the left column.				
Stanja raspoloženja Mood States	Uopšte ne Not at all	Malo A Little	Osrednje Moderately	Poprilično Quite a Bit	Extremno Extremely
Živahno (Lively)					
Loše naravi (Bad-tempered)					
Alarmirano (Alert)					
Iznervirano (Annoyed)					

Zbunjeno (Confused)					
Iscrpljeno (Exhausted)					
Umorno (Tired)					
Energično (Energetic)					
Nervozno (Nervous)					
Zabrinuto (Worried)					
Zbunjeno (Muddled)					
Istrošeno (Worn-out)					
Panično (Panicky)					
Ljuto (Angry)					
Neodređeno (Mixed-up)					
Aktivno (Active)					
Pospano (Sleepy)					
Ogorčeno (Bitter)					
Nedefinisano (Uncertain)					
Smiren (calm)					
Radosno (joyful)					
Olakšanje (relief)					
Pun nade (hopeful)					
Miran (peaceful)					

Percepcija zvuka poslije istraživanja (Post -Survey Questionnaire of Sound Perception)		
No Studije #: _____ Study ID#	Datum: _____ Today's date	Vrijeme: _____ Time

Instrukcije (Instrukcije): **Molim Vas da zaokružite broj pored izjave koja najbolje opisuje Vaš nivo slaganja sa svakom rečenicom.** Please circle the number next to the statement that best represents your level of agreement with each statement.	Nikako se ne slažem.	Ne slažem se	Neutralan	Slažem se	Jako se slažem
Ja bih radije da ne slušam dodatne zvukove tokom mog tretmana. I prefer to listen to no additional sounds during my treatment session.	1	2	3	4	5
Uzeo bih u obzir da slušam zvukove preko slušalica tokom tretmana. I would consider using headphones to listen to sounds during my treatment session.	1	2	3	4	5
Radije bih da se zvuk pušta preko zvučnika u prostoru tokom mog tretmana. I prefer sounds be distributed through a speaker within the treatment area during my treatment session.	1	2	3	4	5
Radije bih da se zvuk pušta kroz zvučnika koji je ugrađen u dio namještaja, npr. sjedište, krevet, jastuk tokom tretmana. I prefer sounds be distributed through a speaker built into furniture, ease or bed pad, and a pillow during my session	1	2	3	4	5
Smatram da bi svaki učesnik trebao da ima mogućnost izbora zvuka dostupnog tokom vašeg rada. I believe each user should have a choice and selection of sounds available to choose from during your session.	1	2	3	4	5

Dodatni komentari vezani za zvuk (Additional Comments Related to Sound):

SELF DIRECTED REFLECTION QUESTIONNAIRE

Hvala Vam za učešće u ovoj studiji!

(Thank you for your participation in this study!)

WholeTones: Portable Boxes	CDs 7 Hertz Sounds
Disposable Ear Plugs (bulk)	Sound Level Meter Log
Biometric: Heart Pulse Reader	Fingertip Pulse Oximeter

· POTENTIAL CLINICAL SETTING & STUDY TOOLS

MASTER STUDY PARTICIPANT LIST

DATE	ID TRACKING #	NAME	SOUND CHOICE/LIVE	LISTENING TIME PERIOD	M/F	AGE	PRE/POST BIOMETRICS COMPLETED	QUESTIONNAIRE SURVEY(S) COMPLETED	ROOM TYPE
	001								
	002								
	003								
	004								
	005								
	006								
	007								
	008								
	009								
	010								
	011								
	012								
	013								
	014								
	015								
	016								
	017								
	018								
	019								
	020								
	021								
	022								
	023								
	024								
	025								
	026								
	027								
	028								
	029								
	030								

APPENDIX H

MASTER STUDY PARTICIPANT LIST

LISTA UCESNIKA U MASTER STUDIJU

Datum	Identifi-cacijski broj#	IME | PREZIME	IZBOR ZVLJKAUZIMO	VRIJEME SLUSANJA	M/Z	DOB	ZAVRSENO BIOMETRUSKI ISPITIVANJE PRUE I POSLIJE	ISPUNJENE PRE| POSLIUE ANKETE	TIP SOBE
	001								
	002								
	003								
	004								
	005								
	006								
	007								
	008								
	009								
	010								
	011								
	012								
	013								
	014								
	015								
	016								
	017								
	018								
	019								
	020								
	021								
	022								
	023								
	024								
	025								
	026								
	027								
	028								
	029								

APPENDIX J – Recruitment Flyer

Patient Education | Trifold Flyer Outside

3 – Outside Flap

2 - Outside Center Back Section

1 – Outside Front Cover Flap

APPENDIX J - Recruitment Flyer

Patient Education | Trifold Flyer Inside

A - Left Inside Flap

B - Inside Center Section

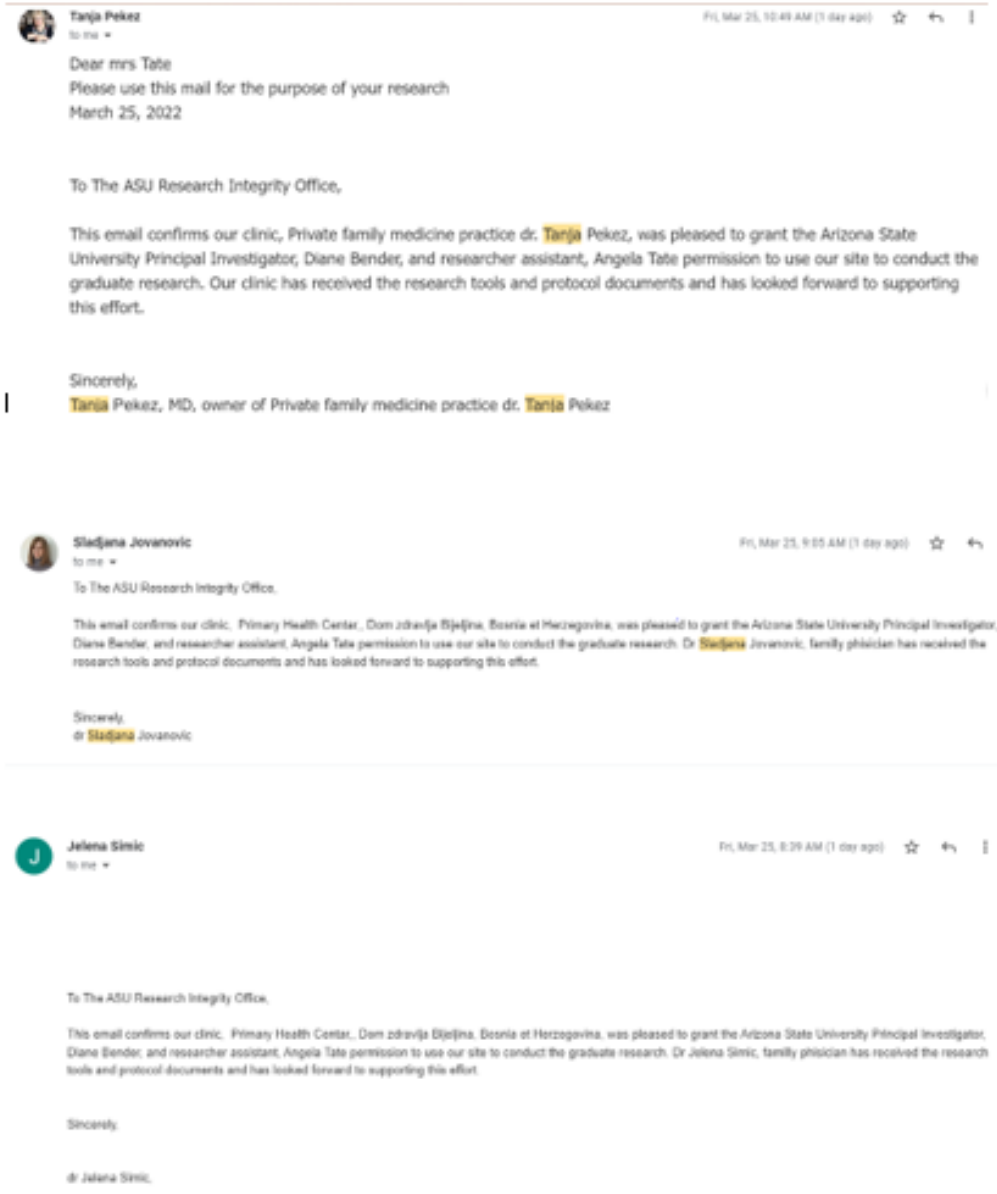
C - Right Inside Flap


Da li i vi volite melodičnu muziku?
Listen to the Music!
Pridružite nam se u istraživanju! Volontirajte ako ste stariji od 17 godina
ASU
Utvrdimo akustične parametre u vašoj kliničkoj praksi
Razgovor
Uredjaji
Klima uredjaji
Računari
Alarmi
Kartoni
Da li je vaše okruženje u klinici prepuno Neželjenih i Harmonijskih Zvukova?
Saznajmo to zajedno!
Šta vi trebate uraditi?
Prije, tokom, i poslije vašeg pregleda.
Mogu li terapijske zvučne frekvencije biti od koristi iskustvu pacijenata u kliničkim prostorijama?
Potrebni volonteri za istraživanje
PIJAVA
Pridružite nam se!
Javite se na recepciji kako biste saznali više o istraživanju.
Kontaktirajte Angie Tate na email adtate2@asu.edu
ili putem sms-a: 001-602-859-2521
Volonteri trebaju:
1. Ispuniti 5 minutni upitnik prije i poslije pregleda
2. Prije i nakon slušanja zvukova obavite biometrijska očitanja
3. Trajanje se temelji na trajanju vaše sesije u rasponu od minimalnih 20 pa do 150 minuta

APPENDIX E

STUDY SITE PERMISSIONS

SITE LOCATION PERMISSION(S) FROM CLINICIANS



Tanja Pekez Fri, Mar 25, 10:49 AM (1 day ago)
to me

Dear mrs Tate
Please use this mail for the purpose of your research
March 25, 2022

To The ASU Research Integrity Office,

This email confirms our clinic, Private family medicine practice dr. Tanja Pekez, was pleased to grant the Arizona State University Principal Investigator, Diane Bender, and researcher assistant, Angela Tate permission to use our site to conduct the graduate research. Our clinic has received the research tools and protocol documents and has looked forward to supporting this effort.

Sincerely,
Tanja Pekez, MD, owner of Private family medicine practice dr. Tanja Pekez

Sladjana Jovanovic Fri, Mar 25, 9:05 AM (1 day ago)
to me

To The ASU Research Integrity Office,

This email confirms our clinic, Primary Health Center, Dom zdravlja Bijeljina, Bosnia et Herzegovina, was pleased to grant the Arizona State University Principal Investigator, Diane Bender, and researcher assistant, Angela Tate permission to use our site to conduct the graduate research. Dr Sladjana Jovanovic, family phisician has received the research tools and protocol documents and has looked forward to supporting this effort.

Sincerely,
dr Sladjana Jovanovic

Jelena Simic Fri, Mar 25, 8:39 AM (1 day ago)
to me

To The ASU Research Integrity Office,

This email confirms our clinic, Primary Health Center, Dom zdravlja Bijeljina, Bosnia et Herzegovina, was pleased to grant the Arizona State University Principal Investigator, Diane Bender, and researcher assistant, Angela Tate permission to use our site to conduct the graduate research. Dr Jelena Simic, family phisician has received the research tools and protocol documents and has looked forward to supporting this effort.

Sincerely,

dr Jelena Simic,

APPENDIX F

TRANSLATION CERTIFICATION FORMS

ASU Knowledge Enterprise Development
Arizona State University

Operations
Office of Research Integrity and Assurance

For Office Use Only:
Date Received:

Translation Certification Form
Institutional Review Board (IRB)

PROTOCOL TITLE: A Soundscape Healing Environment: An Exploratory Study of the Relationship between Therapeutic Sound Frequency and Biopsychosocial Outcomes in a Clinical Care Setting
HS NUMBER:
PRINCIPAL INVESTIGATOR: Diane Bender, Ph.D.
LANGUAGE OF TRANSLATED DOCUMENTS: English to Croatia, Croatia back to English

TYPE OF SUBMISSION	
	The initial submission of the following forms (Please list the forms). **APPENDIX E SELF DIRECTED REFLECTION QUESTIONNAIRE** Appendix "E" Self-Directed Reflection Questionnaire, Pre-Survey of Sound Perception
	The modification of the following forms that have been approved. (Please list forms) Pre-Survey of Sound Perception Section
	Other (Please describe and list forms)

CERTIFICATION OF TRANSLATION

I certify that I have performed the translation of the following documents: (list here…) for the referenced project.

Printed Name of Translator: Dr. Tanja Pekez

Signature of Translator: Tanja Pekez Date: 09/29/2021

CERTIFICATION OF BACK-TRANSLATION

I certify that I have performed the back-translation of the following documents: (Pre-Survey of Sound Perception Section) for the referenced project. Please note that it is preferable if the back-translation is done by someone who is not part of the research team.

Printed Name of Back-Translator: Bill and/or Dusanka Parks

Signature of Back-Translator: Bill Parks Date: 3/11/2022

IRB NOTE: The translation and back-translation should be done by two different people.

300 East University Drive, Suite 310 ■ PO Box 877205 ■ Tempe, AZ 85287-7205

For Office Use Only:
Date Received:

Translation Certification Form
Institutional Review Board (IRB)

PROTOCOL TITLE: A Soundscape Healing Environment: An Exploratory Study of the Relationship between Therapeutic Sound Frequency and Biopsychosocial Outcomes in a Clinical Care Setting
HS NUMBER:
PRINCIPAL INVESTIGATOR: Diane Bender, Ph.D.
LANGUAGE OF TRANSLATED DOCUMENTS: English to Croatia, Croatia back to English

TYPE OF SUBMISSION	
☐	The initial submission of the following forms (Please list the forms).
☐	The modification of the following forms that have been approved. (Please list forms) Appendices for C, D-1, E, H, Combined, and Pre/Post Vital Sign documents
☐	Other (Please describe and list forms)

CERTIFICATION OF TRANSLATION

I certify that I have performed the translation of the following documents: (list here...) for the referenced project.

Printed Name of Translator: Dr. Tanja Pekez

Signature of Translator: Tanja Pekez Date: 09/29/2021

CERTIFICATION OF BACK-TRANSLATION

I certify that I have performed the back-translation of the following documents: Appendices for C, D-1, E, H, Combined, and Pre/Post Vital Sign documents for the referenced project. Please note that it is preferable if the back-translation is done by someone who is not part of the research team.
The translation generally follows the original documents rather well.

Printed Name of Back-Translator: Branislav Banjac

Signature of Back-Translator: Branislav Banjac Date: 04/08/2022

IRB NOTE: The translation and back-translation should be done by two different people.

BIOGRAPHICAL SKETCH

Angela Diane Tate was born and raised in Ann Arbor, Michigan August 5, 1959. She attended the University of Michigan elementary school, secondary education from Greenhill's High School college prep. Attended Oberlin College and transferred to Syracuse University graduating in 1984 from Crouse College of Design from a CIDR Interior Design accredited program. Led her into an exciting career having worked at Herman Miller Incorporated, CB Richard Ellis, Staples Corporate Office, Herman Dealerships, AZ ARNG Construction Facility Management Office, and Training professionals in the best practice of the PMI project management professional methodologies. Prior to her graduate studies, Angela has taken great delight to work as adjunct instructor at Henry Ford Community College, Baker College, and Collins College. In 2014, she began her graduate studies for two degrees while working halfway into this journey full-time to obtained two master's degrees in health Innovation the spring 2021 then completed the companion concurrent degree from Herberger Art Institute of Design in Master of Science in Design in the of spring 2022. Her academic research explores the study of how therapeutic sound frequencies impact on biopsychosocial healing. Sound frequencies have a potential to impact healing beyond the healthcare clinical soundscape environment. There are good therapeutic sounds and operational unwanted sounds in the space we work, live, and heal in. This knowledge will be useful for the AE and medical communities built from other evidenced-based design guidelines. Expansive opportunities for other markets, like education, mental health/addiction, military crisis and trauma recovery, transfusion/dialysis centers to name a few areas where sound can have a direct application for the future for many by creating a soundscape healing environment for all to heal, live, work, and thrive in.