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Music Intervention and its Effect on State Anxiety: An Integrative Literature Review

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MUSIC INTERVENTION AND ITS EFFECT ON STATE ANXIETY: AN INTEGRATIVE LITERATURE REVIEW

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ABSTRACT

Approximately 5 million patients are admitted to Intensive Care Units (ICU) in the United States for acute or life-threatening medical problems or injuries annually. The ICU patient experience has been described in the literature as dehumanizing, stressful, and anxiety provoking. Given the adverse physiological and psychological effects of sustained state anxiety, it is important anxiety is effectively managed in the ICU environment. Standard care for management of anxiety often relies heavily upon sedative medications and are correlated with poor outcomes when used in high doses and over a long duration. The SCCM recommends nonpharmacologic adjunctive measures to decrease the occurrence of post intensive care unit syndrome (PICS).

The purpose of this integrative literature review was to identify evidence whether the use of an adjuvant therapy, music intervention, can reduce state anxiety for ICU patients. A review of the literature spanning the years 2011-2021 was performed based on the concept of music intervention implemented in the critically ill adult population and its effect on state anxiety. Several systematic reviews and many randomized control trials were identified for this inquiry; Evidence found was not homogenous in intervention and application and various factors were identified by researchers. Despite this, state anxiety, as measured by various scoring tools across the literature, was reduced after music interventions regardless of the implementation process. Irrespective of study design, no adverse effects were noted with music intervention.

Recommendations are made for nursing staff to be included in the planning and implementation of music interventions or protocols. is unclear if this is an intervention that could be implemented in a standardized way, or if this is an intervention needing an individualized approach. Further research should be considered to address volume of music, method of delivery,

effect of single versus double patient rooms, duration, timing of the intervention, and overall patient acuity as it impacts music intervention and state anxiety.

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INTRODUCTION

Introduction to the Inquiry

Over 5 million critically ill patients are admitted to Intensive Care Units (ICU) in the United States annually (Society of Critical Care Medicine [SCCM], 2021). ICU's provide care during a period of life-threatening organ system insufficiency. These units are incredibly complex with many moving parts, each working synergistically at all times of day to sustain the life of the critically ill patient. To accomplish this grandiose task, specialized medical and nursing care, enhanced patient monitoring, and a full spectrum of sophisticated life supportive technology and equipment are required (Marshall et al., 2017). The equipment used to monitor patient status and support bodily functions often includes intravenous lines, feeding tubes in nose or abdomen, drains to remove fluid from the body, catheters inserted into the bladder to drain urine, monitoring equipment to assess heart rate, blood pressure and oxygen levels, and often a ventilator to support oxygenation or airway protection (SCCM, 2021). As a result, patients admitted in the ICU are subject to bright lighting, loud alarms and beeping, lack of routine, and absence of personal privacy (Huang et al. 2021).

Nearly 800,000 of the five million admitted to the ICU annually will require mechanical ventilation (Wunsch, et al., 2010). This invasive, life sustaining intervention aids in oxygenation and ventilation of patients experiencing hypoxemic, hypercapnic respiratory failure, or overall airway compromise (Walter, et al., 2018). Chlan and Savik (2011) found patients receiving ventilatory support reported moderate levels of anxiety despite sedative and analgesic medications. Difficulty communicating and being understood, while in an unfamiliar environment contributes to psycho-affective side effects, specifically, state anxiety, while

intubated. State anxiety, in contrast to trait or chronic anxiety is a transient normal defensive response to perceived threats, the sympathetic nervous system is triggered causing an increase in heart rate, blood pressure, and respiratory rate. State anxiety can produce experience feelings of dread, apprehension, and nervousness (Huang et al, 2021).

Standard care interventions to decrease state anxiety, including sedation or physical restraints, are not risk free (Tate, et al., 2012). Chlan and Savik (2011) note that mechanically ventilated patients who receive excessive sedation to combat state anxiety are predisposed to polyneuropathy, long term psychiatric outcomes, lung injury, malnutrition, ventilator acquired pneumonia, muscle atrophy, hypotension, pressure ulcers to soft tissue, and venous stasis. Moreover, high levels of sedation, even briefly, is correlated with higher rates of delirium, prolonged mechanical ventilation, ICU length of stay, and death (Gradwohl-Matis et al., 2015).

Mofredj et al. (2015) estimates state anxiety is provoked by the ICU environment in 70-80% of patients; he emphasizes this number is consistent in the mechanically ventilated patient population. Unmanaged state anxiety stimulates the sympathetic nervous system and subsequently results in increased work of breathing, arterial and venous constriction, bronchoconstriction and increased airway resistance, and myocardial stimulation; each of these elements lead to increased oxygen demand, increased muscle tension and ultimately generalized fatigue. Furthermore, psychological stressors, like state anxiety, activate the hypothalamic-pituitary- adrenal- axis resulting in myopathy, hypertension, and immunosuppression; each increasing recovery time and overall patient mortality (Mofredj et al., 2015).

State anxiety shares biological neurohormonal mechanisms with pain and sleep. If state anxiety is left untreated from constant triggering of the sympathetic response, increased pain and impaired sleep may be the result, creating a synergistic cycle detrimental to patient healing

(Huang et al., 2021). State anxiety, pain, and sleep are correlated with the use of sedative medications and additionally the occurrence of post ICU syndrome (PICS) in the adult ICU patient population. PICS describes the cognitive, psychological, and physical consequences that 75% of all patients who survive life threatening illness suffer (Colbenson et al., 2019). ICU care guidelines by the SCCM suggest how decreasing pain and agitation and improving sleep quality can decrease the occurrence of PICS by threefold (Society of Critical Care Medicine, 2013). Given the detrimental psychological and psychological effects of state anxiety it is important clinicians have the tools to manage it. Gradwohl-Matis et al. (2015) suggests complimentary, combined non-pharmacologic strategies to minimize sedation is essential to decreasing occurrence of PICS, improve overall patient outcomes, and decrease length of stay in the ICU.

Background and Rationale

The critically ill are especially sensitive to minor changes in equilibrium resulting in state anxiety (Chlan & Savik, 2011). The mechanically ventilated ICU patient will experience sensations of breathlessness, inability to talk/communicate, uncertainty, discomfort, and isolation; all of which can lead to elevated levels of fear and overall state anxiety (Tate, et al., 2012). State anxiety is a normal defensive response to perceived threats to life or homeostasis, further it can be explained as a specific form of anxiety which is experienced at a particular moment which involves feelings of dread or lack of control. While state anxiety is an important part of the sympathetic response in keeping us safe, the constant stress response to state anxiety can be detrimental to even the healthiest of patient populations if it is not resolved (Tate et a., 2012).

Huang et al. (2021) describes the ICU patient experience as dehumanizing, stressful, and anxiety inducing. Given the physiological and psychological effects of sustained state anxiety, it

is imperative anxiety is effectively managed in the ICU environment. Standard care in the ICU setting for easing state anxiety and promoting comfort and safety involves administration of sedative and analgesic medications. These medications delivered for prolonged periods are correlated with adverse effects such as immobility, weakness, PICS, delirium, and gut dysmotility. Continuous use of these medications is strongly corelated with increased rates of organ failure and increased length of ICU stay (Society of Critical Care, 2013).

Recent research suggests that prolonged deep sedation is related to longer days on mechanical ventilation, longer ICU stays, increased overall hospital length of stay, and higher mortality in critically ill patients (Shah et al., 2017). Given this, the SCCM Guidelines for the management of pain, agitation, and delirium in the ICU strongly support non-pharmacologic interventions to improve ICU related stress and anxiety because they are considered sedative/opioid sparing, easy to provide, safe, and relatively low cost (Society of Critical Care Medicine, 2013). Colenson et al. (2019) submits a focus on encouraging a more soothing environment to reduce state anxiety in the ICU patient population. Research suggests that the best environment for one to recover from illness or injury is one in which sleep, relaxation, and rest is promoted (Huang et al. 2021). Paradoxically the environment in which the ICU must exist inhibits sleep, relaxation, and rest resulting in an emotionally and physiologically taxing environment for patients, further supporting the need for effective adjunct therapies for the ICU adult patient (Topcu et al., 2017).

Non-pharmacological interventions, such as music therapy, have been suggested by Chlan and Savik (2011) as effective in decreasing anxiety in the mechanically ventilated patient while also reducing sedative administration. Music, a complex blend of planned sound, stimulates the unconscious autonomic response controlling heart rate, respiratory rate, electrical

conduction, blood pressure, and endocrine functions (Villarreal, 2012). Music is unanimously treasured for its therapeutic characteristics for both psychological and physiological responses in humans (Villarreal, 2012). Physiologically music has been documented to release endorphins that generate a response much like morphine in the body (Kwan et al., 2013). If music's effect on anxiety levels in healthy individuals is considered, it would be worthwhile to consider music as a viable intervention for the acutely ill (Hutchinson & Sherman, 2014).

Särkämö (2013) found when confused or agitated patients were exposed to familiar music the potentially confusing stimuli, such as noise pollution from the environment, was overrode by the musical stimuli. It is possible that implementing individualized or therapeutic music prior to or during periods of agitation one could expect a decrease in distress, improved relaxation, and even an overall reduction in agitation (Särkämö, 2013). Music seems to provide caregivers the opportunity to create a sense of acquaintance for the patient in a sterile and otherwise unfamiliar environment (Särkämö, 2013). Research by Hutchinson and Sherman (2014) suggests that listening to relaxing music may reduce cortisol, leading to lower levels of anxiety and improved overall wellbeing and relaxation.

Lai and Li (2011) explain music can be used as a stimulus for movement, further discussing that one's preferred music can augment the state of motivation and stimulation through the sympathetic branch of the autonomic nervous system. Hutchinson and Sherman (2014) discuss the aptitude of loud volume music to distract individuals from uncomfortable stimulus, such as fatigue, soreness, or shortness of breath. Music interventions in the ICU population have the potential to abate the known stress response, which is related to state anxiety, moreover it has the potential to induce overall relaxation by positively impacting the emotional feelings of the listener. This relaxation response related to music interventions has the

potential to lower myocardial workload, decrease oxygen consumption and improve overall outcome. Historically in research of healthy populations, music has been shown to reduce the stimuli that causes stress by synchronizing body rhythms such as breathing and heart rate. Incorporating music into the care of the critically ill patient has the potential to lighten the symptom burden, while also decreasing risk factors for the occurrence of PICS, while overall improving patient satisfaction and experience.

Purpose of the Inquiry

As a result of critical illness, unfamiliar surroundings, and the chaotic ICU environment, the ICU patient often experiences pain, sleep disturbances, delirium, and state anxiety. Music intervention has been utilized to reduce anxiety and distress in healthy persons outside of the ICU, however the efficacy for mechanically ventilated patients should be evaluated (Villarreal, 2012). Antidotally this author has utilized music listening in the critically ill and the positive outcomes experienced inspired further inquiry of this topic.It is conceivable that music therapy implemented in the setting of a critically ill patient has the potential to serve as an alternative to chemical restraint to reduce agitation and anxiety levels. Anxiety challenges patient stability, comfort, and inhibits therapeutic care goals (Tate, et al., 2012). Consequences of anxiety for the critically ill ICU patient includes medical device disturbance, increased oxygen consumption, difficulty weaning from mechanical ventilation, and PICS (Tate, et al., 2012).

While deep sedation for the mechanically ventilated is appropriate for some independent patient variables, it is reasonable to try to achieve patient comfort during mechanical ventilation without relying solely on sedative medications (Gradwohl-Matis et al., 2015). The purpose of this paper is to identify the implications of music therapy on levels of anxiety vs standard care for adult patients cared for in the intensive care unit.

Clinical Question

Is there evidence for using music-based intervention to decrease state anxiety when compared to standard care in adult ICU patients?

Method Used for Inquiry

An integrative literature review was completed for this scholarly paper. This method of inquiry allowed for a comprehensive appraisal of the evidence for the reduction of state anxiety in the ICU patient when comparing the use of music intervention versus standard care. An integrative literature review lends a more complete understanding of the clinical problem and provides a further comprehension of interventions supported by the literature to resolve to provide recommendations to the clinical problem discussed above.

LITERATURE REVIEW

An inclusive computerized search of the literature was conducted using the Ebscohost EJS, Nursing & Allied Health Database, PubMed Central, Ovid Fulll Text, CINHAL Complete, ScienceDirect Journals, SAGE Journals, and Academic Search Premier. The search terms in these data bases included: Any field, music intervention AND adult ICU AND state anxiety within the years of 2011-2021. This resulted in 431 results and was further narrowed by peer reviewed/ scholarly journals, which resulted in 318 results. The subject was further narrowed with keywords intensive care, critical care, adult, and anxieties, narrowing search results to 168.

Studies that reviewed pediatric patients and studies not written in English or translated to English were not incorporated in the literature review. Cross-referencing was done to identify any additional articles. Data collection focused on years 2011 to 2021. This literature review was not restricted by design or level of evidence. Each qualitative and quantitative study abstract

which tested the use of music interventions regardless of type in the adult population in the intensive care unit was examined.

The original clinical question for this paper did not include LTACH patients, however upon literature inquiry ICU was not well defined and the literature often combined LTACH and ICU patient populations. This may be related to an increasing acuity in the LTACH population (Bradt & Dileo, 2014). Therefore, for completeness the clinical inquiry question was updated to: Is there evidence for using music-based intervention to decrease state anxiety when compared to standard care in adult ICU and LTACH (long term acute care hospital) patients?

Articles were further narrowed by removing duplicate articles and studies which included pediatric patients. The literature search was not exclusive to electronic articles, however each article identified happened to be available digitally. Eighty-seven potentially relevant articles, identified by review of article title and abstract, were screened for keywords: music intervention, ICU patient, anxiety, and critical care. After editorials and opinion articles were omitted, 34 abstracts were considered for inclusion by level of evidence, and relevance to the inquired concept, population, and procedure of focus. Although many articles were produced in this search 21 were selected for inquiry. On review of the selected articles an additional seven references and studies were selected from within the articles for their relevance to the inquiry for a total of 28 articles reviewed on this topic. Literature was ultimately narrowed by identifying evidence level and quality of research, using the *Johns Hopkins nursing evidence-based practice: Model & guidelines* (Dang & Dearholt, 2018), which can be seen in Appendix D. Evidence levels I, II, and III which integrated both quantitative and qualitative studies narrowed the reviewed literature to 12. These final 12 were selected with the intention to provide a

complete review of music intervention. Appendix A displays specifics of the literature search completed for this review.

The literature around music intervention in the ICU population was extensive related to the various article descriptions for music intervention (music listening, music therapy, music intervention, patient directed intervention). The literature review was narrowed to identify articles of significance for the ICU patient population, music intervention, and state anxiety. Most articles with all desired subjects: music, ICU, and anxiety, included mechanical ventilation as a main variable or topic of research. An attempt was made to include a generalized ICU population in this literature review for a broader implication across the ICU population.

Levels of Evidence

The Johns Hopkins Nursing Evidence level guide was used to determine of levels of evidence for this literature review. Glasofer et al. (2019) explain that for a clinician to arrive at an evidence-based conclusion, they must identify levels of evidence available and further understand what they mean in regard to their clinical inquiry. Evidence levels in the Johns Hopkins Nursing Evidence level guide range from level I to level V. These evidence levels are arranged by research design, level I represents the strongest evidence (Glasofer et al., 2019). No studies were reviewed at level IV or level V in this literature review. Levels of evidence included in this review can be found in Appendix C.

Study Designs

Study designs across the identified literature included one systematic review of RCTs with meta-analysis (level I evidence), two systematic reviews of RCTs and quasi-experimental without meta-analysis (level II), one systematic review without meta-analysis of RCT quasi-

experimental and non-randomized control trials, (level III), five randomized control trials (level I), and four quasi-experimental (level II).

Systematic Reviews

Brandt and Dileo (2014), Chen et al. (2021), Umbrelo et al. (2019), and Gonzzalo et al. (2019) were included as systematic reviews for appraisal, with levels of evidence ranging from I-III. These systematic reviews were further evaluated for quality using the Duffy Tool for Critical Appraisal of Systematic Reviews (Duffy, 2005). See Appendix B for detailed appraisals.

Literature Review Table Organization

The literature review table, which organizes purpose, sample and setting, design and framework, variables or instruments, study results, and implications is found in Appendix A. The literature review is organized by study design and further organized by level of evidence within the study designs with alphabetical organization where possible. Huang et al. (2021) a quasi-experimental study - was included at the end of the literature review for analysis of music selection. Appendix D1 is a quick organization look at the types of studies, levels of evidence and variables found throughout the literature review table.

Outline of Literature Reviewed

The purpose of this review is to perform an integrative literature review. Four several systematic reviews, five randomized control trials, and four quasi-experimental trials to identify if there is evidence for music intervention in the adult ICU patient population.

Patient Population and Setting

This literature review includes studies of adult patients, over the age of 18 years old. All data included in this literature review were collected an intensive care or long-term acute care rehab unit, except for two studies included for context. One review of music intervention types

(Huang et al., 2021) was performed with an outpatient population and documented as healthy participants. No restrictions were placed on gender, native language, or ethnicity for data collection. Patients undergoing mechanical ventilation were included in the literature search, and overall, this population dominates the data collated here. A variety of medical diagnoses were included across the literature, primarily patients were diagnosed with pulmonary related problems; other diagnoses included post-surgical, cardiac disease, and sepsis. Patients reviewed were documented to be receiving sedative medications or analgesia prior or during the music intervention.

Interventions

Collectively across the literature, interventions for this inquiry were related to music interventions. Music interventions varied across the literature including music listening, music therapy, music intervention, and patient directed music intervention. Music intervention was most frequently documented as delivered by headphones (Beaulieau et al., 2013; Chlan, Weinert, et al., 2013; Dijkstra et al, 2010; Liang et al., 2016; Korhan et al., 2011). Music type varied across the literature and included classical (Beaulieau et al., 2013), songs with 60-80 beat temp per minute (Liang el al. 2016), slow (Lee et al., 2017), various including major and minor key music with varied tempo and unspecified (Brandt & Dielo, 2014; Chen et al., 2021; Gonzalo et al., 2019; Huang et al., 2021; Umbrelo et al., 2019). The selection of music type varied across the literature including patient directed music therapy, assistance of a music therapist, and preselected predetermined music. Duration of the music intervention ranged from thirty minutes (Chlan, Weinert, et al., 2013; Golino et al., 2019), to 1.5 hours (Korhan et al., 2011) single or multiple sessions of music a day. The most common duration of music intervention was twenty to thirty minutes once daily.

Control Variable

Standard care was identified as the control variable across the randomized control and quasi-experimental trials included for this inquiry. Standard care in the ICU was not defined within the context of the trials reviewed. Standard care for the purpose of this inquiry is considered use of sedative medications to reduce state anxiety in the critically ill. Standard care variables as a control when compared to music intervention were further categorized into standard care alone, standard care with aromatherapy, or standard therapies with placebo or quiet time.

Music Selection

DellaVolpe and Haung (2015) and Liang et al. (2016) utilized patient directed/ implemented music therapy vs music therapist chosen music and tempo. Patients were allowed to select music that was offered, based on the assumption that music preference would play a significant role in the effectiveness of relaxation (DellaVolpe & Haung, 2015; Liang et al., 2016). The music selection in the Brand and Dielo (2014) study was not specific for selection in their intervention groups.

Themes and Outcomes

Themes and outcomes identified through this literature review include state anxiety by assessment of visual analog score- anxiety (VAS-A) and Spielberger State and Trait Anxiety Inventory (STAI) scores, physiological symptoms, opioid and analgesia use, sleep, stress hormone levels, ventilator weaning, and visual analog scale- dyspnea (VAS-D) scores. Appendix D2 includes results and outcomes identified throughout the literature review in a table format.

State Anxiety. State anxiety was considered a primary outcome in eight of the selected articles to review for this literature review (Brandt & Dielo 2014; Chen et al., 2021; Chlan,

Weinert, et al., 2013; Goliono et al., 2019; Huang et al., 2021; Lee et al., 2017; Liang et al., 2016; Umbrello et al., 2019). The VAS-A and the STAI were most used as measures of anxiety before and after intervention each found that both VAS-A and STAI scores were decreased after music intervention suggesting music intervention was effective for decreasing state anxiety. Each of these articles utilized both tools, VAS-A and STAI, in their data collection, except for Golino et al. (2019). Golino et al. (2019) conducted their study in the ICU for non-intubated patient population. They utilized an anxiety scale curated by the researchers (anxiety scale 1-10) and found music therapy was statistically significant ($p<.001$) when compared to standard care.

One systematic review with meta-analysis, two systematic reviews without meta-analysis, and three randomized controlled trials (Brandt & Dileo, 2014; Chen et al., 2021; Chlan, Weinert, et al., 2013; Dijkstra et al., 2010; Liang et al., 2016; Umbrello et al., 2019) assessed music interventions effect on state anxiety for patients receiving mechanical ventilation in the intensive care unit. Most found statistically significant values which indicated STAI and VAS-A scores decreased after an average of 20-30 minutes of music intervention. Chalan et al. (2013) and colleagues research was not quantifiable by post-test means as they did not include any change scores, instead they presented findings with statistical modelling which used sedation frequency or intensity. Their models suggested music listening lowered VAS-A scores, (sedation frequency ß -19.5, 95% CI -32.2 to -6.8; sedation intensity ß -19.3, 95% CI -32 to -6.6; P = 0.003 for both) compared to usual care (Chlan, Weinert, et al., 2013).

Additionally, one randomized control trial assessed state anxiety after music intervention on patients who were not mechanically ventilated (Lee et al., 2017). Lee et al. (2017) found significant decrease in state anxiety after 30 minutes of relaxing slow tempo. Conversely, Golino et al. (2019) examined the effect of music intervention on state anxiety and did not find a

statistical difference before or after the intervention. Huang et al. (2021) looked at music types on state anxiety in the healthy individual and will be discussed later in this review.

Of the 12 total articles integrated in this literature review, eight considered state anxiety measured by an assessment tool, before and after music interventions. The most common assessment tools used by the authors reviewed here were STAI and VAS-A scores. Every study reviewed found statistical significance which pointed to a reduction in state anxiety scores after music intervention, when compared to standard care practices.

Other Evaluation Methods

Other evaluation methods found in this inquiry which are correlated with state anxiety included biological stress markers, anxiolytic/ sedative and analgesic intake, and physiological trends, (Beaulieau et al., 2013 and Brandt & Dileo, 2014) Chlan, Weinert, et al., 2013; Chen et al., 2021; Dijkstra et al, 2010; Huang et al., Liang et al., 2015). Additionally, implications of music intervention on sleep, dyspnea and ventilator weaning, music types, and delirium were also discussed in the results of the literature reviewed (Chlan, Heidersheit, et al., 2018; Golino et al., 2019; Huang et al., 2021 Liang et al., 2016; Umbrello et al., 2019).

Biological Stress Markers. Beaulieu-Biore et al. (2013) completed a randomized cross over study utilized biological stress markers to measure effectiveness of anxiety reduction when comparing standard care vs music intervention for the mechanically ventilated patient. They found blood cortisol (p=.05), ACTH (p=.05) and prolactin levels (p=.038) revealed a reduction, representing a decline in biological stress markers for those who received music intervention (Beaulieu-Biore et al., 2013).

Anxiolytic/Sedative and Analgesic Intake. Three systematic reviews and three randomized control trials discussed the effect of music intervention on patients' required dose of

anxiolytic/sedative and analgesic drugs and analgesic medications in their results (Beaulieau et al., 2013; Brandt & Dielo, 2014; Chen et al., 2021; Dijkstra et al., 2010; Gonzalo et al., 2019; Liang et al., 2016). Each of these studies, apart from Chen et al (2021), found little to no statistically significant values when comparing music intervention to standard care for the reduction of these medications, most reviews simply suggested a possible benefit for decrease of overall use of these medications. Chen et al. (2021) discussed positive correlation between music intervention and lower levels of anxiolytic/sedative and analgesic in the results of their systematic review.

One randomized control trials (Chlan, Weinert, et al., 2013) and one quasi-experimental trial (Beaulieau-Bore et al., 2013) discussed sedative/anxiolytic and or analgesic drug intake standard care when music intervention was applied. Beaulieau-Biore et al. (2013) found a reduction in analgesic use, specifically with the utilization of the narcotic fentanyl (p= .06) and found no reduction in the use of sedative/anxiolytic after music intervention. Chlan et al. (2013) found reduced sedation and analgesic use in their results (95% confidence interval, -0.36 to 0.004; p=.04)

Physiological Indicators. Eight of the studies reviewed assessed various physiological stress markers in their results. Physiological markers discussed in the results included heart rate (hr), respiratory rate (rr), blood pressure (sbp, dbp, bp, map), and oxygen saturation (sp02). In each study which reviewed spO2, results were consistent that this value remained unchanged after music intervention (Brandt & Dielo, 2014; Dijkstra et al., 2010; Golino et al., 2019; Korhan et al., 2011; Liang et al., 2016;).

Brandt and Dileo (2014), the only systematic and meta-analysis found to meet the parameters for this literature review, found a positive correlation between music intervention and

hr (95% CI-6.80 to -1.22, p <.001), rr (95% CI -3.64 to -2.10. p <.001), and bp (CI -6.83 to -2.06, p<.001). Similarly Golino et al. (2019), Liang et al. (2016), Lee et al. (2017), and Umbrello et al. (2019) included all populations discussed earlier, and found a positive correlation between these values. Korhan et al. (2011) who had similar results, did not find a positive correlation in hr (p=.170). Statistical values of significance are available in the literature tables found in Appendix D. The remaining trials Beaulieau et al.,(2013) and Dijkstra et al. (2010), reported bp, hr, and rr was not consistently observed in the trials and therefore they did not quantify this in their results as a positive correlation.

Dyspnea/ Mechanical Ventilator Weaning. One study reviewed looked at music intervention during daily ventilator weaning trials. In their randomized crossover trial Liang et al. (2016) found overall improved waning parameters with music intervention when compared to standard care (p<0.05). Additionally, they found the music intervention group had lower Visual Analog Scale- Dyspnea (VAS-D) scores indicating music intervention lead to a decreased overall sensation of breathlessness (p<0.05).

Sleep. Umbrello et al. (2019) a systematic review of randomized control trials was the only trial to mention sleep in their results. Utilizing the PEDro scale they found that music interventions in the critically ill showed improved sleep quality; as this was not done as a meta-analysis, there was no statistical data included with this result.

Delirium. Gonzalo et al. (2019) was the only study which discussed music interventions effect on delirium. They completed a systematic review of randomized control trials and found limited evidence in the critically ill to support or refute the utilization of music intervention to reduce incidence of delirium. Indicating increased incidence of delirium however music intervention also did not decrease occurrence of delirium according to their results.

Music Types. Music intervention types varied across the literature. For instance, Huang et al. (2021) examined the results on their trial evaluating neutral and happy music on anxiety levels in the healthy patient population on state anxiety levels. When both music interventions were compared to a blank stimulus, they found STAI scores to decrease with both music interventions (p <0.001). Interestingly when happy music, described as a tempo of 110 and major key 98% of the time, and neutral music, described as tempo of 70 and split 50/50 between major and minor keys, there was no significant difference in levels of anxiety between neutral music group and happy music group (p=.008; neutral M ± SD = 18.762 ± 11.588, p = 0.013; happy music M ± SD = 17.333 ± 13.047, p = 0.031).

Summary

Each study reviewed found statistical significance which pointed to a reduction in state anxiety scores (VAS-A, STAI) after music intervention, when compared to standard care practices (Brandt & Dielo 2014; Chen et al., 2021; Chlan, Weinert, et al., 2013; Goliono et al., 2019; Huang et al., 2021; Lee et al., 2017; Liang et al., 2016; Umbrello et al., 2019). Other evaluation methods considered as a measure of state anxiety included biological stress markers, anxiolytic/ sedative and analgesic intake, and physiological trends, sleep, dyspnea and ventilator weaning, music types, and delirium (Brandt and Dileo, 2014; Beaulieau et al., 2013; Chlan, Weinert, et al., 2013; Chen et al., 2021; Dijkstra et al, 2010; Huang et al., Liang et al., 2015). Of the evidence identified for music intervention's role in the reduction of state anxiety by these other evaluation methods, no adverse reactions were noted. Results were commonly statistically indifferent without change or significant effect. It is important to note that the evaluation methods discussed here are also influenced by medications delivered and co-morbidities which complicate and confound their measurement; making these measures difficult to interpret. The

literature seems to suggest that music intervention regardless of effectiveness is not harmful to the ICU patient population and advocates for continued investigation and application of music intervention.

CONCEPTUAL FRAMEWORK

Concept Map

The concept derived from this literature review was music intervention's effect on state anxiety. VAS-A scores and STAI scores were documented to measure levels of state anxiety before and after the music intervention. The antecedents that seemed to repeat in the literature reviewed here included standard ICU care, critical illness/ICU patient, and music-based intervention (nurse delivered, patient delivered, neutral tempo, and happy tempo). Music based intervention has a positive relationship to the concept music intervention on state anxiety, additionally the subsets of music-based intervention, neutral tempo and happy tempo had a positive relationship with the reduction of state anxiety. While patient directed and nurse directed had no statistical difference between them when effectiveness of music intervention delivery was considered. The other antecedents have unknown or no relationship to the concept of interest.

Consequences related to the concept include state anxiety (STAI and VAS-A scores), physiologic markers (bp, hr, rr, sp02), biologic stress markers (cortisol, prolactin, IL6, CRP, ACTH), sedative/ anxiolytic, and analgesic intake, sleep, delirium, dyspnea, and ventilator weaning. Positive and negative correlations are shown in the concept map included in Appendix E. A key is utilized to show positive, negative, and no relationship (no statistical difference).

CONCLUSIONS, RECOMMENDATIONS AND IMPLICATIONS FOR NURSING

Introduction

This review analyzed four systematic reviews, five randomized control trials, and four quasi- experimental trials to identify music intervention on the effect of state anxiety. The population reviewed included critically ill persons over the age of 18 who were in ICU or LTACH settings, except for two studies included for context, in which patients were healthy outpatient (Huang et al., 2021). Patients included in literature varied, some needing mechanical ventilation and sedative medications, others were not mechanically ventilated and did not require sedation medications.

Conclusion

Eight of the studies reviewed looked specifically at state anxiety and music intervention (Brandt & Dielo 2014; Chen et al., 2021; Chlan, Weinert, et al., 2013; Goliono et al., 2019; Huang et al., 2021; Lee et al., 2017; Liang et al., 2016; Umbrello et al., 2019). VAS- A and STAI scores across the demonstrated a decrease in state anxiety across the populations. Varied musical interventions were used with the foremost objective to achieve relaxation to ease anxiety symptoms in the adult ICU patient. Average music intervention sessions occurred one time a day for a duration of 30 minutes to one hour at various times of day. Most often headphones were used for the application, and music types used were variable, chosen by the nurse or by patient when able.

Other evaluation methods found through this inquiry linked with occurrence of state anxiety included biological stress markers, anxiolytic/sedative and analgesic intake, and physiological trends (Beaulieau et al., 2013; Brandt and Dileo, 2014; Chen et al., 2021; Chlan, Weinert et al., 2013; Dijkstra et al, 2010; Huang et al., Liang et al., 2015). Beaulieu-Biore et al.

(2013) found decreased biological stress markers following music interventions, suggesting a decrease in sympathetic activity and decreased anxiety. Physiological trends, which included hr, bp, and rr, were the one indicator that was consistently decreased in the setting of music intervention when compared to standard care. Music interventions effect on anxiolytic/sedative and analgesic intake for anxiety was overall inconsistent or unchanged in this review. Other evaluation methods discussed here to measure stress response are also influenced by medications delivered and co-morbidities which complicate and confound their measurement; and therefore, could make the results of these other measures challenging to interpret.

Also, implications of music intervention on sleep, dyspnea and ventilator weaning, music types, and delirium were discussed in the results of the literature reviewed (Golino et al., 2019; Huang et al., 2021 Liang et al., 2016; Umbrello et al., 2019). Umbrello et al. (2019) found an overall improvement in quality of sleep for those receiving music intervention, and Golino et al. (2019) was the only study to discuss delirium and found delirium rates to be unaffected by music interventions. Liang et al. (2016) found decreased levels of perceived dyspnea linked with an improvement in ventilator weaning (Liang et al., 2016).

Implications for Nursing

Stress and anxiety management is prudent for patients facing the distressing environment the ICU exists within (Shah et al., 2017). This literature review suggests music intervention may, indeed, have beneficial effects on state anxiety in the critically ill. Further, the findings from this integrative literature review imply possible benefits of physiological responses, improvements in sleep quality, and decreased occurrence of delirium in the ICU. Because of these results a recommendation can be made for utilizing music intervention as a stress management mediation tool for the critically ill. A written protocol, that is nurse directed and

implemented and directed by evidence is a recommendation from this literature review. Items to consider for protocol development and further research are included below.

It would be reasonable to provide education to nursing staff who work directly with the critically ill about utilization of music intervention for state anxiety. The SCCM (2021) strongly suggests implementing interventions which decrease the need for deep sedation and restraint use during the care of the ICU patient. Music is a nonpharmacological intervention which nursing staff have the autonomy to initiate on their own (Mojfredj et al., 2016). This intervention has great potential, however ownership and buy-in from those delivering the music intervention is imperative. One may consider creating a group of nurses who will champion the implementation of this promising intervention and further identify what triggers to assess and know when to implement music intervention. It is unclear in the literature if music intervention is meant to be utilized as a reactive or proactive tool to decrease state anxiety. Further brainstorming with nursing staff on the realistic implementation of this may also lend to further research. A barrier identified in the literature for music intervention was collection of data and implementation of the therapy itself. This may have been related to impractical timing for nursing staff, unclear expectations, or directions making it difficult for staff to follow the research protocol. Bringing nursing staff to the table for this discussion on how to effectively identify a logistical implementation plan that works for all involved will be imperative.

Music Selection

With a need for nursing to implement evidence-based adjunctive interventions, music intervention is a great tool to compliment pharmacologic treatment. Strong emotional responses can be evoked from music; therefore, it is advised that the nursing be educated on music

selection, identifying music preferences of the individual before implementing (Särkämö et al., 2013).

Each study reviewed used numerous types of music (relaxing, happy tempo, classical, etc.) however, when offering music to the critically ill it may be argued that music selection should be done thoughtfully. The literature is unclear, as each study utilized its own protocols, timing, and music types. Additional controlled trials should be considered in this population to further observe which musical characteristics augment psychological and physiological benefits from music listening. In practice it may be reasonable to involve a music therapist in the music selection if the patient is unable to participate in their music listening choices. It is unclear in the literature if a full-time involvement of a music therapist is necessary for implementation of music listening. Additional research comparing the effect of pre-selected music and music selected by a music therapist on the effect of state anxiety in the ICU patient is recommended.

Recommendations

This review found music intervention as effective and without adverse negative side effects for the critically ill, making this intervention alluring when contemplating an adjuvant therapy to standard care for state anxiety. Music intervention provides an important avenue to improve patient experience, and is an intervention worth further exploration. Nursing staff should be involved in the development of a of a nurse driven protocol to implement music listening. Further research is necessary to explore how to deliver this intervention and develop protocols to implement in the critical care setting.

Future Research

Homogenous patient samples were small and limited throughout the literature reviewed here. Further research should consider clinical conditions and confounding factors that influence

stress response. Future studies should include principal outcomes such as quality of life, patient satisfaction, ventilator days, ICU length of stay, PICS outcomes, and mortality. Cultural considerations were not discussed in any of the literature reviewed and should be included in further research on this topic. Last, prospective studies should continue to include biological stress levels. These levels may provide a window into a more sensitive measure of effect and offer awareness into the fundamental physiology of anxiety and stress reduction.

Variables

Variables yet to be addressed in the literature include volume of music, method of delivery (headphones, etc.), single versus double patient rooms, duration, timing of the intervention, and overall patient acuity. Since medications like anxiolytic or narcotic medications blunt the sympathetic response (Särkämö et al., 2013), one may need to evaluate if physiological measures are an appropriate surrogate to assess for music interventions effect on state anxiety in the critically ill receiving these medications. A study which looks exclusively at the ability to decrease sedation levels or narcotic use with the implementation of music listening may be worth exploring in further research. Further study should be considered to assess effects on multiple music listening sessions over lengthier intervention periods.

Summary

Music intervention provides patients with a soothing recognizable stimulus; it is an economical, straightforwardly applied, nonpharmacological intervention which has been shown to reduce anxiety, improve sleep quality, decrease ventilator days, and potentially has the causative effect of decreasing associated adverse effects of anxiety in the critically ill.

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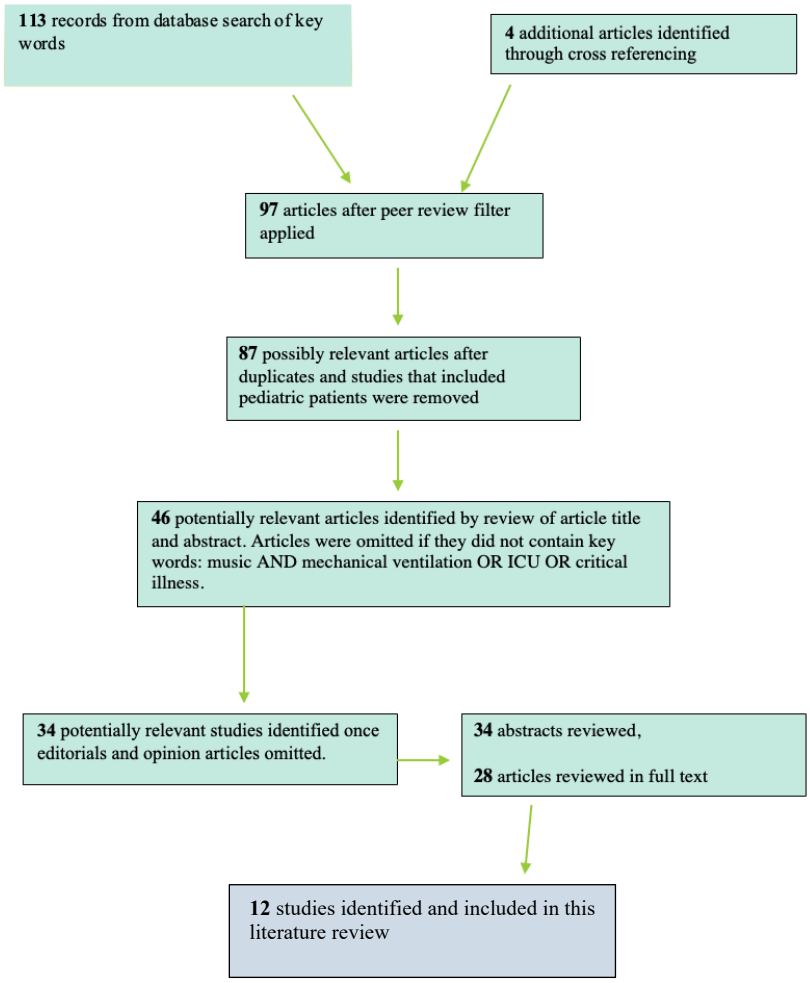
APPENDIX A

Literature Search Results



APENDIX B

Duffy Tool for Critical Appraisal of Systematic Reviews

If a systematic review has been completed you need to determine how well the review was done. The extent to which scientific review methods were used to minimize the risk of bias and of error determines the quality of the review. Duffy (2005) provides a list of questions to help with the rating of the review. The more questions that receive a "Yes" response, the higher the quality of the review.

1. Research Question

a. Does the review address a clearly defined issue?

— b. Does the review describe: i. the population studied?

— ii. The intervention/treatment given?

— iii. The outcome(s) considered?

—

— c. Is the review question clearly and explicitly stated?

—

2. Literature Review

a. Were comprehensive search methods used to locate studies?

b. Was a thorough search of appropriate databases done?

c. Were other potentially important databases explored?

d. Were the search methods thoroughly described?

e. Were conclusions drawn about the possible impact of publication bias?

f. Were the overall findings assessed for their robustness in terms of the selective inclusion or exclusion of doubtful or biased studies?

3. Study Selection

a. Were inclusion criteria for selecting studies clearly described and fairly applied?

4. Critical Appraisal

a. Was study quality assessed by blinded or independent raters?

b. Was the validity of included studies assessed?

c. Was the validity of studies assessed appropriately?

d. Are the validity criteria reported?

5. Similarity of Groups and Treatments

a. Were reasons given for any differences between individual studies explored?

b. Are treatments similar enough to combine?

c. Do the included studies seem to indicate similar effects?

d. If not, was the heterogeneity of effect assessed and discussed?

6. Data Synthesis a. Were the findings from individual studies combined appropriately?

b. Are the methods used to combine studies reported?

c. Was the range of likely effect sizes presented?
d. Were null findings interpreted carefully?
e. Were the methods documented?
f. Are review methods clearly reported?

7. Summary of Findings a. Is a summary of findings provided?
b. Are specific directives for new research proposed?
c. Were the conclusions supported by the reported data?
d. Are the recommendations based firmly on the quality of the evidence presented?

Duffy, M. E. (2005). Systematic reviews: Their role and contribution to evidence-based practice. *Clinical Nurse Specialist*, 19(1), 15-17. Doi: 10.1097/00002800-200501000-00005

APPENDIX B1

Evaluation of Systematic Reviews

Critical Appraisal of Systematic Reviews	*1.Research Question*	*2.Literature Review*	*3.Study Selection*	*4.Critical Appraisal*	*5.Similarity of Groups and Treatments*	*6.Data Synthesis*	*7.Summary of Findings*
Brandt & Delio (2014)	a. Y b.-i: Y b.-ii: Y b.-iii: Y c. Y	a. Y b. Y c. Y d. Y e. Y f. Y	a. Y	a. Y b. Y c. Y d. Y	a. Y b. Y c. Y d. Y	a. Y b. Y c. Y d. Y e. Y f. Y	a. Y b. Y c. Y d. Y
Chen et al. (2021)	a. Y b.-i: Y b.-ii: Y b.-iii: Y c. Y	a. Y b. Y c. Y d. Y e. Y f. Y	a. Y	a. Y b. Y c. Y d. Y	a. Y b. Y c. Y d. Y	a. Y b. Y c. Y d. Y e. Y f. Y	a. Y b. Y c. Y d. Y
Umbrello et al. (2019)	a. Y b.-i: Y b.-ii: Y b.-iii: Y c. Y	a. Y b. Y c. Y d. Y e. Y f. Y	a. Y	a. Y b. Y c. Y d. Y	a. Y b. Y/N c. Y d.Y	a. n/a b. n/a c. n/a d. n/a e. n/a f.n/a	a. Y b. Y c. Y d. Y
Gonzalo et al. (2019)	a. Y b.-i: Y b.-ii: Y b.-iii: Y c. Y	a.Y b.Y c.Y d. Y e. Y f. Y	a.Y	a. Y b. Y c. Y d. Y	a. Y b. Y/N c. Y d.Y	a. n/a b. n/a c. n/a d. n/a e. n/a	a.Y b.Y c.Y d.N

Note:. Evaluation of systematic reviews included in this inquiry using the questions directly from Appendix B. Key: Y- yes, N- no, n/a- not applicable, -- no results

APPENDIX C

**Levels of Evidence

Level I	-Experimental study, randomized controlled trial (RCT) -Systematic review of RCTs, with or without meta-analysis
Level II	-Quasi-experimental Study -Systematic review of a combination of RCTs and quasi-experimental studies only, with or without meta-analysis
Level III	-Non-experimental study -Systematic review of a combination of RCTs, quasi-experimental and non-experimental, or non-experimental studies only with or without meta-analysis -Qualitative study or systematic review, with or without meta-analysis
Level IV	-Opinion of respected authorities and/or nationally recognized expert committees/consensus panels based on scientific evidence *Includes: Clinical practice guidelines, consensus panels/position statements*
Level V	-Based on experiential and non-research evidence *Includes: Literature reviews, quality improvement, program or financial evaluation, case reports, opinion of nationally recognized experts(s) based on experiential evidence*

Note:. This evidence rating scale is based on: Dang, D., & Dearholt, S.L. (2018). *Johns Hopkins nursing evidence-based practice : Model & guidelines* (3rd ed). Sigma Theta Tau International.

APPENDIX D

Literature Tables

Citation	Purpose	Sample/ Setting	Design/ Framework	Variables/ Instruments	Results	Implications	**Level of Evidence/ Comments
1. Bradt & Dileo (2014)	Effects of music therapy on anxiety and other outcomes in mechanically ventilated patients	14 randomized and quasi-randomized control trials (years 1995-2013) Total participants: 912 (ranging from 10-373) MV patients in ICU, LTACH, or stepdown unit All participants alert All adults	Systematic review and meta-analysis and risk ratio Standard care versus with music intervention vs standard care alone	Standard care vs standard care with music listening STAI VAS physiological parameters -HR -BP -RR -Spo2	STAI, VAS-Anxiety reduction: 1.11 standard deviation units greater (95% CI -1.75 to -0.47, $p < .001$) --Decrease HR: 95% CI -6.80 to -1.22, $p < .001$ --Decreased respiratory rate: 9 studies, N = 357; MD -2.87, 95% CI -3.64 to -2.10, $p < .001$ --Decreased SBP: N = 269) (MD -4.22, 95% CI -6.38 to -2.06, $p < .001$ --Spo2 lacked statistical significance p=.86)	No significant results for reduction of opioid or analgesia Recommended for use a stress management intervention May be effective; improving heart rate, respiratory rate, and anxiety	Level I / Recommended for use a stress management intervention Most studies offered one 20–30-minute music session Music listening did not result in harm. Oxygen consumption may have been better assessed with venous blood gas vs spo2

Citation	Purpose	Sample/ Setting	Design/ Framework	Variables/ Instruments	Results	Implications	**Level of Evidence/ Comments
2. Gonzalo Garcia et al. (2019)	Efficacy of music in providing sedation and analgesia and reducing the incidence of delirium in critically ill patients	6 studies (years 1995-2017) 734 total participants (range 41-373) All randomized control trials Adult patients receiving sedative and analgesic drugs ICU With or without MV	Systematic Review of RCTs without metanalyses GRADE	Music (all types) routine care Placebo Sedation and analgesia	Sedation/analgesia- no statistical difference found No adverse effects	limited evidence in adult critical care to support or refute the use of music to reduce sedation and analgesia requirements, or to reduce delirium The quality of this evidence is low due to inconsistency and imprecision	Level II

Citation	Purpose	Sample/ Setting	Design/ Framework	Variables/ Instruments	Results	Implications	**Level of Evidence/ Comments
3. Umbrello et al., (2019)	Effects of music therapy in reducing stress and anxiety in critically ill patients	11 studies (1998-2017) 10 RCT 1 Quasi 959 total participants (range 17-373) Patients in ICU All adult patents	Systematic review- umbrella approach	Music therapy PEDro checklist Anxiety Physiological parameters -HR -BP -RR -Spo2	6 studies showed decreased anxiety 2 studies with decreased HR and RR 2 studies with decreased HR, RR, SBP, and DBP 1 study with decreased HR 1 study with decreased RR and BP 1 study with decreased HR, RR, and BP 1 study with increased level of sedation 1 study with decreased RR, SBP, and DBP 1 study with increased sleep quality	Lack of a meta-analytic PEDro scale 7 studies= score of 8/11 2 studies score of 7/11 2 studies score of 6/11 Despite significant heterogeneity in trial designs, timing and features of the intervention, music therapy is consistently associated with a reduction in anxiety and stress of critically ill patients.	Level II / Total PEDro scores of 0-3 are considered ‘poor’, 4-5 ‘fair’, 6-8 ‘good’, and 9-10 ‘excellent’- a total PEDro score of 8/10 is optimal (Cashin & McAuley, 2020)

Citation	Purpose	Sample/ Setting	Design/ Framework	Variables/ Instruments	Results	Implications	**Level of Evidence/ Comments
4. Chen et al. (2021)	What is the evidence for supporting the effectiveness of music-based intervention in decreasing the uncomfortable symptoms in ICU patients	5 SR articles met the inclusion criteria dates: 41 original studies; 38 RCT and 2 non-randomized control trials / Adult patients in ICU	Systematic umbrella review- Independent review PRISMA framework	Most participants underwent one intervention session lasting ~ 20-30 minutes RCTs included in SR: used music-based intervention (diverse music) and a control group of routine care/ non-music-based intervention JBI questioner to evaluate quality of studies	Decreased anxiety Decreased pain Decreased anesthesia dose and sedative use Decreased chances of delirium, Decreased feelings of , Improved sleep quality	JBI results: All 5 SR obtained >7 "Yes" (positive) results Overall meta-analysis of the intervention methods was lacking	Level III / Only two meta-analyses showed that music-based intervention could improve anxiety and pain and concluded that music-based intervention was beneficial in reducing the anxiety of mechanically ventilated patients Anxiety and pain, are subjective experiences, and the frequency, severity, and degree- subjective experiences for evaluation

Citation	Purpose	Sample/ Setting	Design/ Framework	Variables/ Instruments	Results	Implications	**Level of Evidence/ Comments
5. Chlan, Weinert, et al. (2013)	To test whether listening to self-initiated patient-directed music can reduce anxiety and sedative exposure during ventilatory support in critically ill patients	Adult, critically ill, mechanically ventilated- Alert, intact, adequate vision/hearing Total N 373 patients from 12 ICU's at 5 hospitals. *N*= patient directed music: 126 *n*= noise canceling headphones group: 122 n= usual care: 125	Randomized control trial - three arm parallel group design	Patient directed music (PDM) (CD's, listening time variable) Usual care vs self-initiated patient directed music vs self-initiated use of noise canceling headphones. VAS-A Sedation Frequency of anxiety	VAS improved after music: (95% CI, -32.2 to -6.8. *p*=.003) Reduced frequency by −0.21 (95% confidence interval, −0.37 to −0.05) points/day (*p* = .01) Reduced sedation frequency (95% confidence interval, −0.36 to −0.004) points/day (*p*= 0.04)	Among mechanically ventilated patients- patient directed music resulted in greater reduction in anxiety, but not when compared with noise canceling headphones.	Level I / Offered two or more music sessions ICU nurses not blinded Participants were not able to complete anxiety assessments each day due to fatigue, medical condition, state of sedation, inability or refusal to complete assessments, or were off the unit By the fifth day had a reduction of 36% in sedation intensity PDM may be an appropriate adjunctive intervention by which patients can self-manage anxiety.

Citation	Purpose	Sample/ Setting	Design/ Framework	Variables/ Instruments	Results	Implications	**Level of Evidence/ Comments
6. Dijkstra et al. (2010)	To see if there is a reduction in sedative medication use after music intervention for patients requiring deep sedation while mechanically ventilated	Adults in ICU receiving continuous sedation and on MV Convivence sampling from 3 intensive care units 20 patients	RCT Apache II score	three 30 minute sessions of classical music intervention vs quiet time (no headphones used) BP HR RR Sedation scores (Ramsey score, sedic score)	After third session: BP (p=0.75) HR (p=0.511) RR ($p=0.545$) Ramsay Score (p=0.427) Sedic Score (p=0.146)	No statistical significance between-group difference was detected relating to the change in sedative requirements or physiological parameters Overall trend in the physiological parameters revealed no differences	Level I / This trial in contrast, looks to address of the effect of music interventions for deeply sedated patients on mechanical ventilation. Volume adjusted by nurse No headphones used “Possibly a headphone leads to a calming effect because of the reduction of background noise. To control for this possible confounding factor, we did not use headphones” Small sample size Does administration of sedative drugs lead to a reduction in physiological parameters No specific timing of music intervention (morning, evening, etc) No negative changes in the condition of sedated mechanically ventilated patients.

Citation	Purpose	Sample/ Setting	Design/ Framework	Variables/ Instruments	Results	Implications	**Level of Evidence/ Comments
7. Lee et al. (2017)	Investigate the treatment effects of music and aromatherapy interventions on reducing anxiety for ICU patients undergoing mechanical ventilation.	Single center academic medical *n*=160 Randomized to *n*=41 music *n*=47 aromatherapy *n*=44 control Alert adult patients receiving mechanical ventilation in medical/surgical ICU	RCT ANOVA	30-minute intervention of Music, slow beat 60-80 bpm via headphones Aromatherapy Anxiety Scores: STAI VAS-A Physiological parameters -HR -SBP -MAP	Music group lower than control arm (VAS-A score: 49.56±8.09 vs. 55.94±9.27, ; STAI score: 2.62±0.23 vs. 2.71±0.18, *p*=.001) Decreased HR (75.53±9.98 vs. 79.71±8.15, *p* <.001) Lower SBP vs. control (122.06±14.49 vs. 126.16±14.19, *p*<0.001) Lower MAP (83.20±8.57 vs. 84.35±9.13, *p*=0.03).	Music was effective to decrease anxiety in those who are undergoing mechanical ventilation and could be considered as an alternative to sedation	Level I / Difficult to maintain a blinded study with nature of intervention

Citation	Purpose	Sample/ Setting	Design/ Framework	Variables/ Instruments	Results	Implications	**Level of Evidence/ Comments
8. Korhan et al. (2011)	Investigate if relaxing music is an effective method of reducing the physiological signs of anxiety in patients receiving mechanical ventilatory support.	Adults in ICU receiving mechanical ventilation Total participants: 60	Randomized control trial: Two arm parallel group design- case control	Music group (via headphones, researcher selected music- classical, on headphones) Control group (standard care)	No statistical difference in HR p= .170 or So2 p= .859 RR lowered p=.043 SBP lowered p= 0·024 DBP lowered p= .016 Sa02	Music therapy can be applied with advantage for managing anxiety in ventilator-dependent patients without risking unwanted side effects	Level I / No SD available in text Sedation stopped 30 minutes prior to start of therapy Music therapy reduced the physiological signs of anxiety among mechanically ventilated patients in this study effect had increased by the 60th minute and was still present at the 90th minute

Citation	Purpose	Sample/ Setting	Design/ Framework	Variables/ Instruments	Results	Implications	**Level of Evidence/ Comments
9. Beaulieu-Boire et al. (2013)	Evaluate slow-tempo music listening periods in mechanically ventilated intensive care unit patients	Total participants : 49 Patients in ICU, stable overall medical condition All adult patients needing at least three days of mechanical ventilation Receiving sedation medication for SAS 3 or 4	quasi-experimental Randomized cross-over design Computer generated randomized block	Two study conditions: 1. Music (1 hour of music preselected, classical) 2. Placebo (headphones x1 hour no music) BP, HR, RR Daily sedative drug consumption Blood levels of cortisol, ACTH, Prolactin, leptin, and CRP	Reduction in narcotics (fentanyl) (p= .06) Cortisol decreased with music (p=.005) Prolactin decreased (p=.038) BP, HR, RR- no reduction in these measures observed No statistical difference between groups: -Anxiolytics and hypnotics -ACTH -IL6 -CRP	Clinically relevant trend in reduction of narcotic consumption for sedated patients in music arm of trial Slow tempo music has the potential to decrease biological stress markers in the still sedated mechanically ventilated patients Reduction in stress-related VS, was not consistently observed	Level II / Offered two or more music sessions Biological response was more sensitive than clinical response An “earplug effect” of noise-reducing MP3 circumferential headphones could have reduced several parameters, affecting in-between group comparisons

Citation	Purpose	Sample/ Setting	Design/ Framework	Variables/ Instruments	Results	Implications	**Level of Evidence/ Comments
10. Liang et al. (2016)	The effect of music intervention on physiologic variables	Adults in acute care 30 bed long-term rehab hospital for patients requiring prolonged mechanical ventilation Patients alert, undergoing daily weaning trails- *n*=31 total, n =23 completing the 6-day intervention	Quasi-experimental Crossover repeated measures design 6 days total 3 days consecutive with music and then intervention 3 days with no music.	Music vs standard care (Each subject was their own control) Music preference was selected with music therapist using 13 question yes/no tool- all music was 60-80 bpm to mimic heart rate- headphones used Anxiety Scale: VAS-A Dyspnea scale VAS-D Ventilator weaning duration Physiological parameters -HR -BP -RR -Spo2	Music vs no music: Decreased HR, RR, VAS-D, and VAS-A ($p<0.05$) Improved weaning parameters with music vs no music- RR VAS-D Daily weaning duration tolerance (in time) ($p<0.05$) No significant statistical change for SPO2 MAP	Patient selected music during weaning trials is a simple and potentially beneficial tool for patients on prolonged mechanical ventilation. Additional studies are needed to test benefits of earlier weaning related to music	Level II / Low sample size

Citation	Purpose	Sample/ Setting	Design/ Framework	Variables/ Instruments	Results	Implications	**Level of Evidence/ Comments
11. Golino et al. (2019)	Examine the effect of an active music therapy intervention on physiological parameters and self-reported pain and anxiety levels of patients in the intensive care unit	52 ICU patients 12 bed adult ICU-single center	Pre and post test non-experimental Within subject, single group design	30-minute music therapy session consisting of either A relaxation intervention or a "song choice" intervention Vital signs Pretest/post test Anxiety 0-10 scale SAS	(all P <.001) Were found in respiratory rate (mean difference, 3.7 [95% CI, 2.6–4.7] breaths per minute) Heart rate (5.9 [4.0–7.8] beats per minute) Self-reported pain (1.2 [0.8–1.6] points) Anxiety levels (2.7 [2.2–3.3] points). No significant change in oxygen saturation level was observed.	Not mechanically ventilated patients Music therapist discussed patients current emotional and physical state and utilized this to choose music intervention	Level II

Citation	Purpose	Sample/ Setting	Design/ Framework	Variables/ Instruments	Results	Implications	**Level of Evidence/ Comments
12. Huang et al. (2021)	To compare neutral music vs happy music's effect on state anxiety	Total Participants: 62 Healthy adult's w/o history of anxiety, mental health disorder, not on medication- in outpatient setting Randomly divided into three groups after visual evoked anxiety paradigm	Qasi-experimental	Neutral music Happy music Blank stimulus ---------- STAI scores ANOVA tests	Reduced state anxiety levels Neutral music Happy music vs blank stimulus ($p < 0.001$) No significant difference between neutral music group and happy music group p=.008 Neutral (M ± SD = 18.762 ± 11.588, p = 0.013) and happy music (M ± SD = 17.333 ± 13.047, p = 0.031)	Music therapy is useful to decrease anxiety levels for health individuals experiencing state anxiety Neutral or Happy music similarly effective Happy music suggested a trade between anxiety and happy emotion Neutral music may cause decreased anxiety by enhanced emotional blunting	Level II / Studied for baseline understanding- no patients with chronic anxiety included Useful for identifying if type of music is important when implementing in acute care setting Happy music described as average tempo 110 and in major key >98% of time Neutral music described as having average tempo of 70 and split 50/50 between major and minor key

APPENDIX D1

Study Design and Variable Matrix

Reference	STUDY DESIGN				LOE			PATIENT TYPE			MUSIC INTERVENTION					
	Systematic Review	*Meta-Analysis*	*RCT*	*Quasi*	*LOE III*	*LOE II*	*LOE I*	*MV*	*No MV*	*Non-ICU*	*Nurse Delivered Music Therapist*	*Patient Directed*	*30 Minutes*	*More Than 1 Session*	*Music Type*	*Headphones*
1.Brandt & Dileo (2014)	x	x					x	x			x	x	x		all	
2.Chen et al. (2021)	x					x		x	x		x	x	x		all	
3.Umbrelo et al. (2019)	x					x		x	x		x	x			all	
4.Gonzalo et al. (2019)	x					x		x	x		x	x				
5.Beaulieau et al. (2013)				x		x		x			x			x	classical	x
6.Lee et al. (2017)			x				**x**		x		x		x		slow	
7.Dijkstra et al. (2010)			x				x	x					x	x	classical	
8.Liang et al. (2016)				x		x		x			x				60-80 bpm	x
9.Chlan, Weinert, et al. (2013)			x			x		x				x	x			x
10.Korhan et al. (2011)			x			x		x			x			60-1.5hr	classic	x
11. Golino et al. (2019)				x		x			x			x	x			

Reference	STUDY DESIGN				LOE			PATIENT TYPE			MUSIC INTERVENTION					
	Systematic Review	*Meta-Analysis*	*RCT*	*Quasi*	*LOE III*	*LOE II*	*LOE I*	*MV*	*No MV*	*Non-ICU*	*Nurse Delivered Music Therapist*	*Patient Directed*	*30 Minutes*	*More Than 1 Session*	*Music Type*	*Headphones*
12.Huang et al. (2021)				x		x		healthy patients			x		happy vs neutral			

Note:. Studies included in literature review. Details the derived results by study design, level of evidence, patient type, and music intervention type. Key: x= indicated in description or results of study

APPENDIX D2

Literature Review Results Comparison

KEY + *positive correlation* *-No SD*	**STAI VAS**	**HR**	**rr**	**sbp**	**sp02**	**opiod**	**analgesia**	**delirium**	**sleep**	**acth**	**il6**	**crp**	**prolactin/cortisol**	**ventilator weaning/ dyspnea**
1.Brandt & Dileo (2014)	+ +	+	+	+	-	-	-							
2.Chen et al. (2021)	+ +					+	+							
3.Umbrello et al. (2019)	+ +	+	+	+					+					
4.Gonzalo et al. (2019)						-	-	-						
5.Beaulieau et al. (2013)		-	-	-		+	-			-	-	-	+	
6.Lee et al. (2017)	+ +	+		+										
7.Dijkstra et al. (2010)		-	-	-	-	-	-							
8.Liang et al. (2016)	VAS-a VAS-D	+	+		-	-	-							+
9.Chlan et al. (2013)	+ and reduced frequency						+							
10.Korhan et al. (2011)		-	+	+	-									
11.Golino et al. (2019)	+	+	+	+	-									

KEY + *positive correlation* **-***No SD*	**STAI VAS**	**HR**	**rr**	**sbp**	**sp02**	**opiod**	**analgesia**	**delirium**	**sleep**	**acth**	**il6**	**crp**	**prolactin/cortisol**	**ventilator weaning/ dyspnea**
12.Huang et al. (2021)	music better than not- no difference in happy and neutral music + stai scores													

Note:. Results derived from the literature for utilization in conceptual mapping. Key: + positive correlation, - no statistical significance, no entry indicates it was not discussed in the literature reviewed.

APPENDIX D3

Abbreviations in Literature Tables

STAI- state-trail anxiety inventory
VAS-A- visual analogue scale- anxiety
VAS-D- visual analog scale – dyspnea
SAS- sedation agitation scale
ANOVA- analysis of variance
PRISMA- preferred reporting Items for systematic reviews and meta-Analyses
PEDro- physiotherapy evidence database
JBI- joanna briggs institute evidence appraisal
GRADE
SD- statistical difference
ICU- intensive care unit
LTACH- long term acute care rehab
MV-mechanical ventilation
SR- systematic reviews
RCT- randomized control trial
VS- vital signs
HR-heart rate
BP-blood pressure
SBP- systolic blood pressure
DBP-diastolic blood pressure
RR-respiratory rate
Sp02- saturation pulse oxygen
ACTH- adrenocorticotropic hormone
IL6- interleukin 6
CRP-C-reactive protein
PDM- patient directed musi

APPENDIX E

Conceptual Map