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The Effect of Music Listening on Anxiety and Agitation in Adult Mechanically Ventilated Patients: A Systematic Review

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Abstract

Mechanical ventilation causes anxiety and agitation in patients in intensive care units, which increases risk for complications and prolonged hospital stays. Since pharmacological interventions have adverse effects and are not always effective at reducing anxiety and agitation, nonpharmacological interventions, such as music listening, could be considered. The purpose of this systematic review is to identify, review, and critically appraise the evidence from studies that examined the effect of music listening, compared with standard care, on anxiety and agitation in mechanically ventilated patients in the intensive care unit (ICU). Using search engines, data bases, key words, and criteria, twenty studies are discussed and critically appraised. Findings consistently show that music listening may be a cost effective and alternative therapy to decrease anxiety and agitation in this population. Based on appraisal of study validity, reliability, and applicability, recommendations for practice and future research are advanced.

Within hospital settings, nursing scope of practice includes providing patients with effective care that decreases distress and pain, promotes health outcomes, and decreases length of stay (Byrd, 2015). Mechanically ventilated adult patients in intensive care units (ICU) are at risk for anxiety, agitation, and ventilator associated complications from time duration on ventilators.-In addition, the insertion of the endotracheal tube increases anxiety and agitation, and is associated with increased trauma such as lung injury, oxygen toxicity, and ventilator-associated pneumonia (Byrd, 2015). This is a problem because increased anxiety and agitation can increase the time of mechanical ventilation, which may contribute to other health complications, such as risk for pressure ulcers, muscle atrophy, and greater susceptibility to further infections (Byrd, 2015).

In the United States, more than one million patients admitted to the ICU annually require mechanical ventilation as a lifesaving measure (Heiderscheit, Breckenridge, Chlan, & Savik, 2014). Wunsch and colleagues (2013) examined the admittance rates of patients to the ICU over a period of three years. The occupancy of those in the ICU ranged from 57.4% to 82.1%, and the prevalence of those mechanically ventilated ranged from 20.7% to 38.9%. Based on these statistics, many patients in the ICU experience mechanical ventilation and, as nurses, it is important to examine interventions to decrease the anxiety and agitation associated with being mechanically ventilated. Pharmacologically, to decrease anxiety and agitation, patients placed on a mechanical ventilator may receive doses of analgesics and sedatives, yet these may result in prolonged periods of unconsciousness, which interrupts the opportunity for spontaneous breathing trials and eventual weening off of the ventilator (Heiderscheit et al., 2014). An alternative needs to be considered.

Researchers have investigated the effects of non-pharmacological interventions on anxiety and agitation (Chlan, Tracy, Nelson, & Walker, 2001; Heiderscheit et el., 2014). For example, because of the effects of music listening on physiological and emotional responses, i.e., listening to music as a way to relax, escaping from reality, and experiencing comfort, researchers have investigated the effect of music listening as a means of stress reduction (Linnemann, Ditzen, Strahler, Doerr, & Nater, 2015). However, music listening may also increase agitation in patients (Scutti, 2015). For example, sad or aggressive music has been shown to increase anxiety, especially in males (Scutti, 2015). Thus, it is important to review the evidence about whether music listening affects anxiety and agitation in mechanically ventilated patients in the ICU. The purpose of this systematic review is to identify, review, and critically appraise the evidence from studies that examined the effect of music listening, compared with standard care, on anxiety and agitation in mechanically ventilated patients in the ICU. The following PICO question is answered: In mechanically ventilated adult patients in the ICU, does music listening, compared with standard care, such as sedation, analgesics, and reducing environmental stimuli, affect anxiety and agitation? Once the evidence is critically appraised, recommendations for practice and future research are advanced, supporting nurses incorporating music listening interventions to keep patients as comfortable as possible.

Methods

Studies were retrieved from primary sources from CINAHL, MedLine, and a university library database. Inclusive criteria included samples of adults greater than 18 years of age, current studies within the past five to eight years, samples of ICU patients on mechanical ventilation, outcomes of anxiety and agitation, and music listening as interventions by nurses. Exclusive criteria were studies that used music therapy as an intervention, because music therapy

is directed and carried out by licensed music therapists, registered nurses. Key words included

mechanically ventilated patients, music listening, intensive care, interventions, agitation, anxiety,

and adults. Studies were chosen based on accuracy of findings, their relevance, and our

understanding of the material presented. Out of 40 studies identified and reviewed, the 20 most

recent and relevant were used to critically evaluate music listening as a possible

nonpharmacological intervention to reduce agitation and anxiety in mechanically ventilated adult

patients. Studies were excluded on the basis of publication date and relevance to today's practice

as well as referencing other systematic reviews.

Review of Literature

Anxiety during Mechanical Ventilation

Before researchers study the effect of interventions, it is important to determine if and

why such interventions are necessary. As previously described, mechanical ventilation increases

risk of complications, such as ventilator association pneumonia, and is associated with physical

and psychological problems and burdens (Chlan & Savik, 2011; Ely et al., 2001; Jaber et al.,

2005). Further, although mechanical ventilation is used as a life-saving treatment, it is often

found to be physically irritating and uncomfortable for patients. While researchers have found

that ICU environments and mechanical ventilation increase anxiety in critically ill patients

(Chlan, Engeland, & Savik, 2012), it is important to study patients' experience to increase

understanding of those patterns of stress and anxiety. For example, patients have referred to

mechanical ventilation as a form of inhumane treatment, during which they are miserable a

majority of the time (Chlan & Savik, 2011). While mechanically ventilated, patients report often

feeling as if they are not in control of their bodies when a machine is breathing for them, which

often leads them to feel vulnerable and dependent on the health care team (Engström, Nyström,

Sundelin, and Rattray, 2012). In a qualitative study in northern Sweden, Engström, Nyström, Sundelin, and Rattray (2012) used personal interviews with eight patients following their time on mechanical ventilation. During these interviews, themes arose with patients reporting feeling vulnerable, due to the fact that they could not breathe on their own and had to be dependent on machines and other individuals for their survival, which ultimately increased their anxiety about the situation.

In addition to studies about patient experiences during mechanical ventilation and findings of increased agitation in ventilated patients (Chlan et al., 2012), researchers have also explored anxiety during mechanical ventilation. Anxiety is defined as an emotional state involving subjective feelings of tension, apprehension, nervousness and worry that elicits sympathetic nervous system arousal, brought on by some external stressor (Chlan et al., 2012). Standard treatment for managing anxiety in mechanically ventilated critically ill patients includes the administration of intravenous sedative agents to reduce central nervous system activity and sympathetic nervous system outflow (Chlan et al., 2012). However, these medications have many adverse effects such as bradycardia, hypotension, gut dysmotility, immobility, weakness, and delirium (Chlan et al., 2012). Continuous use of sedation is strongly associated with delayed weaning from the ventilator which in turn increases the length of hospital stay and hospital care costs (Han et al., 2010).

Patterns of anxiety have been found to vary during the course of mechanical ventilation. Chlan and Savik (2001) found that patterns of anxiety in some patients seemed to decrease over time, as patients get acclimated to the treatment. However, this was not the case in all mechanically ventilated patients, as certain patients experienced increased anxiety, while others showed no change (Chlan & Savik, 2001). Further, in spite of mechanical ventilation being

uncomfortable, it is important to consider additional activities that can increase anxiety and

agitation during ventilation, such as simple tasks like turning, repositioning, or oral hygiene

(Tate, Dabbs, Hoffman, Milbrandt, & Happ, 2012). When patients on mechanical ventilation are

not able to care for themselves, promoting feelings of helplessness and possibly depression,

some have even reported having difficulty coping after the mechanical ventilation treatment

(Engström et al., 2012).

Rationale for Music Listening Interventions

Practice implications of the findings above include that nurses use non-pharmacological

interventions in addition to administration of sedative agents to reduce anxiety and elicit a

relaxation response by desensitizing and reducing overall activity within the limbic system

through the reduction of sympathetic nervous system arousal, neuromuscular arousal, and

cognitive excitation (Chlan, Engeland, & Savik, 2012). Music listening is one non-

pharmacological intervention that has been shown to modulate anxiety, promote relaxation, and

distract patients from current environmental and health related stressors (Han et al., 2010; Wong,

Lopez-Nahas, & Molassiotis, 2001; Chlan et al., 2001).

The benefits of music listening are that it is a non-invasive, inexpensive and an easy to

administer nursing intervention. The rationale for using music therapy is that it may serve as a

therapeutic modality interrupting the physiological response to stress and lessening anxiety in a

variety of ways. First, music can be used to synchronize or entrain various body rhythms such as

breathing, heart rate, speech, gait, and blood flow (Han et al., 2010). For example, by using a

slow, flowing rhythm that mirrors 60-80 beats per minute, music may copy a relaxation rhythm

for the heart. As a result, a decrease in the firing of the sympathetic nervous system occurs, in

turn bringing about a lowering in heart rate, respirations, blood pressure, and epinephrine levels circulating in the blood (Han et al., 2010). Second, music's vibrational quality influences the limbic system ~~to~~ which can evoke a psychophysiological response in the listener. This aesthetic pleasure received by the brain may cause the pituitary gland to release endorphins, in turn producing a state of analgesia and a sense of well-being in the patient (Han et al., 2010). Finally, music has been used as a diversion therapy to distract stimuli that cause a stress response (Wong et al., 2001). It can act to distract the patient from painful procedures such as blood draws, intravenous line insertions, chest tube insertions, central line insertions, suctioning of the intubation tube and other invasive procedures (Wong et al., 2001). Music listening can also aid in blocking out noisy sounds coming from the unit such as call lights, monitor alarms, and IV pumps that make sleeping difficult (Wong et al., 2001). Noise cancelling headphones are beneficial to implement for blocking out auditory stimuli during rest periods and times for relaxation as well (Chlan et al., 2013).

Intervention Studies

Researchers have studied the effect of music listening interventions on anxiety, agitation, and related outcomes in mechanically ventilated patients in ICU settings (Chlan & Savik, 2011). These intervention studies have frequently been randomized controlled trials where mechanically ventilated adult patients were randomly placed into a group who listened to music or a group who did not listen to music (Aktas & Karabulut 2015; Almerud & Petersson, 2003; Beaulieu-Boire, et al., 2013; Chlan et al., 2012; Chlan et al., 2013; Dijkstra, Gamel, Vanderbijl, Bots, & Kesecioglu, 2010; Han et al., 2010; Heiderscheit, Chlan, & Donley, 2011; Korhan, Khorshid, & Uyar, 2011; Lee, Chung, Chan & Chan, 2005; Szilagyi, Dioszeghy, Frituz, Gal, and Varga, 2014; Chlan et al., 2001; Wong et al., 2001). In other studies, patients were randomly assigned to

a group who used noise canceling headphones or a group who did not listen to music, both used as control groups (Chlan et al., 2012; Chlan et al., 2013; Han et al., 2010).

Randomized controlled trials are better known as quasi-experimental studies because they are not true experimental studies using randomized sampling. The limitations of these studies are lack of randomized sampling and frequently no evaluation of the long-term effects of music listening on anxiety and agitation, which are maintenance effects (Chlan et al., 2012; Chlan et al., 2013; Tracy & Chlan, 2013; Heiderscheit et al., 2011). For example, researchers have frequently evaluated the effect of music on anxiety over two to three days, but not the effect of music over an extensive period of time, such as the duration of time patients are on the ventilator or those who have dependence of mechanical ventilation of weeks to even upwards of a month. Vital signs and other markers for anxiety and agitation have been measured for minutes before, during, and after music listening (Beaulieu-Boire et al., 2013; Aktas & Karabulut, 2015; Almerud & Petersson, 2003; Dijkstra et al., 2010; Korhan et al., 2011), but there are no current studies evaluating music as an intervention to affect symptoms of anxiety after the time of music listening throughout the duration of the day.

Further, researchers have not determined therapeutic dosages of music listening, such as duration and number of sessions, as well as whether or not it has a significant influence on outcomes, such as number of days ventilator dependent or length of stay in the intensive care unit. Additionally, because of mechanical ventilation, patients cannot communicate how they are feeling (Ely et al., 2001). Non-verbal cues are needed, such as changes in vital signs or other motor movements (Tate et al., 2012). Also, when it comes to measuring anxiety and agitation, perceptions vary and complicate self-report measures. For example, Tate, Dabbs, Hoffman, Milbrandt and Happ (2012) found that patients did not specifically use the word anxiety in their

descriptions of their experience, but rather used words such as panic, fear, and frustration. Thus, it may be difficult for measurements to be used universally and communication of needs is often a large limitation to these forms of studies.

In general and across studies, music listening as an intervention to decrease anxiety in mechanically ventilated patients seemed to benefit most participants. However, a majority of the researchers focused on the effect of music, but did not examine or compare specific types of music used during ventilation. Although most individuals enjoy listening to music, certain types of music or a specific song may elicit certain emotions that may negatively affect patients. Thus, it is important to take into consideration music preference. Heiderscheit, Breckenridge, Chlan, and Savik (2014) found that classical music was the most preferred genre, followed by religious, country, and jazz in the mechanically ventilate patients in the study, per patient or family member report. The researchers also examined certain demographics that affected music preference, such as gender, race, age, ethnic heritage, and personal experiences. Piano, voice, and guitar were the three most commonly preferred instrumental sounds (Heiderscheit et al., 2014). Because of the varying music tastes, music preference may play a role in healing and it is not safe to assume that one type of music genre will benefit all populations. When patients are given the option to choose their own type of music, there is great variety (Heiderscheit et al., 2014). Overall, "the wide variety of music preferences among study participants illustrates the necessity for assessment prior to initiating a music listening intervention in order to maximize patient benefit" (Heiderscheit et al., 2014, p. 10).

Variations in Outcome Measures

Depending on the study and characteristics of the sample, anxiety has been measured with vital signs, such as hypertension, tachycardia, and increased respiratory rate (Chlan et al., 2012). Other measures of anxiety have included (a) behaviors, such as patients sitting up in bed or trying to remove the various tubes that were causing them the distress (Tate et al., 2012), (b) frequencies of administrated sedative agents (Dijkstra et al., 2010), (c) stress and inflammatory blood markers (Beaulieu-Boire et al., 2013; Chlan et al., 2012), and (d) self-reported subjective accounts of anxiety levels in more conscious, alert, and oriented patients (Lee et al., 2005). Aktas and Karabulut (2015) measured anxiety in critically ill non-verbal adults with an assessment tool common in the intensive care unit called the Critical Care Observation tool. This tool examines four behaviors: facial expressions, body movements, muscle tension, and compliance with the mechanical ventilator in regards to complying with the intubation tube. The categories are rated from 0 to 2 with a total score possible of 8 (Aktas & Karabulut, 2015). Finally, because mechanically ventilated patients are often administered intravenous sedation medication which may affect some anxiety measures, Dijkstra, Gamel, Vanderbijl, Bots, and Kesecioglu (2010) used the Ramsay Sedation Scale to assess wakefulness, consciousness, and the amount of sedation given. The scale was used to assess patients prior to music listening so researchers could verify more accurate data collection about the effect of music on outcomes measured with physiological markers or other forms of measurement.

Variations in Interventions and Samples

Type of music, ways of music listening, and selection of music varied across studies. For example, some researchers administered music through headphones (Chlan et al., 2012) and others used ergonomic audio pillows with speakers to project the music to the patient at a volume that would not disturb other patients (Aktas & Karabulut, 2015). Some researchers selected type

of music (Beaulieu-Boire et al., 2013) and others had subject-selected music in more alert

patients (Chlan et al., 2012). Duration of music listening also varied across studies with

increments of time between 30 (Almerud & Petersson, 2003; Dijkstra et al., 2010; Han et al.,

2010; Lee et al., 2005) and 90 minutes (Korhan et al., 2011; Beaulieu-Boire et al., 2013) and for

more alert patients, however long they desired to listen to music and at any point in time (Chlan

et al., 2012; Chlan et al., 2013; Heiderscheit et al., 2011). The characteristics of subjects also

ranged from alert, oriented and cognitively competent patients without sedation (Chlan et al.,

2013) to patients receiving varying amounts of intravenous sedation medication (Korhan et al.,

2011). Those who were alert, oriented, and cognitively competent were able to participate more

in selection of music and self-report (Chlan, Donley, & Heiderscheit, 2012). In regards to

varying other levels of consciousness, for example, Korhan, Khorshid, and Uyar (2011)

compared outcomes in randomized groups of patients that received music listening therapy

without sedation and those who received sedation medication alone. The music listening

intervention was initiated and administered by nurses. The researchers found that systolic and

diastolic blood pressures as well as respiration rate and heart rate decreased in the group of

patients assigned to music listening during the allotted time compared with the control group

receiving sedation only to rest. The mean decreases in heart rate in the music listening group

dropped from 96 beats per minutes to 92 beats per minute. Systolic blood pressures decreased

from 130 mmHg (millimeters of mercury) to 110 mmHg. Diastolic blood pressures decreased

from 67 mmHg to 55 mmHg. Respiration rates decreased from 20 breaths per minute to 17

breaths per minute (Korhan et al., 2011). The control group's vital signs displayed a varying

pattern of decreases during their rest period that proved to have no statistical significance of

change. These vital signs are indicators of relaxation or anxiety with increases or decreases.

Evidenced by these findings, music can help reduce the physiological stressors of anxiety and agitation for short term benefits of listening.

Cost-savings and Music Listening

Despite differences in types of music, selection of procedures for administering music, music interventions, and subjects, researchers, in general, have found that music listening decreases anxiety in this population. Therefore, music listening should be considered as an effective nonpharmacological intervention to implement into practice that is inexpensive and relatively effortless to perform, as mechanically ventilated patients are one of the most costly populations for hospitals to take care of. Daily incremental costs of mechanical ventilation for ICU patients is estimated at between $600 and $1500 per day, with average costs of hospital stays for these patients being around $34, 257 in total (Kirton, 2011). Because prolonged dependence upon mechanical ventilation for respiratory support leads to longer lengths of stay and higher costs for institutions, it is crucial to implement interventions that are cost effective and care effective to aid in the weaning off of mechanical ventilation and a quicker healing time.

In summary, music listening is an inexpensive, easy to administer nursing intervention that can be implemented with very little energy and effort. Music listening can be an option through a variety of ways. Many intensive care unit beds have music listening choices built into the bed itself, with speakers placed in the upper railings near the head for the patient to listen to (Stryker, 2015). The choices can be changed on a monitor at the foot of the bed by the nurse. Other options for music listening include the purchasing of a music playing device, the music itself, and headphones. The most basic of MP3 players are as little as $50 for one unit and includes headphones (Best Buy, 2015). The songs played can be purchased via subscriptions to

music sharing websites such as Rhapsody, with a low monthly cost of $9.99 per month to download music (Rhapsody, 2015). For example, if an ICU holds twelve beds, the cost of the devices altogether would be $600 as a one-time cost. The cost of one year's subscription to a music downloading site such as Rhapsody would be around $120. In total, the cost of implementing a music listening intervention would be around $720 for an entire year. Sedation medications such as Propofol are also used as a means to promote relaxation in these patients. However, the cost of this medication is quite costly. One 20 milliliter amount of Propofol costs between $2.64 and $4.80 (White, 2014). When thinking about how much of this drug is administered to one ICU patient, the costs add up, as one vial of 20 milliliters could be used in just one day. The amount of patients in the ICU who are administered this drug over the span of one year costs the hospital hundreds of thousands of dollars (White, 2014). Music, compared to sedation medication administration, is a significantly inexpensive tool to add to care that has been shown to help reduce patient stress and the effects of stress, including anxiety and agitation and related to decreasing the prolongation of mechanical ventilation dependence.

Overall, all of the previously stated studies concluded that anxiety, stress, agitation, and delirium are consequences of mechanical ventilation, which inhibits a patients healing time. Due to these problems, it is important for nurses to implement different interventions to help decrease these feelings. While there are not many alternatives to mechanical ventilation itself, there are certain interventions, such as music listening, which can help decrease feelings of distress and ultimately benefit the mechanically ventilated patient.

Critical Appraisal of Evidence

Limitations of Findings

Across the studies examined in this review, several trends in limitations were found. To begin, numerous studies defined anxiety and agitation differently and were therefore measured differently. For example, one study conducted by Wong, Lopez-Nahas, and Molassiotis (2001) defined anxiety as, "An emotional state involving subjective feelings of tension, apprehension, nervousness, and worry experienced by a person and that it is found to be associated with sympathetic nervous system arousal" (p. 377). Their focus for their study results, were determined by physiological parameters such as respiratory rates and blood pressure that reflected changes caused by innervation of the sympathetic nervous system. Therefore, their results reflected quantitative changes in physiologic parameters amongst groups in their study. However, another study, conducted by Chlan, Weinert, Heiderscheit, Tracy, Skaar, Guttormson, and Savik (2013) defined anxiety as, "A state marked by apprehension, agitation, increased motor activity, arousal, and fearful withdrawal" (p. 2336). Their study differed greatly in that their results reflected self-reported anxiety from their patients using a scale to reflect what the patients were feeling. This study reported statistically significant decreases in anxiety based on self-reported data given by the patients in their studies. These two studies show how there were differences in measuring anxiety across the studies examined. Qualitative data findings reported in research articles in this review were found to be limited in their application to current practice due to researcher bias. The study performed by Almerud and Petersson (2003) interviewed several patients after their mechanical ventilation experiences. The researchers also recorded and synthesized the responses, threatening the internal validity of their study, because the study on anxiety and agitation in mechanically ventilated patients showed results based on researcher observation, interviews of clinicians, and interpretation of medical data (Almerud & Petersson, 2003). This methodology was self-limiting in that clinical interpretation of patient status varied

based on researcher and clinician backgrounds. The researchers found that identifying anxiety and agitation in their patients was largely affected by clinician and researcher assessment and management of the patient. The study identified limitations in regards to extraneous factors of the caregivers, such as their own attributes and viewpoints about anxiety and agitation as well as knowing the patient through continuity of care (Tate et al., 2012). Because anxiety, sedation, and pain scales used in mechanically ventilated patients are subjective based upon the observations made by clinicians, it can be difficult to identify the true complex psychological state of the patient (Tate et al., 2012). It is imperative to consider researcher and caregiver bias when utilizing scales used by those helping conduct the study.

Some studies showed limitations in their results by incorrectly using correlation as possible causation for anxiety. One study measured stress and used stress as an interchangeable term with anxiety, by evaluating urine cortisol during music interventions throughout a 24 hour period (Chlan et al., 2012). This study's results were limiting in that the researchers were not evaluating for changes in anxiety but physiological blood markers for elevated stress which did not change in twenty-four hours, but incorrectly correlated stress with anxiety by hypothesizing stress cortisol levels arose with higher levels of anxiety (Chlan et al., 2012). Another study performed by Aktas and Karabulut (2015) measured pain before, during, and after invasive endotracheal interventions such as suctioning while listening to music. This study also equated correlation between pain and anxiety when faced with invasive procedures, but could not support causation and thus was limited in its findings. Anxiety could have arisen as a result of anticipated procedures and thus decreased the patient's threshold for pain, but study results only reported evaluations of pain, not levels of anxiety (Aktas & Karabulut, 2015).

One of the greatest limitations noted across study findings was their lack of generalization. Several of the studies examined had specific inclusion and exclusion criteria that narrowed the availability of subjects for their research in turn limiting the types of patients that could benefit from music listening. For example, in a study performed by Dijikstra, Gamel, Van der Bijl, Bots and Kesecioglui (2010), the experiment groups were comprised of alert and oriented patients that had lower APACHE scores (an assessment of the severity of patient disease risk of mortality) which showed greater positive outcomes for their given illness, had no prior neurological or cognitive deficits nor psychiatric histories, and could direct their own music listening at any given time (Dijikstra et al., 2010). Additionally, all studies performed by the researcher Linda Chlan and associated colleagues (2001, 2011, 2012, 2013, 2014) did not include any high acuity patients in their studies. Patients had to be hemodynamically stable, on no vasoactive medications, and had to be well enough to communicate in an effective manner with the research team and follow commands. In many intensive care units, there is a considerable number of patients considered to be high acuity that would be excluded from music listening therapy according to the above study standards. It is unknown if music listening is beneficial to those more intensive patients. Their research findings, then, could potentially only be applied to the specific patient characteristics the researchers found to be inclusive material for their studies. Additionally, several studies found that they could not generalize their findings to larger populations due to their small sample sizes in their studies. The sample sizes varied from having 373 patients participating (Heiderscheit et al., 2014) to as little as 20 patients included in the study results (Wong et al., 2001). The smaller the study, the difficult it is to apply the results to larger demographics of populations.

Next, several important factors that are routine in mechanically ventilated patient care became limitations due to the nature of the intensive care unit protocols. Sedation was a common limitation across studies that confounded results. Sedation medications and analgesics are an effective tool to promote rest and synchronization with the mechanical ventilator in those receiving ventilator support. However, sedative agents produce a somnolent effect on patients and can lower physiological parameters that were measured in these studies such as blood pressure and respiration rate. Opioid analgesics were also a common pharmacological therapy and can in turn produce a sedative effect with changes to respiration rates and blood pressure. Studies performed while patients were on sedation and pain medications had to be evaluated using the Glascow Coma Scale and Ramsay Sedation Scale to determine their level of consciousness and sedative level (Szilagyi et al., 2014). Not only do sedative agents affect the varying changes in vital signs but they also can influence the qualitative responses given to researchers about the level of anxiety they were experiencing. It could not be ruled out that decreased levels of anxiety were not affected by sedation medication or scheduled analgesic medications given to patients in the study (Beaulieu-Boire et. al., 2013). Finally, mechanical ventilation settings could have affected the outcomes of studies that measured respiration rate as an indicator of decreased levels of anxiety. Some ventilator settings such as the synchronized intermittent mandatory ventilation (SIMV) mode could have affected the results on patient respiration rates in the studied conducted by Lee, Chung, Chan, and Chan (2005). This ventilator mode delivers a mandatory breath to the patient when his/her breathing rate became too slow, thus increasing their respiration rate (Lee et al., 2005). Other studies such as the study done by Han, Li, Sit, Chung, Jiao, and Ma (2010) had patients included in their study using pressure support to assist with the work of breathing, excluding patients in need of ventilator delivered

breaths. Weaning trials where the patient is breathing on their own would be an ideal condition for measuring physiological parameters for changes in anxiety levels because the patient is doing the work of breathing. One study did not include mechanical ventilator settings at all (Almerud & Petersson, 2003).

Of the studies examining music listening's effect on anxiety in mechanically ventilated patients, there were mixed results depending upon the variables measured to determine changes. For studies that solely examined vital sign changes before, during, and after the music listening intervention, there were no statistically significant fluctuations in vital signs such as respirations, blood pressure, and heart rate from the patient's baseline during or after the music intervention (Wong et al., 2001; Lee et al., 2005; Han et al., 2010; Dijkstra et al., 2010; Beaulieu-Boire et. al., 2013). As previously mentioned, when examining inflammatory or cortisol blood levels as a possible indication of anxiety related to stress in patients, the study performed by Chlan, Savik, and Engeland (2012) showed that there was extreme variability in the study's results due to patient comorbidities, acute renal insufficiency or failure, or medications that could affect cortisol levels thus exposing the study's inability to correlate cortisol levels with music interventions as a means to decrease overall stress. However, for studies that recorded patient reports of levels of anxiety using scales showed a decrease in anxiety after the music listening intervention. The study performed by Han, Li, Sit, Chung, Jiao, and Ma (2010) showed that their patients self-reported a reduction in anxiety after their music listening time by reporting from a scale provided a lower level of anxiety. These patients, however, were not on any sedation medications, no analgesics, and were cognitively intact, as well as soon to be extubated. It is possible, then, that patients who are close to being completely weaned off ventilator support could benefit from music listening. Findings from Chlan, Weinert, Heiderscheit, Tracy, Skaar,

Guttormson, and Savik's study (2013) also reported reductions in anxiety levels from their patients using the Visual Analog Scale for Anxiety (VAS-A) after listening to music. However, their patients were also alert and oriented, on minimal ventilator support, and could communicate efficiently with staff. It is difficult, then, with qualitative data like from these studies to say that all mechanically ventilated patients could benefit from music listening when only those who can communicate their needs are those being currently studied

In the studies reviewed, there were no longitudinal results reflecting music listening's effect on the patient's anxiety over time. Studies examining music's effect on anxiety were merely a means of an acute or short term nonpharmacological intervention. Study durations of implementing music listening for patients varied but were between one day of study (Wong et al., 2001) to several days of interventional study (Beaulieu-Boire et al., 2013) with varying intervals of music listening time. There were no studies that measured the effect music listening over the entire duration of being mechanically ventilated, nor could one study pinpoint an accurate therapeutic dosing for music listening. Duration of time for each music listening interval varied across studies as well. Some researchers allowed patients to freely use music listening (Chlan et al., 2013; Chlan et al., 2012) while others monitored closely intervention times such as durations of 30 minutes (Almerud & Petersson, 2003) with upwards of 60 minutes (Korhan et al., 2011) or during invasive procedures such as suctioning down the endotracheal tube, lasting only for a few minutes (Aktas & Karabulut, 2015). Some studies only allowed one session of music listening per day (Han et al., 2010) while other studies used multiple sessions throughout a 24-hour period (Dijkstra et al., 2010). Wide variances in duration of music listening and the number of interventions show the difficulty of pinpointing what is a therapeutic dose.

Finally, patient behavior was a factor that confounded results in studies where self-reports of anxiety levels were analyzed. Because researchers need to have informed consent, the patients knew they were going to be evaluated for their anxiety levels and could have had the potential to behave in a particular manner. This effect is known as the Hawthorne effect, and could be a threat to the external validity of qualitative studies because patients could report responses deemed to be what the researchers are looking for instead of what the patient was actually experiencing (Wong et al., 2001).

Validity of Methods

Most of the studies in this systematic review were randomized control trials in which participants are allocated at random (by chance alone) to receive one of several clinical interventions. One of these interventions is the standard of comparison or control. The control may be a standard practice, a placebo, or no intervention at all. The validity, or quality of research methodology of these studies were analyzed. Randomized control trials performed by the team of researchers Chlan, Savik, Tracey, Heiderscheit and Engeland (2012) randomized patients into experimental and control groups after thorough inclusion and exclusion characteristics were implemented. However, in their study of evaluating urine cortisol, they did not control in their methodology for clinical conditions and patient comorbidity related to renal function as potential threats to results and thus their study was inconclusive (Chlan, Engeland, & Savik, 2010). Extraneous factors found in the patient were not controlled for and thus were overlooked by the researchers. Their other studies, however, measured anxiety in mechanically ventilated patients, utilizing research nurses to assist with the study and were not in relation with the researchers themselves (Chlan & Savik, 2012). The researchers removed themselves from the implementation of the music listening process and allowed intensive care nurses working in the

units with the patients in the study to provide the resources for patients to direct their own music listening (Chlan et al., 2013). Several studies used convenience samples in intensive care units in the areas they were performing the study but also randomized the convenience samples into a controlled trial accordingly. Convenience samples are merely a means to find the first available participants and then provide further screening. Because these studies used convenience samples, their validity of methods are poor, for their research lacks generalization in their results and could introduce researcher bias by means of the hospital and patients to which were selected (Dijkstra et al., 2010; Korhan et al., 2011; Han et al., 2010; Lee et al., 2005). Other studies such as the one performed by Beaulieu-Boire et. al. (2013) used randomized control trials and incorporated hospital staff in the intensive care unit to record vital signs and implement music listening in patients not in their direct care. This increases their validity in their study because the researchers did not involve those clinicians that were directly caring for the patient, decreasing possible caregiver bias.

Qualitative studies included in this systematic review were also analyzed. Collection of patient responses was an important factor in evaluating study validity of methods. In the study performed by Almerud and Petersson (2003), the researchers conducted interviews on the patients they had selected for music listening intervention that had been extubated. The researchers and authors of the study conducted the interviews, which provided a validation problem in exposing the potential for a researcher's inability to set aside his/her own preconceived ideas and to be able to produce objective and accurate reports (Almerud & Petersson, 2003). Additionally, patients were not randomized into control or experimental groups; the researchers chose the participants to be placed in each group, thus increasing the infiltration of researcher bias in their study (Almerud, & Petersson, 2003). The study performed

by Tate, Dabbs, Hoffman, Milbrandt, and Happ (2012) also exposed the decreased validity of

qualitative methodology in their study of how to evaluate the presence of anxiety and agitation in

mechanically ventilated patients. From clinician observation reports and interviews of the

clinicians by the researchers, they found that the methods to which clinicians evaluate anxiety

and agitation in this population of patients varied depending upon clinical interpretation (Tate et

al., 2012). Different clinicians, both in the researchers and people taking care of the patients in

this study, indicated that their own attributes and how well they know their patients affects their

assessment and management of anxiety and agitation (Tate et al., 2012). Therefore, validity of

methods by the researchers through their own observations and their interviews exposes bias

from their own perspectives as well as the clinicians involved in their study.

Reliability of Methods and Findings

        Many of the methods used throughout these studies had good intentions, but their

reliability may be in question. All of the studies researched were conducted in an intensive care

unit. Many of the patients on these units require some form of life-sustaining treatment in order

to stay alive. Specifically, the population focused on were mechanically ventilated with an

artificial airway allowing them to breathe. Because of this, the methods used had to be altered for

each individual patient. In order to be reliable, it would have been beneficial for all of the

patients researched to listen to the music intervention at the same time during the day and for the

same amount of time with minimal distractions. However, if a patient were to de-saturate or lose

oxygen because of increased mucus in the airways, it would be neglectful for the nurse to not

interrupt the music listening and suction the patient. Many of the research studies used various

tests in their methods such as The Ramsay Sedation Score, the VAS-A scale, and the critical care

observation tool throughout their study (Aktas & Karabulut, 2015; Chlan et al., 2013; Dijkstra et

al., 2010). These tests set up parameters for the nurses to follow, which aided in the reliability of

the methods chosen. One interesting method that was used throughout every study included

inclusion and exclusion criteria when choosing the participants. In order to be considered for this

intervention study, the patient needed to be hemodynamically stable and without the use of

vasopressors to stabilize blood pressure. This criteria helped strengthen the methods used,

because the researchers were able to use a change in blood pressure as an indication of the

intervention working as it was intended to do. If patients included in this study were using

medication to stabilize their blood pressure, then the methods would no longer be reliable, as it

would be impossible to tell if the change in blood pressure was due to the medication or the

music listening (Aktas & Karabulut, 2015). Another inclusion and exclusion criteria used

included whether or not the patient suffered from mental retardation or a psychiatric disorder. If

a patient did not have the mental capacity to choose their own music or provide information as to

whether the music listening helped with their anxiety, then they were not included in the studies

(Almerud & Petersson, 2003). Trials in these studies worked best when the nurses were unaware

which group was the control, and which group was the experimental. This is extremely important

in order to avoid any type of bias (Beaulieu-Boire et al., 2013; Dijkstra et al., 2010).

Methodologically speaking, some studies used a change in vital signs, some used biochemical

markers present in the urine or blood, and some used the effects of sedation as an indication as to

whether the music listening helped the patient with anxiety and agitation. However, not one

study conducted used all three. Overall, each individual study used a different method in

conducting the research. While some seemed more reliable than others, the ICU environment

decreases the consistency of the methods, because the patient's safety is of utmost priority.

Limitations Across Studies

During the research process, there were many limitations noted across the studies. First of all, one of the most frequent encountered limitations was the small population size. Most of the studies population was based in one intensive care unit (Aktas & Karabulut, 2015; Almerud & Petersson, 2003; Chlan et al., 2001; Ely et al., 2001). With such a small sample size, it is difficult to gauge whether all groups of people are well represented. Also, although the core values of nursing are the same, every ICU runs differently, and because the studies were constricted to one unit at a time, it is not justifiable to say that an intervention is successful simply based off of one location and one group of people. Secondly, this systematic review focused on any changes in anxiety and agitation because of music listening. Through these studies, it was evident that both anxiety and agitation are difficult to measure, whether qualitatively or quantitatively. Although blood pressure, heart rate, respiratory rate, and oxygen saturation can be measures of anxiety, every person is different, and their baselines must be taken before the intervention. A low blood pressure after listening to relaxing music means nothing if the patient already had low blood pressure to begin with. Qualitatively, after being mechanically ventilated with levels of sedation, it is often difficult for the participants to recall what they felt before, during, and after the intervention (Engstrom et al., 2013). The type and strength of sedation was not consistent throughout these studies, which is ultimately a limitation. A third limitation throughout these studies was the overlapping of authors. In seven of the literatures reviewed, the same author is represented. Although this could be seen as a strength, based on the extensive knowledge of the collaborating individuals, it could also be seen as a limitation. Another limitation included the types of music listened to, and whether or not the patient chose the music. In certain cases, the participants or their family members picked a genre of music that they felt made them feel most relaxed (Heiderscheidt et al., 2014; Dijkstra et al., 2010). However, in other cases, the music was

picked by a music therapist (Korhan et al., 2011; Szilagyi et al., 2014). This brings up the question of does the type of music listened to affect the patient outcome. Limitations are often unavoidable, but there are measures that can be put into place to try and correct these.

Synthesis of Evidence

The critical appraisal of the studies in this review concluded several key findings in regards to clinical practice. The first finding found across studies was that anxiety is difficult to quantify, especially in reflection of changes in physiological parameters and is defined differently amongst researchers (Tate et al., 2012). How anxiety can be measured varied across studies with mixed, unreliable results due to how researchers sought to prove anxiety was measured either through physiological changes in the body or in reports made by participating patients. Studies that looked at physiological changes in the body in response to music listening found no changes from patient baselines, but researchers who elicited self-reports of changes in levels of anxiety in their patients reported significantly lower levels of anxiety because of music listening, thus construing generalization. Sample sizes were not large enough for application to larger populations and specific exclusion and inclusion criteria in studies could not incorporate multiple illnesses or high acuity patients. However, anxiety and agitation is a commonplace problem in intensive patients and is associated with higher risks of increased length of stay, patient self-harm through extubation or pulling of invasive lines, and nosocomial infections (Jaber et al., 2005). The study performed by Ely et al. (2001) indicated that as many as eight in ten mechanically ventilated patients experienced delirium while intubated, a possible byproduct of environmental factors as well as the patient's anxiety. Anxiety and agitation can be intermittent or sustained periods of heightened psychological stress and it is important that clinicians are trained to understand the difference in manifestation of symptoms so other

conditions such as delirium, confusion, or pain are not overlooked and categorized with anxiety or agitation (Tracy & Chlan, 2011). Most of mechanically ventilated patients receive pharmacological interventions to assist with rest and synchronization with the ventilator but are also associated with adverse effects such as bradycardia, hypotension, gut dysmotility, immobility, weakness, and delirium (Chlan, Weinert, Heiderscheit, Tracy, Skaar, Guttormson, Savik, 2013). An adjunctive therapy is needed to decrease these adverse effects. However, music listening research has not synthesized adequate results to show evidence it is effective. Researchers, seeing that music listening has no adverse effects or contraindications, recommend music listening as a *potentially* therapeutic intervention for mechanically ventilated patients (Dijkstra et al., 2010). Other researchers such as Wong, Lopez-Nahas and Molassiotis (2001) suggest that music listening being a therapeutic intervention is also influenced by individual coping mechanisms of the patients, therapeutic relationships between clinicians and patients, presence of close family and relatives during care, and physiological improvement in the patient's condition which could potentiate music listening's effect or construe its effect amongst other important nonpharmacological interventions. Music listening, being an intervention that has no adverse effects could be utilized to potentiate other interventions to improve patient anxiety and agitation. Unfortunately, studies included in this systematic review did not evaluate the potential cost of implementing music listening protocols or determination of what a therapeutic "dose" is for patients, thus further research is needed in these areas. However, current practice indicates the beginning of implementation of this intervention. Newer intensive/critical care beds have built in speakers with therapeutic music and tones in the railings of the bed for clinicians to utilize with their patients, such as those built by the company Stryker (Stryker, 2015). Hospitals also utilize the Continuous Ambient Relaxation Environment (C.A.R.E.)

channels on their televisions. These channels combine therapeutic instrumental music and peaceful videos and scenes of nature to promote rest and reduction of anxiety, available 24 hours a day (Healing Healthcare Systems, 2017). Available in over 900 hospital facilities in the United States, C.A.R.E. channels are becoming increasingly more prevalent. Further investigation is needed to determine how anxiety can be reduced by music listening, greater application to higher acuity patients receiving mechanical ventilation in research studies, and how music listening affects patient outcomes. Positive outcomes, beneficial results, and easy implementation of this intervention concluded from research studies in the future will certainly aid in the furthering of music listening into the healthcare setting for mechanically ventilated patients.

Recommendations

Based on the evidence appraised, there are recommendations to continue music listening as an intervention in clinical practice. In certain cases, (Han et al., 2010) there was a significant decrease in vital signs correlating with anxiety and agitation, which indicated that listening to music can indeed help relax those who are mechanically ventilated. In another study, listening to music did have an effect on the release of stress hormones (Beaulieu-Boire et al., 2013). Music is known to help relax and comfort those in distress. However, while mechanically ventilated and on some form of sedation or pharmacological interventions, it is difficult to tell whether music has a reportable effect. Throughout all studies, however, there were no negatives or problems associated with the music listening that could be considered dangerous or detrimental to the patient's health condition. Although music listening may not be the best intervention in reducing anxiety and agitation in mechanically ventilated patients, there is no indication to not use it. If it only helps a small margin of participants, but hurts essentially no one, then it may be seen as a justifiable intervention.

For future studies, there are many recommendations. Collaboration of many differences throughout these studies could indeed bring about more valid and reliable findings. Longitudinal studies across multiple intensive care units can paint a better picture as to how music affects individuals in more than one setting. From the critical appraisal, it would be beneficial for consistency to have stricter parameters, such as starting the music listening as the same time each day and for the same amount of time. It is important to remain consistent. Double-blind studies are also recommended for this intervention, so that bias can be limited and not a variable to consider. Medications also need to be more closely assessed. Although many were hemodynamically stable, these patients may have a range of chronic disorders that require different medications, all of which could affect the response to the music listening intervention. More research is needed to be done to better understand if music listening is beneficial in reducing anxiety and agitation in mechanically ventilated patients. However, because there are currently no cons associated with this intervention, it is justifiable to continue the research.

Timeline of Project Completion

We plan to submit our proposal to the Honors College in the fall of 2016. We plan on enrolling in the senior honors independent study project by splitting our credit hours between the fall and spring semesters of our senior year. We plan to further develop our review of literature and critically analyze our articles during the summer of 2016 throughout the fall of 2016 as well. To make recommendations about clinical practice, education, and future research, we plan to create a poster and present it in some newer facet, as the UASIS is no longer in existence.

Currently, our readers for our project include two members of the nursing faculty, Ms. Lisa Hart and Mrs. Wanda Csaky in addition to our sponsor, Dr. Carolyn Murrock.

Appendix A

APA reference	Background of clinical problem, purpose statement, research question	Clinical practice setting, population, sampling methods, sample size	Design, level of evidence	Evidence-based findings	Practice and research implications
Aktas, Y., & Karabulut, N. (2015). The effects of music therapy in endotracheal suctioning of mechanically ventilated patients. *BACCN Nursing in Critical Care*, 1-9. http://dx.doi.org/10.1111/nicc.12159 Primary source Quantitative	Background: "endotracheal suctioning has been indentified as a painful procedure for critically ill patients" and there is little to no research studying the efficiency of music therapy in pain management during suctioning Purpose statement: "to examine the effect of music therapy on pain, sedation, and physiologic parameters during endotracheal suctioning of mechanically ventilated patients" Research question: does music therapy decrease pain during endotracheal suctioning/how effective is music therapy in decreasing pain	Setting: Cardiovascular Surgery Intensive Care Unit, Medical Park Hospital, Ordu Population: pts scheduled for a CABG or valve replacement, >18 y/o, intubated & needing endotracheal suctioning & in the level of wakefulness 2 or 3 acc. to Ramsay Sedation Scale Sample size: 66 Sampling methods: convenience sampling with random group assignment IV: music listening DV: pain, sedation, physiologic parameter markers Control: usual care	Design: randomized, single-blind experimental study Level 2	pain scores in exp. group were significantly lower than control group during suctioning	"music has an influence that can be used as a therapeutic tool for lowering pain scores in mechancially ventilated pts" music therapy is low cost with no side effects which makes it a viable option of pain managment for pts on mech. ventilators diff kinds of music should be studied in larger trials

Almerud, S., & Petersson, K. (2003). Music therapy--a complementary treatment for mechanically ventilated intensive care patients. *Intensive and Critical Care Nursing*, 19, 21-30. http://dx.doi.org/10.1016/S0964-3397(02)00118-0 Primary source Mixed methods	Background: ICUs have a continuously high noise level which is stress producing Purpose: to ascertain whether music therapy had a measurable relaxing effect on pts who were temporarily on a respirator in an ICU and after completion of respirator treatment investigate those pts' experiences of the music therapy Research question: How does music therapy influence anxiety and agitation in MV pts in the stressful setting of the ICU?	Setting: a moderately large hospital in southern Sweden Population: adult intensive care patients who were temporarily in need of MV and whose condition was physically stable Sampling methods: consecutive sampling Sample size: 20 IV: music listening DV: agitation levels Control: rest under similar circumstances as study group but without the headphones with music	Design: mixed method--non-randomized controlled, and descriptive (interviews) Level 3	SBP and DBP fell during music therapy sessions "no significant differences were shown in repeated measurements between the two groups" pts remember little of their time on the respirator	Music therapy may have a better relaxing effect than the use of headphones without music
Beaulieu-Boire, G., Bourque, S., Chagnon, F., Chouinard, L., Gallo-Payet, N., & Lesur, O. (2013). Music and biological stress dampening in mechanically-ventilated patients at the intensive care unit ward--a prospective interventional randomized crossover trial. *Journal of Critical*	Background: ICU settings and mechanical ventilation are both stressful and cause discomfort, and pharmacological	setting: CHUS MICU of Fleurimont from Jan 200 to April 2011 sample size: 49	design: randomized crossover study level 2	"a trend toward reduction in narcotics was observed with music listening" but consumption of	music listening tends to decrease pain killer consumption and dampens stress hormone release

Care, 28, 442-450. Primary source Quantitative	methods for reducing pain and increasing sedation have a variety of negative side effects Purpose: "to evaluate the impact of slow-tempo music listening periods in mechanically ventilated ICU patients" Research question: does slow-tempo music listening during MV in ICU pts reduce sedative drug consumption and slow down vital signs in not fully alert pts and does it damper inflammatory and HPA axis hormonal release	sampling methods: convenience sampling IV: music listening DV: sedative drug consumption, vital signs, level of stress markers control group: sham-mp3		other sedative drugs remained overall unchanged "biological response is more sensitive than the clinical response after music listening in the current setting"	further research needs to be done to "clarify optimal timing, type, and dose of music listening periods"
Chlan, L., Engeland, W., & Savik, K. (2013). Does music influence stress in mechanically ventilated patients? *Intensive and Critical Care Nursing*, 29, 121-127. http://dx.doi.org/10.1016/j.iccn.2012.11.001 Primary source Quantitative	Background: mechanical ventilation is a stressful experience which produces stress response in body which has deleterious effect on health Purpose: to explore the influence of music on stress in a sample of patients over the duration of ventilatory	Setting: 12 ICUs in the Midwestern United States Sample Size: 65 Sampling methods: convenience with random group assignment IV: music listening, noise-cancelling headphones DV: urinary free	Design:randomised controlled trial Level 2	urinary free cortisol markers did not indicate reduction in stress response for any of the groups. previous studies of music intervention compared to this study indicate that timing of music intervention initiation may play a	urinary free cortisol may not be the most effective way to measure stress response more research needs to be done in which music therapy is initiated immediately after mechanical ventilation is initiated

	support Research question: do mechanically ventilated pts who self-initiate music listening experience less stress than pts who do not listen to music as indicated by levels of urinary free cortisol	cortisol/stress response markers control group: usual care (non-music, non headphones)		role in stress reduction--other studies initiated treatment within a few days of admission to ICU and initiation of mechanical ventilation, while this study initiated music intervention at a median of 8 days after admission to ICU/initiation of ventilator	
Chlan, L., & Savik, K. (2011). Patterns of anxiety in critically ill patients receiving mechanical ventilatory support. *Nurs Res,* 60, 1-17. http://dx.doi.org/10.1097/NNR.0b013e318216009c Primary source Qualitative	Background: "mechanical ventilation is one of the most frequently used technological treatments in critical care units and induces great anxiety in patients" Purpose: describe anxiety ratings, identify pattern of change in ratings, determine if anxiety decreases over course of ventilation, explore influence of sedatives on anxiety ratings Research question: Is there a pattern of change in anxiety	Setting: 5 medical centers (12 separate ICUs) in Minneapolis-St. Paul urban area Population: M/V pts who were randomly assigned to the control group of a randomized controlled trial designed to assess the efficacy of music interventions on anxiety of M/V pts in ICUs Sampling methods: see above Sample size:57	Design: descriptive Level 6	individual anxiety ratings demonstrated patterns of highly individual and variable anxiety "The overall pattern of anxiety ratings for this group of participants over the duration of study enrollment suggested a possible slight decline over time with a highly variable pattern of this symptom experience" "sedative exposure did not significantly influence the	"anxiety is an individual patient experience which requires on-going management with appropriate assessment and intervention over the duratino of M/V support" -some pts don't readily adjust to ventilator & don't experience less anxiety over course of treatment

	ratings, and does anxiety decrease over the course of ventilatory support?			participants' daily anxiety ratings"	
Chlan, L., Tracy, M., Nelson, B., & Walker, J. (2001). Feasibility of a music intervention protocol for patients receiving mechanical ventilatory support. *Alternative Therapies, 7*(6), 80-87. Primary source Qualitative	Background: music has been found to be an effective nonpharmacologic adjunct for managing axiety and promoting relaxation in limited trials of critically ill patients receiving MV Purpose: to test the feasibility of a pt-initiated music intervention protocol over a 3-day trial and to discern the associated abrriers to adherence by study participants and nursing staff Research question: Will critically ill pts receiving MV support use music when feeling anxious or wanting to relax? What are the response patterns of anxiety and selected relaxation indices to music intervention? What are the barriers and challenges to the use	Setting: 2 adult CCUs contained in 1 university-affiliated tertiary care center in the urban Midwest Population/Sample size: 5 alert, critically ill adults receiving MV support Sampling methods: convenience, purposive sampling	Design: descriptive pilot study Level 6	"barriers to this intervention included inaccessibility of the equipment and lack of knowledge and experience of the nursing staff" "due to missing date, physiological measures were not interpretable"	Pt-initiated music is a feasible intervention protocol

	of music by MV pts and critical care staff nurses?				
Chlan, L. L., Weinert, C. R., Heiderscheit, A., Tracy, M. F., Skaar, D. J., Guttormson, J. L., & Savik, K. (2013). Effects of patient-directed music intervention on anxiety and sedative exposure in critical ill patients receiving mechanical ventilatory support. *Journal of the American Medical Association, 309*(22), 2335-2344. Primary source Quantitative	background: patients who are mechanically ventilated require interventions to reduce anxiety and stress and pharmacologic methods (when used alone) may have adverse effects purpose is to test whether listening to self-initiated patient-directed music (PDM) can reduce anxiety and sedative exposure during ventilatory support in critically ill patients Research question: does pt-directed music reduce anxiety and sedative exposure during ventilatory support in critically ill pts?	Setting: 12 ICUs at 5 hospitals in the Minneapolis-St Paul Minnesota Population: ICU adult patients receiving acute mechanical ventilatory support for respiratory failure Sampling method: convenience with randomized group assignment Sample size: 373 IV: music listening, noise-cancelling headphones DV: anxiety and sedative exposure control group: usual care (no headphones, no music)	"randomized clinical trial Level 2	"PDM resulted in greater reduction in anxiety compared with usual care, but not compared with NCH -PDM resulted in greater reduction in sedation frequency compared with usual care or NCH -PDM resulted in greater reduction in sedation intensity compared with usual care, but not compared with NCH"	decreased stress/anxiety levels may be due to noise reduction in general as opposed to music intervention, however, music intervention still does have an effect compared to usual care
Dijkstra, B., Gamel, C., van der Bijl, J., Bots, M., & Kesecioglu, J. (2010). The effects of music on	"Background: mechanically	"Setting: ICU in a university teaching	"Design: randomized controlled trial with	Physiological parameters did not	for the sedated, mechanically ventilated

physiological responses and sedation scores in sedated, mechanically ventilated patients. *Journal of Clinical Nursing*, 19, 1030-1039. primary source Quantitative	ventilated ICU patients, even when receiving intravenous sedatives, may experience stress and anxiety. One possible intervention to reduce stress and anxiety is listening to music Purpose statement: to determine the effects of music on physiological responses and sedation score in sedated, mechanically ventilated patients Research question: does listening to music decrease anxiety and stress in mechanically ventilated patients"	hospital in Netherlands Population: mechanically ventilated adult patients Sampling Method: convenience sampling; random group assignment Sample size: 20" IV: music listening DV: level of anxiety and agitation control: usual care	repeated measures Level of Evidence: 2 "	show a significant difference between the groups. Patients in the experimental group showed significantly higher Ramsay (sedation) scores than patients in the control group after the first session of music intervention. The higher score indicate that patients were less responsive to external stimuli	ICU patient, the benefit of music may lie in the associated (deeper) level of sedation that is achieved, which may in turn make the patient less susceptible to stress and anxiety
Ely, E., Inouye, S., Bernard, G., Gordon, S., Francis, J., May, L., . . . Dittus, R. (2001). Delirium in mechanically ventilated patients: Validity and reliability of the confusion assessment method for the Intensive Care Unit (CAM-ICU). *Journal of the American Medical Association, 286*(21), 2703-2710.	Background: "delirium is a common problem in the ICU. accurate diagnosis is limited by the difficulty of communicating with MV pts and by lack of a validated delirium	Setting: Vanderbilt University's academic medical center ICU Population: M/V adult medical and coronary ICU pts Sample size: 96	Design: prospective cohort study Level 4	CAM-ICU validated; 40% of pts who were at a neutral level (baseline) were delirious by both reference	validated CAM-ICU allows for more standardized evaluation; future investigation to determine risk factors for delirium; delirium

Primary source Qualitative	instrument for use in the ICU" Purpose: "to validate a delirium assessment instrument that uses standardized non-verbal assessments for mechanically ventilated pts and to determine the occurence rate of delirium in such pts" Research question: Is the CAM-ICU a valid tool and what is the occurrence rate of delirium in MV pts?	Sampling methods: convenience		standards' and nurses' evaluations--10% met full delirium criteria, 20% met partial delirium criteria, and nearly 50% demonstrated substantial cognitive impairment at the time of discharge	is associated with poor outcomes and should be incorporated into the daily assessment/intervention plan in the ICU
Engström, A., Nyström, N., Sundelin, G., Rattray, J. 2013. People's experiences of being Mechanically ventilated in an ICU: A qualitative study. *Intensive and Critical Care Nursing*, 29, 88-95. http://dx.doi.org/10.1016/j.iccn.2012.07.003 Primary Source: Patient Interview Qualitative descriptive design	Background: More research is needed to improve the ICU experience and promote recovery; achieving this requires a deep understanding of common experiences and needs of the patients. Purpose Statement: The aim of this study was to describe the reported ICU experiences of patients undergoing mechanical ventilation.	Setting: ICU in Northern Sweden Population: Four adult males and four adult females ranging from 45 to 72 years (mean = 59) Sampling method: Purposive Sampling Sample size: 8 individuals (small population size)	Design: Qualitative Descriptive Design through patient interviews Level of Evidence: 4	Patients felt that losing the ability to communicate made them vulnerable, dependent, and powerless which increased anxiety and frustration. Being given a diary and attending a follow-up visit to the ICU helped fill in the missing information. Some did not want to remember.	Does mechanical ventilation increase anxiety in ICU patients? What do patients experience while mechanically ventilated, in order to help solve these problems and provide interventions?

				Further research is necessary to determine their needs and the support that will be best for them.	
Han, L., Li, J., Sit, J., Chung, L., Jiao, Z., & Ma, W. (2010). Effects of music intervention on physiological stress response and anxiety level of mechanically ventilated patients in China: A randomized controlled trial. *Journal of Clinical Nursing*, 19, 978-987. http://dx.doi.org/10.1111/j.1365-2702.2009.02845.x Primary source Quantitative	Background: effects of music on Chinese population are inconclusive and warranted systematic study to evaluate its effect fully for a different Asian culture Purpose: identify the effects of music listening on the physiological responses and anxiety levels of patients receiving MV while in ICU Research question: Do pts exhibit a difference in physiological stress response with music intervention?	Setting: university teaching hospital in Chengdu, China Population: Chinese mentally competent adults in the ICU on MV who not receiving sedatives or IV analgesia continuously Sample size:137 Sampling methods: convenience with random group assignment IV: music listening DV: physiologic response Control: usual care	Design: randomised placebo-controlled trial Level 2	there was a significant reduction in physiologic parameters in the music intervention group, with no change in parameters in the headphones group and a significant increase in parameters in the usual care group	"music as a non-pharmacological nursing intervention can be used as complememntary adjunct in the care of pts with low-energy states who tire easily, such as those requiring mechanical ventilatory support"
Heiderscheit, A., Breckenridge, S., Chlan, L., & Savik, K. (2014). Music preferences of mechanically ventilated patients participating in a randomized controlled trial. *Music Med, 6*(2), 29-38. Secondary source: secondary analysis Qualitative	Background: previous research done on the effects of music therapy in pts on MV lacks info regarding type of music and the different effects based on different music	Setting: 12 ICUs in the Midwestern United States Sample Size: 107 Sampling methods: convenience	Design: descriptive secondary analysis Level 6	Classical music was most requested Genre and instrumental preferences tended to remain stable	music is a useful intervention for decreasing anxiety in MV pts, and determining the pt's music preferences is important for making

	Purpose: to examine music preferences of MV pts to help manage the psychophysiological symptom of anxiety Research question: does pt preference of music make a difference in outcome of music intervention	sampling with random group assignment (population consisted of PDM group from parent study)		over time (demonstrated by 3 pts longest enrolled in study) "when patients are empowered to select their preferred music there is variety in the music they chose"	this intervention as effective as possible
Heiderscheit, A., Chlan, L., & Donley, K. (2011). Instituting a music listening intervention for critically ill patients receiving mechanical ventilation: Exemplars from two patient cases.*Music Med, 3*(4), 239-246. http://dx.doi.org/10.1177/1943862111410981 Primary Source Qualitative	Background: Patients often experience distress and anxiety while mechanically ventilated. Purpose Statement: The case examples illustrate the importance of implementing a music listening protocol to manage the varied and challenging needs of patients in the	Setting: Minneapolis-St. Paul urban area Population: Alert, mechanically ventilated patients recruited from 5 medical centers, resulting in a total of 12 participating ICUs. Sampling method: Random sampling and random assignment. Sample size: this	Design: Case study Level of Evidence: 4	The first patient discussed feeling less anxious when listening to music before other treatments (dialysis). Music listening was used as a means of coping and comfort while the patients' health deteriorated. The second patient used music listening as a	"Despite the numerous challenges in the chaotic critical care environment and the medical complexity of patients, non-pharmacologic, adjunctive interventions, such as music, can provide the mechanically ventilated patient with alternative and meaningful stimuli while promoting relaxation."

	critical care setting.	study looked at 2 individual cases. IV: music listening, and noise canceling headphones. DV: levels of anxiety Control group: standard ICU care		distraction from the stressors of the hospital environment, as well as a coping mechanism to deal with the stress of being critically ill.	
Jaber, S., Chanques, G., Altairac, C., Sebbane, M., Vergne, C., Perrigault, P.-F., & Eledjam, J.-J. (2005). A prospective study of agitation in a medical-surgical ICU. *CHEST, 128*(4), 2749-2757. Primary source Qualitative	Background: agitation is common in the ICU but it has been poorly studied Purpose: to evaluate the incidence, risk factors, and outcomes of agitation in the ICU Research question: does agitation in ICU pts have an impact on outcomes such as self-extubation, removal of arterial and venous catheters, nosocomial infections, and ICU length of stay?	Setting: med-surg ICU of St. Eloi Hospital in Montpellier, France Population: all pts in this setting who were awake and had no history of dementia prior to ICU admission Sampling method: convenience sampling Sample size: 211	Design: prospective observational study Level 6	Agitation is associated with higher incidence of self-extubation, self-removal of catheters, nosocomial infections, longer duration of stay Independent risk factors for agitation are age>65 yr, medical cause of ICU admission (as opposed to surgical cause), sepsis, alcohol abuse, use of sedatives, body temp >38C, sodium level<134 or >143, and long-	"a better knowledge of incidence and risk factors should facilitate identification of patients at risk and decrease the incidence of agitation"

				term use of psychoactive drugs	
Korhan, E., Khorshid, L., & Uyar, M. (2011). The effect of music therapy on physiological signs of anxiety in patients receiving mechanical ventilatory support. *Journal of Clinical Nursing*, 20, 1026-1034 Primary source Qualitative	Background: few studies have focused on the effect of music on physiological signs of anxiety in pts receiving mechanical ventilatory support Purpose: to evaluate the effect of music therapy on a group of Turkish pts and the value of including music therapy in nursing care in this country Research question: What are the effects of classical music (relaxing music) on the physiological signs of anxiety in pts on MV?	Setting: the ICU of a university hospital in Izmir Population: pts in ICU of this hospital on MV Sampling methods: convencience sampling Sample size: 60 (power analysis) IV: 60 minutes of music listening (classical music with 60-66 bpm tempo) DV: physiological markers of anxiety Control group: usual care	Design: case-control study Level 4	Statistically significant difference in mean SBP and DBP and mean respiratory rate between groups, showing decreases in each of these parameters over time for the the experimental group	"music should be considered a first-line therapy to allay anxiety in pts receiving mechanical ventilation" "nurses should include music therapy in the routine care of pts receiving MV" "further research is needed to explore the effect of the duration and kind of music sessions to be used on pts receiving MV"
Lee, O., Chung, Y., Chan, M., & Chan, W. (2005). Music and its effect on the physiological responses and anxiety levels of patients receiving mechanical ventilation: a pilot study. *Journal Of Clinical Nursing, 14*(5), 609-620. http://dx.doi.org/10.1111/j.1365-2702.2004.01103.x	Background: mechanical ventilation, although sometimes lifesaving, is often associated with levels of anxiety	Setting: Hong Kong Polytechnic University teaching hospital ICU Population: adult pts in this ICU	Design: randomized controlled trial Level of Evidence: 2	Pts on MV that listened to a single 30-minute session of music appeared to show greater relaxation as manifested by a	"Music can provide an effective method of reducing potentially harmful physiological responses arising from anxiety in mechanically ventilated pts"

Primary source Quantitative	requiring sedatives, which has inevitable implications on costs and complications Purpose:to investigate the effects of music on the physiological responses and anxiety levels of pts on MV Research question: Will music reduce the HR, RR, SBP, and DBP of pts on MV and are there any differences between a music intervention group and control group for these parameters? Will music reduce the Chinese State Trait Anxiety Inventory (C-STAI) anxiety levels of pts on MV and is there any difference between a music intervention group and control group for this parameter?	who were mechanically ventilated, alert, able to obey commands, able to hear, hemodynamically stable, and had no psychiatric illnesses Sampling Methods: convenience sampling with random group assignment Sample Size: 64 (power analysis) IV: 30 minute music intervention DV: physiologic and subjective indicators of anxiety Control group: 30 minute rest period		decrease in physiological indices and an increase in comfortable resting behaviors	"Music therapy can act as a simple and safe nursing intervention to allay anxiety and promote pt comfort"

Linnemann, A., Ditzen, B., Strahler, J., Doerr, J., & Nater, U. (2015). Music listening as a means of stress reduction in daily life. *Psychoneuroendocrinology*, 60, 82-90. http://dx.doi.org/10.1016/j.psyneuen.2015.06.008 Primary source Mixed methods	Background: stress has potential to be a major health threat facilitating the development of disease and illness Purpose: to examine the potential stress-reducing effect of music listening in everyday life Research question: does music listening reduce stress levels, both subjectively and physiologically?	setting: University of Marburg, Germany psychology classes Population: healthy students in these classes between age 18-35 Sampling methods: convenience sampling Sample size: 55 (35 female, 20 male) IV: music listening, time of assessment (beginning of semester or exam week) DV: stress levels control: beginning of semester stress level	Design: ambulatory assessment study Level 3	Music listening reduces stress in daily life Relaxation as a reason for music listening is associated with the stress-reducing effect of music listening	listening to music may be a promising adjuvant treatment option for patients; Interventions for the purpose of stress reduction should focus on manipulating the intentions behind music listening
Szilagyi, A., Dioszeghy, C., Frituz, G., Gal, J., & Varga, K. (2014). Shortening the length of stay and mechanical ventilation time by using positive suggestions via MP3 players for ventilated patients. *Interventional Medicine and Applied Science, 6*(1), 3-15.	Background: "long stay in ICU and prolonged ventilation are deleterious for	Setting: Department of Anesthesiology and Intensive Therapy of Semmelweis University,	Design: randomized controlled trial Level 2	the suggestion group could be weaned off from MV 3.6 days earlier and were	results need confirmation by another study with more subjects "Using positive

http://dx.doi.org/10.1556/IMAS.6.2014.1.1 Primary source Quantitative	subsequent quality of life and surcharge financial capacity." suggestive communication has been demonstrated to shorten recovery time Purpose: to evaluate whether suggestions offer anything extra compared to the already known methods of stress-reduction Research question: is the length of recovery reduced by preventing complications which are usually the consequences of learned helplessness and other negative psychological effects developing due to the ICU environment via possitive suggestions?	Budapest, Hungary Population: adult ventilated pts admitted to the ICU Sampling methods: convenience sampling with random group assignment Sample size: 26 (no power analysis) IV: group assignment (positive suggestion, music control, traditional control) DV: time spent on ventilator, length of stay Control: music listening group, traditional care group		discharged 4.2 days earlier than the control group	suggestions is now an accepted method, but it supplements the standard intensive care in a few places only"
Tate, J., Dabbs, A., Hoffman, L., Milbrandt, E., & Happ, M. B. (2012). Anxiety and agitation in mechanically ventilated patients. *Qualitative Health Research, 22*(2), 157-173. http://dx.doi.org/10.1177/1049732311421616	Background: anxiety and agitation occur frequently and are important considerations when	Setting: a 28-bed, medical step-down ICU Population: pts	Design: qualitative secondary analysis Level 6	"All patients exhibited agitation or described feeling anxious at	It is very important for clinicians to communicate with their pts about potential

Primary source Qualitative	weaning pts from prolonged MV Purpose: to "describe characteristics of anxiety and agitation experienced by MV pts, to explore how clinicians recognized and interpreted anxiety and agitation, and to describe strategies and interventions used to manage anxiety and agitation with MV pts" *to provide a more thorough describption from the viewpoint of individuals who experienced and managed anxiety and agitation during critical illness	who required MV for at least 4 days with a minimum of 2 failed weaning attempts Sampling methods: purposive non-probability sampling Sample size: 30		least once during the study period" Instances of anxiety made it more difficult for the pt to wean off the ventilator, and situations that increase oxygen demand were found to be common triggers of major anxiety which would result in a failed weaning attempt	barriers to weaning from the ventilator, as well as possible methods of overcoming those barriers
Wong, H., Lopez-Nahas, V., & Molassiotis, A. (2001). Effects of music therapy on anxiety in ventilator-dependent patients. *Heart and Lung: The Journal of Acute and Critical Care, 30*(5), 376-387. Primary source Quantitative	Background: mechanical ventilation is a life-saving measure that also induces a great deal of stress and anxiety which can have harmful effects on the course of recovery Purpose: to assess the effectiveness of music therapy in decreasing anxiety in ventilator-dependent pts	Setting: the ICU of a university hospital in Hong Kong Population: adult Chinese pts who were ventilator-dependent Sampling methods: non-probability convenience sampling Sample size: 20 IV: music listening	Design: crossover repeated measures design with random group assignment; pretest-posttest Level 2	"Findings indicated that music therapy was more effective in decreasing state anxiety than was an uninterrupted rest period" BP and RR were lower at the end of the intervention in the study group than in the control group	"Music therapy is an effective nurisng intervention in decreasing axiety in ventilator-dependent pts and its use should be incorporated into the care of MV pts"

	Research question: Does listening to relaxing music decrease anxiety in terms of physiological response and C-STAI?	DV: anxiety and agitation Control: uninterrupted rest period			

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