Sleep Disruptions within the Hospital: A Growing Problem Affecting all Patients

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A Senior Thesis submitted in partial fulfillment
of the requirements for graduation
in the Honors Program
Liberty University
Spring 2022

Acceptance of Senior Honors Thesis

This Senior Honors Thesis is accepted in partial
fulfillment of the requirements for graduation from the
Honors Program of Liberty University.

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05/01/2022

Abstract

The circadian rhythm is a complex and interwoven system within each human being that creates an internal clock each day. However, patients in all hospital settings continue to have their sleep disrupted by many factors. Seep being disrupted in the hospital patients can develop serious complications. To this day, the issues causing have not been adequately assessed and therapeutically intervened with consistency within nursing practice. Using the Whittemore and Knalf Framework, this integrative review will examine the literature on aspects of inpatient care that contribute to circadian disruptions within hospitals. By doing so, the research can be built upon with further research to raise awareness and outline new nursing recommendations for better practices moving forward.

Keywords: circadian rhythm, hospital, sleep deprivation, care

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Problem Identification

The U.S hospital system is prided on being one of the best healthcare systems in the world. In 2021 this literature regards U.S healthcare as the eleventh best in healthcare worldwide (Schneider et al., 2021). This being said, here are often many faults found within the United States healthcare system including recent years of sleep disruption.

The United States healthcare system has many errors in healthcare including sleep disorders. Specifically, patients' circadian rhythm within the hospital can become disrupted, dysfunctional, and become complicated due to the care patients receive. The circadian rhythm is defined as variations in a biological clock due to intrinsic factors that cause a 24 hour and 7 days-a- week cycle (Goldstein, 2022). This cycle not only controls the sleep-wake cycle but also controls blood pressure, cortisol levels, and temperatures within the body. However, the main function of the circadian rhythm is to drive wakefulness within the body. This drive allows the body to wake up in the morning and accumulates during the day to initiate tiredness at the end of the day. In the first half of the sleep period, the sleep drive within the body decreases significantly to decrease alertness within the night. This action creates deep sleep for healing, hormones, and memory to regulate within the body (Goldstein, 2022).

For a patient to maintain this circadian rhythm cycle, the body uses zeitgebers. Zeitgebers are cues within the body's circulation, such as the light-dark cycle, feeding, social interactions, and activity. This phase-shifting including the light-dark cycle is maintained by the light exposure, throughout the day. If light exposure is changed throughout the day, into the night, or the early morning the circadian rhythm can become altered. Sleep disruption occurs as a result of

an alteration to circadian rhythm caused by extrinsic factors. Besides the light-dark cycle, there are many other extrinsic factors that affect sleep. Many other external factors within the hospital can alter sleep for patients which in turn can cause complications (Goldstein, 2022). These external factors include sound, light, and medical interruptions.

As these external factors play into a patient's sleep, there also may be intrinsic factors that may alter the circadian rhythm. External factors alter a patient's sleep cycle, which then alters intrinsic factors within the circadian rhythm. These intrinsic factors can include patients' preferences, comorbidities, awakenings, and accommodations. Within the hospital, there are 3.3 % more awakenings during a hospital stay than within the home (Wesselius, 2018). Also, in a recent study, the average duration of sleep within the hospital was 5.5 hours (Arora et al., 2017). These awakenings can cause a significant impact on a patient's health and can decrease healing outcomes internally and externally. Due to the impact these disruptions can have on patients, medical personnel should make circadian rhythm changes a priority to improve healthcare delivery.

Normal Pathophysiology of Sleep

The pathophysiology of sleep starts with the sleep architecture. Two types of sleep make up sleep architecture including non-rapid eye movement (NREM) and rapid eye movement (REM). NREM is further divided into stages 1, 2, 3 and 4 (Smith et al., 2017). The stage 1 of NREM begins at the start of sleep as it is very light and an individual still can be awakened with disruptive noise. This stage of sleep lasts 1-7 minutes taking up 2-5 percent of sleep during the night. The stage 2 within NREM is a deeper sleep as it takes a more intense stimuli to become awakened. This stage lasts around 10-25 minutes within the initial cycle and prolonging with each cycle. Specifically, this cycle lasts around 40-55 percent of sleep. Within this cycle, EEG

has shown that this stage includes low voltage, mixed activity within the brain with the presence of sleep spindles and K-complexes. The sleep spindles are important for memory consolidation causing long -term memory within this cycle. The K complexes change blood pressure and heart rate during sleep. The sleep stage 3 and 4 are known together as the slow-sleep wave. These stages together occur at the first third of sleep within the night. Stage 3 directly only lasts for several minutes only taking up 3-8 percent of sleep. The last stage, stage 4, lasts for 20-40 minutes and takes up 10 percent of sleep altogether. Both stage 3 and stage 4 have high vulvate slow brain wave activity causing deep sleep in the body. Collectively, NREM decreases the sympathetic nerve pathway as sleep deepens within the stages causing relaxation and decreasing respirations. NREM cycles also helps build bone, muscle, tissues, and strengthens immune system causing overall healing in the body.

REM is defined by the desynchronized brain activity with low voltage, high frequency within the brain with temporary paralysis of arms and legs, and rapid eye movements within the body (Smith et al., 2017). In this sleep cycle sawtooth waveforms and slow activity of brain appears during the night. At the first sleep cycle of REM lasts only 1-5 minutes but continues to prolong with each sleep episode. A significant factor of this cycle is that the sleep produces dreams and helps process memories for consolation within the brain. Additionally, within the REM cycle endocrine functions such as growth hormone, thyroid hormone, and melatonin are secreted. Specifically, growth hormone is most impacted within REM and the slow sleep wave stages. The normal pathophysiology of sleep can be influenced by many factors including internal and external stimulus. Through research, sleep can be heavily disrupted within healthcare can individually impact the stages of sleep in NREM and REM cycles. The specific disruptions of sleep cycles from hospital factors will directly be stated at later within the paper.

Significance of Problem

Patients' stays within the hospital have often been regarded as unpleasant and uncomfortable. Though many factors contribute to these feelings of dissatisfaction, sleep is commonly one of them. As research has been studied, patients through time have experienced unfulfilling sleep during their hospital stay. This affected sleep that people experience causes complications to their bodies. These complications include increased delirium, decreased immune response, and dementia. In 2017 a study using regression analysis found that disturbances of the sleep-wake cycle caused delirium (FitzGerald et al., 2017). This complication to circadian rhythm disturbances showcases the importance of the issue and the changes that need to be made. Additionally, a research study suggested that "64% of disruptive noises in the ICU setting over a 24-h period (such as unnecessary alarms, and conversations) were avoidable through behavioral modification on the part of healthcare staff" (Stewart et al., 2017). The research found on impaired sleep within the hospital has been absurdly clear that patients continue to have sleep affected through several avoidable factors including external environment and aspects of healthcare delivery.

With these problems discussed, the significance of this research is geared toward the patient. As stated previously, a patient's sleep becomes negatively impacted during a hospital stay. This area of concern drives the research to understand the factors which most disrupts the patients' sleep. By doing so, this research can help increase the care of patients, decrease hospital costs, and decrease complications within the hospital. Moreover, this research is vital to improving the health care system in the United States and throughout the world for better health outcomes for patients in the near future.

Research Questions and Purpose Statement

The study focuses on the literature on multi-level factors of sleep disruption during hospitalization, including hospital facilities, staff procedures, and personal accommodations. More specifically, the study aims to answer the following research question: What aspects of care are contributing to the occurrence of sleep disorders among hospital patients? The purpose behind this question and study is to actively advocate for the sleep cycles of patients in the hospital setting. By synthesizing the literature, steps can be made toward giving overall better patient care and hospital experience. Furthermore, this can result in improved patient outcomes, stays, and costs. Inquiry regarding the dynamics of these factors can provide recommendations for improvement of circadian rhythm disorders in the hospital setting for all patients within the United States of America.

Methods

Conceptual Framework

Foundational research is framed by a number of frameworks and guidelines. This current study consists of an integrative review design, with the application of the Whittemore and Knalf Framework. The Whittemore and Knalf Framework is defined as having five categories to organize a literature review (Whittemore & Knafl, 2005). These components include problem identification, literature search, data evaluation, data analysis, and presentation. Through this chosen framework, the research findings are organized and showcases the themes found. To clarify, the problem identification within this research includes the significance of the project as the problem with sleep disruption in the hospital facility is stated. The second component of this framework includes the literature search. Within the literature search, the PRISMA framework, was utilized to identify databases and sources used to systematically identify research found. The

third component of the framework is the data evaluation. This component exposed three strong themes from the literature found within the review. These themes include changes in the hospital setting, process of giving care, and health outcomes. The fourth component of the framework is the data analysis which involves processing the strengths, weakness and limitations to the data found. The last component of the Whittemore and Knalf Framework (2005), is the presentation of findings. This component includes recommendations and implications of the results that are found within research. Overall, the Whittemore and Knalf Framework can be outlined in appendix B for reference.

Literature Search

Inclusion Criteria

Inclusion criteria are applied to the final data compilation and analysis to ensure the most effective results. Firstly, the literature review required the articles to be of original research. This did not include previous literature reviews as they are not primary research. However, the use of original research is used in the integrative review including mixed-method studies, quantitative and qualitative research. Secondly, the inclusion criteria required these studies to be peer-reviewed or high quality to ensure effective literature. Thirdly, this criterion required that at least one factor on the effects of sleep disruption be mentioned within the research article. Specifically, these studies must present findings of sleep disturbance within the hospital system as that is the main categorical research problem. Fourthly, the articles must be presented within the last 5 years to provide up-to-date information within the hospital setting. This ensures accuracy and effective research. Lastly, the inclusion criteria must be written in English to prevent confusion and inaccuracy within the research articles. The inclusion criteria helped lead the way for articles and ensured the highest level of accuracy in the studies found.

PRISMA Framework

As part of the inclusion criteria, each article search was analyzed and was either kept or discarded for accuracy. Furthermore, when articles met the inclusion criteria, they were screened for proper condition. This process of reducing the number of research articles was aided by the PRISMA framework (Liberati et al., 2009). The PRISMA framework starts with the phases of search, eliminating duplicates, evaluating articles, and synthesizing the literature (Liberati et al., 2009). The synthesis of articles led to the implementation of guidelines to improve research reporting. Often, guidelines for literature reviews are put in place to improve the research process. The synthesized PRISMA framework that was used within this study is seen in Appendix A.

The search for these research articles was started by entering the research terms within the databases. The databases used were Medline, CINHAL, PubMed, PsychInfo, SAGE Journals, MEDLINE Ebsco, and ScienceDirect. Once the search terms were put in the databases, the first set of results was classified into the identification portion of the PRISMA framework. Once these sources were gathered, duplicates of sources were removed to improve the efficiency of the research. After the duplicates were removed, the remaining sources proceeded through the initial screening process. This initial screening process was done by looking at the article's title and abstract to see if there was any mention of sleep disruptions within the hospital setting. If the sources did not mention anything about sleep disruptions within the hospital, the resource would then be discarded. Also, if the source did not meet the inclusion criteria that were previously stated, it was excluded as well.

Following this, the next step was to verify the eligibility of the source. This included a full-text reading of the article (Liberati et al., 2009). If the article was not pertinent to the

inclusion criteria and did not stay relevant to the research article it was again discarded. The literature that was still included from the previous screenings, was then included in the article synthesis. The article synthesis is what makes up this research study. Once these articles had been synthesized, the literature was processed through a system of data extraction. Specifically, the identified data extraction includes the author, study design, year, sample size, sleep disruption factor, and the outcome of the study. This data extraction table allows the previous literature to be categorized and collected. After this process has been completed the research is then compiled into themes of hospital sleep disruption and findings to be used within the literature review. This complication of findings will include statistics, data, statements, and quotes. The data extraction table can be viewed in Appendix C. Using the data extraction table, relevant research and identifiable factors can be used for future research in the United States healthcare system.

Data Analysis

Overview of Findings

The first search within these seven databases resulted in the data retrieval of 6,681 sources. The data from each database source is as follows: 580 in Medline, 2,590 in CINHAL, 1,489 in PubMed, 50 in PsychInfo, 746 in SAGE Journals, 241 in MEDLINE Ebsco, and 1030 in ScienceDirect. After the first search through the database, 58 duplicates were removed. Also, after the initial search, 6,102 sources were eliminated. These sources were eliminated for various reasons. Firstly, many studies did not focus on the outcome of the sleep disruption within the hospital causing those sources to be removed. Secondly, many studies were not primary research which had to be eliminated. Lastly, many studies did not fit the inclusion criteria. The 579 articles that remained went under a full-text analysis. Within the eligibility phase, these 579

articles were read with only 20 articles to be included in the compilation of the research study. The 559 articles excluded did not include the following: hospital sleep disruption not listed as an outcome, fails to mention a factor within the hospital sleep disruption, does not include or is unable to access the full text of the source. See appendix C again for the resources of the 20 articles and their primary statistics used. The PRISMA framework helped organize the research with a beginning search, duplicates removed and eligibility to allocate the best sources for a literature review about patients' sleep disturbed within a hospital setting.

Summary of Literature

Article Type and Quality

The PRISMA framework compiled 20 articles about the effects of sleep disruption within a hospital setting, varying in article type and quality. As stated previously, these 20 articles have been published in the past five years. The issue of sleep disruption within the hospital remains relevant and demonstrates the urgency of the issue within the healthcare system. In addition, these articles written in the last 5 years, indicate the reliability of the research within multiple databases.

Accompanied by the quality of the articles chosen, the literature reviewed varied widely in article types. The data collected and synthesized comes from two cross-sectional studies, two randomized studies, two pilot studies, two multimodality studies, three non-randomized studies, one qualitative study, eight observational studies, one case-control study, and one exploratory descriptive study. All 20 articles included more than one author throughout, indicating a higher level of reliability of the resources. Additionally, all these pieces of literature met the inclusion criteria but contained different aspects of the impact of sleep within the hospital. As the information found about sleep disruption within the healthcare system was organized by the

frameworks stated previously, the findings of each source will be discussed in considerable detail. Research of this kind will be able to provide a deeper understanding of the issue at hand.

Theme 1. Through the research process, there was an abundance of literature focusing on the theme of structures of care that damage sleep within the hospital. As part of the structures of care, there are individual elements including environmental sound, activity, and lighting. Furthermore, these characteristics revolve around the setting of the hospital that affects a patient's sleep during their hospital stay. To begin with, the amount of ambient noise within the hospital is crucial for a patient's sleep. Studies have shown that hospital environmental sounds are higher than recommended, causing disturbances. According to Knauert et al. (2016), the average ICU sound level is between 43 and 66 decibels on the A-weighted scale (dba), with peak levels reaching 80-90 dba. Thus, the noise levels are simply too high. Knauert et al. (2016) specifically point out that WHO recommends limiting hospital noises to an average of 30 dB to 40 dBA at a maximum. In another study, Locihová et al. (2020) explicitly pointed out, "The present study also showed a strong association between time and noise levels, with minimum values between midnight and 1 a.m. Noise levels consistently exceeded the recommended standards, with the highest level being 64.3 dB". Noise levels within the hospital are well above health guidelines, indicating a growing concern over sleep disturbances. Again, in a recent research study, it is stated that 11-17% of awakened nights can be attributed to noise (Darbyshire & Duncan Young, 2021). With high amounts of noise disruptions, noise above the recommended limit of 30 dB decreases REM cycles and increases stage 1 of NREM sleep (Blume et. al, 2019). This change in sleep 1 cycle and REM prolongs wakefulness sleep and decreases memory consolidation within the brain. Due to this, the correlation of sounds within the hospital environment does have an impact on the recovery of patients as healing can be impaired.

Not only are the sounds within the hospital an issue but the background noises also contribute to sleep disruptions within patients. In a study, areas with dense floors and walls tend to amplify reverberation (Darbyshire & Duncan Young, 2021). Due to these factors, speech understanding can become impaired causing increased vocal use when background noise rises above 50 dba. A hospital averages most noises at around 50 dba, so vocal sounds continue to increase and disrupt sleep for patients. In this article, Danielson et al. (2018) have similar responses as it shows that even in empty hospital rooms there is still an average of 42 dba due to acoustic floors and background noise sources, including ventilation systems. In addition, Adell et al. (2021) also reported the most irritating factors causing sleep irritation on the first day of admission as alarms, nebulizers, and aspiration secretions as these factors create noise for patients. Patients reported hearing people speak when trying to fall asleep at night (Garcia Guerra et al., 2018). The increased noise has been shown to increase the production of hormones such as epinephrine, cortisol, and increase heart rate. With the stimulation of the SNS, patients' wakefulness can become increased and prolong the ability to fall asleep (Fink et al., 2018). Displaying that hospital environmental settings correlates with impaired ability to sleep and attributing to further complications.

These noise disruptions experienced within the hospital setting are recognized by clinicians and healthcare staff in many research studies. The nurses reported that the hospital floors were "inappropriately loud" during the night (Danielson et al., 2018). The admission of nursing staff proves that noise levels within the hospital setting are a considerable issue both during the day and at night. Again, in another study, "100% of clinical staff members identified noise as the major environmental stressor that affected patients' nighttime sleep" (Ding et al.,

2017). There has been a noticeable increase in sound issues within the healthcare staff, supporting the significance of this healthcare problem found worldwide.

In addition to the ambient sounds within the hospital that disturb sleep, other forms of environmental activity can also negatively impact sleep. Environmental activity includes the workforce within the hospital coming to and from the hospital floor. Oftentimes, emergency departments and ICUs are found to be more heavily trafficked than outpatient centers. This environmental activity can disrupt patients and cause poor sleep. In a research study patients' sleep was found to be improved on the weekend. The clinical activity in the ICU reduces at weekends due to variations in staffing levels and a reduction in elective hospital activity (Darbyshire & Duncan Young, 2021). In Darbyshire & Duncan Young (2021) the differences between weekend and weekday activity levels were statistically different in an impactful way. This environmental activity change could benefit patients from their sleep being disrupted in the REM and NREM stage 1 sleep cycles if implemented on a day-to-day basis compared to only a weekend basis.

While environmental sounds can negatively impact a patient's health, light levels found within the hospital setting can also create sleep barriers. Lux is a measure of the amount of light in a healthcare environment. Lux is a unit of measurement defined by the illuminance on a certain surface (1 lux = 1 lumen/m2) (Craig et al., 2021). A patient's circadian rhythm is known to be affected by illumination levels up to 180 lux (Diaz et al., 2019). However, in ICU settings the lux level should not be above 20 lux at night (Craig et al., 2021). According to Diaz et al (2019), the study results indicate that the ICU light level exposures varied from 5 to 1500 lux throughout the environment. Due to this, patients in the ICU for seven days began to have

desynchronization of clock genes. This desynchronization of clock genes led to a loss of circadian rhythmic behavior. In Craig et al. (2021), the mean maximum lux illumination of light was 33.43 which is 13 units above the recommended rate in an ICU during the night hours. This case study does indicate that the more medically demanding a patient may be throughout the night, the lighter exposure there may be due to increased care needs. Nevertheless, this increased light exposure can be detrimental to the patient's health as it can desynchronize the patient's circadian rhythm. The transitions between the sleep cycles can be fragmented due to increased light levels. Furthermore, this fragmentation of sleep can cause poor deep sleep and altering bodily hormones further impairing healing. In addition, a third research study (Engwall et al., 2017) measured 145 lux during the night. This exposure to light at night across numerous hospital studies showcases how this light level can impair the production of melatonin within the body. As melatonin relies on light cues to induce sleep and produce melatonin the consistent light levels can impair this ability. Furthermore, as melatonin can become impaired, the lack of production can cause restlessness and poor ability to want to sleep. This causes a serious concern for sleep disturbance within the hospital setting as the patient’s sleep is continually being disturbed.

Research studies indicate that lux levels remain high at night even when the recommended lux levels should be lower. However, during the daytime lux levels should increase, to stimulate natural circadian rhythms for patients in their hospital beds. As stated previously, a human being’s circadian rhythm is scheduled to have a 24 hour/7 day a week circadian rhythm. Among all factors, lighting has the highest influence on sleep rhythm. The recommended lux levels for daytime hours to promote the circadian rhythm are 1000 lux

(Lusczek & Knauert, 2021). In a study by Knauert et al. (2019), morning light levels were seen to be dim on the hospital floor, with several quick exposures to bright light. The compilation of low light in the morning with brief exposures to light can quickly desynchronize a patient's circadian rhythm. In a second study, the lux illumination levels were 318 during daylight hours (Engwall et al., 2017). This theme is seen again in a third study as the lux levels during the day range from 55-103 lux and a morning median of 116 lux (Lusczek & Knauert, 2021). The lack of light illumination can dysfunction the secretion of melatonin as it can produce during the day and cause a longer duration of sleep during the daytime (Blume et. al, 2019). This impairment of melatonin causes the brain to become confused of sleep times within the body resulting in patients often sleeping throughout the day and not at night. The changes to activity, sound, and light within the structure of care deeply affect patients' sleep cycles during their hospital stays. Topics such as these are linked to the locality of care as the factors are specific to the hospital setting alone. The other factors contributing to sleep deprivation will be discussed further.

Theme 2. The second principality found within literature that influences the outcome of a patient's sleep cycle within the hospital setting is the process of care setting. This theme is again defined as the way in which patients receive care. Within this realm, the findings from research studies identified staff procedures, and personal accommodations as the themes for care settings. To start, the staff procedures within the hospital are set in stone by institutional writing. A nurse must follow the hospital's protocol regarding what healthcare personnel must do. The research study found that at least 100 percent of the participants (38 out of 38) reported that the in-room disruptions frequently shortened their sleep (Ding et al., 2017). Again, this theme was reiterated by another study in which patients reported that healthcare workers woke them up every 2-3

hours for medical services causing discomfort to their sleep at hand (Mouch et al., 2020). Patients in a third research study had the same issue with being awoken up to 8 times an hour within the ICU (Stewart et al., 2017). The presence of healthcare works within hospital rooms can cause sympathetic factors including epinephrine and cortisol (ATCH) to release (Blume et. al, 2019). This sympathetic stimulation counteracts the NREM stages causing wakefulness and poor deep sleep. This further prevents tissue, bone and muscle regeneration causing serious sleep discomfort to many patients.

Though in-room disruptions for hospital care affect patient sleep it can be a non-modifiable stressor as many of these interventions are time-sensitive. As the staff stated in a research study, “Participants from the clinical staff group (50%) perceived environmental disturbance caused by an unpredictable workflow as contributing to sleep disturbance. Staff also indicated that workflow may be a nonmodifiable stressor on sleep and a trigger for multiple other environmental stressors such as noise, light, and in-room interruptions” (Ding et al., 2017). These medical interruptions are a significant threat to alerted circadian rhythms that need further investigation.

The second component found within the process of care setting is the patient’s personal accommodations. Oftentimes, patients have certain circumstances and preferences that can impact their sleep. One of the personal accommodations that made patients lose sleep or have a poor quality of sleep was roommates. In a research study, patients found that their roommates kept making noise themselves to decrease sleep (Mouch et al., 2020). Or the roommate’s visitors and healthcare provider caused a disruption within the room. The research showed that as an individual, the patient already had increased medical interruptions. However, with a roommate,

there were more medical interruptions within the room. The second factor within-person accommodations that affected patients' sleep is the psychological factor within the hospital. The psychological factor of fear within the hospital disrupted patients' sleep. A research study reported that more than half of the study group, 57%, had psychological factors that affected their sleep (Ding et al., 2017). The idea of uncertainty about their health status caused patients to stress about their health condition and lose sleep overall. Again, the stress patients experience can cause sympathetic stimulation within the body further impairing NREM sleep and increasing bodily wakefulness (Blume et. al, 2019). In a study by Diaz et. al (2018) nurses visited patients before surgery in the hospital to educate on expectations on the ICU to decrease stress and sleep disruptions in the hospital. Through this study, patients had an increase in sleep and decreased stress level. This personal accommodation can be alarming for many and is a very challenging factor to modify for patients in this mental state but through education intervention, a solution can be achieved.

The last personal accommodation that causes patients to disrupt their sleep is pain. In Ding et al. (2017), 50% of the staff noted that the patient's pain and illness affected their sleep in a negative way. According to a second study whose theme was similar, a handful of participants found that pain was a barrier to their sleep. This pain was often described by the patient as discomfort within the bed (Mouch et al., 2020). As part of the hospital setting, there are factors such as personal accommodations and staff procedures that negatively affect the patient's sleep cycle.

Theme 3. The two categories of the structure of care and process of care setting affect the third theme found using the Whittemore and Knalf Framework which is health outcomes. Due to

the impairment of the sleep cycle within the two previous categories, a patient's health is altered. Specifically, because of the setting of care and process of care patients, sleep has become negatively affected with dysfunction in sleep cycles of NREM and REM which in turn influences a patient's health outcomes of healing. As disruptions occur oftentimes the sympathetic response is stimulated, melatonin decreases, and stage 2 of sleep becomes affected. With these changes, particularly within stage 2 of NREM sleep psychological changes can occur (Blume et. al, 2019). As states previously, stage 2 within NREM has sleep spinals which help produce long term memory and psychological functions. As sleep 2 cycle becomes disrupted psychological changes become more prominent. In a research study, 39.3% of participants who had short and long sleep disruptions experienced more severe depressive symptoms (Zheng et al., 2018). These depressive symptoms can continue to occur with more sleep disruptions. It is found that through adequate deep sleep patients' depressive symptoms may be treated. Not only does research indicate that disturbed sleep can lead to depression, but also long-term cognitive dysfunction.

Long-term cognitive dysfunction is attributed to poor sleep cycles with limited deep sleep. According to a research study, sleep effectiveness was 59.9% with sleep cycles falling into categories NREM stage 1 and NREM stage 2 within the hospital setting (Srikanth et al., 2021). This finding is again stated in another study indicating that patients had poor sleep efficacy within the hospital of less than 50/100mm (Aitken et al., 2017). A third research study indicated that the sleep efficacy is 66.1 for patients in the study which is poor quality of sleep within patients in the hospital (Locihová et al., 2020). This theme is indicating that there are significant reductions in the restorative sleep stages when sleeping in the ICU (Díaz-Alonso et al., 2018). Sleep in the ICU can be described as fragmented due to a reduction in restorative sleep stages.

The poor sleep efficacy of only NREM stage 1 and NREM stage 2 sleep cycles reflects fragmented sleep as these cycles are only surface-level sleep. Compared to NREM stage 3 and REM these cycles are for long-term memory and deep thinking. According to this study, memory function can be negatively impacted by a lack of REM cycles and NREM stage 3; but high amounts of N1 and N2 cause poor memory formation. Without deep sleep, the memory of each day cannot be transferred into long-term memory for the patient. This can lead to cognitive delay and ultimately cognitive alteration. Delirium is the result of cognitive impairment in the patient which is another alteration in mental function.

The last cognitive alteration found in research due to sleep alteration is delirium. Research states, “Our study showed that serum melatonin rhythms were altered in patients with delirium. We observed a loss of the melatonin circadian rhythm with the acrophase at 06:00 hours in patients with delirium. Additionally, fluctuations in melatonin secretion were moderate in patients with delirium. However, diurnal variation and a diurnal curve of melatonin secretion were observed in patients in the control group. These findings suggest that the physiological pattern of melatonin secretion is greatly disturbed among patients in the ICU” (Sun et al., p.7, 2021). The alteration of the melatonin within patients causing poor deep sleep throughout night specifically within REM. Without consistent melatonin exposure, patients can have poor sleep function and lead to delirium. In a second research article, the evidence shows 20% of patients out of 145, developed delirium within the first week of their hospital stay (FitzGerald et al., 2017). The evidence behind cognitive alteration when a patient has an impaired sleep cycle is undeniable. These main themes call for action in healthcare to prevent complications of altered sleep in the future.

The second pattern of health outcomes found within changes in sleep in the hospital is impaired immune response. In the circadian rhythm, cortisol plays a key role as the hormone that sets the central cik. Cortisol is used in synchronization and has a diurnal distribution of innate immune system cells (Coiffard et al., 2019). The theme found in research is that a patient's sleep becomes disrupted when the cortisol release becomes delayed. Specifically, in the ICU patients who developed sepsis, the peak of the cortisol levels was delayed. As patients' circadian rhythms are negatively affected, their cortisol levels become delayed, thereby decreasing their immune function. As a patient's immune function is altered, sepsis can increase and overtake their body. Due to this, healthcare suffers from a serious problem that can be prevented by fixing patients' sleep disruptions. The effects of impaired sleep within the hospital have become unavoidable as the problems of cognition and immune response can be avoided in healthcare with implementation.

Data Evaluation

Inconsistent and Supportive Findings

The findings from this literature review were largely consistent, as the information found was supported by other authors researching the same topic. Through the research process, there was widespread agreement that patients within the hospital had disrupted sleep especially within hospitals and especially intensive care units. In addition, the research study authors concluded that the problem of sleep disturbance within the hospital is not unifactorial. Instead, the authors of the literature indicate that many interventions need to be made for the issue of circadian

rhythm disturbance to be resolved within the healthcare system. Research within this review indicated similar findings on all seven databases studied.

Inconsistent findings from the study were rarely found. However, there was one consistent issue throughout the review. This issue was, there was not enough established research for the long-term effects of sleep disruptions within the hospital. The articles found concentrated on the acute changes to health outcomes however there was minimal research on the long-term effects of sleep deprivation. To conclude, the literature review revealed many aligning findings with only minimal inconsistent findings.

Strengths

Strengths of the Article Included

Within the literature review, there are many strengths found within the collection of research articles found. Firstly, the literature review process caused hundreds and thousands of articles to be reviewed. By reviewing these articles, pieces of literature were excluded if the articles did not meet the inclusion criteria and were not of high quality. This demonstrates that the remaining studies found within the literature review are of high caliber. Particularly, the thorough collection process of these 20 articles ensures that the data is applicable to patient sleep disruption within the healthcare system in the current society. The selection of the research studies was by primary research alone with no exception to previous literature reviews or secondary research. Not only are the research studies of high quality but they range from several databases. By researching in several databases, the same search terms eliminate author bias within the literature review. Additionally, the use of several databases enables more diverse

information, authors, and countries researched within the topic of sleep disruptions in the healthcare system. Though the research was done on several databases with thousands of results, the main conclusion is still made which is that a patient's circadian rhythm is deeply affected during their stay in a hospital.

Limitations

Limitations of Articles Included

Though there are numerous strengths found within the literature review but there are also limitations within the study. It is vital to point out the limitations within research to allow improvements to be made in the future. First and foremost, the number of articles researched on the structure of care was extremely higher than the number of articles researched on the health outcomes of circadian rhythm disruptions. As health outcomes of sleep disruption are clearly a problem, there were not as many research studies about these issues compared to other categories. Through this, the literature review may not have been able to precisely portray the health outcomes of a patient with sleep deprivation in the healthcare system. The literature review also has a limitation in that sleep deprivation is a widespread issue that is well researched, but the research that simultaneously addresses the solution is lacking. It is difficult to understand how much research is being done to address the problem within sleep deprivation as the problem itself is just being understood within the healthcare system. The last limitation to the literature review is the vast variety within the topic. There are mass amounts of reasons behind sleep deprivation within the hospital and is hard to research in a small literature review. As this topic is broad this review pinpointed the themes found within the research but the possibility of other

factors being left out is likely. In conclusion, the research behind sleep disturbance within the hospital is multifactorial and very wide-ranging leading to several limitations within this literature review.

Limitations of Study Methodology

Several limitations were found in the methodology used for the literature review. First and foremost, there were several articles and data sources that could not be used due to the inability to access the literature. Secondly, there is difficulty in compiling various studies and comparing them. For instance, there is a limitation to combining studies with varying sample sizes, methods, year, population, hospital unit, and country. Due to this alteration in the study, the comparison of data can cause unpredictability within the literature review. Additionally, due to the compilation of the data, personal bias could have affected the data. In cases where bias is possible in evidence, the analysis of the statistics and study findings could have been altered in a negative way. Furthermore, bias could have affected the analysis portion of the data, as well as the data extraction process. Moreover, as the literature review was compiled a portion of the data was handpicked causing further possible bias within the given research paper. Lastly, there is a limitation in the fact that it is impractical to conduct a literature review on all the research found on the topic of sleep disruption within the hospital. The literature review conducted a portion of the research on this topic as it is unrealistic to be able to use all research found. These gaps within the literature review are a possibility and can cause limitations within the study at hand.

Implications

The concept of sleep disruption within the healthcare setting causing altered health outcomes is of substantial significance as it affects patients in all healthcare settings across the globe. Patients staying in hospitals deserve adequate sleep-in order to rest and recover without worrying about sleep complications. As stated previously, sleep deprivation is often times preventable and can be fixed within multifactorial interventions (Stewart et al., 2017). The problem at hand has solutions due to the preventability of the problem. The literature review revealed a variety of factors that contribute to sleep deprivation within the hospital, highlighting the pressing need for interventions for improved patient health.

It has been found in the literature that sleep deprivation is a multifaceted problem within the healthcare system. Following this literature review, recommendations can be made to improve the setting of care, and the process of care to increase the health outcomes of patients within the hospital. The first implication to be made is that more research should be done to solidify the understanding of the problem. Through this literature review, problems have been identified that have worsened health outcomes due to sleep disturbance. By continuing this research, more data and evidence can be brought up to date and begin to dive deeper into the more affected health outcomes within the hospital. By using current research, hospitals will be able to find more evidence-based solutions and prevent patients from developing health complications. Additionally, further research will be able to provide multifactorial solutions to the sleep disruption issue. As research has concluded, the combination of many factors causing sleep disruptions needs to be solved in the same manner. Although the problem is solvable, it is multifactorial and requires extensive research to determine the most effective solution to implement for the patient's well-being.

Another implication that can be used after conducting this literature review is creating a questionnaire for all incoming patients within the hospital. Creating a questionnaire for all incoming patients about preferences for sleep would increase their ability to sleep throughout their hospital stay. This questionnaire would allow healthcare workers to see the patient's personal preferences and accommodate accordingly. The questionnaire would highlight non-pharmacological preferences to increase sleep including music, dark lighting, and background noise. However, this questionnaire could also guide hospital care around the patient. Including times to be awakened, roommates, tolerance to noise, etc. By creating this questionnaire care for the patient would improve and health outcomes may increase as well. In future research, this implication could be examined directly to determine whether health outcomes are improved for patients.

Recommendations

In addition to the implications for improving patient outcomes within the hospital, recommendations can be made as well. Several of these recommendations have been explored in previous research but must be continually refined in order to be implemented in healthcare systems throughout the world. The first recommendation category is nonpharmacological interventions to promote sleep. This creates the option for patients to improve sleep in an appropriate way without having side effects associated with pharmacological methods. In a study it stated, there is "insufficient evidence to determine if melatonin would improve the quality and quantity of sleep" (Morse & Bender, 2018). As a first recommendation, earplugs can be used in hospitals as a nonpharmacological method. In previous research, study patients had used earplugs and had impacted sleep. The research study states, "We compared the 31 patients in the

control group with the 21 patients in the intervention group who actually put on earplugs all night long in a per-protocol analysis. Among them, polysomnography could be scored in 15 patients (Additional file 3: Table S3). N3 sleep time was higher and prolonged awakenings were less frequent in intervention group patients who wore earplugs all night long than in the control group patients." (Demoule et al., 2017). This shows an increase of sleep patients received when wearing the earplugs comparative to those who did not. These earplugs with further research can help eliminate the background noise within the hospital to create restorative sleep for patients. The second recommendation for a nonpharmacological method is the use of eye masks to sleep. An article studied eye-mask wearing stating that 28 participants from the study reported that the eye masks helped block out light disturbance which improved their sleep within the hospital (Sweity et al., 2018). Through the use of both eye masks and earplugs, the background light and noise can be dimmed within the hospital setting, allowing patients to sleep better.

The third nonpharmacological method to prevent sleep disruption within the hospital and increase sleep quality is providing back massages within the hospital. In a study done, "significant difference in the improvement of objective sleep quality between the groups from baseline to the second and third days ($p = 0{\cdot}04$; $p < 0{\cdot}001$, when given 10-15 minute back massages before bed" (Hsu et al., 2019). This back massage was able to decrease muscle tension found within the body, which increased blood circulation. As blood circulates to muscles, the body begins to have a relaxation response causing patients to have more restful sleep (Hsu et al., 2019). It's beneficial to the patient in more ways than one to recommend a back massage to promote sleep. Back massage can not only relieve tension within the body but also within the mind. The research found that back massages can help patients relieve anxiety and depression. In

the study, on the third day, patients had an increased improvement in their mood. With a patient's anxiety decreasing in the hospital, this can also help increase their sleep. According to the study, an aggravating factor to sleep was anxiety about health status (Ding et al., 2017). If healthcare workers can decrease a patient's anxiety and mood in a nonpharmacological way, patients can find themselves to have an easier time sleeping with decreased complications.

Another nonpharmacological method recommended for decreasing sleep disruptions within the hospital are environmental sounds. The environmental sounds within the hospital and inevitable but navigating how to minimize the sound is a good way to promote sleep within the hospital. In several research studies, limiting sound has been evaluated. Recommendations of closing doors, posting quiet signs, and having quiet hours all can help decrease the environmental sounds during the evening hours. In the data, the survey went to get patient feedback and had 72.73% of the sample felt that closing doors were the best strategy to contain noise on the unit, 45% limiting the quiet signs, 45.45% limiting the number of visitors, and 27% limiting equipment (Walker & Karl, 2019). These recommendations helped patients sleep better as before the interventions 7/10 felt that the hospital floor was noisy and after the intervention 8/10 felt that the unit was mostly quiet. The interventions to limit sound within a hospital floor may be small but can have a big impact in return.

The second environmental alternation that can cause improved sleep-in healthcare is the impact of lighting. In the literature review, patients found the lighting within the hospitals has disturbed them tremendously. Through this, a recommendation to this issue is to decrease artificial light exposure within the hospital during the evening to night hours. In one research study, light exposure was decreased during the night and had natural light increased during the

day. The results displayed that patient within the intervention group had increased amounts of melatonin and decreased cortisol levels. This balance of hormones allows patients' bodies to have a regular circadian rhythm and decreased complications. The recommendation of decreased light exposure during the night is a simple intervention that can easily improve patients' sleep quality for the better.

The last recommendation to enhance sleep quality for patients during their hospital stay is to minimize sleep interruptions during night hours. This recommendation is based on the literature review of patients having disrupted sleep due to medical care and protocols that healthcare workers needed to follow. A study was conducted on this recommendation. Patients attributed healthcare protocols to 63% of their awakening in the night but after the intervention took place, patients only experienced 7% of healthcare awakenings (Lampron & Copeland, 2019). The ability to cluster care and decrease medical interruptions not only improves care for the patient but helps healthcare workers as well. In a second research article, the results of the study were similar. The research indicated, that, "patients have an average of approximately 20 min at a time to rest illustrates the high level of disturbance that patients experience. Our sleep protocol increased this rest time to greater than 45 min" (Knauert et al., 2019). This protocol within hospitals allows more time for sleep which increases healing and decreases health complications.

Furthermore, as healthcare workers enter the room less during the night hours less sound, light, and activity will be affecting the patient as a whole. Though this recommendation causes positive effects for patients, it comes at the highest challenge. For this recommendation to come to fruition, healthcare workers would have to work with the physician on a patient-level basis to

determine which healthcare protocols are urgent and what can be delayed for the priority of the patient's sleep. Due to this, a sleep protocol can be time-consuming and energy-draining for healthcare workers who already are very busy. Nevertheless, the recommendation to create a sleep protocol within the hospital setting to cluster care in the evening hours can change patients' sleep for the better. These nonpharmacological recommendations showcase multifactorial solutions to the growing problem of sleep disruption during hospital stays for patients across the globe.

Conclusion

This conducted literature review identified and utilized the PRISMA and Whittemore and Knalf framework to illustrate the ongoing problems found within hospitals. Patients have increasing issues with sleep disruption during their hospital stay. Respectively, the main problems found within the sleep disruption in healthcare were divided into three categorical factors. These factors are the settings of care, the process of care setting, and health outcomes. With the research conducted, the problem of sleep disruption was made clear. The studies conclude that the effects of sound, light, activity, personal accommodations, hospital protocols can negatively affect sleep which in turn can change health outcomes for the worse. These negative health outcomes that are often seen are psychological changes including delirium, impaired memory, and depressive symptoms. The second major negative health outcome that was noted in the review was immunologic alterations within the body. These factors found within the studies were continual themes noted when conducting the literature review. Through the research and themes found, it can be concluded that not one issue alone can solve the problem of sleep disruption. Instead, the problem of sleep disruption in the hospital is a

multifaceted issue at hand. Indicating that the research behind the issue has an abundant need for growth and continual research. As patient's health outcomes are at stake with this problem continuing. In conclusion, this literature review was able to identify and display the determinants of sleep disruptions found within the hospital; in order for recommendations to be made and health outcomes changed for patients in the future to come.

References

Adell, M. D. B., Barrachina, L. G., Andrés, E. B., Graullera, G. C., Aznar, G. P., Marmaneu, M. Á. M., Selles, M. D. F., & Urendez, A. M. (2021, August 26). *Factors affecting sleep quality in intensive care units*. Medicina Intensiva (English Edition). Retrieved January 7, 2022, from https://www.sciencedirect.com/science/article/pii/S2173572721001077

Aitken, L. M., Elliott, R., Mitchell, M., Davis, C., Macfarlane, B., Ullman, A., Wetzig, K., Datt, A., & McKinley, S. (2017). Sleep assessment by patients and nurses in the intensive care: An exploratory descriptive study. *Australian Critical Care*, *30*(2), 59–66. https://doi.org/10.1016/j.aucc.2016.04.001

Arora, V. M., Adachi, M., Staisiunas, P. G., Knutson, K. L., Beveridge, C., & Meltzer, D. O. (2017, May 22). *Sleep in hospitalized adults*. Journal of Hospital Medicine. Retrieved January 6, 2022, from https://www.journalofhospitalmedicine.com/jhospmed/article/128224/sleep-hospitalized-adults

Blume, C., Garbazza, C., & Spitschan, M. (2019). Effects of light on human circadian rhythms, sleep and mood. *Somnologie : Schlafforschung und Schlafmedizin = Somnology : sleep research and sleep medicine*, 23(3), 147–156. https://doi.org/10.1007/s11818-019-00215-x

Coiffard, B., Diallo, A. B., Culver, A., Mezouar, S., Hammad, E., Vigne, C., Nicolino-Brunet, C., Dignat-George, F., Baumstarck, K., Boucekine, M., Leone, M., & Mege, J.-L. (2019).

Circadian rhythm disruption and sepsis in severe trauma patients. *Shock*, *52*(1), 29–36. https://doi.org/10.1097/shk.0000000000001241

Craig, T., Mathieu, S., Morden, C., Patel, M., & Matthews, L. (2021). A prospective multicentre observational study to quantify nocturnal light exposure in intensive care. *Journal of the Intensive Care Society*, 175114372110453. https://doi.org/10.1177/17511437211045325

Darbyshire, J. L., & Duncan Young, J. (2021). Variability of environmental sound levels: An observational study from a general adult Intensive Care Unit in the UK. *Journal of the Intensive Care Society*, 175114372110221. https://doi.org/10.1177/17511437211022127

Danielson, S. J., Rappaport, C. A., Loher, M. K., & Gehlbach, B. K. (2018). Looking for light in the DIN: An examination of the circadian-disrupting properties of a Medical Intensive Care Unit. *Intensive and Critical Care Nursing*, *46*, 57–63. https://doi.org/10.1016/j.iccn.2017.12.006

Demoule, A., Carreira, S., Lavault, S., Pallanca, O., Morawiec, E., Mayaux, J., Arnulf, I., & Similowski, T. (2017). Impact of earplugs and eye mask on sleep in critically ill patients: A prospective randomized study. *Critical Care*, *21*(1). https://doi.org/10.1186/s13054-017-1865-0

Diaz, E., Diaz, I., del Busto, C., Escudero, D., & Pérez, S. (2019). Clock genes disruption in the Intensive Care Unit. *Journal of Intensive Care Medicine*, *35*(12), 1497–1504. https://doi.org/10.1177/0885066619876572

Díaz-Alonso, J., Smith-Plaza, A. M., Suárez-Mier, B., & Lana, A. (2018). Impact of a nurse intervention to improve sleep quality in intensive care units. *Dimensions of Critical Care Nursing*, *37*(6), 310–317. https://doi.org/10.1097/dcc.0000000000000319

Ding, Q., Redeker, N. S., Pisani, M. A., Yaggi, H. K., & Knauert, M. P. (2017). Factors influencing patients' sleep in the intensive care unit: Perceptions of patients and clinical staff. *American Journal of Critical Care*, *26*(4), 278–286. https://doi.org/10.4037/ajcc2017333

Engwall, M., Fridh, I., Jutengren, G., Bergbom, I., Sterner, A., & Lindahl, B. (2017). The effect of cycled lighting in the Intensive Care Unit on sleep, activity and physiological parameters: A pilot study. *Intensive and Critical Care Nursing*, *41*, 26–32. https://doi.org/10.1016/j.iccn.2017.01.009

Fink, A. M., Bronas, U. G., & Calik, M. W. (2018). Autonomic regulation during sleep and wakefulness: A review with implications for defining the pathophysiology of neurological disorders. *Clinical Autonomic Research*, *28*(6), 509–518. https://doi.org/10.1007/s10286-018-0560-9

FitzGerald, J. M., O'Regan, N., Adamis, D., Timmons, S., Dunne, C. P., Trzepacz, P. T., & Meagher, D. J. (2017). Sleep-wake cycle disturbances in elderly acute general medical inpatients: Longitudinal relationship to delirium and dementia. *Alzheimer's & Dementia: Diagnosis, Assessment & Disease Monitoring*, *7*(1), 61–68. https://doi.org/10.1016/j.dadm.2016.12.013

Garcia Guerra, G., Joffe, A. R., Sheppard, C., Pugh, J., Moez, E. K., Dinu, I. A., Jou, H., Hartling, L., & Vohra, S. (2018). Prospective cohort study on noise levels in a pediatric cardiac intensive care unit. *Journal of Critical Care*, *44*, 318–322. https://doi.org/10.1016/j.jcrc.2017.12.008

Goldstein, C. (2022). *UptoDate*. UpToDate. Retrieved January 6, 2022, from https://www.uptodate.com/contents/classification-of-sleep-disorders#!

Hsu, W. C., Guo, S. E., & Chang, C. H. (2019). Back massage intervention for improving health and sleep quality among Intensive Care Unit Patients. *Nursing in Critical Care*, *24*(5), 313–319. https://doi.org/10.1111/nicc.12428

John Hopkins. (2022). *Appendix C final.evidence level and Quality Guide*. from https://www.hopkinsmedicine.org/evidence-based-practice/_docs/appendix_c_evidence_level_quality_guide.pdf

Lampron, S., & Copeland, D. (2019). Using a sleep protocol to limit sleep interruptions on a medical-surgical unit. *JONA: The Journal of Nursing Administration*, *49*(7/8), 350–353. https://doi.org/10.1097/nna.0000000000000766

Knauert, M. P., Pisani, M., Redeker, N., Murphy, T., Araujo, K., Jeon, S., & Yaggi, H. (2019). Pilot study: an intensive care unit sleep promotion protocol. *BMJ open respiratory research*, 6(1), e000411.

Knauert, M., Jeon, S., Murphy, T. E., Yaggi, H. K., Pisani, M. A., & Redeker, N. S. (2016). Comparing average levels and peak occurrence of overnight sound in the Medical

Intensive Care Unit on a-weighted and C-weighted decibel scales. *Journal of Critical Care,* 36, 1–7. https://doi.org/10.1016/j.jcrc.2016.06.005

Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gøtzsche, P. C., Ioannidis, J. P. A., Clarke, M., Devereaux, P. J., Kleijnen, J., & Moher, D. (2009). The prisma statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: Explanation and elaboration. *Journal of Clinical Epidemiology*, 62(10). https://doi.org/10.1016/j.jclinepi.2009.06.006

Locihová, H., Axmann, K., Žiaková, K., & Šerková, D. (2020). Effect of a multicomponent sleep protocol on sleep quality in conscious patients in the Intensive Care Unit. *Journal of Turkish Sleep Medicine*, *7*(3), 140–148. https://doi.org/10.4274/jtsm.galenos.2020.08208

Lusczek, E. R., & Knauert, M. P. (2021). Light Levels in ICU Patient Rooms: Dimming of Daytime Light in Occupied Rooms. *Journal of Patient Experience.* https://doi.org/10.1177/23743735211033104

Measuring quality and safety. Howell M.D., & Stevens J.P.(Eds.), (2020). *Understanding Healthcare Delivery Science*. McGraw Hill. https://accessmedicine.mhmedical.com/content.aspx?bookid=2736&sectionid=228656724

Morse, A., & Bender, E. (2018). Sleep in hospitalized patients. https://doi.org/10.20944/preprints201809.0100.v1

Mouch, C. A., Baskin, A. S., Yearling, R., Miller, J., & Dossett, L. A. (2020). Sleep patterns and quality among inpatients recovering from elective surgery: A mixed-method study. *Journal of Surgical Research, 254*, 268–274. https://doi.org/10.1016/j.jss.2020.04.032

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021, June 25*). The Prisma 2020 statement: An updated guideline for reporting systematic reviews*. Oregon Health & Science University. https://ohsu.pure.elsevier.com/en/publications/the-prisma-2020-statement-an-updated-guideline-for-reporting-syst-5

Schneider, Eric, Shah, Arnav, Doty, Michelle, Tikkanen, Roosa, Feilds, Katharine, & Williams, Reginalds. (2021). *Mirror, mirror 2021: Reflecting poorly*. Commonwealth Fund. Retrieved January 6, 2022, from https://www.commonwealthfund.org/publications/fund-reports/2021/aug/mirror-mirror-2021-reflecting-poorly

Srikanth, J. K., Kumar, R., Gupta, N. K., Ish, P., Yadav, S. R., Chakrabarti, S., & Gupta, N. (2021). A prospective study evaluating sleep quality and disorders in post-ards patients. *Sleep and Vigilance*, *5*(2), 267–274. https://doi.org/10.1007/s41782-021-00158-0

Stewart, J. A., Green, C., Stewart, J., & Tiruvoipati, R. (2017). Factors influencing quality of sleep among non-mechanically ventilated patients in the Intensive Care Unit. *Australian Critical Care*, *30*(2), 85–90. https://doi.org/10.1016/j.aucc.2016.02.002

Sun, T., Sun, Y., Huang, X., Liu, J., Yang, J., Zhang, K., Kong, G., Han, F., Hao, D., & Wang, X. (2021). Sleep and circadian rhythm disturbances in Intensive Care Unit (icu)-acquired delirium: A case–control study. *Journal of International Medical Research*, *49*(3), 030006052199050. https://doi.org/10.1177/0300060521990502

Sweity, S., Finlay, A., Lees, C., Monk, A., Sherpa, T., & Wade, D. (2018). Sleepsure: A pilot randomized-controlled trial to assess the effects of eye masks and earplugs on the quality of sleep for patients in hospital. *Clinical Rehabilitation*, *33*(2), 253–261. https://doi.org/10.1177/0269215518806041

Walker, L., & Karl, C. A. (2019). The hospital (not so) quiet zone: Creating an environment for patient satisfaction through Noise Reduction Strategies. *HERD: Health Environments Research & Design Journal*, *12*(4), 197–202. https://doi.org/10.1177/1937586719839229

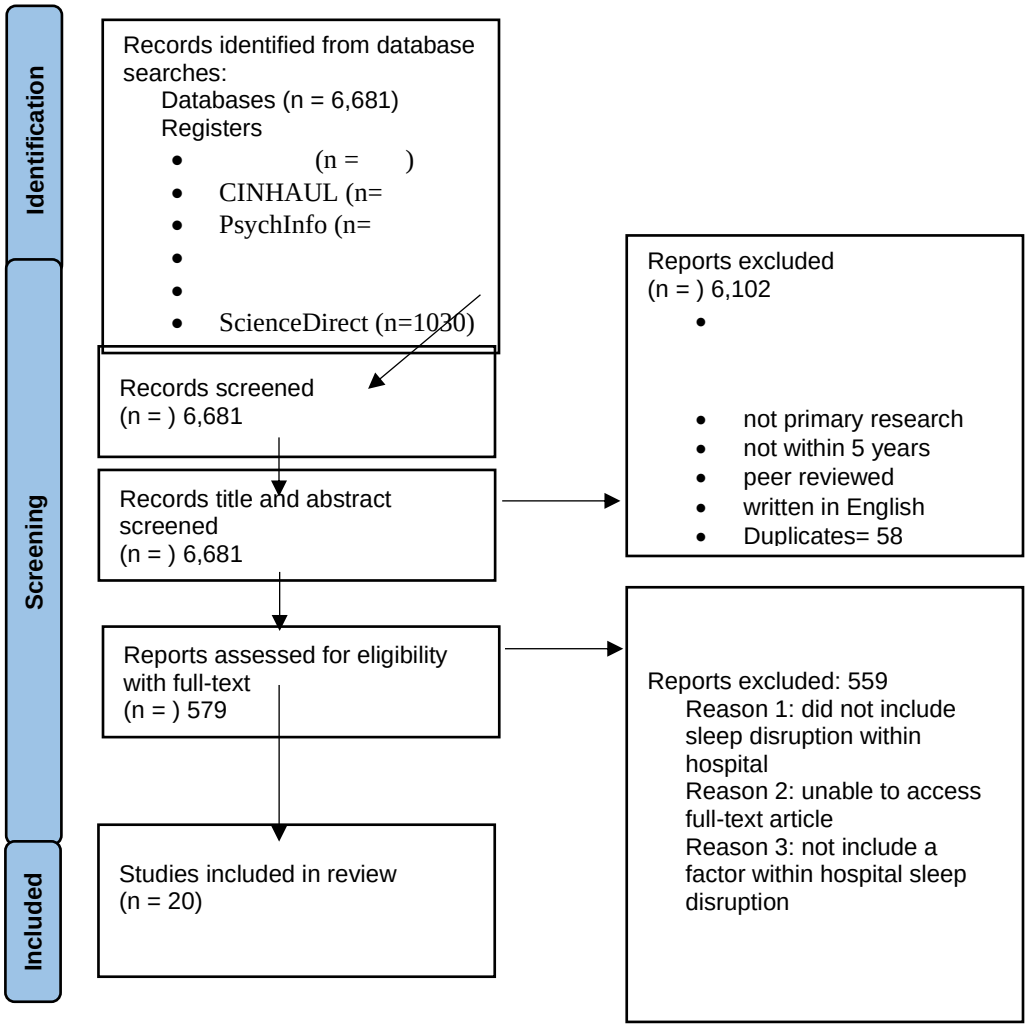
Wesselius HM, van den Ende ES, Alsma J, et al. Quality and Quantity of Sleep and Factors Associated With Sleep Disturbance in Hospitalized Patients. JAMA Intern Med. 2018;178(9):1201–1208. doi:10.1001/jamainternmed.2018.2669

Whittemore, R., & Knafl, K. (2005). The Integrative Review: Updated Methodology. *Journal of Advanced Nursing*, 52(5), 546–553. https://doi.org/10.1111/j.1365-2648.2005.03621.x

Zheng, W., Luo, X.-N., Li, H.-Y., Ke, X.-Y., Dai, Q., Zhang, C.-J., Ng, C. H., Ungvari, G. S., Xiang, Y.-T., & Ning, Y.-P. (2018). Association of sleep duration with sleep disturbances, quality of life, and sociodemographic factors in general hospital outpatients. *Perspectives in Psychiatric Care*, *54*(3), 422–427. https://doi.org/10.1111/ppc.12288

Appendix

Appendix A: PRISMA Framework



From: Page MJ, Mckenzie JE, Bossuyt PM, Boutron l, Hoffman TC, Mulrow CD, et. al. The PRISMA 2020 statement: an updated guideline for reporting systemic reviews. BMJ 2021; 372: n71. doi:10.1136/bmj. N71

Appendix B: Whittemore and Knafl Framework

(Whittemore & Knafl, 2005)

Appendix C: Data Extraction Table

First author	Within 5 years	Study design (not lit review)	Sample size	Must investigate sleep quality/disturbance in the hospital setting	Outcomes	Levels of Evidence
Zheng, Wei	2018	Cross sectional study	4,399 outpatients	Health outcomes	Analysis confirms there a strong connection between short and long sleep affecting depressive factors.	Level 3
Knauert, Melissa	2019	Pilot study	56 patients 30 assigned to usual care 26 assigned to sleep protocol	Settings of Care (sound)	The average ICU sound level is between 43 and 66 decibels on the A-weighted scale (dba), with peak levels reaching 80-90 dba. Thus, the noise levels are simply too high. Knauert et al. (2019) specifically point out that WHO recommends limiting hospital noises to an average of 30 dB to 40 dBA at a maximum. "patients have an average of approximately 20 min at a time to rest illustrates the high level of disturbance that patients experience. Our sleep protocol increased this rest time to greater than 45 min" (Knauert et al., 2019)	Level 1
Srikanth, Juvva	2021	Quasi-experimental study	30 patients	Health outcomes	"Reuced duration of N3 sleep and REM indicates a lack of deep sleep, which are the restorative sleep stages for memory forma-tion; poor sleep quality might contribute to long-term cognitive dysfunction" (Srikanth et al., 2021).	Level 2
Locihová, H	2020	Non-randomized	40 participants 20 control	Settings of Care (sound)	"The present study also showed a strong association	Level 2

		Non-control study	20 uncontrolled	Health outcomes	between time and noise levels, with minimum values between midnight and 1 a.m. Noise levels consistently exceeded the recommended standards, with the highest level being 64.3 dB" (Locihová et al., 2020). Patients got 66.1 rating for sleep efficacy which is poor quality of sleep within patients in the hospital (Locihová et al., 2020).	
Ding, Qinglan	2017	Qualitative study	Eight patients, 6 surrogates, and 24 clinical staff participated in this study	Process of care (hospital care and personal accommodations)	Analysis showed an aggravating factor to sleep was anxiety about health status (Ding et al., 2017). Anaylsis also found that 38 out of 38 participants reported that the in-room disruptions frequently shortened their sleep (Ding et al., 2017). "50% of the staff noted that the patient's pain and illness affected their sleep in a negative way" (Ding et al., 2017).	Level 5
Diaz-Alonso, Julian	2018	Pilot randomized control	40 participants, 2 groups 20 control group 20 experimental group	Process of Care	The review showed Diaz et. al (2018) nurses visited patients before surgery to decrease stress and sleep disruptions in the hospital. Helped personal accommodations.	Level 2
Coiffard, Benjamin	2018	Nonintervention al observational study	40 patients	Health outcomes (decreased healing)	Disrupted sleep causes cortisol and immune function to change. This increases sepsis and infection.	Level 3
Diaz, Elena	2019	Non-randomized research study	11 patients from the ICU studied first day of ICU and 1 week later	Light levels Decline in circadian rhythm longer stay in icu Setting of care (light levels)	Therefore, it could be deduced that ICU stay for at least 1 week affects the molecular machinery of the biological clock or, in other words, it generates chrono disruption.	Level 2

					Analysis results indicate that the ICU light level exposures varied from 5 to 1500 lux throughout the environment.	
Craig, Thomas	2021	Observation Mutlicenter study	49 different patients	Settings of care (lighting)	The light levels of illumination were 33.43 which is 13 units above the recommended rate in an ICU during the night hours. LUX levels should not be higher than 20 lux (Craig et al., 2021).	Level 3
Sun, Ting	2021	case-control study	60 patients	Health outcomes (delirum)	Study suggests that memory consolidation is impaired by disruption of the natural slow-wave sleep and REM sleep cycle.	Level 4
Darbyshire, Julie	2021	Observational study	data collected over 275 full 24-h periods between 28 October 2016 and 21 May 2018	Settings of care (activity)	Research shows the hospital activity in the ICU reduces at weekends due to variations in staffing levels. This improves sleep quality in patients.	Level 3
Danielson, Samantha	2017	Prospective observational study	138 assesments on patients	Settings of care (sound)	The study declares that within empty hospital rooms there is still an average of 42 dba due to acoustic floors and background noise sources, including ventilation systems. Hospital floors are naturally very loud increasing environment sounds.	Level 3
Adell, Bernat	2020	Cross sectional study	129 patients	Settings of care (sound)	Analysis showed the irritating factors causing sleep disruption on the first day of admission as alarms, nebulizers, and aspiration secretions as these factors create noise for patients.	Level 3
Engwall, Marie	2017	Pilot study	60 patients	Settings of care	The research showed that a measured 145 lux during the night. This exposure to light at night is of concern as the patient’s sleep is	Level 2

					continually being disturbed (Engwall et al., 2017)	
Knauert, Melissa	2016	Prospective observational study	59 medical rooms	Settings of care (sounds)	Significant discordance between A- and C-weighted values suggests that low frequency sound is a meaningful factor in the medical ICU environment.	Level 3
Aitken, Leanne M.	2017	Qualitative study	174 participants	Health outcomes	Research study showed that patients had poor sleep efficacy within the hospital of less than 50/100mm (Aitken et al., 2017)	Level 5
Mouch, Charles A.	2020	mixed-method study	195 patients	Process of Care And Health Outcomes	Analysis of this study, found that nurses woke patients up every 2-3 hours for medical services causing sleep disruption.	Level 2
Garcia, Gonzalo	2017	prospective cohort study	39 patients	Settings of Care	This study had reports of people talking in the background when trying to fall asleep at night (Garcia Guerra et al., 2018).	Level 4
Stewart, John A.	2017	Non-randomized research study	56 patients	Process of Care	Research shows "64% of disruptive noises in the ICU setting over a 24-h period (such as unnecessary alarms, and conversations) were avoidable through behavioral modification on the part of healthcare staff" (Stewart et al., 2017). Analysis showed that nurses can interrupt patients up to 8 times an hour within the hospital disrupting sleep in the protocol's healthcare provides.	Level 2
FitzGerald, James M.	2017	Prospective study	145 patients	Health Outcomes	Studied shows how sleep-wake cycle disturbances have attributed to symptoms of delirium. "20% of patients out of 145, developed delirium within the first week of their hospital stay" (FitzGerald et al., 2017)	Level 4

(John Hopkins, 2022)