



A Systematic Literature Review of Noise and Nurse Stress Levels in Intensive Care Units

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

This systematic literature review focused on the noise levels within intensive care units (ICU) and how this can negatively affect nurses working on the unit. A comprehensive literature search and systematic review were conducted to find evidence-based research on noise levels and its impact on nurses. Studies revealed various sources of noise, elevated noise levels, health effects of increased noise, and its impact on patients and nurses. Several interventions were implemented to decrease the number and level of sounds in ICUs. Increased amounts of noise in intensive care units, for extended periods of time, led to quicker nurse "burn-out" and caused adverse physiological and detrimental emotional effects. Major trends found for this systematic review included relocation of the intensive care units, implementing quiet times, limiting staff conversations, and modifying the alarm levels.

Keywords: 'Nurse stress'; 'noise; nurses'; 'stress'; 'intensive care unit'; 'occupational noise' and 'ICU'.

1. INTRODUCTION

Noise is a constant part of a nurse's job within any setting they may choose to work. The noise level and type can be detrimental to their overall well-being and mental health if not adequately controlled or minimised. Florence Nightingale recognised noise as an environmental hazard to health and is reflected in her writing, "Unnecessary noise, then, is the most cruel absence of care which can be inflicted either on sick or well" [1]. Her environmental theory is based on this premise and has had a major positive impact to the overall standards in hospitals.

The World Health Organization (WHO) recommends that noise in hospital units not exceed 30 decibels (dBA) in general hospital areas, 40 dBA in patient rooms at night (maximum of 45 dBA), and 35 dB in patient rooms in the ICU to minimise patient sleep disturbances [2]. Normal talking is 40 dBA, and conversations at one meter are 60 dBA, which already puts noise over the acceptable limits within an ICU [2]. Noise has the ability to impact attention and performance, and is a factor in annoyance levels [2]. This is important as nurses must pay attention to patient medical conditions and respond immediately. Higher levels of stress lead to an increased stress response, which contribute to long-term health issues. The increased amounts of different noises in the intensive care units affect both the endocrine and cardiovascular systems interrupt sleep and healing for patients [3]. The impact on nurses' stress levels can contribute to increased health issues as well, time out of work, and can contribute to increased cost to the hospitals. Increased stress over time can lead to dissatisfaction with the job and burn out.

2. METHODOLOGY

A comprehensive review of the literature, research studies, and gray literature related to nurse stress levels with regard to noise was conducted to explore the perceptions, physical and emotional symptoms, and interventions related to noise in the intensive care unit. Several databases were used in this systematic review: CINAHL Complete, PubMed, EBSCO, ScienceDirect, Ovid, Medline, Academic One file, Social Sciences Citation Index, Google Scholar, Cochrane Library. The following keywords were used 'nurse stress', 'noise', 'nurses', 'stress', 'intensive care unit', 'ICU', and

'occupational noise'. The search was initially limited to peer-reviewed journals published from 2013 through 2018 to provide the most relevant, advanced, and evidence-based information available. The search was expanded to include additional articles from bibliography searches of initial studies significant to the review. The search yielded 25 peer reviewed articles.

3. SYSTEMATIC LITERATURE REVIEW

3.1 Noise Levels and Sources

Everyone in the ICU, including patients and nurses, is affected by noise. Noises come from a variety of sources including alarms, call bells, televisions, public address systems, staff conversations and housekeeping. During emergencies, noise levels can escalate [4]. Additional sources of noise in a hospital setting that cause detrimental effects such as stress to nurses and patients include elevators, tube systems, alarms, monitors, ventilators, telephones, staff, and various carts for equipment [5]. It is difficult to control the amount of noise within the ICU due to the many different types of equipment for the high acuity patients such as ventilators and cardiac monitors [4]. Konkani, Oakley, and Bauld [6] found similar sources of noise in the ICU. The increase in the number of alarms contributed to the already loud environment throughout the intensive care unit. Christensen, Dodds, Sauer & Watts [7] found that 75-99% of the alarms that sound tended to be false alarms, which contributed to alarm fatigue in many nurses. Alarm fatigue can lead to ignored alarms and safety concerns for patients [6].

Noise is a sound or set of sounds that can be loud, harsh or disharmonious. The WHO recognised that noise had a deleterious effect on humans, and patients in particular, and had outlined the aforementioned set of research based sound level recommendations [2]. Hospitals are no longer quiet places, and ICUs have noise levels higher than WHO permissible levels [8]. As Choiniere [9] described, average hospital sound levels in 1960 during the day were 57 dBA, and noise at night was 42 dBA. The noise increased to 72 dBA during the day, and 60 dBA at night in 2005. The effects of noise are well documented in patient sleep disturbances [10], delayed wound healing, increased delirium, and other physiological effects that disrupt patient improvement [11]. Nurses are exposed to the same noxious

stimuli, including noise, as patients, and these findings were summarised by Halm [12] as it related to patients and nurse stress. One of the first studies to research the impact of noise on nurse stress was done in a pediatric intensive care unit (PICU) [13]. That study found as noise increased, so did nurse heart rates, annoyance ratings and self-reported stress levels.

Darbyshire and Young [14] monitored day and night noise levels over a two-week period in 2012 in five ICUs in England. Levels were monitored at the central nursing station and in patient rooms, at their heads. Average sound levels at the nursing station ranged between 51.3-59.1 dBA, and at the patients' heads, between 54.1-59.9 dBA. These values exceeded the WHO recommendations. The study also found that the noise levels never fell below 50 dBA and got as high as 128 dBA in the ICU. In a survey, the staff felt noise disrupted communication on the units, and that the biggest contributor to noise was the monitors ringing [14].

Noise levels, their sources and locations were recorded and compared to nurse heart rate and perceived stress in a study by Watson et al. [15]. Mean noise was 71.9 dBA with a range of 45-107 dBA recorded over several twenty-four hour periods during weekdays. Again, the loudest source of noise was staff communication (57.5% of the time), which exceeded 75 dBA at times, as well as, in-room equipment (12.6% of the time). Noise that exceeds 85 dBA for eight hours can lead to hearing loss [15].

A typical nurse shift is eight to twelve hours, putting nurse health at risk. There was a positive correlation between noise level and heart rate, as well as nurse stress level [15]. Nurse stress levels decreased during two hour quiet times during the day shift, when noise and light levels were decreased [16]. Noise levels during quiet time on average decreased from 62.93 dB to 60.88 dB, but increased to 61.69 dB after quiet time. Nurses reported a decrease in stress throughout the quiet time period, which continued even if just lights were dimmed without any noise reduction interventions [16].

Certain measured levels within different departments in another hospital study found noise levels around 70 dBA [17]. Sound levels for the cardiac ICU within the study were measured at medicine pass times, meals, and quiet times both in the old hospital and in the new wing. Noise levels in the new ICU were

much lower than in the previous location [17]. All the studies that were reviewed for this systematic review revealed noise levels did not meet or WHO recommendations. These findings were consistent throughout the literature.

3.2 Effects of Excessive Noise on Health

Excessive noise can be detrimental to human health in several physical and emotional ways. Several studies and observations had been performed on intensive care units measuring ambient noise, alarms, visitors, staff, and placement of the room in relationship to high traffic areas. Many of the studies provided a repeated conclusion that excessive noise within the ICU caused negative physical and emotional side effects. Noise caused annoyance [13], which interfered with daily activities such as work. Noise interrupted sleeping patterns and caused daytime lethargy and difficulty concentrating [18]. Noise increased anxiety and perception of stress in humans. Physiologically, noise caused an increase in stress hormones including catecholamines and glucocorticoids that lead to physical ailments. Cardiovascular disease such as hypertension, ischemic heart disease, and stroke were potential side effects of increased stress hormones related to the excessive noise [18]. In addition, blood glucose levels, lipid levels and blood viscosity increased [18]. Another study concluded that some employees felt physically ill after a day of work in the hospital due to excessive noise [19]. Nurses and relatives of patients perceived higher stress levels than the patient due to specific physical, psychological, and environmental factors.

Lawson et al. [4] explained that continuous amounts of noise, even at low levels, affected blood pressure. Increased amounts of noise contributed to patients not getting enough sleep, which can lead to delirium. Konkani, Oakley, and Penprase [20] found similar results with cardiovascular effects, headaches, anxiety, emotional stress and nurse burnout. In the study by Ding et al. [10], it was found that excessive noise was the most common cause of disrupted sleep for patients in a medical intensive care unit (MICU). Increased levels of noise can also have effects on nurse's job satisfaction as well as performance and potentially jeopardise patient safety [20].

3.3 Assessing Nurse Stress

The Bianchi Stress Scale (BSS) was used in several cross sectional studies to assess levels

of stress in nurses in ICUs. Monte, Lima, Neves, Studart and Dantas [21] reported medium to high levels of stress, whereas the noise contributor to nurse stress was rated as medium [22,23]. A recent comprehensive study by Munnangi, Dupiton, Boutin and Angus [24] examined the extent of the relationships among burnout, job satisfaction, and perceived stress in nurses in a level I trauma center. The trauma center nurses were from both medical and surgical ICUs in addition to the emergency room. Nurses used the Perceived Stress Scale (PSS) for self-reporting stress at work.

3.4 Critiquing of the Evidence

There were many articles found within this systematic review that were related to the effects of noise on both nurses and patients within the intensive care unit setting. Although there was a comprehensive systematic review conducted and large number of articles reviewed, many of the articles were not considered to have a high level of evidence. Most of the articles that were reviewed and appraised were considered Level III to Level VI in terms of hierarchy. The levels of evidence were related to the limitations within the studies, and also the study designs. Most of the study designs consisted of cross-sectional studies quantitative studies, descriptive cross-sectional studies, cross-sectional surveys, quasi-experimental studies, literature reviews and qualitative studies.

3.5 Interventions for Noise Reduction

There was a large amount of literature discussing the options for the reduction of noise by nurses and hospital organisations. A hospital in the Czech Republic posted signs to remind visitors to be quiet while visiting their loved ones and this simple intervention was found to be successful for noise reduction [25]. A quiet time bundle was implemented by McGough et al. [5] and included specified quiet hours, dimming light in rooms and hallways, masks for patients' eyes, turning down cell phone ringers, and encouraging a quiet tone of speaking for staff. Training was also implemented for the hospital staff for why this intervention was needed and how to use it in their everyday work environment. Nurses perceived less noise after the implementation of this care bundle [5]. Konkani et al. [6] looked at staff behaviour modification programs focused on healthcare providers lowering the amount of noise from non-medical equipment including pagers, telephones, and mobile phones. In a

later study by Konkani et al. [20], behavior modification alone was found to not be sufficient in reducing noise to an acceptable level in the ICU. The researchers looked at dBA of noise in an ICU over an extended period of time and found that further research and development is needed with advancements in medical alarm technology to effectively decrease noise levels [20]. Souza, Cortez and Carmo [26] suggested continuing education programs for reducing noise and the development of more noise reducing designs would be effective in reducing noise in the ICUs.

Maidl-Putz, McAndrew & Leske [27] discussed various interventions that could be done in order to reduce the amount of noise on the nursing floors. This included limiting staff conversations, and modifying the alarm levels. This study also found that closing the patients' doors could decrease the amount of noise in and outside the rooms, but could pose a safety risk for patients who might be confused or delirious [27].

3.6 Location of the Intensive Care Unit

Changing the location of the intensive care unit (ICU) is not an option for many hospitals considering the cost and disruption of flow for patients and staff. However, in an article by Wang et al. [17], the cardiac ICU was relocated to a new wing and a service corridor for excess traffic and staff was implemented. The study showed not only did it reduce the noise for patients, it also decreased the perception of stress due to excess noise to the staff in the ICU and increased staff satisfaction [17]. The problem with increased noise in patient-care settings is the increased risk for miscommunication between staff and nurses. Increased noise can lead to medical or medication errors due to distraction and decreased the ability to focus on patient care tasks [17]. With the new environment, the staff reported less noise, stress, and increased energy during working hours [17].

3.7 Interventions for Stress Reduction

Redesigning an ICU and its location is not feasible for most hospitals. Reducing the number and volume of alarms, and educating ICU personnel as to the impact of noise on both patients and nurses is something that can be done. Mindfulness training has been found to be effective in reducing the stress of ICU nurses as measured by the PSS [28]. While aromatherapy

during work time was not effective in reducing nurse stress, taking a 15 minute break away from the ICU in a quiet, restful location resulted in reduced stress as measured by the PSS [29].

4. LIMITATIONS

There were several limitations found during the research portion of this systematic review. The most substantial limitation was evidence being of mid to low level in rating. There were no randomized control trials found or thorough systematic reviews when searching the topic of noise and its effects on nurses in the workplace. Most levels of evidence were level III through level V.

However, the evidence that was found within this systematic review consistently demonstrated the negative health effects posed to nurses from excessive noise that constantly reached decibels above the acceptable limit according to several respected health organizations. Again, the level of evidence was graded low but the common theme was repeated throughout all of the studies resulting in saturation of the research.

Other notable limitations would be the sample size of participants in some of the case studies and observations were low and not necessarily constant. Some of the research was difficult to find due to a deficit in research when looking for the effects of noise on nurses versus the effects of excessive noise on patients within the intensive care unit. Lastly, three different research students that could potentially cause variation in the interpretation of each study when reading and synthesising the evidence conducted the research.

5. CONCLUSION

Noise has been an ongoing issue since the time of Florence Nightingale. There have been various numbers of studies confirming sources of noise and its effects. Extreme amounts of noise in the ICU can clearly cause unfavourable effects both physically and emotionally to the nurses working within the harmful environment. Hospitals should make every attempt to adhere to acceptable levels of noise for the safety of the nurses and staff caring for critically ill patients. More higher-level studies are needed to determine the direct impact of noise on nurse stress, and its impact on patient care and nurse burnout. The evidence points out the need for change within the intensive care unit setting, and

Nightingale's Environmental Theory supports this necessity for nurses. Decreasing noise will allow for a healthier work environment.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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