

Noise Pollution in the Operating Room: Student Registered Nurse Anesthetist Education: Reduction Strategies and Tools

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Abstract

Noise pollution in the operating room (OR) poses a safety concern to both patients and providers. Sound levels often exceed recommended standards set forth by the National Institute for Occupational Safety and Health (NIOSH) and the Occupational Safety and Health Administration (OSHA). The purpose of this project was to examine current evidence and implement education for student registered nurse anesthetists (SRNAs) regarding noise pollution in the OR. A pre-test and post-test methodology was utilized to assess the efficacy of the education module. Results generated from the education module illustrated a knowledge deficient in SRNAs pertaining to noise reduction, cognitive demand, and attention allocation during the delivery of an anesthetic in the OR. Average post-test scores were found to have a statistically higher average compared to the average pre-test scores ($p < 0.001$). Noise pollution has been shown to be a complex, multifactorial problem. Emphasis should be placed on sustaining and integrating noise reduction education into curriculum schemas of nurse anesthesia programs.

BACKGROUND

Noise pollution in the operating room (OR) poses a significant threat to both patients and OR staff during the intraoperative period. Evidence shows that operating room noise levels often exceed the standards set by the National Institute for Occupational Safety and Health (NIOSH) and the Occupational Safety and Health Administration (OSHA).^{1,2,3} Katz and Englemann highlight the magnitude of noise levels, suggesting levels in the OR are greater than those generated from lawn mowers or passing trucks on a major highway.^{4,5} Currently, OSHA suggests limiting exposure to 95 decibels in four hours compared to NIOSH suggesting exposure limits of 95 decibels to one hour.¹ Routine exposure to noise pollution can predispose OR staff to increased chances of hearing loss, cardiovascular disease, cognitive stress, and hinders one's ability to provide clear communication with other team members.^{6,11}

The purpose of this project was to construct and evaluate a noise pollution education module for student registered nurse anesthetists (SRNAs) with the goals of knowledge attainment and personal reflection pertaining to current practices. Future ramifications of this project could have an impact on improving overall patient outcomes and provider safety. Operating room staff work in a fast paced, high acuity, stressful environment. During the intra-operative time period, care providers must remain vigilant, as their work requires critical thinking and a tremendous amount of responsibility. Noise pollution presents a serious challenge in this setting. Interdisciplinary collaboration to achieve decreased noise levels and improve patient outcomes is essential.

Investigation of current evidence identified initiatives such as the National Institute for Occupational Safety and Health (NIOSH) standards set forth in conjunction with the Centers for Disease Control (CDC).⁸ The CDC asserts, "The mission of the NIOSH Hearing Loss Prevention Program is to provide national and world leadership to reduce the prevalence of occupational hearing loss."⁸ Emphasis on noise pollution and provider distraction has also been examined by the Anesthesia Patient Safety Foundation (APSF) recommending elimination of unnecessary clinical distractions, modulating unavoidable distractions, minimizing avoidable distractions, and reducing environmental noise.^{9,10} Multiple sources of noise exist during perioperative care. Staff behaviors, clinical practices, and OR traffic in and out of the operating suite contribute to noise pollution. Patient monitors and associated alarms, as well as surgical and anesthesia equipment, all contribute to a significant increase in noise pollution.^{1,3,5} A loud environment not only creates an occupational hazard or distraction but can negatively affect care delivery which may ultimately result in patient harm. In addition to affecting staff performance, exposure to high noise levels can be harmful to patients by triggering physiologic changes like tachycardia, hypertension, oxygen desaturation, and laryngospasm.^{6,7}

METHODS

Literature Search

PubMed, CINAHL and Scopus databases were searched using key words: *noise, noise pollution, operating room, anesthesia,*

occupational safety. Systematic reviews, randomized and non-randomized controlled trials, cohort studies, case studies, qualitative studies, and expert opinions were all considered. A total of 117 articles were retrieved, of which thirty-seven were included for review.

Educational intervention

This SRNA education module was constructed with consideration of the Joint Commission's 2018 National Hospital Patient Safety goals. Institutional review board (IRB) approval was deemed exempt for non-human subjects from the academic medical center. An in-depth analysis of current initiatives in the United States of America were reviewed to establish the need for this quality improvement project. The CDC Hearing loss prevention program, the Joint Commission's 2017 Hospital Patient Safety goals and the Anesthesia Patient Safety Foundation (APSF) conference reviewing *Distractions in the Anesthesia Work Environment*, were utilized to establish project need and construct the education module.^{8,9,10} The noise pollution education content was not in the basic curriculum or nurse anesthesia traineeship programs evaluated. Furthermore, regulatory bodies have mandated institutions to protect employees from occupational hazards and that employees understand what occupational hazards pose a threat to their health.

Student recruitment was elicited via email and participation was voluntary. Forty students participated in two education modules and lectures focusing on noise pollution. The education module for SRNAs on noise pollution was constructed to provide learners with a comprehensive summary of noise pollution, factors contributing to excessive noise, and the effects of noise pollution on patients and providers in the OR.

An oral presentation was utilized to provide learners information on the characteristics of sound waves and how that leads to the production of noise. The primary sources of noise from monitors, alarms, equipment, and staff behavior were reviewed.^{1,4} Several tools and strategies to ameliorate noise pollution were provided including the use of noise measuring phone applications for reference sound levels and how to facilitate interdisciplinary huddles to address noise pollution. Actions to eliminate or minimizing unnecessary noise like music and suction were discussed.

Evaluation Method

A pre-test and post-test methodology was utilized to assess effectiveness of the educational content delivery (Figure 1). Ten minutes were allotted to complete a pre-test, fifteen minutes for delivery of educational content, and ten minutes for post-test completion. Students were provided an open forum session following delivery and completion of the education module to ask more detailed questions or express concerns regarding the content. Scores were analyzed using a *t*-test for paired data.

RESULTS

The aim of this quality improvement education project was to assess SRNA awareness of noise pollution in the operating room and the associated consequences. The null hypothesis stated: *There will not be a statistically significant difference between*

pre-test scores and post-test scores. The pre-tests and post-tests included 8 multiple-choice questions and two open-response questions (Figure 1). Answers to questions were marked as correct or incorrect. The mean average pre-test score was 60% compared to the mean average post-test mean score of 90%. A 2-tailed *t*-test for paired data was completed and revealed the observed difference (30%) was statistically significant ($p < 0.001$). Assumptions for the *t*-test for paired data included continuous, interval/ratio level data and normality of data distribution. After analyzing data generated from the *t*-test demonstrating a statistically significant difference (30%) between the average pre-test scores and the average post-test scores, the decision was made to reject the null hypothesis. Results generated from the education module illustrated a knowledge deficit pertaining to noise pollution, cognitive demand, and attention allocation when providing anesthesia. The education module appeared effective in shedding light on noise pollution in the OR- a true knowledge deficit of SRNAs.

The open forum discussion section revealed that over half the students were, "not concerned with noise" (N=29). Four stated they were, "sometimes concerned," and seven stated they "were concerned." However, 100% of students would change future practice after completing the education modules.

DISCUSSION

Noise pollution in the operating room has been an overlooked, but significant environmental and occupational hazard for both patients and providers. There has been a large body of evidence to support that sound levels in the operating room often exceed safe levels^{1,2,3,13} Special attention should be given to the current initiatives in place that acknowledge noise pollution as a significant threat. This project aim was to disseminate the current body of knowledge pertaining to noise pollution and provide suggestions to decrease or eliminate noise. Even if the findings had not been statistically significant, there was a profound argument that this project was clinically important in that interdisciplinary practice changes may yielded improved outcomes.

Van Pelt stated, "*distractions in the perioperative work environment can adversely affect vigilance, situational awareness, and the ability to respond promptly to changes in the patient's condition and pose a risk to patient safety.*"¹⁰ One may assert that in order to achieve a system wide culture change, early delivery of formal education pertaining to environmental and occupational hazards should be

employed. This initiative could improve patient safety and patient and provider satisfaction.

LIMITATIONS

The main limitation for this project was a small convenience sample from one nurse anesthesia program for the educational content delivered. Future projects should expand educational content to other OR professionals (eg, anesthesia providers, OR staff). Furthermore, this quality improvement project was limited by the time constraint allotted for implementation. Students completed the pre-test, education module, and post-test in one session. Follow-up six months post-education would be beneficial to assess retention. A follow-up survey would assist in collection of data regarding practice changes have and any other perceived beneficial changes.

CONCLUSION

Excessive noise in the operating room poses a significant threat to both patients and providers. Noise pollution strains an anesthesia providers' cognitive ability to function and challenges attention allocation. Interdisciplinary teams should be formed to identify, implement, and evaluate processes to decrease noise pollution in the operating room. It is imperative that ongoing assessment of interventions be conducted to ensure progress and augmentation of a therapeutic environment. Although several national initiatives are in place to reduce noise, it is imperative the knowledge pertaining to noise reduction is disseminated, and effective interventions implemented to protect both providers and patients.

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Tyler Davis-Sandfoss DNP, CRNA currently practices at Ann & Robert H. Lurie Children's Hospital of Chicago with special interests in pediatric anesthesia and occupational safety for clinicians. Rachel Smith-Steinert DNP, CRNA is the Assistant Program Director at the University of Cincinnati Nurse Anesthesia program and currently practices at the University of Cincinnati Medical Center with special interests in nurse anesthesia education, grant writing, and collaboration with international schools of nursing. The authors currently are involved in ongoing quality improvement efforts addressing noise pollution and reduction in the operating room.

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Figure 1. Educational Module Pre/Post Test

1. What is the average noise level in the operating room?
 - a. 40 decibels
 - b. 65 decibels
 - c. 75 decibels
 - d. 85 decibels
 - e. 100 decibels

2. What organization regulates occupational noise exposure limits?
 - a. National Institute of Occupational Health and Safety (NIOSH)
 - b. American College of Surgeons
 - c. State Associations (eg, Ohio State Health Association)
 - d. American Association of Nurse Anesthetist

3. What is the maximum amount of noise exposure suggested by the above-mentioned regulatory body in an 8-hour period?
 - a. 65 decibels
 - b. 75 decibels
 - c. 85 decibels
 - d. 95 decibels
 - e. 105 decibels

4. During noisy procedures, such as neurosurgical, orthopedic surgery, etc., what is the average noise level 40% of the time?
 - a. 85 decibels
 - b. 90 decibels
 - c. 100 decibels
 - d. 110 decibels

5. Please list one organization that has established a task force or has been proactive in attempting to educate OR staff on noise pollution.
 - a. _____

6. Please list 3 variables that can be most easily manipulated to decrease noise pollution.
 - a. _____

 - b. _____

 - c. _____

7. Please list 3 complications for patients associated with noise pollution in the operating room.
 - a. _____

 - b. _____

 - c. _____

8. Please list 3 complications associated with noise pollution for providers.
 - a. _____

 - b. _____

 - c. _____
