Implications of an Education Tool as a Noise Reduction Strategy in the Operating Room

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Abstract

Noise in the operating room (OR) can be from many sources, including personnel and medical equipment. Excessive noise is prevalent in the OR and can lead to distractions, interruptions, stress, and medical errors. These distractions have been well-documented in the literature and can reduce the quality of patient care. Awareness and education have proven to be solutions to noise reduction, but there is little evidence in the literature regarding the adoption of a clinical guideline. The goal of this study is to bring awareness of noise levels in the OR, the most common noise distractions, and how these relate to adverse events for the patient through the adaptation of an education tool as an initial step for future researchers to develop a guideline. The researchers measured decibel levels in the OR prior to and after the implementation of an educational tool for noise reduction in the OR. Seventeen surgical cases were evaluated, and a post-intervention survey was sent out to OR staff. While there was no significant difference between the sound levels pre- and post-intervention, the majority of healthcare providers defined excessive noise as a problem in the OR that ultimately leads to miscommunication and specifically, added stress.
Introduction

Background and Significance

The operating room (OR) environment includes devices, equipment, and individuals that create noise. Noise can be generated by communication between all team members, as well as safety aspects of equipment that alarms the providers of pertinent patient data (Burlingame, 2019; Hogan & Harvey, 2015). However, crucial information can be obscured by excessive and unnecessary noise. This can occur in the OR, frequently leading to miscommunication, distractions and unnecessary interruptions which can potentially increase medical errors, stress, and fatigue that jeopardizes patient safety (Hogan & Harvey, 2015). Education and awareness of OR noise are successful at minimizing excessive noise, but further study regarding sound reduction strategies in the OR is required.

As nurse anesthetist trainees (NAT), current experience in the OR is limited to the time in clinical residency. During this experience, the learning curve is tremendously steep. Transitioning from registered nurses in the intensive care unit (ICU) to new NATs is a challenging adjustment, and additionally alarm fatigue and the effects of excessive noise are critical aspects that greatly impact the care of patients. As seasoned ICU nurses in a comfortable environment, NAT were able to focus on important alarms while completing tasks without threatening patient safety. In a new role, NAT are placed in the unfamiliar surroundings of the OR and find themselves consumed with problem solving with the challenge to pay attention to the overall situation around us. Due to the immense impact on patient safety, it is imperative to understand the influence of an education tool for all team members, and how it can reduce excessive noise, and thus, improve the care they provide.
Methods

Study Design

This study used a modified pretest-posttest and post-intervention research design. The modification included pre-intervention and post-intervention data collection as well as a post-intervention questionnaire. The research plan included measuring noise levels in similar surgical cases before and after implementation of a noise reduction education tool. The purpose was to bring awareness of 1) noise levels in the OR, 2) the most common noise distractions, and 3) how these relate to adverse events for the patient.

Key concepts related to this study include: noise distraction, critical event, adverse event. Definitions listed below:

- *Noise distraction*: loud sound occurring that draws attention away from one’s original focus
- *Critical event*: “events in routine surgery during which there is a high risk of an adverse occurrence”; for example, during induction or emergence of anesthesia (Wright, 2016).
- *Adverse event*: an undesirable, unexpected occurrence resulting in medical injury

Sample

The sample for this study included seventeen surgical cases, and all personnel working in the operating room at these times. The process required cooperation from the surgical team, circulating nurses, and anesthesia team. Inclusion criteria comprised willingness to participate in the implementation of an education tool as a noise reduction strategy and surgical procedures scheduled for 3 hours or less.
Setting

The authors requested permission from NorthShore University HealthSystem Evanston Hospital to measure noise in various OR cases and implement a noise reduction education tool and received NorthShore IRB approval. Ten surgical cases were chosen to measure decibel levels before any education was provided. The next ten surgical cases measured sound levels after participants and staff members reviewed the noise reduction clinical education tool. A brief post-intervention survey was dispersed to participants and staff members to collect additional information.

Instruments

Accurate data collection was imperative to answer the research questions regarding the effects of excessive noise. The Meterk Digital Sound Meter was utilized for each case and placed in the same location each time. The machine was calibrated before each use. To increase reliability, the measured intervals were the same for each patient.

Pretest-posttest research designs typically have weak internal validity. Threats to internal validity related to this study include history, selection, and instrumentation (Polit & Beck, 2017). To minimize these confounding variables, the researchers were present in all OR cases when noise levels were measured. Similar surgical cases utilizing general anesthesia were chosen, since they had similar inductions, types of critical events, and emergences.

Both the educational tool and post-interventional survey were validated by a panel of experts. The panel consisted of five certified registered nurse anesthetists (CRNAs) with several years of clinical practice experience, who were educated in the concerns of excessive noise in the operating room. The panel recommended improvements and ultimately, unanimously approved
Recruitment Procedures

Recruitment of participants for data collection was done through email and flyers posted for all OR staff. Intraoperative participants were assembled according to the surgical cases selected for sound measurement. A waiver for consent for participation was completed before data collection, due to the lack of participant and patient information obtained. Implementation of the education tool was administered to all team members with active roles in the OR setting with the intention to educate all OR staff.

Data Collection Procedures

Data was collected through the use of the Meterk Digital Sound Level Meter, which measures a range between 30 and 130 decibels. This device was chosen for its ease of use, precise measurements, and measurement range. This sound meter was calibrated before each use and turned on to collect data as the patient entered the operating room. Sound levels were measured until the patient left the operating room. The researchers were present to document timing of intraoperative critical events including induction, intubation, extubation, and any other pertinent events. The researcher also recorded the sound level during each of these critical events, as well as every three minutes throughout the case. For post-intervention surgical cases, the researchers additionally documented adherence to the noise reduction strategy by participants.

Data Analytic Procedures

By using a modified pretest-posttest study, the authors examined the influence of the clinical education tool by measuring noise levels in the OR directly, and used SPSS software for data analysis. First, descriptive statistics were used to determine distribution of sound levels
throughout the procedures, including the mean and median sound levels as well as standard deviations. A Spearman’s rho correlation was utilized to correlate decibel levels with the number of people in the room throughout the case. Finally, descriptive statistics were used to analyze survey responses.

**Ethics and Human Subjects Protection**

The Institutional Review Board (IRB) at DePaul University and NorthShore University HealthSystem reviewed and approved this study prior to data collection. The authors recorded data only on decibel levels during specific phases of surgeries, and no specific patient information was recorded. However, the type of surgical procedures and anesthetic were recorded, and this information was obtained from the daily OR schedule, thus not violating patient confidentiality. The researchers completed the required collaborative institutional training initiative (CITI) training for human subjects, as well as financial conflict of interest (FCOI) and good clinical practice (GCP) training. Participation in the study from the surgical staff was voluntary. The researchers received no compensation from Meterk for use of the digital sound meter.

**Results**

**Decibel Levels**

Throughout the ten pre-intervention surgical cases, a total of 333 sound levels were measured. The sound level ranged from a minimum of 56.7 decibels, to a maximum of 98.4 decibels. The median sound level was 75.2 decibels, with a standard deviation of 6.9398. A total of 264 sound levels were measured throughout the seven post-intervention surgical cases. The minimum sound level was 61 decibels, ranging to a maximum of 90.5 decibels. The median sound level was 76 decibels, with a standard deviation of 5.8426.
Because both pre- and post-intervention data sets were not normally distributed (see Figure 1 and Figure 2 below), non-parametric tests were used to analyze data. Researchers utilized Spearman’s rho to correlate the sound level in the OR with the number of people in the room. The p value for the correlation between pre-intervention sound levels and people in the room was 0.087, while the post-intervention sound levels p value was 0.348. Both of these p values are larger than the alpha value of 0.05. Therefore, there was no statistically significant correlation was found between the number of people in the OR and sound levels in the OR (see Figure 3 and 4 below).

Figure 1. Distribution of Pre-Intervention Sound Levels
Figure 2. Distribution of Post-Intervention Sound Levels
Figures 3 and 4. Correlations between Sound Levels and Number of People in the Room.

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<tr>
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<th>Post-Intervention Sound Levels</th>
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<td>Post People in Room</td>
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Survey

Demographic data from 45 participants included their roles in the OR and experience levels. Roles included nurse, surgeon, anesthesiologist, and CRNA. Experience was classified into four categories: 0-3 years, 4-7 years, 8-10 years, and over 10 years in their specified role. 22% of the participants were nurses, 22% were anesthesiologists, 27% were surgeons, and 29% were CRNAs. 71% of all respondents had over 10 years of experience. 18% had 0-3 years’ experience, 7% had 4-7 years’ experience, and 4% had 8-10 years’ experience. 44% of participants received the educational tool provided by the researchers, while 56% stated they had not received it.
Questions were also asked regarding excessive noise in the OR. 62% of participants perceived excess noise or distractions while in the operating room (Figure 5). These sources of noise included music (35%), equipment (30%), conversation (30%), and non-specified other (4%) (Figure 6). Respondents were asked what consequences they perceived were from excessive noise in the OR. Miscommunication (35%), increased stress (27%), medical errors/adverse events (14%), patient safety (20%), and non-specified other (3%) were all included as potential repercussions of excessive noise.

Figure 5.
Discussion

As discussed previously, the purpose of this study was to explore the effects of excessive noise during critical times in the operating room from the perspectives of a multidisciplinary team, before and after implementation of a noise reduction education tool. Critical times include induction, emergence, and any other significant events throughout the case. In decreasing excessive noise in the operating room, the goal is to reduce associated adverse events and thus improve patient safety.

Distractions in the operating room have been well-documented and have shown to reduce the quality of patient care. Awareness and education have proven to be solutions to reduce noise, but there is little evidence in the literature regarding the adoption of a clinical guideline. The purpose of this study was to bring awareness of noise levels in the OR, the most common noise
distractions, and how these relate to adverse events for the patient through the adaptation of an education tool as an initial step for future researchers to develop a guideline.

The authors found that distractions such as music, non-essential conversation, and equipment contributed to the overall increase in noise levels. It was also concluded that the average decibel levels during this study were above the average operating noise levels found in our literature review which emphasized the need for an education tool to decrease excessive noise. Furthermore, the majority of healthcare providers in the operating room conveyed that excessive noise is a problem they face continuously, many citing miscommunication and added stress as ramifications of noise.

Through pre-intervention and post-intervention data collection of sound levels, the researchers were able to emphasize the issue of excessive noise in the operating room. Though this was an apparent issue that was highlighted in the literature review, we were able to investigate the impact of an education tool as a noise reduction strategy. Additionally, our post-intervention survey provided imperative information regarding demographics of providers, perceived sources of excessive noise, stress levels, and other useful data that can contribute to the overall goal of noise reduction. Most importantly, this pilot study provided a significant amount of strengths and limitations that can be included in future research.

**Strengths and Limitations**

During each step of the research process, several strengths and limitations were identified that can improve future research. An obvious strength is the applicability of the research topic, and its effects on patient safety. Excessive noise is prevalent in the OR and can lead to distractions, interruptions, stress, and medical errors. Effects of excess noise are well-documented in the literature and can reduce the quality of patient care. Awareness and education have proven to be solutions to the negative outcomes of excessive noise in regard to patient
safety. Thus, this research project and development of an education tool, have brought awareness and knowledge in reducing excessive noise to team members of the operating room.

One of the strongest limitations to this pilot study was the unanticipated complexity of the many variables surrounding excessive noise. Variables included the type of surgical procedures, type of anesthesia provided, and the participants involved in each case. Additionally, an initial proposed target was to measure sound levels in ten pre-intervention cases and ten post-intervention cases. Due to the COVID-19 pandemic, sound levels of only seven post-intervention cases were obtained, which resulted in a significant difference in the data when comparing pre- and post-intervention sound levels. Furthermore, when comparing pre- and post-intervention cases, there were a variety of cases that were found to be incomparable during data analysis. For example, comparing sound levels of a laparoscopic hernia repair to sound levels of anal polyp excision is arbitrary and does not take into account the complexity of the case or the devices used. These two factors may have contributed to the results of the research study. More consistency, in participants and case variables, will allow future research to focus on the implications of an education tool and its impact on excessive noise.

**Directions for Future Research**

Measuring excessive noise in the OR was found to be much more complex than the previous literature notes. This research project was essentially a pilot study and needs to be replicated with a larger data set. Future studies must be mindful of the challenges that this study faced, including the decisions about continuous decibel level monitoring, the types of surgeries, and the high level of variability of the surgical procedure process. Such variabilities included the type of surgical procedures, type of anesthesia provided, and the participants included in each case. Suggestions for future research would include matching similar surgical procedures in the pre-intervention and post-intervention data collection. By doing this, the type of anesthesia
provided would also be consistent in the pre-intervention and post-intervention data collection. For example, comparing a simple mastectomy under general anesthesia would eliminate such variability, and thus, allow for better comparison of data.

**Conclusion**

The goal of this pilot study was to explore the implications of an education tool as a noise reduction strategy in the operating room. Though the results did not show a significant improvement when comparing pre-intervention sound levels to post-intervention sound levels, several lessons were learned. Most importantly, future research is necessary and will require overcoming the limitations while highlighting positive outcomes. Incorporating the strengths and limitations of this study into future research as well as a larger data set will allow for a more robust study that can highlight the implications of an education tool as a noise reduction strategy. It is imperative that excessive intraoperative workplace noise be further examined in order to improve patient safety and better outcomes.
References


Plaxton, H. (2017). Communication, Noise, and Distractions in the Operating Room:


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___ Cover letter
___ Title page (Appendix A)
___ Manuscript, including references
___ Clinical manuscript (Appendix B)
___ Management manuscript (Appendix C)
___ Research manuscript (Appendix D)
___ Quality Improvement manuscript (Appendix E)
___ Education manuscript (Appendix F)
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___Literature Review manuscript (Appendix K)
___Tables, figures, photos, or video
___Applicable permission forms
___Permissions letter (Appendix G)
___Photographic consent (Appendix H)
___Signed AORN Journal Copyright Transfer/Publishing Agreement (Appendix I)
___Instructions (Appendix J)

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