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Best Practice

Increased Patient Satisfaction in the Postanesthesia Care Unit with the Implementation of a Controlled Noise Reduction Program

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A B S T R A C T

Purpose: Noise in the postanesthesia care unit (PACU) is a significant source of postoperative patient discomfort and can affect patient sleep and recovery. Interventions involving structural alterations in the environment reduce noise and improve patient satisfaction; however, there are no studies focusing on staff education as a method to reduce PACU noise.
Design: We designed and implemented a prospective PACU noise reduction program using education and training to minimize staff contributions to noise.
Methods: Noise levels, measured hourly with a decibel meter, patient satisfaction, and patient rest were assessed before and after implementation.
Findings: We found statistically significant decreases in noise levels and increases in patient satisfaction scores after the implementation of our noise reduction project.
Conclusions: These findings demonstrate that an inexpensive and easily implemented noise reduction program can effectively reduce environmental noise, increase patient satisfaction, and potentially improve recovery.

Loud noise environments have long been associated with patient dissatisfaction because of interrupted or insufficient rest, postoperative discomfort, and prolonged patient recovery because of physiological and psychological effects.[1] Florence Nightingale recognized noise as a stress factor more than 150 years ago in her book *Notes on Nursing*, writing "Unnecessary noise is the most cruel abuse of care which can be inflicted on either the sick or the well."[2] Although extreme noise is acknowledged as a stressful element in a clinical setting, hospital environments continually exceed recommended noise levels, potentially affecting patients' health and recovery periods.[3,4] Gabor et al[5] demonstrated in an inpatient setting that excessive noise levels, caused by machines and other technology, visitors, the physical environment, and staff, interfered with patients' ability to sleep and caused recurrent awakenings and disturbances. Sleep disruption or deprivation can result in altered immune function, increased inflammation, higher blood pressure, heart rate, and systemic vascular resistance, lower carbohydrate metabolism, and affect cognitive performance.[6] These physiological and psychological health repercussions of loud noise environments can adversely impact the patients' hospital experience and more importantly their recovery.

Although sometimes unavoidable, noise is one of the most disturbing aspects of the hospital environment and efforts should be made to minimize it. Studies have previously shown that higher than recommended noise levels in patient rooms are related to "clinically significant sleep loss," which may hinder patient recovery.[7] The World Health Organization (WHO) recommendations include a patient room (non–intensive care unit [non-ICU], surgical ward) noise level range of 30 to 40 dB, whereas the Environmental Protection Agency recommends a hospital noise level of 45 dB.[8,9]

There are a number of studies that demonstrate higher than recommended hospital noise levels. Yoder et al[3] measured noise levels in patient rooms that exceeded the WHO recommendation for all 155 days of their study. Another investigation that studied the sources and intensity of noise in a postanesthesia care unit (PACU) found an average noise level of 67.1 dB from 20,187 measurements

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for more than 1,678 minutes. Staff conversation caused 56% of the sounds greater than 65 dB, whereas environmental noise, such as alarms, caused less than 10%.[4] High noise levels can be found in all clinical settings of a hospital; noise level data from a level III neonatal ICU demonstrated a baseline level that consistently exceeded recommended levels.[10] In efforts to reduce the exceedingly high noise levels found in hospitals, there have been a few studies using some type of noise reduction programs in patient care areas of hospitals, none of which were conducted in the PACU.[11-13]

The PACU represents a critical component of a patient's recovery from surgery and their perioperative experience. Patients recovering from anesthesia can experience a combination of postoperative pain, nausea or vomiting, and disorientation. Patients in the PACU are usually not heavily sedated and not mechanically ventilated, which contrasts with patients in an ICU who require specific levels of sedation for their critical care needs (ie, mechanical ventilation). Thus, patient perception and awareness of noise in the PACU is usually higher than in other hospital settings. PACU care is a large component of every patients' perioperative experience. Therefore, their impression of the PACU environment strongly influences their opinion of their entire perioperative experience, affecting their perception of the hospital and their care. Therefore, a quiet environment in the PACU and during the recovery period with minimal disturbances is likely to enhance patient satisfaction, the ability to rest, and overall recovery.

Few studies have examined noise level reduction specifically in the PACU setting. A study examining the effects of music therapy and lower noise levels on the pain experienced by patients in the PACU found a significant improvement in comfort with music among postoperative patients.[14] Other noise reduction studies have investigated how changing environmental features and structurally redesigning the PACU can affect noise levels and patient satisfaction scores.[15]

We hypothesized that a noise reduction program, focused on nursing staff education and reducing environmental noise, would improve patient satisfaction and rest. We found that simple and inexpensive environmental training for nursing staff significantly reduced noise levels and improved patient satisfaction and ability to rest scores in the PACU.

Methods

Study Design

We performed a prospective, longitudinal, survey-based analysis of patient satisfaction and noise levels before and after the implementation of a structured noise reduction program in the PACU. This is a Phase I and Phase II PACU that cares for all patients postoperatively. Their bedside care provider(s) remaining constant throughout their stay. If there is a change of shift, there is a direct person-to-person hand off. The University of Maryland Medical Center is a tertiary care center treating a range of surgical patients including ambulatory 23-hour observational admissions to severe, high acuity critically ill patients. Approval from the University of Maryland institutional review board was obtained for the study (HP-00073766).

Patient Recruitment

We recruited male and female adult patients (older than 18 years) who had undergone general anesthesia. Inclusion criteria included a minimum of an 8-hour stay in the PACU to ensure the patient had a lengthy PACU experience that was comprehensive enough to form an opinion with regard to satisfaction and the ability to respond to survey questions. Exclusion criteria were patients that were (1) heavily sedated on continuous infusions (ie, propofol, fentanyl, or benzodiazepines), (2) necessitated intubation or ventilator support postoperatively (ie, endotracheal tube intubation, continuous positive airway pressure, or bilevel positive airway pressure), or (3) those that exhibited any neurologic compromise resulting in their inability to follow simple commands and participate in the patient survey. Regardless of the type of anesthesia or medications given during the intraoperative period, each patient who was included in this study was able to participate in conversations with the research team. We assessed all elective surgical patients who were to be admitted to the hospital (floor status) or discharged after recovery in the PACU. Patient consent for answering the brief survey questions was verbally obtained from patients who met inclusion criteria. A researcher delivered the summary of the study to each patient before receiving verbal consent from these eligible patients. As this was a survey of the environment, every patient who was included was assessed by an anesthesiologist regarding appropriateness to answer the two questions regarding noise and ability to rest. These patients were surveyed 4 hours after their admission to the PACU.

Data Collection

Sound levels were measured with a BAFX Decibel Reader (model BAFX3370; BAFX Products, Milwaukee, WI). Three readings were taken at each of the following time points: 9:00 a.m., 10:00 a.m., 11:00 a.m., 12:00 p.m., 1:00 p.m., 2:00 p.m., 3:00 p.m., 4:00 p.m., 10:00 p.m., 11:00 p.m., 12:00 a.m., 1:00 a.m., 2:00 a.m., 3:00 a.m., 4:00 a.m., and 5:00 a.m.. The three values were averaged for each time point. Study participants answered questions verbally regarding the noise level and their ability to rest in response to a study coordinator, and the data were entered immediately into a database (Microsoft Excel, 2007). Patients participated in the survey at the end of their recovery time in the PACU before their transfer or discharge. We surveyed 50 patients before and after the implementation of the program. Both survey responses and noise levels were collected.

Noise Reduction Program ("Quite Time")

Baseline noise levels and patient satisfaction were measured 2 weeks before the implementation of the program before any training or education of the PACU staff. The Quiet Time noise reduction program hours consisted of one 4-hour session and one 2-hour session each shift (12:00 to 4:00 a.m. and 2:00 to 4:00 p.m.). These sessions were selected for association with average sleep wake cycles (4-hour session) and high-volume period in the PACU (2-hour session) to detect the minimum and maximum noise levels in the unit. Both sessions also contained no shift changes of bedside care providers. An introductory 15-minute presentation was made to each of the two nursing shifts followed by a second briefing given immediately before the implementation of the program. The charge nurse for each shift was counseled to observe for loud conversations or a high level of noise occurrences and to actively reduce these noise events by strategies including encouraging people within their area to lower their voices and silencing alarms. The Quiet Time noise reduction program consisted of the following components: (1) Dimming lights to increase staff awareness of the initiation of a Quite Time interval, (2) efforts to reduce conversation levels among staff, (3) switch from overhead paging to intercom-based paging for staff queries, (4) emphasis on staff acknowledging and silencing alarms on machines in a timely manner, and (5) health care staff and family members visiting patients were asked to lower their voices.

Twenty-four hours before the implementation of the Quite Time program, posters emphasizing noise reduction were placed in prominent locations throughout the PACU to enhance awareness. The posters advertised the specific hours for the Quite Time program and stressed the importance of lowering the overall noise level throughout the day. Two weeks after implementation, noise levels and patient satisfaction were measured again using the same methods.

Statistical Analysis

Baseline sound level data were collected on three nonconsecutive days for each time point (Figure 1). For the continuous variables, a paired *t* test was used to compare the before and after noise level data for each time point and the means. Dichotomous variables from the survey responses were analyzed with a χ^2 test. Differences were considered significant at $P < .05$.

Results

Initial Noise Assessment and Study Implementation

We sampled daytime noise levels throughout the day (three nonconsecutive days) to determine the baseline level of ambient sound in our PACU. Peak levels were noted between 12:00 and 2:00 p.m., measuring an average of 85.93 dB (Figure 2), which exceeds the Environmental Protection Agency hospital noise level recommendation of 45 dB, and the WHO hospital room noise level recommendation of 30 dB (maximum of 40 dB).[8,9] The noise was a result of a combination of multiple factors including conversations (ie, patient, families, and health care provider related), monitor alarms, telephone rings, and ambient noise. These specific sources of noise were not measured in aggregate, but the total combination decibel level was measured during the intervals tested. Patients who met the inclusion criteria and were consented were given the preprogram patient satisfaction survey. Simultaneously, an hourly noise level assessment was completed. We then implemented the

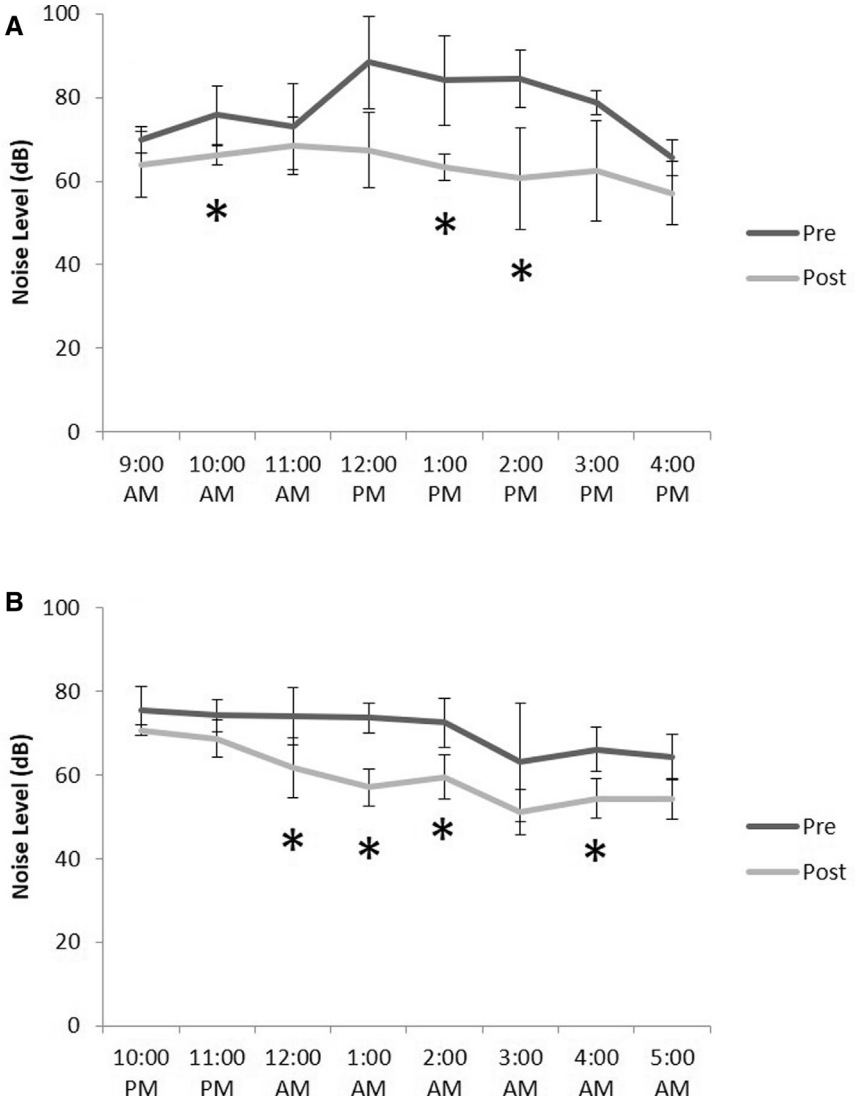

Figure 1. Noise levels as measured at the indicated time points before (pre) and after (post) the implementation of the noise reduction program. Daytime (A) and nighttime (B) levels as indicated. Each point is average of 3 days. Error bars indicate standard deviation for each time point. *Time points that were statistically significant with $P < .05$ (comparison between preimplementation and postimplementation of the noise reduction program).

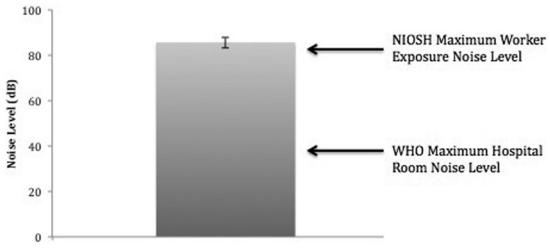

Figure 2. Graph indicating daytime (noon) noise levels in the postanesthesia care unit compared with national standards for hospital rooms and occupational worker exposure. Error bars indicate standard deviation (±11.06). NIOSH, National Institute of Occupational Safety and Health; WHO, World Health Organization.

Quiet Time noise reduction program described previously Two weeks after the implementation of the program, the patient satisfaction survey and noise level assessments were repeated.

Noise Levels

Daytime noise levels were higher than nighttime levels, with a peak between the hours of 12:00 and 2:00 p.m. Nighttime noise levels were lower than 80 dB and demonstrated a minimal slope and variation (Figure 1). After the implementation of the Quite Time program, there was a significant decrease in the average noise levels throughout the daytime and nighttime intervals (Figure 1). In addition, when noise levels were averaged over all time points to a single "day" value and single "night" value, there was a significant decrease after the implementation of the Quite Time program from 77.5 dB (±7.91) to 63.7 dB (±3.72) during the daytime, and 70.5 dB (±5.01) to 59.7 dB (±6.99) during the nighttime with $P < .05$ (Figure 3). Before the implementation of the program is delineated by "pre" and after the implementation of the program is delineated by "post" to signify before and after the program institution, respectively.

Patient Satisfaction and Ability to Rest

Implementation of the noise reduction program led to a statistically significant increase in patient satisfaction, specifically with the noise level and having the ability to rest (Figure 4). Before the implementation of the program (n = 50), about half of the patients reported being satisfied with the noise level in the PACU and the ability to rest/sleep (52%). Two weeks after the implementation of the noise reduction program, there was a significant increase in patients reporting satisfaction with the noise level in the PACU (72%). Before the implementation of the program, less than half of patients reported an ability to rest with the noise level in the PACU (40%). Two weeks after the implementation of the noise reduction program, there was a significant increase in patients reporting the ability to rest (66%) (Figure 5).

Discussion

The major findings in this study are as follows: (1) high baseline daytime noise levels in the PACU; (2) only 40% of patients reported being able to rest in the PACU before the noise reduction program; (3) a targeted noise reduction program significantly lowered noise levels (average daytime reduction = 13.84 dB and average nighttime reduction = 10.75 dB); and (4) this noise reduction was associated with significant improvements in patient satisfaction and ability to rest.

Some studies have demonstrated the physiological effects of poor sleep and high environmental noise. A study conducted in an ICU demonstrated that patient's perception of sleep quality in the

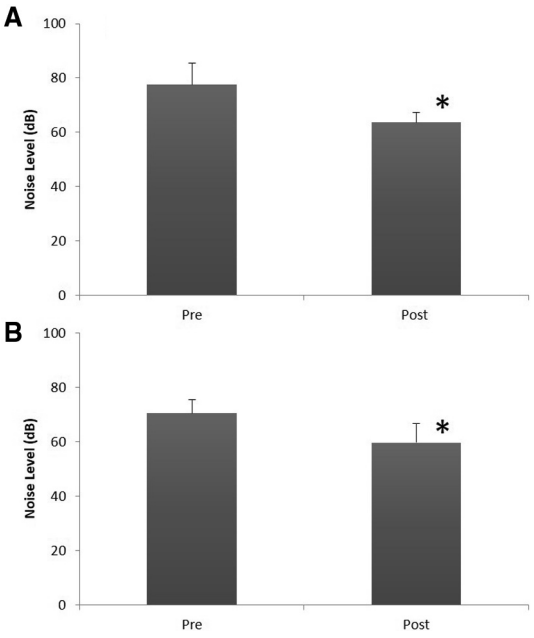

Figure 3. Average noise levels before and after the implementation of the noise reduction program—daytime (A) and nighttime (B). Data are average of all time points for more than 7 hours. Error bars indicate standard deviation (Pre day ±7.91, Pre night ±5.01, Post day ±3.72, and Post night ±6.99). *$P < .05$. Pre, before noise reduction program implementation; Post, after noise reduction program implementation.

hospital was poor compared with the patient's baseline sleep levels (regular levels of sleep at home), and poor sleep quality and daytime sleepiness are problems commonly found in several types of ICUs.[16] The consequences of the sleep deprivation that occur in hospital care areas can be severe, resulting in altered immune functions, increased inflammation of injured areas, parasympathetic and sympathetic loss of equilibrium, altered carbohydrate metabolism, and altered cognitive performance.[6] Thus, many patient care settings have worked to lower noise levels to improve patient rest and prevent these consequences.

The PACU has been the subject of noise reduction analysis in several studies. Allaouchiche et al studied the sources and intensity of noise in the PACU and found that the noise level constantly exceeded the WHO's recommendation for noise level intensity of 40 dB.[4] The study also measured patient satisfaction concerning their experience in the PACU using two questionnaires. However, contrary to our investigation, the study found that pain was the only factor affecting patient discomfort and there was no statistically significant difference in noise levels for patients who found

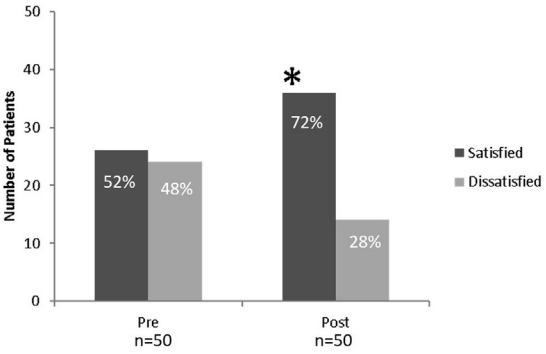

Figure 4. Patient satisfaction with noise levels in the postanesthesia care unit before and after the implementation of the noise reduction program. *$P < .05$, χ^2 variable = 4.2445.

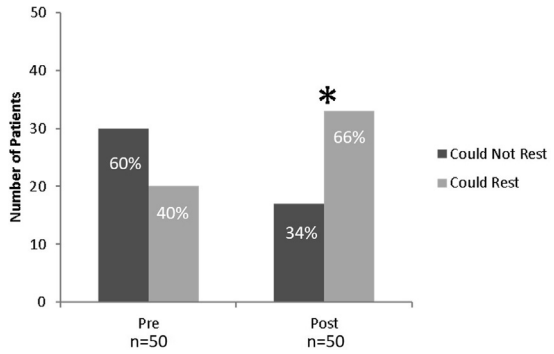

Figure 5. Patient ability to rest in the postanesthesia care unit before and after the implementation of the noise reduction program. *$P < 0.05$, χ^2 variable = 6.7844.

the PACU noisy and those who did not. In the Memorial Sloan Kettering Cancer Center PACU, a redesign with a unique floor plan to minimize noise and improve privacy combined with staff education resulted in improvements in patient satisfaction.[15] However, the study did not report changes in noise levels and did not identify whether the change in patient satisfaction levels was statistically significant. Our findings indicate that PACU staff education and minor changes in behavior can significantly reduce noise levels and increase patient satisfaction without costly structural changes to the PACU design. Furthermore, staff-based noise reduction implementations have been shown in other inpatient settings to have benefits, including the adult ICU and an acute orthopaedic unit.[17,18] These studies support our findings that low-cost environmental modifications and staff education can effectively reduce noise levels and increase patient satisfaction in patient care environments other than the PACU.

Staff-based interventions for noise reduction have been studied in several health care settings. Cabrera and Lee proposed establishing a “Department of Sound” assigned to controlling the amount of noise in the hospital and providing a center for music therapy. This study found their initiatives effective in addressing the combination of the noise and efficacy of music therapy.[13] In contrast to the establishment of a distinct department, our staff-based intervention was executed by existing nursing personnel in the PACU, demonstrating that a focused effort organized by caregivers can have a significant impact without the need for additional personnel.

Our medical center is Magnet designated, and this staff-driven intervention demonstrated several components of the Magnet Model,[19] including the following:

- *Structural empowerment*, where the staff engaged with influential and interprofessional leadership to meet current challenges.
- *Exemplary professional practice*, where competent, dedicated nurses applied their knowledge to achieve their professional best.
- *New knowledge, innovations, and improvements*, where the continued innovation that improved staff knowledge and clinical practice led to improvement and excellence.
- *Transformational leadership*, where leaders empower staff to fix broken systems and transform the organization to meet the future.

The limitations of the present study are as follows: (1) the noise reduction program was not able to reduce environmental noise to levels below the WHO recommendations (40 dB); (2) the nature and structure of the PACU did not allow a clear randomization strategy; and (3) long-term follow-up data were not collected to determine any long-term effect of this intervention.

Conclusion

The present study demonstrates that the implementation of a staff-based noise reduction program can effectively reduce noise levels and increase patient rest and satisfaction levels. As increasing attention is focused on the detrimental effects of environmental noise on patient recovery, cost-effective and simple strategies that can significantly decrease the high levels of noise present in busy PACUs may play an increasing role in improving patient satisfaction and clinical outcomes.

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