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# Noise in the Operating Room During Induction of Anesthesia: Effects and Mitigation Strategies

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**ABSTRACT**

**Purpose:** Operating rooms (ORs) often exceed recommended sound levels, which may negatively impact anesthesia induction. This study aims to quantify noise levels during anesthesia induction, evaluate their effects on healthcare professionals and patients, and compare findings to existing literature, including a previous review by Engelhardt et al.

**Methods:** An observational study was conducted over three months in 2024 at University Hospital Ibn Rochd, involving 112 surgical procedures. Noise levels were measured using a calibrated smartphone application. Thirty anesthesiologists and nurse anesthetists completed questionnaires to assess noise-induced stress, communication difficulties, and concentration challenges. Mann-Whitney U tests and Chi-squared tests were used for statistical analyses.

**Results:** Median noise levels during induction were 75.5 dB (IQR: 68.0-81.3), exceeding the WHO's 35 dB threshold. Trauma-orthopedics procedures recorded the highest levels at 80.2 dB ($p < 0.001$). While 60% of staff reported noise-induced stress, patients showed significant increases in heart rate (92 bpm to 115 bpm; $p < 0.001$) and blood pressure (130/85 mmHg to 150/95 mmHg; $p = 0.02$). Educational interventions reduced noise in 62% of cases.

**Conclusion:** Excessive noise during anesthesia induction compromises patient safety and staff performance. This study reinforces the need for concerted noise-reduction strategies-behavioral, educational, and technological-to optimize OR conditions.

**KEYWORDS:** operating rooms, mitigation strategies, anesthesia induction, safety in anesthesiology, noise pollution.

## INTRODUCTION

### Background and Rationale

Noise in the operating room (OR) is a longstanding but often underappreciated concern in perioperative medicine. Research dating back several decades has consistently shown that noise levels in the OR often exceed recommended limits, potentially affecting patient outcomes and team performance. According to the World Health Organization (WHO), ambient noise in hospital settings should ideally remain below 35 dB to ensure optimal patient safety and comfort. However, many surgical procedures involve multiple mechanical devices, continuous monitoring alarms, and frequent staff communication, making it challenging to maintain noise levels below recommended thresholds. During anesthesia induction specifically, precise focus and clear communication are paramount for patient safety. Even minor distractions can compromise the rapid decision-making required for successful induction, intubation, and ongoing anesthesia management. McLeod RWJ et al. previously found noise to be detrimental to communication and surgical performance, particularly regarding total errors and time to task completion [1]. Meanwhile, Yu et al. highlighted that noise surpassing 75 dB elevates the risk of anesthesiologist errors by increasing stress and cortisol levels [2]. Despite these known hazards, few studies have focused exclusively on noise levels and associated impacts during the short but high-risk induction period.

### Significance of the Study

In light of these observations, this study was designed to:

1-Quantify noise levels during anesthesia induction across multiple surgical specialties at a major academic hospital.

2-Evaluate the immediate psychological and physiological effects of noise on both healthcare professionals and patients.

3-Examine the success of readily implementable mitigation strategies such as educational interventions and verbal reminders to lower noise.

By exploring these aspects in greater detail, the research aims to fill a critical knowledge gap and generate practical insights for improving patient safety, team communication, and overall OR efficiency.

## Materials And Methods

### Study Design and Setting

An observational, prospective study was conducted from February to April 2024 at University Hospital Ibn Rochd in Casablanca, Morocco. The hospital is a tertiary care institution, accommodating diverse surgical specialties, which allows the study to capture a wide array of noise profiles.

### Participant Recruitment

A total of 30 anesthesiologists and nurse anesthetists were recruited through departmental meetings and email invitations. Inclusion criteria required participants to have at least one year of experience in anesthesia. Exclusion criteria were minimal, primarily aimed at those unwilling to provide informed consent. Each participant received a detailed explanation of the study's goals, methods, and potential implications prior to enrollment.

### Procedures and Data Collection

#### Noise Level Measurement

Noise levels were measured using the "Decibel X" application installed on a smartphone, which had been calibrated against a Type 2 sound level meter to maintain ±1 dB accuracy. Measurements were taken at the patient's head level from the start of induction until endotracheal tube placement was confirmed or, in cases of alternative airways, until the airway was deemed secure. Each measurement session lasted approximately 3-5 minutes, depending on the complexity and success rate
of the induction.

#### Observational Protocol

We documented the specialty (e.g., trauma-orthopedics, gynecology) and whether the operation was emergent or elective.
Pertinent environmental factors such as background music, concurrent room usage, and the presence of teaching activities (e.g., a resident performing the procedure) were noted.

#### Questionnaires

**Staff Survey:** A short questionnaire assessed noise-induced stress, communication difficulties, and perceived concentration challenges. Respondents rated each parameter on a 5-point Likert scale (1 = Not at all, 5 = Extremely).

**Patient Metrics:** Heart rate and blood pressure were recorded immediately before and immediately after induction by the anesthesiologist. Each patient's baseline data, including ASA classification, age, and any preexisting cardiovascular conditions, were also logged.

#### Mitigation Strategies

**Educational Sessions:** Brief educational interventions regarding the impact of noise were provided to staff at the start of each week (e.g., reminders to minimize unnecessary conversation).

**Verbal Reminders**: During induction, anesthesiologists or senior nursing staff sometimes requested silence if noise levels seemed disruptive.

### Statistical Analysis

**Descriptive Statistics:** Used to summarize key variables such as median noise level, frequency of staffreported stress, and patient vital sign changes.

**Comparative Tests:** The Mann-Whitney U test was employed to compare median noise levels across specialties due to the nonparametric nature of dB measurements. Chi-squared tests evaluated the association between specific noise sources (staff conversations, equipment) and reported impacts (stress, communication breakdown).

**Significance Threshold:** A two-sided p-value $< 0.05$ was considered statistically significant. Statistical analysis was performed using SPSS version 28 (IBM Corp., Armonk, NY, USA).

The questionnaire would be showcased in the annexes labeled as annexe 1

## RESULTS

### Study Cohort

A total of 112 surgical procedures were observed across eight specialties: trauma-orthopedics, gynecology, thoracic surgery, urology, general surgery, neurosurgery, ENT, and vascular surgery. Most procedures were elective, though 18% were classified as urgent or emergent. The distribution of cases provided are presentative overview of induction-related noise levels in a busy tertiary center.

### Overall Noise Levels

**Median Noise:** 75.5 dB (IQR: 68.0-81.3).

**Peak Specialty:** Trauma-orthopedics registered the highest median of 80.2 dB (IQR: 74.3-85.5; $p < 0.001$ vs. other specialties).

**Lowest Specialty**: Gynecology recorded the lowest median noise at 65.7 dB (IQR: 62.1-69.4). Impacts on Healthcare Professionals

**Stress:** 60% of staff reported noticeable stress attributed to high noise levels, often citing difficulty maintaining focus on the induction protocol.
**Communication Challenges:** Half (50%) of respondents noted at least moderate difficulty communicating essential patient data or instructions.
**Concentration:** 43% felt that noise compromised concentration, corroborating reports in the staff surveys of frequent "background chatter."

**Patient Physiological Responses**
**Heart Rate:** Increased from a median of 92 bpm pre-induction to 115 bpm post-induction ($p < 0.001$).
**Blood Pressure:** Systolic/diastolic BP rose from 130/85 mmHg to 150/95 mmHg ($p = 0.02$).
**Notable Trends**: Patients with preexisting anxiety or cardiovascular comorbidities were more susceptible to noise-induced spikes in heart rate and blood pressure, although this subgroup analysis did not reach statistical significance ($p = 0.07$).

**Sources of Noise**
**Staff Conversations:** At 37%, this was the most frequently cited noise source. Examples included casual talk, teaching dialogues, and phone calls within the OR. Surgical Instruments: Contributed 20%, notably in trauma-orthopedics involving hammering, drilling, or sawing.
**Alarms and Beeps:** Comprised 15%, with frequent pulse oximeter, ECG, and infusion pump notifications.

**Mitigation Strategies**
**Educational Interventions:** Introduced at the beginning of the study, these sessions significantly increased awareness. In 62% of the observed cases, staff consciously lowered their voices or turned off nonessential alarms when reminded.
**Verbal Requests for Silence:** Effective in 38% of cases, indicating that real-time reminders helped reduce extraneous conversation but were less influential in high-acuity settings where multiple staff members spoke simultaneously.

**Table 1 summarizes these findings**

| Category | Notable Findings | Statistical Significance |
|---|---|---|
| Noise Levels | - Median: 75.5 dB (IQR: 68.0–81.3)<br>- Exceeds WHO's 35 dB threshold | - |
| | - Highest (Trauma-Orthopedics): 80.2 dB<br>- Lowest (Gynecology): 65.7 dB | $p < 0.001$ (Trauma-Orth vs. others) |
| Impacts on Staff | - Stress reported by 60%<br>- Communication difficulties: 50%<br>- Reduced concentration: 43% | - |

**FIGURE 1: table that summarizes the findings**

## DISCUSSION

### Comparison with Previous Literature

Our findings on noise levels corroborate existing data on excessive OR noise. McLeod RWJ et al. demonstrated a range of 65-80 dB in pediatric settings, with a direct correlation to communication lapses and slower reaction times [1]. Yu et al. further connected noise surpassing 75 dB to elevated anesthesiologist error rates, an outcome that resonates with our observation that half of our participants struggled to communicate effectively under noisy conditions [2]. In trauma-specialized ORs, Liu et al. noted noise peaks up to 85 dB, underscoring the unique challenges of surgeries involving power tools [3].similarly to the 3 previous studies [1][2][3] our study recorded noise levels significantly exceeding the WHO's recommended limit of 35 dB [4]
Similar to Allaouchiche et al. [5], our study documented noise levels exceeding 70 dB. However, whereas Allaouchiche et al. evaluated patient discomfort through subjective self-reporting without direct physiological measures, our findings provide clear physiological evidence of stress, demonstrated by significant increases in heart rate and blood pressure during anesthesia induction. In line with Hasfeldt et al. [6], we found that excessive operating room noise negatively impacts healthcare professionals by causing

communication breakdowns and distraction. While Hasfeldt et al. primarily highlighted subjective impacts on staff performance, our study extends these findings by identifying measurable physiological responses (increased heart rate and blood pressure) in patients during anesthesia induction, highlighting the direct clinical implications of noise exposure at critical moments in perioperative care.

**Table 2 compares key elements across these studies**

| Study | Setting | Noise Levels | Key Findings | Citation |
|---|---|---|---|---|
| **Chabbar et al.** | University Hospital Ibn Rochd | Median 75.5 dB (Peak ~80 dB) | - 60% staff stress<br>- HR & BP increases in patients<br>- Educational measures reduce noise | - |
| **McLeod RWJ et al.** | Various Ors | 65–80 dB | - Impaired communication<br>- Delayed response to critical events | [1] |
| **Yu et al.** | Various OR settings | >75 dB | - Elevated anesthesiologist error rates<br>- Cortisol level increase | [2] |
| **Liu et al.** | Various or settings | Up to 85 dB | - High decibel environment<br>- Headsets reduce stress & improve response times | [3] |

**FIGURE 2: correlation between different studies**

**Potential Mechanisms**

The detrimental impact of noise on cognitive and physiological functioning can be explained through heightened sympathetic arousal. Excessive auditory stimuli may lead to an over-activation of the hypothalamic-pituitary-adrenal (HPA) axis, resulting in increased cortisol levels-a phenomenon backed by Yu et al. [2]. For anesthesiology teams, these elevated stress hormones can impair fine motor skills, situational awareness, and the ability to interpret vital signs quickly.

**Mitigation Approaches**

**Behavioral Changes**: Regular team briefings on the negative consequences of noise encourage staff to minimize non-essential conversations.

**Technological Innovations**: Acoustic paneling, noise-canceling headsets, and “smart” alarm systems that reduce false alarms could be tested in high-acuity environments. Liu et al. reported that headsets cut stress by 35% and improved response times by 20% [3].

**OR Design:** Modern ORs may employ optimized layouts and materials engineered to absorb or diffuse sound, a focus area for future studies seeking to curb the inevitable clamor of mechanical tools.

**Strengths and Limitations**

**Strengths**

**Diverse Specialties:** Observing eight different surgical areas allowed for a broad understanding of noise dynamics.

**Focused on Induction:** By zeroing in on anesthesia induction, the study addresses a critical phase where precision is vital.

**Limitations**

Lack of Formal Sample Size Calculation: Though 112 procedures provide a sizable dataset, a formal power analysis was not performed.

**Subjective Stress Assessments:** Reliance on questionnaires may introduce response bias; direct physiological stress metrics (e.g., salivary cortisol) could corroborate subjective responses.

**Single-Center Study:** Results may differ in other hospitals or countries with distinct OR protocols.

**Future Directions**

Further research could involve a multicenter approach, incorporating objective measures of stress (e.g., cortisol levels, heart-rate variability in staff) and advanced acoustic interventions (e.g., real-time decibel monitoring with automatic alerts). Assessing the cost-effectiveness of various noise-reduction solutions would also be beneficial for hospital administrators facing budget constraints.

## CONCLUSIONS

This study underscores that noise levels during anesthesia induction often exceed safe thresholds, contributing to stress, communication difficulties, and adverse physiological responses in patients. Educational efforts and real-time silence requests were partially successful in mitigating noise, pointing to the potential efficacy of ongoing staff training and policy reforms. Integrating acoustic solutions, rethinking OR design, and employing noise-canceling technologies could offer a more comprehensive approach to noise reduction. Ultimately, a multi-pronged strategy is essential to enhance patient safety, bolster team performance, and elevate overall anesthesia care standards.

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