

ANESTHESIA GAS EXPOSURE AND ITS IMPACT ON THE HEALTH OF MEDICAL PERSONNEL AT THE OPERATING ROOM OF DR. R. SOEHARSONO MILITARY HOSPITAL BANJARMASIN: A QUALITATIVE APPROACH

¹ Puji Ayu Asri Sri Lestari, ²Endang Suprihati Ningsih

¹Politeknik Kesdam VI Banjarmasin, Indonesia, pujiayuasrisrilestari@gmail.com

²Rumah Sakit Tk. III Dr. R. Soeharsono Banjarmasin, Indonesia, pujiayuasrisrilestari@gmail.com

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CORRESPONDENCE

Puji Ayu Asri Sri Lestari
Politeknik Kesdam VI Banjarmasin
Indonesia
pujiayuasrisrilestari@gmail.com

ABSTRACT

Waste anesthetic gas (WAG) exposure in surgical settings presents occupational health risks to medical personnel, potentially affecting the nervous, respiratory, and reproductive systems. Although safety protocols are available, implementation is often suboptimal, particularly in resource-limited facilities.

Objective: This study aimed to explore the health impacts of anesthetic gas exposure on operating room staff at Dr. R. Soeharsono Military Hospital, Banjarmasin, by gaining an in-depth understanding of their perspectives, experiences, and perceived challenges.

Methods: A phenomenological qualitative design was employed, with in-depth semi-structured interviews conducted with ten purposively selected operating room staff, including anesthesiologists, nurses, and technicians. Thematic analysis was used to identify patterns and key insights from participant narratives. Participants reported symptoms such as headaches, fatigue, nausea, and decreased concentration, which they associated with prolonged anesthetic gas exposure. While awareness of the risks was generally present, many cited limited ventilation, inadequate scavenging systems, and the absence of routine air quality monitoring. Institutional training and occupational health measures were also perceived as insufficient. Anesthetic gas exposure remains a significant occupational hazard in the surgical unit. Addressing this issue requires improving safety infrastructure, ensuring functional ventilation and scavenging systems, implementing regular air quality assessments, and providing ongoing training to protect the health of medical personnel.

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INTRODUCTION

Inhaled anesthetic substances, including nitrous oxide, sevoflurane, isoflurane, and desflurane, are frequently applied in surgical procedures. However, less than optimal air circulation or faulty scavenging systems in operating theaters may result in the accumulation of residual anesthetic gases (WAGs), possibly exposing healthcare staff to long-term, low-level inhalation (Boiano et al., 2014; OSHA, 2021). Prolonged contact could cause health-related issues such as impaired cognition, persistent tiredness, dizziness, liver and kidney dysfunction, and reproductive system disorders. Some research also suggests possible genetic and developmental risks (Cohen et al., 1980; Sessler et al., 2020). Progress in medical technology in anesthetic administration and gas elimination have improved safety measures. However, practical limitations—especially in facilities with constrained budgets or outdated infrastructure—still hamper effective implementation (Brognia et al., 2019). In Indonesia, systematic approaches to monitor and regulate WAG exposure are still evolving. Engineering measures, environmental assessments, and training programs are often implemented inconsistently. This research investigates the effect of prolonged exposure to anesthetic gases on surgical personnel at Dr. R. Soeharsono Military Hospital in Banjarmasin. Using a qualitative framework, the study aims to understand the staff's knowledge, lived experiences, and institutional practices concerning exposure control. The ultimate goal is to identify critical gaps and propose practical solutions for improving workplace safety in surgical settings.

METHODS

Research Design

The research employed a qualitative phenomenological design to capture the subjective experiences of operating room personnel concerning exposure to anesthetic gases.

This approach is suitable for uncovering how individuals interpret and assign meaning to particular workplace conditions, such as long-term contact with residual anesthetic gases (Creswell & Poth, 2018).

Study Location and Participant Criteria

The investigation took place at Dr. R. Soeharsono Military Hospital, a referral class C military hospital located in South Kalimantan, Indonesia. Respondents were recruited using purposive sampling, specifically targeting those with direct roles in anesthetic procedures. Inclusion criteria included: (1) a minimum of one year working experience in the operating room, (2) regular involvement in anesthesia-related tasks, such as anesthesiologists, surgical nurses, or anesthesia technicians, and (3) willingness to provide informed consent. In total, ten individuals participated in the interviews. Recruitment continued until thematic saturation was reached, meaning no additional unique insights were obtained (Guest, Bunce, & Johnson, 2006).

Data Collection

Semi-structured in-depth interviews were carried out between May and June 2025 in private areas of the hospital to ensure confidentiality. Each interview lasted between 30 and 45 minutes. The interview guide, developed based on prior research, included questions on (1) awareness of anesthetic gas risks, (2) personal symptoms experienced, (3) existing safety practices, and (4) institutional risk management initiatives.

All interviews were conducted in Bahasa Indonesia, recorded with permission, transcribed verbatim, and translated into English for analysis purposes.

Data Analysis

Thematic analysis was employed following Braun and Clarke's six-step framework: familiarization, coding, generating themes, reviewing themes, defining themes,

and producing the report. NVivo 12 software supported efficient data organization and coding.

Ethical Approval

Ethical clearance was obtained from the Research Ethics Committee of Dr. R. Soeharsono Military Hospital with number: Diklat/50/V/2025. Written informed consent was collected from all Respondents, and their identities were protected through anonymization. All data were securely stored to maintain participant confidentiality.

RESULTS

Following an in-depth review of interviews with ten operating room staff members, four primary themes emerged regarding their perceptions of anesthetic gas exposure and institutional responses:

1. General Awareness of Associated Health Hazards

The majority of Respondents demonstrated a basic awareness of the health implications associated with anesthetic gases. Commonly mentioned symptoms included headaches, fatigue, nausea, and dizziness. However, awareness of more complex, long-term effects—such as neurotoxicity or reproductive issues—was relatively low. "We understand that inhaling these gases too much can cause lightheadedness, especially during lengthy surgeries." (Participant 3) This aligns with prior observations which suggest that while immediate symptoms are recognized, long-term dangers often go unnoticed (Boiano et al., 2014; Brogna et al., 2019).

2. Repeated Physical Discomfort

Many respondents reported recurring symptoms such as exhaustion, shortness of breath, poor concentration, and drowsiness, often following long shifts in the OR. "After extended operations, I feel extremely drained and mentally foggy. I'm not entirely sure if it's because of the gas, but it happens a lot." (Participant 7) These firsthand experiences align with existing studies that link

halogenated anesthetic exposure to neurocognitive and physiological symptoms (Sessler et al., 2020).

3. Gaps in Equipment and Monitoring

Respondents noted inconsistencies in the use and upkeep of scavenging systems and ventilation units. Despite the presence of modern machines, respondents indicated that gas levels were not routinely monitored, and maintenance was rarely conducted. "There's a suction device, but no one checks if it works properly. Gas concentration monitoring? We don't have that." (Participant 5)

This reflects infrastructure-related challenges commonly faced in under-resourced hospitals (OSHA, 2021).

4. Absence of Structured Training

Nearly all informants expressed that they had never received formal instruction or regular updates regarding anesthetic gas safety. Many mentioned the absence of specific protocols or safety briefings in their workplace. "We've never had any in-house training on gas safety. Maybe we learned a bit during school, but not here at the hospital." (Participant 2) This finding reinforces other studies that highlight the critical role of ongoing training in ensuring occupational safety (Boiano et al., 2014).

DISCUSSION

This qualitative study aimed to investigate the lived experiences of operating room staff who are routinely exposed to anesthetic gases at Dr. R. Soeharsono Military Hospital in Banjarmasin. The analysis brought to light recurring health complaints, inadequate control measures, limited formal training, and a lack of robust institutional support—all of which contribute to occupational vulnerability.

Firstly, respondents frequently mentioned symptoms such as dizziness, fatigue, headaches, and difficulty focusing. Although these symptoms were not definitively linked to anesthetic gas exposure by the Respondents themselves,

their consistent appearance following surgical procedures raises valid occupational health-related issues. Prior literature has established that long-term, low-level exposure to residual anesthetic gases can have adverse effects on cognitive function, reproductive health, and neurological systems (Cohen et al., 1980; Sessler et al., 2020).

Secondly, several Respondents pointed to significant deficiencies in the hospital's environmental safety infrastructure. While modern anesthesia equipment was available, respondents noted that essential components such as scavenging systems were not consistently maintained or checked. Ventilation systems also appeared insufficient in some cases. Most notably, the absence of routine air quality testing indicates a major gap in workplace environmental monitoring—echoing conditions reported in other low-resource healthcare settings (Brojna et al., 2019; OSHA, 2021).

Thirdly, the data reveal that knowledge regarding anesthetic gas hazards was often informal and fragmented. While some staff members understood short-term effects, few had in-depth knowledge about long-term consequences or best practices for prevention. Furthermore, structured training programs and safety briefings were largely unavailable. This lack of targeted occupational health education reflects a broader systemic issue within healthcare environments, particularly in institutions where occupational safety is not prioritized (Boiano et al., 2014).

Beyond individual awareness, this study highlights deeper organizational weaknesses. In high-pressure healthcare environments, chronic symptoms such as tiredness and nausea are frequently normalized rather than investigated, which can result in prolonged exposure without intervention. Furthermore, without policy-driven surveillance and safety procedures, even aware personnel lack the tools and support needed to protect themselves effectively. To improve safety outcomes, hospitals must

move toward comprehensive occupational health strategies that include investment in reliable infrastructure, regular environmental assessments, and institutionalized training. These components must be integrated into broader health and safety management systems to promote sustained well-being among healthcare workers. Although this study contributes valuable insight into the experiences of OR staff, it is limited by its focus on a single hospital and a small sample size. Future investigations should include multiple sites and incorporate objective exposure data—such as air sampling and biological monitoring—to triangulate and strengthen the observations.

CONCLUSION

This study reveals that anesthetic gas exposure in the operating room continues to pose a significant occupational health concern for medical staff at Dr. R. Soeharsono Military Hospital in Banjarmasin. Respondents described various symptoms—such as fatigue, dizziness, headaches, and difficulty concentrating—that correspond with the effects of chronic exposure to waste anesthetic gases reported in previous research (Cohen et al., 1980; Sessler et al., 2020). There was a general understanding among staff regarding the health hazards of anesthetic gases; however, the absence of structured safety education, formalized procedures, and consistent air quality monitoring highlights a substantial gap between knowledge and practice. Engineering controls—such as scavenging equipment and ventilation systems—were available but not always fully functional or properly maintained. The lack of occupational health training and institutional oversight further increases the vulnerability of staff to potential long-term exposure risks. These observations underline the need for a comprehensive and systematic approach to enhance workplace safety. Recommended measures include investments in updated infrastructure, implementation of

reliable air monitoring systems, enforcement of safety protocols, and continuous professional development for operating room staff. Prioritizing worker safety in surgical environments not only safeguards individual health but also contributes to the delivery of high-quality and sustainable healthcare services.

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