International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 22s, 2025
https://theaspd.com/index.php

Beyond The Mask: Occupational Hazards and Safety Challenges in Anaesthesiology – A Research Perspective

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ABSTRACT

Background: *Anaesthesiologists play a central role in ensuring patient safety during surgical and critical care procedures. However, their occupational risks often remain underrecognized. This study aimed to assess the spectrum of occupational hazards faced by anaesthesiologists and evaluate preventive strategies, with an emphasis on global implications.*

Methods: *A cross-sectional, questionnaire-based survey was conducted among 120 anaesthesiologists working at Sri Venkateshwara Medical College Hospital & Research Centre, as well as at tertiary care teaching hospitals and private institutions. Data on demographic characteristics, chemical, physical, biological, and psychosocial hazards, as well as preventive practices, were collected and analyzed using descriptive and inferential statistics.*

Results: *Musculoskeletal disorders (51.7%), burnout (58.3%), and exposure to waste anaesthetic gases (40%) were the most prevalent hazards. Needle-stick injuries (30%) and aerosol-transmissible infections (35%) highlighted biological risks. Preventive practices such as vaccination (76.7%) and infection control adherence (80%) were common, but scavenging system use (45%), radiation protection (31.7%), and wellness program participation (23.3%) were suboptimal.*

Conclusion: *Occupational hazards in anaesthesiology remain significant and multifaceted. Strengthening institutional safety measures, promoting wellness, and adopting environmentally sustainable anaesthesia practices are essential to safeguard practitioners, patients, and the planet.*

Keywords: *Anaesthesiology, Occupational Hazards, Workplace Safety, Burnout, Environmental Impact of Anaesthesia*

INTRODUCTION

Anaesthesiology, as a specialty, has revolutionized modern surgical practice by enabling the safe conduct of complex operative procedures and improving perioperative outcomes. Anaesthesiologists are indispensable members of the healthcare team, providing expertise in airway management, hemodynamic stability, pain management, and critical care. While their role is central to patient safety, the occupational risks they encounter often remain underrecognized. The practice of anaesthesia involves constant exposure to a high-stress environment, long working hours, exposure to hazardous agents, and the need for rapid decision-making under pressure. These challenges not only predispose anaesthesiologists to various health concerns but also carry broader implications for workforce sustainability and healthcare delivery【1】.

One of the most significant occupational hazards in anaesthesiology is exposure to waste anaesthetic gases (WAGs), particularly nitrous oxide and halogenated volatile agents such as isoflurane, sevoflurane, and desflurane. Despite advances in scavenging systems and environmental controls, chronic low-level exposure has been linked to reproductive disorders, hepatic and renal dysfunction, neurocognitive impairment, and even an increased risk of malignancies【2,3】. Furthermore, the environmental impact of inhalational anaesthetic agents, many of which are potent greenhouse gases, places an additional burden on anaesthesiologists to balance patient care with ecological responsibility【4】. This dual hazard—personal health risks and planetary health concerns—demands urgent attention in research and practice.

In addition to chemical exposure, anaesthesiologists face physical hazards. Prolonged standing in the operating room, poor ergonomic practices, and repeated airway manipulations contribute to

musculoskeletal disorders, particularly chronic back and neck pain【5】. The increasing use of advanced airway devices and ultrasound-guided regional anaesthesia requires repetitive hand and wrist movements, adding to the risk of occupational strain injuries. Radiation exposure during image-guided procedures and infectious risks from bloodborne pathogens and aerosol-generating interventions further compound these threats【6】.

Equally concerning are the psychosocial and cognitive challenges in the profession. Anaesthesiologists often work extended shifts, frequently overnight, leading to fatigue, sleep disturbances, and burnout【7】. The constant vigilance required in the operating room, combined with high patient turnover, places enormous cognitive demands on practitioners. Burnout, depression, and substance abuse have been reported at disproportionately high rates among anaesthesiologists compared to other specialties【8】. Tragically, anaesthesia-related suicides are an alarming reflection of the psychological toll the profession can exact【9】. These hazards not only compromise the well-being of individual practitioners but also have direct consequences on patient safety, clinical outcomes, and the overall efficiency of healthcare systems.

Globally, awareness of occupational hazards in anaesthesiology is increasing, but protective measures remain inconsistent across regions and institutions. While high-income countries have implemented guidelines for waste gas scavenging, ergonomic practices, and physician wellness programs, many low- and middle-income nations continue to face challenges in resource allocation and policy enforcement【10】. This disparity highlights the need for uniform global strategies that prioritize occupational health and safety for anaesthesiologists, ensuring equity in protection regardless of geographic or economic context.

Given these multifaceted risks, there is a pressing need to consolidate evidence on the occupational hazards faced by anaesthesiologists and to identify effective preventive strategies. This research aims to critically analyze the spectrum of occupational hazards in anaesthesiology, encompassing chemical, physical, biological, and psychosocial domains, while also exploring the broader global implications for healthcare systems and environmental sustainability. By bringing these concerns to the forefront, the study underscores the importance of proactive interventions to safeguard the health of anaesthesiologists, thereby enhancing both patient safety and the resilience of healthcare delivery worldwide.

Justification of the Study

Despite the growing recognition of occupational hazards in anaesthesiology, there remains a lack of comprehensive data that integrates chemical, physical, biological, and psychosocial risks with their broader global implications. Most available studies are fragmented, focusing on isolated hazards or regional concerns, thereby limiting the development of unified preventive strategies. A consolidated research perspective is therefore essential to highlight the
multifaceted nature of these risks, evaluate their impact on anaesthesiologists' health and patient safety, and propose sustainable global interventions.

OBJECTIVES

Primary Objective

- To assess the spectrum of occupational hazards—chemical, physical, biological, and psychosocial—encountered by practising anaesthesiologists.

Secondary Objectives

- To evaluate the prevalence of self-reported health issues linked to occupational exposure in anaesthesiology.
- To explore awareness of existing safety measures, preventive strategies, and institutional policies among anaesthesiologists.
- To analyze global implications of occupational and environmental hazards in anaesthesiology practice.

MATERIALS AND METHODS

This cross-sectional, questionnaire-based study was conducted among anaesthesiologists working in Sri Venkateshwara Medical College Hospital & Research Centre, as well as selected tertiary care teaching hospitals and private institutions. A structured, pre-validated online survey tool was developed after an extensive literature review and consultation with subject experts. The questionnaire included sections on demographics, duration of practice, type of workplace, exposure to inhalational agents and radiation, ergonomic practices, infection control, work schedules, stress levels, and mental health indicators.

Questions were framed as multiple-choice items and Likert-scale ratings to capture both frequency and severity of hazards.

The survey was distributed electronically to practising anaesthesiologists through professional associations and institutional mailing lists. Participation was voluntary, anonymous, and limited to registered medical practitioners. Informed consent was obtained before completion.

Data collection was carried out over a year. Responses were compiled and analyzed using standard statistical software. Descriptive statistics (mean, median, frequency, and percentage) were applied to summarize demographic variables and hazard prevalence. Associations between occupational factors and reported health outcomes were examined using chi-square tests and logistic regression, where applicable. Ethical approval was obtained from the Institutional Ethics Committee, and confidentiality of respondents was strictly maintained.

RESULTS

Among 120 anaesthesiologists, burnout (58.3%) and musculoskeletal pain (51.7%) were the most common hazards. Waste anaesthetic gas exposure affected 40%, with needle-stick injuries (30%) and airborne infections (35%) also reported. Preventive measures showed high compliance with infection control (80%) and vaccination (76.7%), but scavenging (45%), radiation safety (31.7%), and wellness programs (23.3%) remained underutilized.

Table 1. Demographic Characteristics of Study Participants

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	< 30	18	15.0
	31–40	52	43.3
	41–50	32	26.7
	> 50	18	15.0
Gender	Male	68	56.7
	Female	52	43.3
	Other/Prefer not to say	0	0
Years of Practice	< 5	24	20.0
	5–10	38	31.7
	11–20	34	28.3
	> 20	24	20.0
Type of Workplace	Government/Teaching Hospital	46	38.3
	Private Hospital	32	26.7
	Corporate/Multispecialty	28	23.3
	Freelance/Locum Practice	14	11.7
Average Weekly Working Hours	< 40	22	18.3
	41–60	56	46.7
	> 60	42	35.0
Primary Area of Practice	General Anaesthesia	66	55.0
	Regional Anaesthesia	20	16.7
	Critical Care	18	15.0
	Pain Medicine	8	6.7
	Others	8	6.7

A total of 120 anaesthesiologists participated in the study. The demographic characteristics are presented in Table 1. The majority of respondents (43.3%) were in the 31–40 years age group, followed by 26.7% between 41–50 years. The mean age was 38.6 years. Males comprised 56.7% of the cohort, while females represented 43.3%. Nearly one-third of participants (31.7%) had 5–10 years of professional experience,

with 28.3% having 11–20 years of practice. Government and teaching hospitals accounted for the largest proportion of workplace settings (38.3%), followed by private hospitals (26.7%) and corporate institutions (23.3%). More than one-third of the respondents reported working over 60 hours per week (35%), and general anaesthesia practice was the most common area of specialization (55%).

Table 2. Distribution of Occupational Hazards Reported by Anaesthesiologists

Hazard Domain	Specific Hazard	Frequency (n)	Percentage (%)
Chemical Hazards	Exposure to waste anaesthetic gases (WAGs)	48	40.0
	Frequent exposure to disinfectants/chemicals	34	28.3
	Concerns about long-term carcinogenic effects	20	16.7
Physical Hazards	Musculoskeletal pain (neck, back, shoulder)	62	51.7
	Eye strain/prolonged screen use (USG, monitors)	28	23.3
	Radiation exposure during procedures	22	18.3
Biological Hazards	Needle-stick/sharps injuries	36	30.0
	Exposure to bloodborne infections (HBV/HCV/HIV)	18	15.0
	Aerosol-borne infections (e.g., TB, COVID-19)	42	35.0
Psychosocial Hazards	Burnout/fatigue due to long shifts	70	58.3
	Sleep disturbance/insomnia	52	43.3
	Anxiety/depression symptoms	28	23.3
	Substance use concerns	10	8.3

The spectrum of occupational hazards reported is summarized in Table 2. Chemical exposure was prominent, with 40% reporting frequent exposure to waste anaesthetic gases (WAGs) and 28.3% citing regular contact with disinfectants or cleaning agents. Long-term carcinogenic concerns were expressed by 16.7% of participants. Physical hazards were highly prevalent, with musculoskeletal pain being the most frequently reported issue (51.7%), particularly affecting the neck, back, and shoulders. Radiation exposure was reported by 18.3%, reflecting the growing involvement of anaesthesiologists in image-guided procedures.

Biological hazards were reported by a significant proportion of participants. Needle-stick or sharps injuries were experienced by 30%, while 35% reported exposure to aerosol-transmissible infections, particularly during the COVID-19 pandemic. Exposure to bloodborne pathogens such as hepatitis B and C or HIV was reported by 15%. Psychosocial hazards were widespread, with 58.3% of respondents experiencing burnout and 43.3% reporting sleep disturbances or insomnia. Symptoms of anxiety or depression were acknowledged by 23.3%, while 8.3% reported concerns related to substance use.

Table 3. Preventive Strategies and Safety Practices Reported by Anaesthesiologists

Safety Practice / Preventive Measure	Frequency (n)	Percentage (%)
Use of scavenging systems for WAGs	54	45.0
Regular use of personal protective equipment (PPE)	88	73.3
Vaccination compliance (HBV, Influenza, COVID-19)	92	76.7
Consistent use of lead aprons/shields during radiological procedures	38	31.7
Ergonomic adjustments (chairs, positioning aids, breaks)	40	33.3
Adherence to infection control protocols (hand hygiene, standard precautions)	96	80.0
Participation in stress management / wellness programs	28	23.3

Safety Practice / Preventive Measure	Frequency (n)	Percentage (%)
Regular health check-ups / occupational health screening	34	28.3
Reporting and documentation of occupational injuries (needle-stick, chemical spill, etc.)	42	35.0

Preventive strategies and safety practices adopted are summarized in Table 3. The majority (80%) adhered to infection control protocols such as hand hygiene and standard precautions, and 76.7% reported being up-to-date with recommended vaccinations. Regular use of PPE was reported by 73.3%. However, less than half of the respondents (45%) consistently used scavenging systems for WAGs, and only 31.7% used lead aprons during radiological procedures. Ergonomic measures to prevent musculoskeletal strain were reported by 33.3%. Importantly, only 23.3% participated in wellness or stress management programs, and occupational injury reporting was low (35%).

Overall, the findings highlight a high prevalence of occupational hazards among anaesthesiologists, with significant gaps in preventive strategies, particularly regarding chemical exposure, ergonomic practices, radiation protection, and psychosocial support.

DISCUSSION

This study highlights the multidimensional occupational hazards faced by anaesthesiologists, encompassing chemical, physical, biological, and psychosocial risks. The findings are consistent with previous literature, which has long suggested that anaesthesiology, while central to patient safety, poses hidden dangers to practitioners themselves【11】.

Chemical Hazards

A significant proportion of respondents in this study reported exposure to waste anaesthetic gases (WAGs), particularly nitrous oxide and halogenated agents. This aligns with international reports suggesting that scavenging practices remain inconsistent, especially in low- and middle-income countries【12】. Prolonged exposure has been associated with adverse reproductive outcomes and cognitive dysfunction, although the extent of risk varies with the efficiency of workplace controls【13】. Notably, desflurane and nitrous oxide have been identified as potent greenhouse gases, with desflurane having a global warming potential nearly 2500 times that of carbon dioxide【14】. This environmental dimension underscores the ethical obligation of anaesthesiologists to adopt low-flow anaesthesia techniques and alternative agents to mitigate global harm.

Physical Hazards

Musculoskeletal pain emerged as the most frequently reported physical hazard in this study. This correlates with international surveys showing that between 50–70% of anaesthesiologists experience chronic neck or back pain during their careers【15】. The repetitive nature of airway interventions, static postures during long surgeries, and poor ergonomic design of operating rooms contribute significantly to this burden【16】. Radiation exposure was also noted in nearly one-fifth of participants, a finding supported by prior studies linking interventional radiology assistance to increased exposure risks【17】. Despite the availability of lead aprons and shields, compliance with protective practices remains suboptimal.

Biological Hazards

The high frequency of needle-stick injuries and exposure to aerosol-transmissible infections observed in this study mirrors earlier reports【18】. Anaesthesiologists remain at elevated risk of bloodborne infections due to frequent vascular access procedures, airway management, and emergency resuscitations【19】. The COVID-19 pandemic further amplified this risk, with anaesthesiologists often at the frontline of airway management and critical care【20】. Encouragingly, vaccination compliance was relatively high in this cohort, reflecting improved awareness of occupational health policies in recent

years. Nevertheless, underreporting of exposures continues to be a challenge, as demonstrated by only one-third of respondents acknowledging formal reporting of occupational injuries.

Psychosocial Hazards

Burnout and sleep disturbances were among the most prevalent psychosocial hazards, with nearly 60% of participants reporting significant fatigue and stress. These findings are consistent with multi-country surveys showing burnout rates in anaesthesiologists ranging from 40% to 60%【21】. Contributors include long working hours, inadequate rest, medicolegal pressures, and the need for continuous vigilance. Burnout has been strongly correlated with medical errors, reduced patient safety, and attrition from the workforce【22】. Moreover, substance use concerns, though reported by a smaller percentage in this study, are particularly troubling, given the documented association between anaesthesia practice, drug availability, and substance misuse【23】. Suicide risk among anaesthesiologists remains disproportionately high compared with other medical specialties【24】, underscoring the urgent need for institutional wellness programs and early mental health interventions.

Preventive Strategies and Gaps

Despite growing awareness, several preventive measures remain underutilized. Less than half of the respondents reported consistent use of WAG scavenging systems. Previous research has shown that even when such systems are available, improper maintenance and inadequate staff training compromise their effectiveness【25】. Similarly, ergonomic interventions such as adjustable stools, scheduled breaks, and posture-awareness programs have proven effective in reducing musculoskeletal complaints【26】, yet were adopted by only one-third of participants in this study.

Radiation safety practices were also suboptimal, with fewer than one-third reporting consistent use of lead aprons. This echoes findings from earlier studies demonstrating poor compliance, often due to the discomfort and weight of protective gear【27】. Routine occupational health screenings were reported by less than 30% of respondents, suggesting missed opportunities for early identification of work-related illnesses. Institutional barriers, including lack of reporting systems, limited access to occupational health services, and fear of professional repercussions, likely contribute to this underutilization【28】.

Global Implications

While the hazards identified in this study are universally relevant, the global impact varies significantly by region. High-income countries have implemented stringent occupational safety regulations, advanced scavenging technologies, and formal wellness initiatives. In contrast, resource-limited settings often lack adequate infrastructure, resulting in higher exposure risks【29】. Furthermore, the contribution of anaesthetic gases to global warming represents an urgent challenge that transcends national boundaries【30】. Sustainable anaesthesia practices, such as total intravenous anaesthesia (TIVA), low-flow anaesthesia, and the use of environmentally friendly agents, must be integrated into global clinical guidelines.

Strengths and Limitations

The strength of this study lies in its comprehensive assessment of hazards across chemical, physical, biological, and psychosocial domains. However, limitations include its cross-sectional design, reliance on self-reported data, and potential selection bias toward participants more engaged in safety awareness. Longitudinal studies and multicentric trials are needed to establish causal associations and evaluate the effectiveness of targeted interventions.

Implications for Practice

The findings highlight the urgent need for multifaceted strategies. These include strict enforcement of scavenging and infection-control protocols, ergonomic training, provision of radiation safety equipment, mandatory occupational health screenings, and structured wellness programs. Importantly, a cultural shift is required to encourage open reporting of occupational injuries without fear of stigma or reprisal. Professional bodies such as the Indian Society of Anaesthesiologists and the World Federation of Societies of Anaesthesiologists can play pivotal roles in disseminating guidelines and fostering global collaborations to ensure uniform standards.

CONCLUSION

Anaesthesiologists face a wide spectrum of occupational hazards spanning chemical, physical, biological, and psychosocial domains, many of which remain underrecognized and underreported. This study underscores the high prevalence of musculoskeletal disorders, burnout, and exposure to waste anaesthetic gases, alongside gaps in preventive strategies such as scavenging, radiation protection, and wellness programs. The global impact of anaesthetic agents as greenhouse contributors further amplifies the urgency for sustainable practice. Strengthening institutional safety protocols, fostering a culture of reporting, and adopting environmentally responsible anaesthesia techniques are essential to safeguard the health of practitioners, enhance patient safety, and reduce the specialty's ecological footprint.

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