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Knowledge, Occupational Health and Environmental Awareness About Inhalational Anesthetics Among Surgical Staff

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Abstract

The exposure to inhalational anesthetics (IA) can cause various negative health impacts to surgical staff and patients in operating theatres (OTs), and also contribute to global warming. However, many surgical staff in Nigeria are unaware of these negative impacts, and many OTs have inadequate technical and personal protective equipment to control IA pollution and ensure the safety of surgical staff and their patients. This study assessed the knowledge, occupational health, and environmental awareness on inhalational anaesthetics among surgical staff in three tertiary hospitals in North-Central Nigeria. Only surgical staff present in the OT and having at least one year of OT experience were selected to fill the questionnaire. Frequency counts and percentages were used to analyze the data. At the assessment period, none of the OTs had anaesthetic gas scavenging systems available or functional. Responses to the survey showed that only 54 surgical staff (43.9%) were adequately knowledgeable about the adverse health effects of leaked IAs, and the majority of the respondents (56.1%) were not aware that their OTs did not have anaesthetic gas scavenging systems at the time of the assessment. The occupational health and environmental awareness of the surgical staff were unsatisfactory. Hospital management should support anesthetists and other surgical staff to practice environmentally sustainable anesthesiology. More importantly, hospitals must provide regular and up-to-date training on the hazards of inhalational anaesthetics and measures that prevent them from polluting the OT.



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Introduction

Inhalational anaesthetics (IAs) are gaseous substances used to keep a patient unconscious during surgical procedures and include halothane, isoflurane, sevoflurane, and nitrous oxide [1]. When they are used in operating theatres, small quantities of these unavoidably leak out of the patient's breathing apparatus and are inhaled by the surgical team. Such leaked IAs are known as waste IAs or waste anaesthetic gases. Exposure to inhalational anaesthetics have been implicated in numerous adverse health conditions such as headaches, dizziness, cardiovascular arrhythmia, hypotension, transient tachycardia, mood changes, decreased cognitive function, hyperglycemia, nausea, vomiting, respiratory depression or arrest and malignant hyperthermia as well as abortion in pregnant women and newborns with congenital abnormalities [2-4] in addition to being sources of indoor air pollution in operating rooms, inhalational anaesthetics contribute to healthcare-related greenhouse gas emissions and global warming [5-7]. Unfortunately, many anaesthetists and surgical staff are not aware of these negative impacts, or do not use or administer them properly [9-11]. In addition, many OTs lack the right technical and personal protective equipment to prevent or control IA pollution and ensure the safety of surgical staff and their patients [9, 8]. It has been recommended that, to reduce the risk of pollution, anaesthetists and other surgical staff should be knowledgeable enough to use IAs in an environmentally sustainable manner. Inhalational anaesthetics should only be used when necessary [5, 7]. OTs should also have anaesthetic gas scavenging or evacuation systems in their operating rooms to capture and remove leaked or wasted IAs [2, 8, 1]. The major tertiary hospitals whose surgical staff were assessed are situated in North Central, Nigeria, and are approved by the Medical and Dental Council of Nigeria (MDCN) to train medical personnel, run residency programs, and serve as referral centres for both primary and secondary healthcare institutions [12-16]. This research aimed to assess the occupational and environmental health awareness of surgical staff of selected tertiary hospitals about inhalational anaesthetics, their adverse health effects, and protective measures against them.

This study will help to increase the knowledge, occupational and environmental health awareness of anaesthetists and other surgical staff concerning inhalational anaesthetics, their adverse effects, and the protective measures and systems that should be

available and functional in the OT to prevent IA pollution of the OT and the health and well-being of surgical staff and patients in it. It will also guide hospitals on the design and implementation of measures and programmes that will improve the competence of their staff and the safety of their OT.

Methods

Ethical approval was sought and obtained from the Health Research Ethics Committee (HREC) in each institution before the study commenced. The heads of surgery and the operating theatres also gave their consent for the study. The assessment was implemented onsite using a self-customised but appropriately structured survey instrument. It was distributed onsite. In each hospital, ten (10) surgeries were observed over fourteen days. From each surgical session, the surgical staff were selected to fill out the questionnaire. The OT's environment, constituents, and conditions where they worked were also monitored. The exclusion criterion was not having at least one year of operating theatre (OT) experience. Respondents were assured that their responses would be treated confidentially. The survey instrument (questionnaire) was designed with assistance from other sources [11, 17]. The survey instrument was pretested a month before the actual survey, and necessary adjustments were made. Questions therein were divided into demographic characteristics of respondents, knowledge and perceptions about IAs, and knowledge and perceptions of technical and personal protective measures.

Results

Demographics of respondents

A total of one hundred and twenty-three (123) operating theatre staff (Surgical staff) responded to the Questionnaire. Thirty of them (24.4%) were from Benue State University Teaching Hospital (BSUTH), Makurdi, forty-one (33.3%) from Federal Medical Centre (FMC) Keffi, while fifty-two (42.3%) were from National Hospital Abuja (NHA). The ages of surgical or OT staff ranged from 21 and above (18.7%) to over 60 (0.8%), with those between the ages of 31-40 constituting the highest number, with 47 (38.2%) and just 1 person above the age of 60 (0.8%) (Table 1, question 1). Overall, there were more males (56.1%) among the respondents than females (43.9%). Respondents include thirty-five Surgeons (28.5%), fifty-two Nurses (42.3%), twenty-one Anaesthetists (17.1%), nine Healthcare Assistants/ technicians

Table 1 Demographic characteristics of respondents.

Characteristics	Number	%
1. Age (years)		
21-30	23	18.7
31-40	47	38.2
41-50	36	29.3
51-60	16	13
>60	1	0.8
Total	123	100
χ^2 (4DF) = 51.4, P= 0.000, P<0.05		
2. Gender		
F	54	43.9
M	69	56.1
Total	123	100
χ^2 (1DF) = 1.83, P= 0.176, P>0.05		
3. Profession		
Anesthetist	21	17.1
Intern	2	1.6
Nurse	52	42.3
Surgeon	35	28.5
Assistant/HA/Technical	9	7.3
Biomedical Engineer	1	0.8
Others	3	2.4
Total	123	100
χ^2 (6DF) = 131.1, P= 0.000, P<0.05		
4. Educational qualification		
HND	1	0.8
Bachelors of Science, Technology and Engineering (B.Sc./B.Tech./B.Eng.)	21	17
MBBS	50	40.7
Registered Midwife/Nurse (RM/RN)	30	24.4
Registered Nurse with 1 additional qualification (RN+)	3	2.4
Registered Nurse with multiple additional qualifications (RN++)	4	3.3
Registered Nurse with a B.Sc.* (RN + B.Sc.)	10	8.1
Others	4	3.3
Total	123	100
χ^2 (7DF) = 136.1, P= 0.000, P<0.05		
5. Years of experience in operating theatre		
1-5 max	54	43.9
5-10 max	39	31.7
>10	30	24.4
Total	123	100
χ^2 (2DF) = 7.17, P= 0.028, P<0.05		

*Not all registered midwives or nurses in Nigeria have a B.Sc.

(7.3%), two interns (1.6%), one Biomedical engineer (0.8%), and three Others (2.4%) (question 3). Of all the surgical staff, those with MBBS were the highest in number (40.7%), while the lowest was HND (0.8%) (question 4). Fifty-four of the surgical staff (43.9%) had five years of operating theatre (OT) experience or less, 39 (31.7%) had between five and ten years of OT experience, while 30 (24.4%) had over 10 years of OT experience (question 5).

Knowledge and perception of IAs and technical and personal protective measures

A total of 100 OT staff know that IAs can pollute the OT. On the other hand, six OT staff (4.9%) think that IAs cannot pollute the OT, while 17 (13.8%) do not know if they can be pollutants or not (Table 2, question 6). For question 7, 0 means “no adverse effect”, while 5 means “all the adverse effects listed”. Although 7 Surgical staff (5.7%) feel that leaked IAs can cause no adverse health effects, the rest of the OT staff (94.3%) know that they can cause one or more adverse health effects (Table 2, question 7). For question 8, 54 OT Staff (43.9%) know that their OTs do not have anesthetic gas scavenging systems, while 19 respondents (15.4%) think their OTs have them. The remaining 50 OT staff (40.7%) are not sure if such systems are available or not (Table 2, question 8). For question 9, 0 means “no knowledge”, while 5 means “adequate knowledge. Although 27 OT staff (22%) have never heard of an air filtration or gas scavenging system before, only 10 OT staff (8.1%) of the total respondents had adequate knowledge of what they were. For question 10, 0 means “no knowledge”, while 5 means “adequate knowledge. Although 120 (97.6%) Surgical staff knew one or more means by which IAs can pollute the operating room, only 4 OT staff (3.3%) of the total respondents were knowledgeable of all the means by which IAs could leak into the operating room. In question 11, of all the respondents, 71 Surgical staff (57.7%) said that the ventilation and air conditioning in the OT was inadequate, with 9 (7.3%) not sure or aware if it was adequate or not, while 43 (35%) claimed it was adequate (Table 2, question 11). In question 12, 0 means “no policy or measure”, while 5 means “all the policies and measures listed”. Of all the respondents, 122 Surgical staff (99.2%) saw the need for at least one policy or measure to be put in place to control or prevent air pollutants in the OT. The policies and measures included providing adequate air conditioning and ventilation, high-efficiency air filtration systems, and standard smoke and anaesthetic gas evacuation systems, review and upgrade of various operating theatre equipment and SOPs, as well as training and retraining of surgical staff on how to improve the indoor environmental quality and safety of operating theatres.

Discussion

The majority of the surgical staff had sufficient educational qualifications and OT experience (Table 1, questions 3, 4, and 5). Thus, it was expected that

Table 2 Knowledge and Perception of Inhalational anesthetics.

Characteristics	Number	%
6. Can Inhalational anesthetics pollute the operating room?		
I DON'T KNOW	17	13.8
NO	6	4.9
YES	100	81.3
Total	123	100
χ^2 (2DF) = 128.83, P= 0.000, P<0.05		
7. Adverse effects of IAs		
0	7	5.7
1	29	23.6
2	33	26.8
3	35	28.5
4	11	8.9
5	8	6.5
Total	123	100
χ^2 (5DF) = 42.32, P= 0.000, P<0.05		
8. Is a system/device that can be used to remove waste IAs available in the operating room?		
I don't know	50	40.7
No	54	43.9
Yes	19	15.4
Total	123	100
χ^2 (2DF) = 17.9, P= 0.000, P<0.05		
9. Knowledge of air filtration or gas scavenging systems		
0	27	22
1	48	39
2	9	7.3
3	14	11.4
4	15	12.2
5	10	8.1
Total	123	100
χ^2 (5DF) = 54.32, P= 0.000, P<0.05		
10. Means by which IAs can pollute the operating room		
0	3	2.4
1	19	15.5
2	19	15.4
3	32	26
4	46	37.4
5	4	3.3
Total	123	100
χ^2 (5DF) = 66.61, P= 0.000, P<0.05		
11. Adequacy of ventilation and air conditioning in the operating room		
I don't know	9	7.3
No	71	57.7
Yes	43	35
Total	123	100
χ^2 (2DF) = 47.02, P= 0.000, P<0.05		
12. Policies and measures for the control and prevention of pollution in the operating theatre		
0	1	0.8
1	16	13
2	8	6.5
3	21	17.1
4	25	20.3
5	52	42.3
Total	123	100
χ^2 (5DF) = 76.56, P= 0.000, P<0.05		

they would be adequately knowledgeable about IAs and protective equipment and measures in the OT. This study showed that the reverse was the case. Many of them had the right qualifications and experience, but did not have sufficient knowledge about IAs, gas scavenging systems, or protective measures that should be in the OT. At the time of this study, none of the hospitals had installed air filtration or gas scavenging systems in their operating theatres (OTs). This was duly confirmed by some leading and experienced OT staff. 100 OT staff (81.3%) rightly knew that IAs could pollute the OT, while the remaining 23 (18.7%) did not know or were not sure if they could be OT pollutants or not (Table 2, question 6). Thus, the majority knew that IAs could be OT pollutants. The majority of the OT staff (94.3%) knew that leaked IAs could cause one or more adverse health effects. However, only 54 Surgical staff (43.9%) were adequately of the adverse health effects of leaked IAs (Table 2, question 7). The limited knowledge of these Surgical staff about the adverse health effects of exposure to leaked IAs showed that their occupational health awareness was not good enough. Just 54 OT Staff (43.9%) knew that their OTs do not have gas scavenging systems (Table 2). This implies that while the majority of the respondents (56.1%) were not aware that their OTs do not have air filtration or gas scavenging systems [9]. These systems remove leaked IAs and other gaseous pollutants from the operating room so that they do not constitute a public health risk to occupants of the OT (surgical staff and patients) [5]. Such pollutants have also been implicated in the spread or pathogenesis of nosocomial diseases or HAIs. The absence, unavailability, or non-functionality of these systems exposes occupants to adverse health effects as a result of exposure to such pollutants [2-4]. Some of such adverse health defects are life-threatening.

In addition, the fact that the majority of the respondents were not aware that their OTs do not have air filtration or anaesthetic gas scavenging systems implies that their environmental awareness is not at the level it should be. Such low environmental awareness could increase the risk of occupants' health being adversely impacted. It could also prevent such surgical staff from putting in place systems and/or measures that improve the safety and environmental quality of the OT. Although 96 OT staff (78%) claimed to have heard of air filtration or gas scavenging systems before, only 10 OT staff (8.1%) of the total respondents had adequate knowledge of what they were or their functions in the operating room. What this implies is that, as a result of having

inadequate or no knowledge of what air filtration or gas scavenging systems were, they could not request such systems to be made available and functional in the OT so as to protect themselves from the negative health effects of exposure to pollutants in the OT or increased risk of occupational hazards and HAIs. Although 120 (97.6%) Surgical staff knew one or more means by which IAs can pollute the operating room, only 4 OT staff (3.3%) of the total respondents were knowledgeable of all the means by which IAs could leak into the operating room (Table 2, question 10). This implies that a vast majority of the respondents do not have the level of knowledge required to prevent or control IAs from polluting the OT. It also means that even if gas scavenging systems were available in the OT, they could not be relied upon to either ascertain, maintain, or improve their functionality.

In addition, since IAs are known to be greenhouse gases with high global warming potential [5, 7], the low environmental awareness of Anaesthetists and other surgical staff means that they cannot use or administer IAs in an environmentally sustainable manner that prevents them from contributing to air pollution and climate change. The majority of the respondents (57.7%) rightly perceived that the ventilation and air conditioning in the OT was inadequate (Table 2, question 11). Temperature and relative humidity readings were taken during the survey period, which pointed to inadequate ventilation and air conditioning in the OTs. In addition, the electricity supply that could improve air conditioning in the OT (and other areas or departments of the hospitals) was inadequate in some OTs. Almost all the surgical staff (99.2%) saw the need for at least one policy or measure to be put in place to control or prevent air pollutants in the OT (Table 2, question 12). This means that they are aware that their OTs could be improved upon in certain areas, including provisions of adequate air conditioning and ventilation, high efficiency air filtration systems, and standard smoke and anaesthetic gas evacuation systems, review and upgrade of various operating theatre equipment and SOPs, as well as training and retraining of surgical staff on how to improve the indoor environmental quality and safety of operating theatres.

This study is in agreement with previous works [9, 11], which proved that surgical staff were not aware of protective measures in the OT, especially as it concerns inhalational anaesthetics. Such low knowledge and awareness need to be urgently and adequately addressed to improve the competence and

productivity of surgical staff, and ensure the safety and well-being of staff and patients.

Conclusion

Despite the three tertiary hospitals from which the surgical staff were selected and assessed being regarded as some of the best hospitals in Northern Nigeria, the occupational health and environmental awareness of their surgical staff was not satisfactory. Therefore, healthcare staff who work in the OT need to improve their occupational health and environmental awareness about the technical and personal protective measures and equipment that OTs should have, and occupational hazards associated with inhalational anaesthetics.

Anaesthetists and other surgical staff should be trained on the practice of environmentally sustainable anaesthesiology.

Further training is required to achieve all the aforementioned for their occupational health and safety, as well as for patient safety and wellbeing.

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Conflict of interest

The authors have no relevant financial or non-financial interests to disclose directly or indirectly related to the work.

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