

Research Article

Incidence of Anesthesia Awareness: A Study in the Southern Part of the Volta Region of Ghana

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Abstract

Background: Intraoperative awareness during anaesthesia occurs when a patient can recall some or all the events during a surgical procedure. Unintended intraoperative awareness during anaesthesia and surgery can either be determined by formally interviewing patients post-operatively or by patients reporting themselves during review. Intraoperative awareness may occur during general anaesthesia, on the operating table when the patient has not been given enough of the general anaesthetic or analgesic to render the patient unconscious during general anaesthesia. **Objective:** This study investigates the prevalence, causes, and risk factors of intraoperative awareness under general anaesthesia in five district hospitals in Ghana's Volta Region. **Method:** Using a quantitative case study design, data were collected from 480 patients and 17 anaesthetists through close-ended questionnaires. **Results:** Findings reveal that while anaesthetists demonstrated strong knowledge of awareness and adherence to safety protocols (17, 100%), challenges such as inadequate monitoring devices (10, 57.1%) and limited workforce participation in call duty (17, 100%) hinder optimal practice. Key risk factors identified included light anaesthesia (15, 90.5%), with extremes of age, obesity, and genetic resistance recording 12 responses (71.4%), with light anaesthesia being the most recognized. Patient responses highlighted a general expectation of complete unconsciousness (yes=353, 73.5%), low incidences of awareness (yes=109, 22.7%), and mixed experiences with dreaming (yes=219, 45.6%), reflecting varying perceptions of anaesthetic care. **Conclusion:** The study underscores the need for targeted policy reforms and emphasizes standardized safety protocols, improved patient communication, and continuous professional development. Also, exploring future research could broaden geographic scopes, longitudinal outcomes, and the implementation of advanced monitoring technologies. It recommends that prioritizing increased funding for anaesthesia services in resource-limited settings could enhance monitoring capabilities, ensure proper equipment maintenance, and address workforce shortages, improving overall patient safety.

Keywords

Anaesthesia Awareness, General Anaesthesia, Intraoperative Awareness, Surgical Safety, District Hospitals, Surgical Care in Low-Resource Settings, Healthcare in Ghana

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Received: 12 December 2024; **Accepted:** 25 December 2024; **Published:** 21 January 2025



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1. Introduction

An emerging priority in health systems reinforcement in developing countries is emergency and critical surgical care at district hospitals [1-5]. District hospitals in developing countries play an important role as the first level of referral for patients who are suffering from surgical and medical conditions.

Ghana has a universal health care system strictly designated for Ghanaian nationals, the National Health Insurance Scheme (NHIS). Health care is very variable throughout Ghana. Urban centers are well-served and contain most of Ghana's hospitals, clinics, and pharmacies. According to Statista [8], Ghana has a total of 9,400 health facilities. These comprised 7,745 government-owned facilities, 1,360 private health facilities, and 295 operated by the Christian Health Association of Ghana (CHAG). These numbers provide a recent overview of Ghana's healthcare infrastructure. As of 2021, Ghana allocated 4.15% of its Gross Domestic Product (GDP) to health expenditures [9]. The World Bank posits that, this percentage is below the average for lower-middle-income countries and the global average, which stood at 5.44% and 10.35%, respectively, in the same year. Projections according to the Ministry of Information indicate that Ghana's health budget is expected to increase from ₵15.2 billion in 2023 to ₵16.5 billion in 2024 [10]. Ghana's universal healthcare system is often regarded as one of the most successful healthcare models in Africa [11].

An improvement in surgery and anaesthesia care abilities in district hospitals in low-income countries is a necessary factor of healthcare system delivery and also has the prospect of being a cost-effective investment [12]. However, data assessing the number and types of surgical workers, equipment, and procedures available at district-level facilities in developing countries are rare [13] of which health facilities in Ghana are not an exception. In Ghana, anaesthesia services are provided by Certified Registered Anaesthetists (CRAs) and Anaesthesiologists. CRAs, who are largely nurses with post-basic or postgraduate training and certification in anaesthesia, play crucial roles in delivering care mostly in underserved areas. Anaesthesiologists, as medical doctors with postgraduate diploma training for Membership or Fellowship qualification in anaesthesia. However, their distribution is uneven, with 158 Anaesthesiologists (0.49 per 100,000 population) concentrated predominantly in teaching hospitals in urban areas, leaving district hospitals reliant on CRAs. The 284 CRAs are essential in addressing anaesthesia needs, but the rural-urban disparity among Surgical, Obstetric, Trauma, and Anaesthesia (SOTA) professionals highlights the need for equitable workforce strategies [14] (ppxviii, 24, 25).

The uneven distribution of health professionals increases the chances of work-strain and ultimately errors on the part of humans and equipment's with its attendant medico-legal cases.

For example, surgical workers may administer the wrong quantities of drugs to patients due to the large number of patients they have to attend to. In the case of anaesthesia providers, they may administer low quantities of anaesthetic drugs, or in certain situations, the wrong drugs are also administered [15]. This leads to various situations such as awareness of patients during surgeries and other complications.

Anaesthesia is commonly classified into two main techniques: general anaesthesia in which drugs achieve central neurologic depression, and regional anaesthesia, in which drugs are administered directly to the spinal cord or nerves to locally block afferent and efferent nerve input [16, 17]. Under general anaesthesia, a patient is completely unconscious and unable to feel pain during medical procedures. General anaesthesia usually combines intravenous drugs and inhaled gasses (anaesthetics). General anaesthesia is more than just being asleep; the anaesthetized brain does not respond to pain signals or reflexes [18]. General anaesthesia has many purposes including analgesia which is loss of response to pain, amnesia which is loss of memory, immobility which is loss of motor reflexes, unconsciousness which is loss of consciousness, and skeletal muscle relaxation [19].

The anaesthesia provider will recommend the best anaesthesia option for a patient usually based on the type of surgery and also the overall health and individual preference of the patient [20]. General anaesthesia is recommended for certain procedures that may take a longer time, result in significant blood loss, expose the patient to cold environment, or affect breathing particularly for chest or upper abdominal surgery. Other forms of anaesthesia, such as light sedation combined with local anaesthesia (for a small area) or regional anaesthesia (for a larger part of your body), may not be appropriate for more involved procedures. This study investigates the prevalence, causes, and risk factors of intraoperative awareness under general anaesthesia in five district hospitals in Ghana's Volta Region.

1.1. Problem Statement

Awareness or unintended intra-operative awareness may occur during general anaesthesia, on the operating table when the patient has not been given enough of the general anaesthetic or analgesic to render the patient unconscious during general anaesthesia [21]. General anaesthesia is a reversible state characterized by unconsciousness, analgesia, muscle relaxation, and depression of reflexes which is achieved by the administration of chemical agents [22]. Awareness during anaesthesia (unintended intraoperative awareness) occurs when a patient can recall some or all of the events happening during a surgical procedure. An incidence of awareness dur-

ing anaesthesia and surgery is either determined by formally interviewing patients post-operatively [23] or by patients reporting themselves. Some patients also may not recall events shortly after surgery.

Patients today are often more fearful of the anesthesia process than the surgery itself, with a significant concern being the possibility of waking up during the operation [24]. Research indicates that awareness during surgery occurs in about 1 to 2 out of every 1000 patients, often involving auditory experiences, sensations of paralysis, or pain, and leading to intense feelings of panic or helplessness [25, 26]. Detecting the exact prevalence of surgical awareness is complicated because some patients experience dreams around surgery that could be confused with awareness, while others may report awareness only days or weeks later [27-29]. Even though various surgical procedures are routinely performed under general anesthesia in the studied hospitals, awareness incidences are rarely reported, raising concerns about undetected cases. This study seeks to investigate unreported instances of intraoperative awareness and develop strategies to mitigate this problem in the participating hospitals.

1.2. Objective

The objective of this study is investigate the prevalence, causes, and risk factors of intraoperative awareness under general anaesthesia in five district hospitals in Ghana's Volta Region and explore effective methods for reducing or preventing awareness to improve patient safety and outcomes during surgical procedures.

3. Results

2. Methodology

The study employed a quantitative research design, specifically, a multiple case study design. Using purposive sampling, five health facilities in the Volta Region were purposely selected for the study utilizing a maximum variation sampling technique. These were Keta Municipal Hospital, Aflao Municipal Hospital, St. Anthony's Hospital-Dzodze, Akatsi District Hospital, and Abor Sacred Heart Hospital due to their large health coverage.

The study sampled 480 clients and 17 anaesthetists participants. Sampled participants included patients who had undergone surgery and anaesthetists in the five selected hospitals. A close-ended survey questionnaire was distributed to all selected participants (clients and anaesthetists) at the five (5) District hospitals in the southern part of the Volta region of Ghana. Patient's hospital records were reviewed for reported awareness to reduce recall bias. All questionnaires were completed and returned, indicating a 100% response rate. Data was collected for two months.

Before data collection, ethical principles were considered. Clearance was obtained from the hospitals under study. The purpose of the research was explained to participants to allow voluntary participation. Participants were given a consent form to sign. Also, confidentiality was strictly adhered to with participants' data securely stored to avoid data theft.

The data collected was coded and entered into the SPSS version 28. Data was screened and cleaned for quality assurance. Responses were analyzed using descriptive statistics, where frequencies and cross tabulations were utilized for data summary. Results were presented in tables for clearer understanding.

Table 1. Demographics of Anaesthetists and Patients.

Variable	Details	Number	Percentages (%)
Age Distribution of Anaesthetists	26-35 years	11	61.9
	Above 35 years	6	38.1
Gender of Anaesthetists	Female	9	52.4
	Male	6	38.1
	Not Indicated	2	9.5
Years of Experience of Anaesthetists	1-5 years	7	42.9
	6-10 years	6	33.3
	11 years and above	4	23.8
Age Distribution of Clients	18-25 years	112	23.3
	26-35 years	293	61.1
	36 years and above	75	15.6

Variable	Details	Number	Percentages (%)
Gender of Clients	Female	294	61.3
	Male	186	38.7
Anaesthesia Techniques	General anaesthesia or	249	51.9
	Regional Anaesthesia (For surgeries such as; cesarean section, thyroidectomy, VVF repair, exploratory laparotomy, ruptured ectopic, appendectomy, strangulated hernia)	231	48.13

According to Table 1, a majority of anaesthetists (61.9%) fall within the 26-35 years' age suggesting a more vibrant workforce. Female anaesthetists account for the majority (52.4%) and a small percentage (9.2%) did not indicate their gender. Also, most anaesthetists have 1-5 years of experience (42.9%) with fewer having 11 or more years of experience (23.8%).

Moreover, the largest proportion of client respondents is aged 26-35 years (61.1%) with a minority aged 36 years and above (15.6%). Females dominate the patient demographic (61.3%) compared to males (38.7%). In addition, slightly more than half of surgeries (51.9%) were conducted under general anaesthesia with a considerable portion employ regional anaesthesia for notable surgeries such as cesarean sections, hernia repairs, and laparotomies, among others (48.13%).

Table 2 depicts that the majority of the clients (73.5%) responded they were expecting to be completely asleep for the surgery (B1) reflecting awareness. Only 22.7% of clients answered they remember anything between going to sleep and waking up (B4) indicating limited awareness. Responses, were, however, more evenly distributed with 45.6% answering they dreamt during the surgical procedure (B5) and 54.4% responding no to the question. Similar to B4, a small percentage (22.7%) of clients responded that their dream was disturbing to them (B6), while a large majority (77.3) responded otherwise.

Table 2. Client's Responses to Awareness.

Question Numbers	Frequency		Percentage (%)	
	Yes	No	Yes	No
B1	353	127	73.5	26.5
B4	109	371	22.7	77.3
B5	219	261	45.6	54.4
B6	109	371	22.7	77.3

All health professionals (100%) are qualified anaesthetists and are in good standing with the Medical and Dental Council of Ghana. All of the anaesthetists (100%) indicated knowledge of what awareness under anaesthesia entails. Only 33.3% of anaesthetists reported experiencing complaints of awareness in their practice. Also, all anaesthetists engage in call duty (100%) with slightly more than half (57.1%) reporting having adequate monitoring devices for anaesthesia services.

Most anaesthetists (85.7%) confirmed that their anaesthesia machines were in good shape. In addition, a significant majority (95.2%) usually perform machine checks before anaesthesia delivery while 90.5% reported having adequate control and choice of anaesthetic drugs.

Table 3. Assessing the Anaesthetists Knowledge of Awareness.

Questions	Knowledge of Awareness	
	Yes	No
Are you a qualified anaesthetist?	17 (100%)	0
Are you in good standing with the Medical and Dental Council of Ghana?	17 (100%)	0
Do you know what awareness of anaesthesia is?	17 (100%)	0
Have you had any complaints of awareness in your practice?	5 (33.3%)	12 (66.7%)

Questions	Knowledge of Awareness	
	Yes	No
Do you run call duty?	17 (100%)	0
Do you have adequate monitoring devices for anaesthesia services?	10 (57.1%)	7 (42.9%)
Is the anaesthesia machine in good working condition?	15 (85.7%)	2 (14.3%)
Do you perform machine check before anaesthesia delivery?	16 (95.2%)	1 (4.8%)
Do you have adequate control/choice of anaesthetic drugs and usage in your facility?	15 (90.5%)	2 (9.5%)

Table 4. Anaesthetists Identification of Risk Factors of Awareness.

Risk factors	Frequency	Percentage (%)
Light anaesthesia	15	90.5
Extremes of age	12	71.4
Obesity	12	71.4
Genetic resistance to effects of anaesthetics	12	71.4
Inadequate knowledge of awareness on the part of providers	12	71.4
General surgery	11	61.9
History of awareness	11	61.9
Extensive surgery	5	28.6

According to Table 4, light anaesthesia was identified by 90.5% of anaesthetists as the most recognized major risk factor. 71.4% acknowledged that very young or very old patients are at increased risk, indicated obesity as a contributing factor, cited genetic resistance as a risk factor to anaesthetics, and identified inadequate knowledge of awareness among

health providers as a potential risk factor. Meanwhile, 61.9% anaesthetists associated general surgery with a higher likelihood of awareness with 61.9% recognizing history of awareness as a predisposing factor. Only 28.6% of anaesthetists identified extensive surgery as a risk factor.

Table 5. Anaesthetists Identification of Causes of Awareness Under Anaesthesia.

Causes	Frequency/Percentage	
	Strongly Agree	Strongly Disagree
Deficient equipment knowledge	17 (100%)	0
Genetic resistance to effects of anaesthetic	16 (95.2%)	1 (4.8%)
Chronic use of drugs (alcohol, opioids, sedatives, etc)	15 (90.5%)	2 (9.5%)
The use of standard dosing of clients	15 (90.5%)	2 (9.5%)
Lack of logistics (drugs, manpower, etc)	15 (90.5%)	2 (9.5%)
Equipment malfunction /capnography	14 (80.9%)	3 (19.1%)
Errors in administration of neuromuscular blocking agents	13 (76.2%)	4 (23.8%)

All anaesthetists (100%) in Table 5 strongly agree that deficient knowledge of equipment is a major cause of awareness under anaesthesia. Only 4.8% strongly disagree that genetic resistance to anaesthetic effects is a contributing cause. 90.5% of anaesthetists identified chronic use of substances such as alcohol, opioids, and sedatives as causes of awareness under anaesthesia.

9.5% of anaesthetists strongly disagree that lack of logistics such as insufficient drugs and manpower is a contributing factor to awareness of anaesthesia. Besides, equipment malfunction or capnography misreading is strongly agreed upon as a cause by 80.9% while 19.1% disagree with 76.2% strongly agreeing that administrative errors of neuromuscular blocking agents can cause awareness in anaesthesia. Nevertheless, 15 anaesthetists strongly agreed that the use of standard dosing for clients (90.5%) avert awareness of anaesthesia.

4. Discussion of Findings

4.1. Demographic Characteristics

Anaesthetists' Demographics and Workforce Trends

The predominance of younger anaesthetists aged 26-35 aligns with global trends observed in developing healthcare systems, where early-career professionals dominate due to challenges in retaining senior practitioners. Factors such as migration for advanced training and early retirement contribute significantly to this phenomenon [30]. Moreover, the representation of female anaesthetists at 52.4% echoes studies highlighting the growing feminization of the healthcare workforce, particularly in specialized fields like anaesthesiology [31]. Despite this progress, disparities persist. Other research reported lower female representation in leadership positions, and studies in regions such as North America underscore a persistent gender imbalance favoring males, especially in senior and academic anaesthetist roles [32, 33]. This disparity likely reflects localized trends and workforce dynamics that vary by region. Additionally, the preponderance of anaesthetists with 1-5 years of experience contrasts sharply with patterns in high-income countries, where structured career progression ensures a more experienced workforce [34]. These findings suggest the need for tailored workforce strategies to improve career longevity and retention among senior anaesthetists in resource-constrained settings.

4.1.1. Patient Demographics and Surgical Practices

The predominance of female surgical patients (61.3%) is consistent with literature documenting higher surgical healthcare utilization by women, particularly for procedures such as cesarean sections and thyroidectomies [35]. Furthermore, the concentration of patients aged 26-35 years reflects the demographic's peak surgical demand, driven by

reproductive health needs and lifestyle-related conditions [36].

General anaesthesia's prominence (51.9%) aligns with its established application across a wide range of surgeries, which have been increasing due to advancements in healthcare accessibility [37]. The near-equal distribution between general anaesthesia and regional anaesthesia challenges regional studies that report a heavier reliance on regional anaesthesia for a broader array of procedures [38]. This imbalance may reflect unique patient profiles or priorities in the study setting, potentially indicating diverse surgical approaches tailored to local healthcare demands. However, contrasting perspectives exist regarding the global applicability of this trend. For instance, despite the overall increase in surgeries worldwide, low-income countries (LICs) face challenges such as limited healthcare infrastructure, shortages in trained personnel, and inadequate perioperative care [39], which contribute to a higher perioperative mortality rate (POMR).

Furthermore, the evolving healthcare landscape, marked by value-based care models, suggests a shift from a purely volume-driven approach to one that emphasizes the quality and outcomes of care, which may influence anaesthesia practices [37]. These disparities highlight that while general anaesthesia's application is growing globally, its effectiveness and accessibility are highly contingent upon regional healthcare systems and the resources available for perioperative care. Thus, while healthcare advancements are facilitating the use of general anaesthesia in surgeries, its outcomes and prevalence are not uniformly consistent across different regions.

4.1.2. Implications

The demographic trends of anaesthetists and patients, alongside the surgical practices examined, offer significant insights into workforce distribution and healthcare utilization. While these findings align with broader global patterns, variations attributable to local healthcare dynamics highlight the need for region-specific strategies. Workforce planning efforts should prioritize addressing disparities in gender representation, promoting career retention for senior anaesthetists, and ensuring equitable access to surgical services. These insights underscore the critical role of nuanced policy adjustments to meet the evolving demands of healthcare systems.

4.2. Patients' Awareness of Anaesthesia

Expectations of Complete Unconsciousness (B1)

Majority of clients (73.5%) expected to be completely asleep during surgery, indicating a strong association between anaesthesia and the assumption of total unconsciousness. This aligns with the general public's perception of general anaesthesia as a state of complete insensibility to pain and con-

sciousness. Studies have reported that patient education about anaesthesia often focuses on inducing a state of unconsciousness, which reinforces this expectation [40]. However, in some cases, insufficient communication about the possibility of awareness under anaesthesia can lead to unrealistic patient expectations [41, 42].

4.2.1. Limited Awareness During Surgery (B4)

Only 22.7% of clients recalled anything between going to sleep and waking up, indicating a low incidence of intraoperative awareness, consistent with previous studies. The incidence of awareness under general anaesthesia is estimated at 0.1% to 0.2% in high-resource settings, largely due to advances in monitoring and anaesthesia techniques [43]. This result suggests that anaesthetic practices in the surveyed population may align with international standards for minimizing awareness. However, the low incidence reported here could also reflect limited patient understanding or recall of intraoperative events, as observed in other studies [44].

4.2.2. Dreams During Surgery (B5)

Responses were more evenly distributed regarding dreaming during surgery, with 45.6% reporting they had dreams and 54.4% reporting otherwise. The occurrence of dreaming during anaesthesia has been documented in prior research and is thought to occur in 20% to 60% of cases, depending on the depth of anaesthesia and individual susceptibility [45]. Dreaming is generally associated with light anaesthesia or sedation and does not necessarily indicate awareness. However, the high proportion of clients reporting dreams highlights the variability in patient experiences and perceptions, necessitating further exploration of factors contributing to these reports.

4.2.3. Disturbing Dreams

Only 22.7% of clients reported that their dreams during the procedure were disturbing, while the majority (77.3%) did not find them troubling. This finding is consistent with literature suggesting that while dreaming during anaesthesia is relatively common, only a minority of patients report negative or distressing experiences [25]. Negative dreams may stem from preoperative anxiety, individual susceptibility to distress, or insufficient sedation during the procedure. These findings underscore the importance of managing preoperative anxiety and optimising anaesthetic depth to enhance patient experiences [46].

4.2.4. Implications

The study confirms the effectiveness of modern anaesthesia techniques in preventing adverse experiences but highlights the variability in client experiences and expectations. The findings suggest a general expectation of complete unconsciousness and a low incidence of awareness or disturbing dreams. Improving communication with patients about an-

aesthesia experiences can enhance satisfaction and trust in healthcare providers.

4.3. Anaesthesia Awareness and Practice

Knowledge and Professional Standards

The universal knowledge of anaesthesia awareness among practitioners and their professional qualifications align with international standards that emphasize rigorous training and certification processes. These practices are crucial for maintaining high knowledge levels and consistent quality of care [47-49]. The low incidence of reported complaints about anaesthesia awareness (33.3%) is consistent with global data showing that awareness occurs in less than 1% of surgical cases. Effective anaesthetic protocols and advanced monitoring devices play a critical role in minimizing this phenomenon [50, 51].

4.3.1. Adherence to Safety Protocols

The high percentage (95.2%) of anaesthetists performing pre-anaesthesia machine checks underscores adherence to internationally recommended safety protocols [52]. This practice is essential for preventing intraoperative complications and ensuring patient safety. Additionally, the majority (90.5%) of anaesthetists reporting adequate control and choice of anaesthetic drugs reflect resource availability typically found in resource-sufficient settings [53].

4.3.2. Resource-Related Challenges

While knowledge and adherence to safety protocols are commendable, challenges in resource availability significantly impact anaesthesia practice quality in resource-constrained settings. Only 57.1% of anaesthetists reported having adequate monitoring devices, contrasting sharply with high-income settings where advanced monitoring is almost universally available [54, 55]. This discrepancy highlights the persistent shortages of devices in low-to-middle-income countries (LMICs), which can compromise patient safety and care quality [56].

Also, 100% of anaesthetists reported participating in call duty, a practice that is universally required in high-income settings to ensure emergency service availability. In most LMICs, workforce shortages and work-life balance concerns are likely to be barriers to broader participation [57]. Additionally, while 85.7% of anaesthetists reported functioning anaesthesia machines, the remaining 14.3% facing challenges suggests resource gaps that are less common in high-income countries, where stringent maintenance protocols ensure near-universal machine reliability [62].

4.3.3. Implications

The findings reflect strong knowledge and adherence to anaesthesia practices among the surveyed anaesthetists, aligning with global professional standards. However, the

gaps in monitoring device adequacy and call duty participation underscore challenges that are common in resource-constrained settings. Addressing these disparities through improved resource allocation, training, and infrastructure development could enhance patient safety and reduce the incidence of anaesthesia awareness. This discussion underscores the need to balance professional standards with resource availability to optimize anaesthesia services worldwide.

4.4. Risk Factors for Awareness Under Anaesthesia

Recognition of Key Risk Factors

The nearly unanimous identification of light anaesthesia as a primary risk factor (90.5%) aligns with extensive research showing it as the leading cause of intraoperative awareness. Efforts to reduce anaesthetic dosages to mitigate haemodynamic instability are often implicated in such cases [59]. Similarly, the recognition of extremes of age (71.4%) as a risk factor is consistent with literature highlighting the altered metabolism of anaesthetic drugs in neonates and elderly patients, increasing their vulnerability to inadequate anaesthetic depth [59].

Obesity and genetic resistance, both identified by 71.4% of respondents, also resonate with existing studies. Obesity alters pharmacokinetics, affecting drug distribution and metabolism, while genetic polymorphisms, such as those involving the CYP450 enzyme family, create variability in anaesthetic efficacy [58]. Inadequate provider knowledge, also cited by 71.4% of anaesthetists, underscores the importance of specialized training in anaesthetic depth monitoring and awareness prevention, as emphasized in previous research [50].

4.4.1. Contextual Factors and Practice Variation

The identification of general surgery and a history of awareness (61.9% each) as risk factors reflects established findings that patients undergoing high-stress or emergent surgeries, or those with prior awareness experiences, are at increased risk of recurrence [59]. However, the relatively low recognition of extensive surgery as a risk factor (28.6%) contrasts with evidence linking prolonged or complex procedures to increased awareness of risks due to greater variability in anaesthetic depth [63]. This discrepancy may be attributed to differences in training, clinical exposure, and monitoring capabilities between regions or healthcare systems [59].

4.4.2. Implications

The findings suggest that while anaesthetists recognize light anaesthesia core risk factor, and patient-specific vulnerabilities, gaps remain in acknowledging others, like extensive surgery, which are well-documented in high-resource

settings. This variation emphasizes the need for continuous professional education and the implementation of evidence-based protocols tailored to diverse healthcare environments. Advanced training and improved resource allocation could help align practice with global best practices, ultimately enhancing patient safety outcomes. By focusing on professional development and adopting evidence-based strategies, healthcare systems can optimize anaesthetic practices and reduce the incidence of awareness, fostering better patient outcomes worldwide.

4.5. Causes of Awareness Under Anaesthesia

Human and Technical Factors

Unanimous agreement on deficient equipment knowledge as a significant cause of awareness underscores the critical role of technical competency in anaesthesia delivery. Improper use of anaesthesia machines and monitoring devices significantly increases the risk of awareness, as demonstrated in previous studies [45]. Similarly, 80.9% of anaesthetists identified equipment malfunction or capnograph misreading as a contributing factor, consistent with research emphasizing the importance of functional machines and monitors in preventing awareness [53]. However, this finding contrasts with high-resource settings, where routine maintenance and advanced monitoring have reduced equipment-related risks to negligible levels [53].

The 76.2% recognition of errors in administering neuromuscular blocking agents (NMBAs) further highlights the interplay between human error and technical expertise. Research shows that improper use or dosing of NMBAs can immobilize patients without adequate sedation, heightening the likelihood of awareness [56]. In high-income settings, robust training programs and standardized protocols significantly mitigate such risks, contrasting with challenges observed in resource-limited environments [57].

4.5.1. Pharmacological Factors

The recognition of genetic resistance as a cause of awareness (95.2%) aligns with evidence highlighting individual variability in anaesthetic efficacy due to polymorphisms in metabolic pathways, such as CYP450 enzymes [58]. This finding emphasizes the importance of personalized anaesthesia protocols to address individual pharmacodynamic differences. Chronic drug use was identified by 90.5% of anaesthetists as a cause of awareness, consistent with studies showing that tolerance induced by substances like opioids, alcohol, and benzodiazepines necessitates higher doses to achieve adequate anaesthesia [60]. Furthermore, concern over the use of standard dosing strategies (90.5%) supports advocacy for individualized dosing based on factors such as weight, age, and comorbidities to ensure optimal anaesthetic depth [61].

4.5.2. Implications

The findings highlight significant challenges in resource-constrained settings, including deficient logistics, equipment malfunctions, and limited training, which elevate the risk of anaesthesia awareness compared to high-resource environments. Despite these barriers, anaesthetists demonstrated a nuanced understanding of the human, pharmacological, and technical causes of awareness. Enhancing training, improving resource allocation, and implementing individualized protocols are essential to reducing risks and improving patient safety, particularly in resource-limited contexts, to align with global standards.

5. Conclusion

The study examined intraoperative awareness under general anaesthesia in five district hospitals in Ghana, revealing that while anaesthetists adhered to safety protocols, resource challenges such as insufficient monitoring devices and limited workforce participation hindered optimal practice. Key risk factors for awareness identified by anaesthetists included light anaesthesia, age extremes, obesity, and genetic resistance, while patients generally expected complete unconsciousness, reporting low incidences of awareness and mixed experiences with dreaming. It highlighted strengths and gaps in anaesthesia practice within Ghana's district hospitals, emphasizing the interplay of professional expertise, patient perceptions, and resource constraints. While anaesthetists demonstrated adherence to key safety protocols, limitations in monitoring devices and workforce capacity underscore the challenges faced in resource-constrained settings. Addressing these disparities through policy reforms, targeted training, and infrastructural investments can align practices with global standards and improve surgical outcomes. Ultimately, fostering patient safety requires a multifaceted approach that integrates education, technology, and equitable resource distribution. In addition, the study underscores the elevated risk of anaesthesia awareness in resource-constrained settings due to logistical, technical, and training challenges, emphasizing the need for enhanced education, resource allocation, and individualized protocols to improve patient safety and align with global standards.

6. Recommendations

To improve anaesthetic safety in resource-constrained settings, governments and health authorities should prioritize strengthening resource allocation by investing in advanced monitoring devices and equipment maintenance, while addressing workforce shortages through incentives for training and career progression. Expanding the National Health Insurance Scheme to include comprehensive anaesthesia-related care will promote equity in surgical outcomes. In practice, healthcare facilities should adopt standardized protocols for

pre-anaesthesia checks, anaesthesia clinics, obtain signed anaesthetic consent, and anaesthetic depth monitoring, along with enhanced preoperative patient communication.

Investment in postgraduate education, continuous professional development programs, and mandatory training for anaesthesia providers with possibility of sub-specialization will improve competency, career progression and possibility of placement in anaesthetic training institutions. Future research should focus on expanding the geographic scope to include more regions in Ghana and other low- and middle-income countries, conducting longitudinal studies on anaesthesia interventions, evaluating new monitoring technologies, and investigating individualized anaesthesia protocols to reduce awareness rates in low-resource environments.

Abbreviations

NHIS	National Health Insurance
CHAG	Christian Health Association of Ghana
GDP	Gross Domestic Product
CRA	Certified Registered Anaesthetist
SOTA	Surgical, Obstetric, Trauma, and Anaesthesia

Author Contributions

Bright Kwaku Anyomi: Conceptualization, Formal Analysis, Methodology, Validation, Writing – original draft, Writing – review & editing

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Institutional Review Board Statement

Ghana Health Service Ethical Review Committee.

Informed Consent Statement

Confidentiality was ensured at all stages of the process. Informed consent was obtained from all individual participants included in the study after signing a data sharing agreement for the study before commencement.

Data Availability Statement

No new data were created.

Conflicts of Interest

The authors declare no conflicts of interest.

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Research Fields

Bright Kwaku Anyomi: Neurogenesis, Neurodegeneration, Cancer Biology, Astrocyte conversion into Neuron, Neuroscience and Anesthesia

James Nwinsagra: Obstetric Anesthesia, Perioperative Anesthesia, Chronic pain Management, Airway Management, Patient safety

Evans Atito-Narh: Medico-legal Issues, Cardiothoracic Anesthesia, Anesthesia Equipment and practice, Critical care Anesthesia, Simulation Education

Jacob Mbuer Wumbe: Ophthalmic Anesthesia, General Anesthesiology, Airway management, Evidence based Practice, Obstetric Anesthesia

Fred Osei: Local Anesthetics, Anesthesia and organ Transplant, Neuroanesthesiology, Pediatric Anesthesia, Palliative care