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COST ANALYSIS OF ANESTHESIA SERVICES IN SELECTED CHRISTIAN HEALTH ASSOCIATION OF GHANA HOSPITALS IN THE EASTERN REGION OF GHANA

SUBMITTED BY

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DECLARATION

I, **ESTHER - ROBERTA COSMAS–NYAUNU**, hereby declare that this research study titled "COST ANALYSIS OF ANESTHESIA SERVICES IN SELECTED CHRISTIAN HEALTH ASSOCIATION OF GHANA HOSPITALS IN THE EASTERN REGION OF GHANA" submitted in partial fulfilment of the requirements for the degree of Master of Public Health at the University of Ghana is entirely my own work unless otherwise indicated or acknowledged. I affirm that: The work presented in this thesis is my original contribution and has not been submitted in part or whole for any other degree or qualification. Any assistance received during the course of this research is duly acknowledged, and the contributions of individuals or sources have been appropriately referenced and cited. I acknowledge the efforts and guidance of my supervisors, Dr. Ama Pokua Fenny and Dr Evans Otieku, and the support of my academic institution throughout this research journey.

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(Supervisor)

DEDICATION

This thesis is dedicated to my family, whose unwavering love, support, and encouragement have been my constant source of strength throughout this academic journey. Your belief in me has been the driving force behind my achievements, and I am eternally grateful for your sacrifices and guidance. I also dedicate this work to my colleague anesthetists and mentors who have enriched my life with their wisdom and inspiration. Your insights and discussions have contributed to the depth and quality of this research. Lastly, I dedicate this thesis to the selected Christian Health Association of Ghana hospitals in the Eastern Region of Ghana, whose vibrant spirit and commitment to excellence have inspired me to delve into the cost of Anesthesia services. May this research contribute, in its own modest way, to this dynamic sector's continued growth and success.

May the Good Lord bless you all.

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LIST OF ABBREVIATIONS

CHAG	- Christian Health Association of Ghana
LCoGS	- Lancet Commission on Global Surgery
LMICs	- Low- and middle-income countries
MoH	- Ministry of Health
NHIS	- National Health Insurance Scheme
TIVA	- Total Intravenous Anesthesia
WHO	- World Health Organization
DALYs	- Disability-adjusted life years

ABSTRACT

Background: Anesthesia is essential in modern surgical procedures, ensuring patient comfort and enabling successful operations. However, the financial burden it imposes on patients, including both direct expenses and hidden indirect costs, is not well understood. This lack of awareness may compromise financial protection policy design that should appropriately insulate surgical patients from catastrophic health spending. Furthermore, a clearer understanding of anesthesia-related costs may encourage healthier behaviors, potentially reducing the risk of surgery and the associated financial burdens. Therefore, this study aims to evaluate the economic burden of anesthesia to inform society and policymakers about the appropriate course of action to minimize the risk of surgery and the associated costs.

Method: A cross-sectional consecutive design was used, in which 192 surgical patients were sampled prospectively and data collected within four months, spanning January to May 2024, through face-to-face interviews following informed consent and approval by the patients or their carer, whichever was appropriate. Setting was seven Christian Health Association of Ghana (CHAG) hospitals in the Eastern region. Descriptive statistical analysis was performed on participant background data while inferential statistical analysis was used to estimate anesthesia related costs and the determining factors. Cost analysis was stratified by type of anesthesia for precision estimate.

Results: The findings indicate that the mean total direct cost for patients who underwent regional anesthesia was GHS202.54 (95% CI: 63.36-341.73), while those receiving general anesthesia incurred GHS81.37 (95% CI: -11.90-174.63). No direct costs were recorded for patients under local anesthesia. Indirect costs, measured as lost productivity, were highest for regional anesthesia (GHS1,128.9 per patient), followed by general anesthesia (GHS924.2) and local anesthesia (GHS527.3). Key factors influencing anesthesia costs included the presence of other surgical conditions (p=0.048), household size of 5-9 members (p=0.011), and marital status (p=0.053), indicating that demographic and social factors play a role in determining financial burden. **Conclusion:** This study highlights the financial burden of different anesthesia types, with regional anesthesia being the most expensive in both direct and indirect costs. Understanding these expenses can help prospective surgical patients to better prepare financially or avoid these costs by prioritizing health prevention that reduces their risk of surgery and by extension anesthesia. In the quest for Ghana to ensure better financial risk protection, this study emphasized the need to expand National Health Insurance Scheme (NHIS) benefit package to cover anesthesia services.

CHAPTER ONE

INTRODUCTION

1.0 Background to the study

Anesthesia is a critical medical practice that has transformed the field of surgery and medical procedures. It involves the administration of medications to induce a state of reversible unconsciousness, pain relief, and muscle relaxation, allowing for surgical and medical interventions to be performed safely and comfortably for the patient. The evolution of anesthesia has a long history (Du et al., 2021; Lim et al., 2018). Early surgical procedures were limited to life-threatening emergencies and painstakingly performed. The discovery of ether and chloroform in19th century brought a pivotal moment with the discovery of anesthetics like ether and chloroform (Lim et al., 2018). These breakthroughs transformed medical history, paving the way for modern anesthesia practices. The development of anesthesia has significantly improved patient outcomes, reduced pain and suffering, and expanded the possibilities of various medical procedures (Malik et al., 2010).

Annually, 313 million major surgical procedures are performed worldwide (Meara et al., 2015), all necessitating some form of anesthesia (Guevara-Farias et al., 2022). In 2018, the World Health Organisation (WHO) reported that healthcare expenditures by its 194 member nations amounted to a total of $8.3 trillion. Despite this substantial expenditure, there are significant deficiencies in healthcare provision, particularly in developing nations (Grimes et al., 2014). As reported by Shrime et al. (2015), these shortcomings encompass surgical care, a crucial facet of healthcare systems. The Lancet Commission projected a requirement for an additional 143 million surgeries per year in low- and middle-income countries (LMICs) between 2015 and 2030 to prevent disabilities and save lives. This represents a 46% increase from the existing 313 million annual surgeries (Meara et al., 2015). Notably, in Sub-Saharan Africa (SSA), surgical conditions contribute to the loss of 25 million Disability-adjusted life years (DALYs) each year (Debas et al., 2015).

Where resources are limited or inadequate, the quality of anesthetic procedure could be challenging for healthcare providers (Hodges et al., 2018). Limited resources for anesthetic procedure also mean increased operational cost that is mostly passed on to the patient (WHO, 2019). In countries where user fees are implemented, healthcare costs are paid out-of-pocket by the patients. Thus, the cost of anesthesia can put a considerable burden on patients.

The cost of anesthesia may vary significantly depending on the costing perspective, time horizon, and other hospital resource used considerations such as the duration and type of procedure Nwanna–Nzewunwa et al. (2021). For example, a systematic review and meta-analysis conducted in 2014 compared Balanced General Anesthesia with Total Intravenous Anesthesia (TIVA) in outpatient pediatric surgery. The findings indicate TIVA was associated with higher costs than balanced anesthesia, showing a mean difference per case of USD 11.29 (95% CI USD 8.62-USD 13.96), albeit with a high level of variability (I2 = 86%), as reported by Kumar et al. (2014). In 2015, a cost-minimization analysis, based on a retrospective study conducted in China, concluded that there was no significant cost disparity between balanced anesthesia using sevoflurane/remifentanil and TIVA (Hu & He, 2015). Beside the direct cost of anesthesia is the opportunity cost from productivity loss also termed indirect cost.

Indirect costs associated with anesthesia can make up a significant portion of the total cost of medical services, and it is influenced by wage differentials and the duration of absenteeism from work due to anesthesia (Agarwal et al., 2016). The choice of anesthesia modality employed may influence indirect cost considerations, as underscored by Li et al. (2017). This study explores the costs implications related to anesthesia services from the perspective of patients.

1.1 Problem Statement

Anesthesia services play a crucial role in modern healthcare systems, ensuring patient comfort, safety, and the success of medical interventions (Orser et al., 2019). The provision of anesthesia involves the use of human resources, medical supplies, equipment, and facilities, all of which contribute to the overall cost of care (Simkin et al., 2023). However, there is a significant gap in understanding the cost implications of anesthesia services, particularly in developing countries. The provision of anesthesia services in Ghana particularly in rural and underserved areas is important for enhancing equitable access to needed surgical operations in Ghana. The Christian Health Association of Ghana (CHAG) hospitals, which are mostly accessible by rural inhabitants thus play a vital role in providing healthcare services to the population.

A recent study shows that up to 91% of the cost of surgery including anesthesia is paid for by the patients out-of-pocket in CHAG hospitals, while the national health insurance takes care of the rest of the costs (Jumbam et al., 2022). Reimbursement policies for anesthesia services by insurance companies and government programs such as the National Health Insurance Scheme (NHIS) remain a challenge as the specific cost allocation for anesthesia is fused with the cost of surgery

(Brown & Gotsadze, 2017). CHAG facilities are largely NHIS-accredited facilities, and this phenomenon appears to be worsening the financial burden of patients seeking surgical care in CHAG facilities.

Moreso, the fear of increased cost of healthcare services pushes people to seek alternative care like traditional medicine even when surgery is needed. To ensure that the burden of anesthesia costs does not fall solely on the patient, economic evaluations like this study are essential in advocating for systemic investments that create financial safety nets for those who cannot afford necessary healthcare services, such as anesthesia for surgery. This study highlights the importance of understanding the economic cost of anesthesia not only for patient preparedness but also for informing policy decisions.

From a patient perspective, awareness of these costs can help individuals plan financially, secure adequate funds, and avoid delays in hospital discharge due to unpaid bills. However, beyond individual responsibility, the findings emphasize the need for healthcare system reforms. Policymakers and the National Health Insurance Scheme (NHIS) should consider covering these costs to prevent financial hardship for patients and ensure equitable access to surgical care.

Additionally, cost implications can drive public health interventions that reduce preventable surgical risks. For instance, if people are aware of the financial strain associated with avoidable injuries requiring surgery, preventive measures and safety regulations may become more widely adopted. In a lower-middle-income country like Ghana, addressing anesthesia costs at both individual and systemic levels is crucial for reducing financial strain on households and improving overall healthcare accessibility.

1.2 Objectives of the Study

1.2.1 General objective

The general objective of the research project is to provide data to improve understanding of the cost of anesthesia services in CHAG hospitals in the Eastern region of Ghana.

1.2.2 Specific Objectives of the Study

This study aims to achieve specific objectives that delve into the complex terrain of anesthesia service costs within chosen CHAG institutions in the Eastern Region of Ghana in accordance with the underlying research questions. These goals are as follows:

1. To estimate and compare the direct patient cost of different types of anesthesia services in selected CHAG hospitals within the Eastern Region.
2. To estimate and compare the indirect patient cost of different types of anesthesia services in selected CHAG hospitals within the Eastern Region.
3. To evaluate the factors associated with the cost of anesthesia services patients incur in CHAG hospitals in the Eastern region.

1.2.3 Research Questions

In pursuit of the study aim, the following research questions were answered:

1) What is the direct patient cost of anesthesia services in selected CHAG hospitals within the Eastern Region?

2) What is the indirect patient cost of anesthesia services in selected CHAG hospitals within the Eastern Region?

3) What factors influence the patient cost of anesthesia services in CHAG hospitals in the Eastern region?

These refined research questions capture the essence of the study, delving into the economic aspects of anesthesia services and the factors contributing to the economic burdens on patients within the specified healthcare facilities.

1.3 Justification of the study

The rising cost of healthcare services, including anesthesia, has placed a significant financial burden on patients, particularly those in faith-based hospitals such as those under the Christian Health Association of Ghana (CHAG). This study, "Cost Analysis of Anesthesia Services in Selected CHAG Hospitals in the Eastern Region of Ghana," seeks to bridge critical knowledge gaps by evaluating the financial implications of anesthesia services in these facilities. Firstly, the findings of this research will serve as a crucial reference for insurance companies and the National Health Insurance Scheme (NHIS) in the allocation of funds for anesthesia services. Currently, many patients pay out-of-pocket for anesthesia, which can lead to financial hardship and delays in accessing essential surgical care. Expanding NHIS benefit package to include anesthesia costs would reduce the financial burden on patients, promote equitable access to surgical procedures, and ensure that necessary treatments are not postponed due to cost barriers. Secondly, the study provides evidence-based insights that can inform decision-making among health authorities within CHAG facilities and the Ministry of Health (MoH). By understanding the cost structure of anesthesia services, policymakers and hospital administrators can make informed choices about resource allocation, pricing models, and cost reduction strategies to enhance service delivery and efficiency. Furthermore, while this study does not claim to establish the exact, precise cost of anesthesia services, it will offer a useful framework for estimating expenses and guiding financial planning within CHAG hospitals and the broader healthcare sector. A better understanding of these costs empowers patients by enhancing their financial preparedness and supporting informed decision-making about their healthcare options. Lastly, this research will contribute to the growing body of literature on anesthesia cost analysis, serving as a foundation for future studies in Ghana and beyond. By generating new insights and comparative data, the study aims to stimulate policy discussions and encourage proactive interventions by health policymakers to improve anesthesia service accessibility and affordability across Ghana's healthcare system.

1.4 Outline of the Thesis

The report is organized into five main chapters:

Chapter one: A problem statement that addresses a situation in need of a solution, improvement, or a hole in the body of existing literature that needs to be filled were included in the introduction, along with the research questions and objectives. Chapter one also includes justification of the significance of the study.

Chapter Two: A review of literature highlighting the empirical basis of this study by showing the known and unknown about the economic cost of anesthesia from the patient perspective. It also covered the theoretical review and conceptual framework.

Chapter Three: This outlines both the methodology and the procedures that were used to collect and analyse the data.

Chapter Four: A presentation of the study result providing the basis for discussion of the findings were presented in line with the study objectives and research questions.

Chapter Five: There were three primary sections: a summary of the results, a discussion of the study's findings, and recommendations for further research.

CHAPTER TWO

LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.0 Introduction

This chapter reviews literature relevant to establish the empirical foundation of this present study regarding the cost analysis of anesthesia services in selected CHAG hospitals in the Eastern Region. Anesthesia services are integral to modern healthcare, impacting budgets, resource allocation, and overall care quality. The review aims to synthesize insights from studies in this context. The literatures were sourced from databases like PUBMED, ScienceDirect, and Google Scholar using a focused Boolean search strategy. The review aligns with the study objectives, offering key findings, methodologies, and insights to inform the research questions and objectives.

2.1 Overview of Anesthesia

Anesthesia is a specialized branch of medicine that concentrates on sedation, controlled unconsciousness, and pain management during surgical and medical operations (Trainor et al., 2011). It involves administering anesthetics to make patients asleep so they can receive medical treatment safely and comfortably.

The primary objectives of anesthesia include pain elimination, muscle relaxation, and the maintenance of physiological stability during surgery or medical procedures (Trainor et al., 2011; Miller, Pardo, & Lerman, 2017). The history of anesthesia dates to the 19th century when pioneers like Morton, Wells, and Jackson made significant advancements in the development of inhalation agents, ultimately leading to the introduction of ether anesthesia. This innovation transformed surgical practices, reducing patient pain and mortality rates during procedures (McGuire, 2018).

Since then, anesthesia techniques have evolved, incorporating intravenous medications, advanced airway management, and sophisticated monitoring systems.

Ensuring patient safety is paramount in anesthesia administration, with advanced monitoring systems playing a crucial role in tracking vital signs, oxygen levels, carbon dioxide levels, and anesthetic depth during surgery (Stoelting & Hillier, 2017). The objective is to maintain a delicate balance, keeping the patient in a controlled unconscious state while preserving vital functions. Advances in technology have significantly improved anesthesia administration. Modern anesthesia machines provide precise control over inhalation agents and oxygen delivery. Patient monitoring has evolved from simple blood pressure cuffs to complex systems that offer real-time data on patient physiology, aiding in early complication detection (Patel & Berenholtz, 2018). Additionally, ultrasound-guided techniques have enhanced the accuracy and safety of regional anesthesia, reducing complications and patient discomfort (Sites et al., 2014).

Administering anesthesia requires a thorough assessment of the patient's medical history, physical condition, and potential risks or contraindications (Trainor et al., 2011). Anesthesia providers, such as anesthesiologists or nurse anesthetists, are responsible for monitoring vital signs, adjusting anesthetic medications as necessary, and managing any complications that may arise during the procedure. Anesthesia can be categorized into three main types: general anesthesia, regional anesthesia, and local anesthesia.

2.1.1 Types of Anesthesia

General anesthesia: It is a crucial component of anesthesia services, involving the administration of medications that induce a fully reversible state of unconsciousness. This ensures that patients undergoing surgery do not experience pain and are entirely unaware of the procedure (Trainor et al., 2011). Typically, a combination of intravenous drugs and inhaled anesthetics is used in general anesthesia. It is commonly employed for major surgeries or procedures where complete muscle relaxation and deep sedation are necessary.

General anesthesia achieves a reversible unconscious state using inhalation agents and intravenous medications, rendering patients unresponsive to pain and oblivious to their surroundings (Miller, Pardo, & Lerman, 2017). In this state, patients do not react to painful stimuli, and there are observable changes in their breathing and circulation (The Royal College of Anesthetists & the Association of Anesthetists of Great Britain and Ireland, 2015).

It is important to distinguish between general anesthesia and conscious sedation. Conscious sedation involves a medication-induced state in which the patient's level of consciousness is reduced, allowing them to respond purposefully to verbal commands or light stimulation by touch. This level of sedation is often employed when patients need to remain responsive during certain procedures. Additionally, procedural sedation is used to help patients tolerate procedures that would otherwise be uncomfortable or painful (The Royal College of Anesthetists & The Association of Anesthetists of Great Britain and Ireland, 2015).

Regional anesthesia: It is a specialized technique that involves the precise injection of anesthetics near specific nerves or nerve groups to achieve localized numbness in a particular area of the body (Trainor et al., 2011). Common methods of regional anesthesia include epidural anesthesia, spinal anesthesia, and peripheral nerve blocks. The primary goal of regional anesthesia is to provide targeted pain relief and sensory blockade to a specific region of the body while allowing the patient to remain conscious or lightly sedated.

Regional anesthesia achieves its effects by blocking sensation in a defined body region, often through techniques like spinal or epidural anesthesia. This can be accomplished using nerve blocking devices, such as stimulators, or through the guidance of ultrasound imaging. Once the local anesthetic is injected in the desired region, patients typically experience numbness and tingling in the area supplied by the affected nerves, and they may find it difficult or impossible to move that part of the body.

Regional anesthesia can be broadly categorized into three types: spinal anesthesia, epidural anesthesia, and regional nerve blocks (The Royal College of Anesthetists & the Association of Anesthetists of Great Britain and Ireland, 2015). Among these, spinal and epidural anesthesia are the most utilized techniques. Spinal anesthesia involves the injection of anesthetic into the cerebrospinal fluid surrounding the nerves in the lower part of the spine. It is typically employed for surgeries below the waist or in the pelvic region. Epidural anesthesia, on the other hand, entails the placement of a small plastic catheter in the epidural space at the L3-4 interspace and securing it to the back. This approach allows the anesthetist to administer additional doses of the anesthetic as needed without requiring further injections (The Royal College of Anesthetists & the Association of Anesthetists of Great Britain and Ireland, 2015).

Local anesthesia: It is a specialized technique involving the administration, either through injection or topical application, of anesthetics to a precise area of the body. This process effectively numbs the nerves in the targeted region, preventing pain sensations (Trainor et al., 2011). Local anesthesia is typically reserved for minor surgical procedures or medical interventions where pain relief is required in a specific and limited area.

Local anesthesia involves the direct injection of a local anesthetic into the tissues surrounding the surgical site. This method is commonly employed for minor surgeries such as toenail repair or skin lesion removal. During procedures conducted under local anesthesia, patients remain conscious but experience no pain. Instead, they perceive a localized numbness in the specific area where the anesthetic has been applied (Butterworth, Mackey, Wasnick & Morgan, 2018). In essence, local anesthesia offers a tailored approach to pain management, primarily suited for minor surgical procedures or localized pain relief.

In Ghana, general anesthesia is extensively utilized, particularly in major surgical procedures like open-heart surgeries and organ transplants. However, the cost of general anesthesia services in Ghana is relatively high in comparison to other African countries. The provision of safe and affordable anesthesia services is crucial for ensuring universal access to surgical care (World Health Organization, 2019). However, the high cost of anesthesia services, equipment, and maintenance can create a significant barrier to accessing surgical care, particularly for vulnerable populations in Low- and Middle-Income Countries (LMICs) (Dubowitz et al., 2018). Research has shown that the lack of affordable anesthesia services can lead to delayed or foregone care, resulting in increased mortality and morbidity rates (McQueen et al., 2017). Furthermore, the unaffordability of anesthesia services can exacerbate existing health disparities, particularly for rural or marginalized populations (Meara et al., 2015).

To address these challenges, LMICs can explore innovative solutions such as task-sharing and task-shifting, which involve training non-physician anesthesia providers to deliver safe and effective anesthesia care (Bould et al., 2018). Additionally, the development and use of low-cost anesthesia equipment and supplies can help reduce the financial burden of anesthesia services (Thoms et al., 2018). The socioeconomic implications of anesthesia on access to surgical care in LMICs are significant. However, by exploring innovative solutions and investing in affordable anesthesia services, LMICs can increase access to safe and affordable surgical care, ultimately reducing health disparities and improving health outcomes.

According to Frimpong et al. (2017), the cost of general anesthesia services in Ghana is influenced by several factors, including the nature of the surgical procedure, the duration of surgery, the type of anesthesia employed, and the proficiency level of the anesthesia team. For instance, the cost of general anesthesia for major surgeries, such as open-heart procedures, can vary significantly, ranging from GHC 8,000 to GHC 30,000 (approximately $1,370 to $5,150 USD). Conversely, minor surgeries, such as dental extractions, may incur costs ranging from GHC 500 to GHC 2,000 (approximately $86 to $344 USD). Another study by Arthur et al. (2021) emphasized that the cost of general anesthesia services in Ghana is also contingent on the availability of essential resources such as anesthesia machines, a reliable oxygen supply, and other necessary medications. In certain instances, patients may be required to bear additional charges for the utilization of these resources, further augmenting the overall cost of general anesthesia services.

The practice of general anesthesia in Ghana is still evolving and faces numerous challenges, including inadequate training of anesthesia providers, insufficient infrastructure, and limited funding allocated to anesthesia services. These challenges underscore the need for comprehensive research and initiatives aimed at addressing these issues, improving accessibility to anesthesia services, and ensuring quality and cost-effective healthcare delivery in the country.

2.1.2 Anesthesia Complications and Risk Mitigation

Perioperative pulmonary aspiration is a potentially severe complication that can occur during anesthesia and surgery. A systematic review and meta-analysis assess the incidence and types of adverse events in children undergoing anesthesia underscore the importance of its risk mitigation strategies (Kim et al., 2022).

Another study investigates anesthesia-related complications in pediatric patients with congenital heart disease who are undergoing noncardiac procedures. The findings underscore the critical significance of careful perioperative management and the implementation of risk mitigation strategies in this vulnerable population (Haché et al., 2020).

These references encompass a wide range of perspectives on anesthesia complications and strategies for risk mitigation. They encompass various topics, including neurologic complications, adverse events in preterm children, perioperative pulmonary aspiration, adverse events in children undergoing anesthesia, and anesthesia-related complications in pediatric patients with congenital heart disease (Kim et al., 2022; Haché et al., 2020).

While anesthesia has indeed transformed the field of surgery, it is not without its associated risks. Complications may arise due to patient-specific factors, medication interactions, or unforeseen reactions. Challenges such as awareness under anesthesia, anesthesia-related allergies, and adverse reactions to anesthetic agents represent some of the potential concerns (Eichhorn, 2017). Nonetheless, anesthesia providers diligently employ rigorous preoperative assessments, comprehensive patient histories, and vigilant monitoring to proactively address and mitigate these risks.

2.2.2 **Cost Components of Anesthesia Services**

Cost is a fundamental concept in healthcare economics, representing the financial expenditure required to deliver medical services. It can be classified into direct and indirect costs. Direct costs are directly attributable to a specific medical service, such as surgical procedures, anesthesia, and physician fees, while indirect costs refer to overhead and opportunity costs associated with patient care (Kaplan & Porter, 2011). The cost structure of anesthesia services is complex, including many different components such as staff consultation, drugs, equipment, premises, and overhead expenses. For healthcare organizations to make educated decisions about resource allocation and cost management measures, (Dexter and Epstein, 2015) emphasize the importance of knowing the complex cost components of anesthesia services. According to a study by (Ghisi et al. 2019), costs for competent anesthesia providers, drugs, and monitoring equipment account for a sizable portion of the total cost of anesthesia services.

2.2.1 Direct Cost of Anesthesia

The direct cost of anesthesia services encompasses various elements, including personnel, medications, equipment, and facilities. It includes the cost of medications, supplies, and equipment used during the procedure (Zhou, 2016). Generally, they are expenses that are directly related to patient care, such as nursing services, drugs, medical supplies, diagnostic imaging, rehabilitation, and food services (Gao et al., 2022). Direct costs can also include wages, benefits, professional fees, supplies, purchased services, depreciation, leases and rentals, and other direct expenses related to surgery (Burgette et al., 2020; Childers & Maggard-Gibbons, 2018). Non-billable supplies, such as gloves, packs, and sutures, are also considered direct costs (Childers & Maggard-Gibbons, 2018).
The cost of anesthesia accounts for 5% of the entire cost of patient care in surgery (Zhou, 2016). Anesthetic medication accounts for 10-13% of the pharmaceutical cost of institutions (Zhou, 2016). The price of anesthesia is based on several factors, including the difficulty of the procedure, the time it takes, and the patient's health (Anesthesia Reimbursement, 2023). Personnel expenses constitute a significant portion of direct anesthesia costs. In a study by (Aziato et al. 2019), it was found that personnel costs, including anesthesia providers and supporting staff, accounted for 45% of the direct

costs in Ghanaian healthcare institutions. This statistic highlights the substantial allocation of resources toward anesthesia workforce remuneration. Medications and equipment form integral elements of direct anesthesia costs. A study conducted by (Addo-Atuah et al. 2015) revealed that anesthesia medication and equipment expenses constituted approximately 30% of the total anesthesia cost in Ghana. These costs encompass not only the purchase of medications and equipment but also their proper maintenance and regular updates. Research by Dakurah et al. (2020) indicated that the direct cost of anesthesia services for obstetric surgeries was notably higher compared to other surgical procedures in Ghana. Empirical research on surgical service costs shows that direct costs typically account for 60–80% of total surgical expenses, with anesthesia, surgeon fees, and consumables making up the largest proportion (Shiroiwa et al., 2010). Indirect costs, including administrative overhead and facility maintenance, contribute the remaining 20–40% (Sinha et al., 2021).

2.2.2 Indirect Cost of Anesthesia

The indirect cost of anesthesia services extends beyond direct medical expenditures, encompassing a broad range of financial burdens such as lost productivity, transportation, and caregiver costs. These expenses are not directly related to patient care but arise from non-revenue-producing areas of the hospital, including administrative overhead, facility maintenance, and support services. Additionally, indirect costs can result from lost productivity due to illness or injury, further impacting both patients and caregivers (Yousefi et al., 2014). The broader implications of anesthesia-related costs also include productivity losses stemming from time spent on healthcare-related activities by both patients and caregivers. Two primary economic theories explain indirect costs in healthcare: the human capital approach and the friction cost approach. The human capital approach views indirect costs as lost economic productivity resulting from illness, disability, or death. It quantifies these losses based on a patient's potential contribution to the economy (Rice, 1967). In anesthesia services, factors such as preoperative preparation, recovery periods, and complications significantly contribute to these indirect costs. The friction cost approach, in contrast, argues that the economic impact of lost productivity is moderated by the labor market's ability to replace absent workers (Koopmanschap et al., 1995). This suggests that while patients and caregivers may experience temporary productivity losses due to anesthesia-related procedures, the overall economic effect may be offset by workforce adaptability. Empirical studies provide valuable insights into the extent of these costs. (Agarwal et al. 2016) estimated that anesthesia-related activities, including preoperative preparation and recovery, result in an average loss of six hours per patient. Furthermore, indirect costs were found to constitute 25% of the direct expenses in studies evaluating the financial burden of operating rooms and postanesthesia care units (Golembiewski, 2013). Additionally, some variable costs associated with inhaled anesthetics, such as fresh gas flow rates and vaporizer settings, present opportunities for cost reduction (Golembiewski, 2013).

2.3 Cost Analysis of Anesthesia in Health Delivery

Cost analysis in anesthesia is an essential aspect of healthcare delivery systems. Cost identification analysis is a theoretical framework used to evaluate the relative costs and benefits of different health interventions (Malhotra et al., 2020). The cost of anesthesia in healthcare setup is mainly divided into fixed and variable commodities. The fixed equipment includes gas pipelines, operating tables, anesthesia machines, and various others, which are one-time investments and barely have an impact on the day-to-day expenditure of each (Malhotra et al., 2020). The variable costs associated with the delivery of anesthesia include the cost of consumables, intravenous induction and maintenance drugs used, inhalational agents, O2, N2O, and other intravenous drugs used

(Malhotra et al., 2020). In cost-effectiveness analysis, one compares the cost of alternative ways of achieving a given outcome to the effect (Hogan et al., 2010). Research on the cost of anesthesia providers shows that certified registered nurse anesthetists (CRNAs) require lower training expenses compared to anesthesiologists and can deliver anesthesia care efficiently. (Hogan et al., 2010). Cost analysis in anesthesia is essential to ensure that resources are allocated efficiently and effectively to provide high-quality care to patients while minimizing costs (Malhotraet al., 2020).

2.4 Factors affecting Direct and Indirect Cost in Anesthesia Services

Anesthesia services play a pivotal role in modern healthcare systems, encompassing various medical procedures to ensure patient comfort and safety (Trainor et al., 2011). However, the cost implications of anesthesia services have garnered increasing attention, prompting studies to explore the various factors influencing both direct and indirect costs.

Risk factors within the perioperative context have been evaluated to understand their impact on cost. Fecho et al. (2008) examined factors such as patient age, ASA physical status, type of anesthesia, time under anesthesia care, emergency status, perioperative adverse events, hypothermia, deliberate intraoperative hypotension, invasive monitoring, and postoperative ICU admission. These factors have been previously implicated in anesthesia-related perioperative adverse events (Beecher & Todd 1954; Fecho et al., 2008).

Another critical aspect of cost analysis involves the setting in which anesthesia services are provided. White et al. (2019) conducted a study comparing the costs of carpal tunnel release performed in a clinic setting versus an ambulatory surgery centre. Their analysis considered factors such as personnel costs related to anesthesia or sedation, surgeon fees, and indirect costs, shedding light on the economic considerations associated with different settings.

Li et al. (2011) highlighted the substantial economic burden of atrial fibrillation (AF) in healthcare systems. Their research estimated that hospitalization, anesthesia, personnel, and ancillary procedures costs associated with AF Medicare cost more than $15.7 billion annually, underscoring the financial implications of anesthesia services in managing complex medical conditions.

Anesthesia-related complications and their associated costs have also been a subject of study. Cassai et al. (2020) conducted a meta-analysis on patients undergoing lumbar vertebral surgery, assessing various outcomes including intraoperative hypotension, length of surgery, postoperative side effects, and length of hospital stay. Their findings shed light on the economic considerations in choosing between general anesthesia and spinal anesthesia for these procedures.

Furthermore, the concept of time-driven activity-based costing (TDABC) has been applied to understand the cost structure of anesthesia care. French et al. (2016) employed TDABC to calculate personnel, drugs, supplies, and equipment costs for different surgical procedures, providing insights into how time and resource allocation affect the direct and indirect costs of anesthesia services.

Lastly, Kuczkowski (2010) emphasized the cost implications of postoperative pain management in obstetric anesthesia. Postoperative pain not only affects patient satisfaction but also leads to prolonged recovery and higher healthcare costs, emphasizing the importance of effective pain management strategies.

In summary, the factors influencing direct and indirect costs in anesthesia services encompass a wide range of considerations, from patient-related risk factors to the setting of care and the management of complications. Understanding these factors is crucial for optimizing resource allocation, enhancing cost-effectiveness, and ensuring high-quality anesthesia care.

2.5 Conceptual/Theoretical framework

2.5.1 Theory of costs

In health economics, cost theory indicates that the costs associated with service delivery affect the prices that patients pay or that hospitals incur (Phelps 2009, Turner 2021). For example, the expenses involved in providing surgical care typically exceed those for general medical care due to variations in the resources utilized, including labour, time, and medical supplies (Phelps, 2009]). Patients in an intensive surgical ward are expected to incur higher costs for their care compared to those in a general surgical ward. This is because intensive care patients require more costly treatments, and the disparity in costs between intensive and non-intensive care arises from the different resources used by the hospital. Additionally, the costs associated with hiring a surgeon and anesthetist are approximately double those for labour in a general medical ward.

Similarly, non-medical expenses incurred by patients, such as transportation, are affected by factors like distance, frequency of trips, and the mode of transport. In evaluating transportation costs, the principle holds those longer distances lead to higher costs (linear relationship). In many low- and middle-income countries (LMIC), ambulance services for emergency situations, such as surgeries, are generally more expensive than traveling in a private car (Turner, 2021). Other non-medical costs can vary based on individual preferences. For instance, a patient opting for a private ward with a maximum of two patients per room will pay more for accommodation compared to those in general wards with multiple patients, as costs for utilities like electricity, water, and cleaning are shared among more occupants.

2.5.2 Conceptual Framework

The conceptual framework simplifies the research endeavour, providing a structured lens through which the study understands and investigates the complex interplay of factors within the realm of "Cost Analysis of Anesthesia Services in Selected Christian Health Association of Ghana Hospitals in the Eastern Region of Ghana." It serves as a comprehensive roadmap, delineating the key elements and relationships that shape the inquiry into the economic dimensions of healthcare delivery.

This conceptual framework sets the study's parameters and describes the complex network of variables and influences that characterise anesthesia services. It will support the investigation and allow the study to thoroughly examine and analyse the many aspects that affect anesthetic cost dynamics.

In Figure 3.1, the study presents a conceptual framework that summarizes the intricate relationships between the cost components of anesthesia services. This framework draws inspiration from Jacob's et al. (2011) analysis of access barriers within the healthcare system, which spans geographical accessibility, availability, affordability, and acceptability dimensions. Access challenges to healthcare include facility location, transportation costs, policy requirements, service fees, and service quality.

The framework consists of separate layers, each contributing to an in-depth awareness of the subject matter. The cost-related complexities of anesthetic services are influenced by various aspects, including patient demographics and surgical intricacy. Additionally, there are mediating elements that connect research findings to practical implications. Each of these components plays a crucial part in understanding the overall cost dynamics of anesthesia services.

The provision of anesthesia services is associated with both the specific type of anesthesia utilised and the associated costs. The two factors are interconnected. The type of anesthesia is grouped into general, regional and local anesthesia. Anesthesia expenses are classified into two distinct categories: direct costs and indirect costs. The direct cost refers to the medical expenses incurred from the moment a patient enters at the hospital until all necessary surgeries are completed. This is further divided into medical and non- medical cost. The medical cost is made of drugs, supplies, consultation, and equipment's. The non-medical expenses consist of the costs associated with transportation, housing, and meals.

The indirect cost encompasses the loss of productivity resulting from the patient's absence from work, as well as the expenditure of time and financial resources incurred by family members visiting the patient. Theoretically, measuring the costs associated with productivity loss can be approached in two ways: the human capital approach and the friction-cost approach. The human capital approach assigns the costs of productivity loss to the anticipated economic value of lost output resulting from absenteeism or reduced work capacity (presenteeism) due to the patient's health issues. This method estimates productivity loss costs from the employee's viewpoint, which is also referred to as the patient's perspective (Carozzi *et al.* 2017). In contrast, the friction-cost approach assesses productivity loss costs from the employer's viewpoint, calculating expenses related to absenteeism and presenteeism until a replacement for the absent employee is found (Birnbaum, 2005).

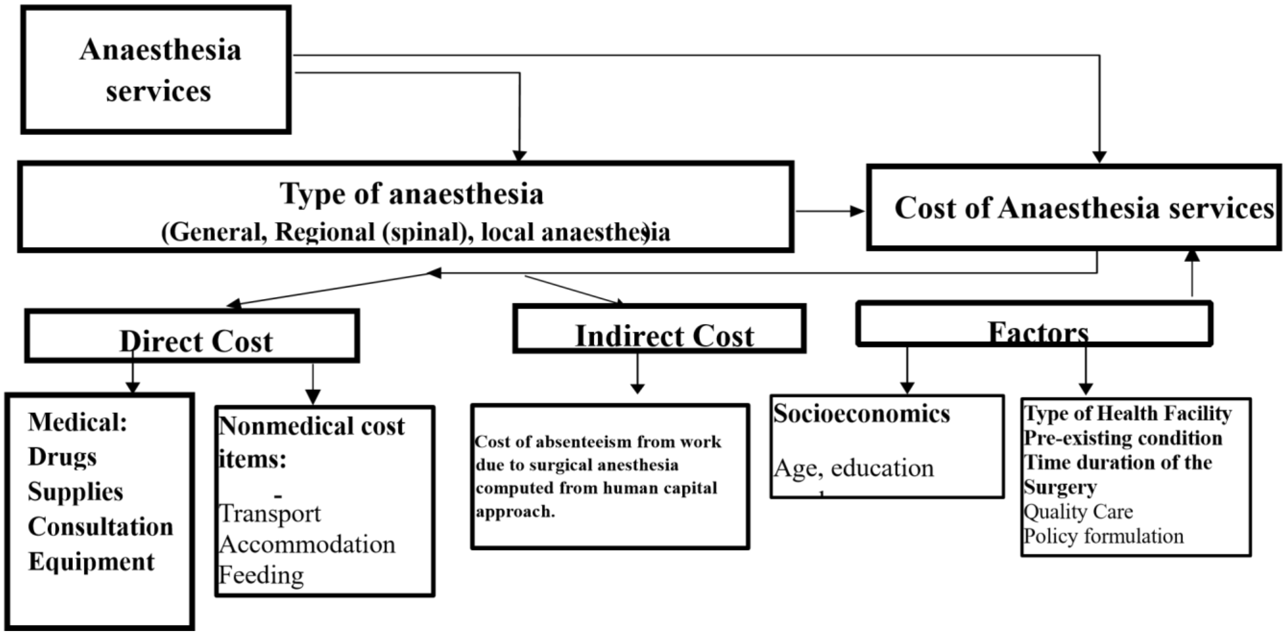


Fig 3.1: A conceptual framework on the cost of anesthesia services; Adopted from Jacobs et al., (2011) with modifications

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This section presents the methodology for the study. The methods include research design, setting, population, sampling size and technique, validity and reliability, data collection plan, plan for data analysis, and ethical considerations.

3.1 Philosophical perspective

This study adopts positivist philosophical paradigm, which remains the most suitable paradigm for minimising subjectivity in data and results. As this study employs economic lenses to quantify patient costs of anesthesia, quantitative data needing objective analytical approach were used.

3.2 Study Design

Planning carefully to consider appropriate design for scientific studies is a step to producing quality and reliable results and conclusions.

This study used consecutive cross-sectional design, in which data was collected prospectively in real-time as anesthesia services were provided. The design is partly cross-sectional because participants were recruited from seven different hospitals at the same time. This design allows for a snapshot of data collection, providing a robust overview of the current anesthesia service costs in the region.

Quantitative data were gathered, specifically focusing on cost and expenditure data related to anesthesia services. This included the cost of anesthetic drugs, medical equipment, personnel, and any other relevant expenses incurred by patient. The target population includes patients undergoing surgical procedures within CHAG hospitals. The study selected a representative sample of CHAG hospitals in the Eastern Region of Ghana. The selection aimed for diversity in terms of hospital size, location, and patient population to ensure the findings are reflective of the region's diversity.

3.3 Study Area

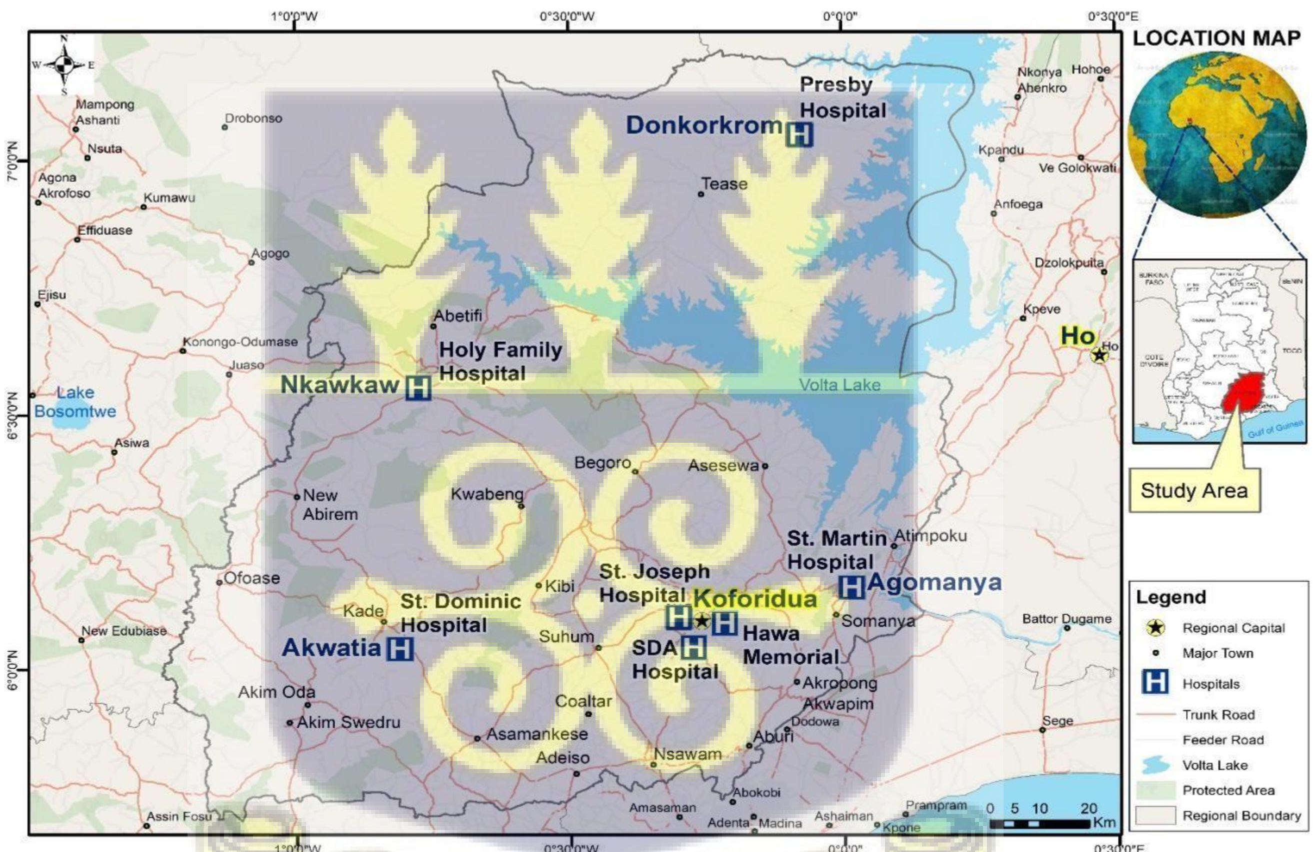
The Eastern Region is in southern Ghana and is one of the sixteen administrative regions of Ghana. The population of the region is projected to be 2.6 million as of 2023 (This is 10.7% of the total national population of Ghana, a little more than its share of 8.1% of the total land area of the country). The region has the third largest population in Ghana.

There are 1226 health facilities in the region comprising CHPS facilities, clinics, maternity homes, health centers, polyclinics, district hospitals and a regional hospital (Ghana Health Service, 2023). The facilities are owned by the government, CHAG, quasi-government, and private owners. Out of the 1226 facilities in the Eastern region, only 19 comprise of CHAG health facilities, and out of this number, seven CHAG health facilities perform surgery services.

According to Domoyeri's research in 2021, there were 89 certified registered anesthetists working in the Eastern Region of Ghana as of 2021. These anesthetists provided anesthesia services for various surgeries at 22 hospitals in the region, including the Eastern Regional Hospital Koforidua, St. Dominic Hospital, Holy Family Hospital, Nsawam Government Hospital, Kwawu Government Hospital, St. Martin Hospital, Suhum Government Hospital, Oda Government Hospital, St. Joseph Hospital, Asamankese Government Hospital, Tetteh Quarshie Memorial Hospital, VRA Hospital, New Abirem Government Hospital, Presbyterian Hospital, Enyiresi Government Hospital, Begoro District Hospital, Kibi Government Hospital, Akuse Government Hospital, New Tafo Government Hospital, Atua Government Hospital, SDA Hospital, and Asesewa Government Hospital.

In 2021, a total of 27,410 anesthetic procedures were performed in the region of which regional anesthesia was the most dominant. The Eastern Regional Hospital Koforidua has the highest number of recorded cases, followed by the St. Dominic Hospital and Holy Family Hospital. The Asesewa Government Hospital has the fewest recorded cases, with 271 in 2021. There were 41 critical incidents recorded and reported, and the mortality rate was 6%. Based on the data collected in 2022, the ratio of anesthetists to patients is 0.002:1. With a total of 38000 cases in 2022, based on the ratio, the total average number of anesthetists who administer were 80.

Figure 3.1 Map of the study area



Source: GIS unit of the Geography Department (University of Ghana)

3.4 Study population

The study population refers to the patient pool undergoing anesthesia procedures in selected CHAG hospitals in the Eastern Region in preparation for surgery and from which a sample was selected for data collection purposes.

3.4.1 Inclusion criteria

Eligible participants included patients of all age groups undergoing surgical procedures in the CHAG hospitals and have accessed anesthesia services. Additionally, only patients and guardians/caregivers who provided informed consent or agreement to participate were selected, ensuring ethical research practices.

3.4.2 Exclusion criteria

Exclusion criteria included patients with severe heart conditions or known allergies to anesthesia drugs. Patients undergoing surgical procedures but did not consent to take part in the study.

3.5. Sample size determination

Sample size for this study was calculated using the Yamane's formular below.

$$n = (Z^2 * p * (1 - p)) / E^2$$

Where:

n = Sample size

Z = Z-score (corresponding to desired confidence level)

p = Estimated proportion of the population with the characteristic of interest

E = Margin of error

Using a confidence level of 95%, which corresponds to a Z-score of approximately 1.96. The proportion *p* used was 0.15 as a conservative estimate. The error margin was 5%.

$$n = (1.96^2 * 0.5 * (1 - 0.15)) / 0.05^2$$

$$n \approx 196$$

The estimated sample size was 196 patients.

3.5.1 Sampling methods

A two-stage sampling strategy was employed. First, a purposive sampling technique was used to select all seven CHAG hospitals in the Eastern Region that provided surgical services, ensuring that only facilities relevant to the study were included. Second, a consecutive sampling approach was used to prospectively select patients undergoing anesthesia procedures. Trained personnel enrolled eligible participants in real time as they presented for surgery, continuing until the estimated sample size was reached.

3.6 Study Variables

3.6.1 Primary outcome

The primary outcome of interest is the patient cost of anesthesia services. This variable encompasses both direct costs and indirect costs associated with anesthesia.

3.6.2 Secondary outcome

Secondary outcome was a determination of factors influencing the patient cost of anesthesia services in CHAG hospitals in the Eastern Region.

3.7 Data Collection – Questionnaire Design and Administration

Questionnaires were administered in-person by trained personnel at the designated CHAG hospitals. For ethical consideration, the interview was preceded by solicitation of participant consent for data. The questionnaire comprised three sections. Section 1: patient demographic and clinical characteristics such as age, gender, date of anesthesia, duration of anesthesia, type of anesthesia, residential location, etc. Section 2: direct cost data such as expenses on patient folder, medical consultation, medications, and non-medical expenses like transportation to and from the hospital, feeding, and accommodation, whichever apply. Section 3: indirect cost data like, type of employment for adult patients and carers of eligible children, duration of absence from work, mean monthly/daily wage, etc.

3.7.1 Sources of data

Primary data were gathered from patients that visited the selected hospitals.

3.7.2 Pretesting

A pretest was undertaken at the St. Joseph Hospital, Koforidua. Pretesting of the questionnaire help to validate the questions and address all ambiguities. It involved testing the questionnaire among 10% of the estimated study sample size. The process allowed for feedback and input to improve the design of the questionnaire. During the pretesting of the data collection tool, the patient relates were confused with the sub section on caregivers out of pocket costs questionnaires. The ambiguity was on whether the "caregiver" referred to the healthcare giver or the patient relative. This was resolved by rephrasing the section to "patient relative out of pocket cost" before the main the collection.

3.7.3 Quality assurance

Quality assurance in research is a systematic process or set of actions and measures put in place to guarantee the credibility and reliability of study outcome(s) (National Institutes of Health, 2021). For this study, quality assurance processes include several internal reviews and comments from study supervisor, ethical consideration for data collection, analysis, and storage. It also includes solicitation of informed consent from the study participants before data collection.

3.7.4 Validity and Reliability

Validity and reliability are two essential concepts in research that ensure the accuracy and consistency of research methods and measurements. They are particularly important in studies like the cost analysis of anesthesia services.

Internal Validity: Internal validity refers to the extent to which the study accurately establishes causal relationships while minimizing biases and confounding variables (Shadish et al., 2002). To enhance internal validity, this study employed random sampling, ensuring that participants were selected without systematic bias. Additionally, data collection procedures were standardized to reduce measurement inconsistencies.

External Validity: External validity concerns the generalizability of the study's findings beyond the specific research context (Shadish et al., 2002). In this study, external validity was strengthened by selecting a diverse sample of CHAG hospitals that represent different regions and facility sizes. Furthermore, the study findings were compared with cost estimates from other healthcare settings within and outside Ghana to assess their applicability beyond the sampled hospitals.

Reliability: Reliability pertains to the consistency and repeatability of the research findings. To ensure reliability, this study used pre-tested data collection instruments to confirm clarity and consistency before the actual data collection. Additionally, multiple data sources were used to cross-verify cost estimates, reducing the likelihood of measurement errors. Finally, data entry and analysis were conducted with double-checking procedures to minimize errors and improve result accuracy.

3.7.5 Data processing and analysis

The collected data was checked for completeness, manually entered, cleaned, and checked in Excel, and then exported to SPSS version 23 for analysis. The analysis was performed, and result presented in tables and graphs.

3.7.6 Estimate and Compare the Direct Patient Cost of Anesthesia Services

Direct patient costs were measured as the total of all medical expenses incurred by patients undergoing anesthesia at the selected hospitals. As described before, the medical cost component will include expenses on folder, medical consultation, laboratory investigations, and medications. The analysis involved estimation of the mean cost and their 95% confidence intervals for the different types of procedures. Differences in direct patient costs were evaluated ANOVA to compare the estimated mean costs between different types of anesthesia. This analysis aimed to determine whether there is a significant difference in the estimated costs between anesthesia type.

3.7.8 Estimate and Compare the Indirect Patient Cost of Anesthesia Services

Indirect costs were calculated as the product of the patient's daily income and the number of lost working days due to anesthesia. The statistical analysis for assessing the indirect costs followed the same approach used for direct costs. ANOVA was applied to compare the mean indirect costs between patient groups based on the type of procedure performed, to determine whether any significant differences existed. This analysis explored the impact of variations in key assumptions, such as the estimated daily income and the number of lost working days, on the overall cost estimates. By adjusting for potential sources of variability, the sensitivity analysis provided insights into the stability and reliability of the findings.

3.7.9 Evaluate and Identify the Factors Associated with the Cost of Anesthesia Services

Analysis of factors associated with patient cost of anesthesia was evaluated using Negative Binomial regression for count data due to the nature of the data. While cost data is typically continuous, it often exhibits overdispersion (where the variance exceeds the mean), which violates the assumptions of standard linear regression models. The analysis followed by marginal effect estimate for determining which factor associated the most with the estimated cost (Fenny *et al.* 2020, Otieku *et al.* 2023).

3.8 Ethical considerations

Ethical approval for this study was obtained from the CHAG Ethical Review Committee in Greater Accra, ensuring adherence to ethical guidelines. Before data collection commenced, written consent was obtained from the administrative heads of the participating CHAG health facilities, ensuring they agreed to facilitate the research. Additionally, informed consent was sought from all patients involved, ensuring they understood the study's purpose, procedures, and their rights, including the voluntary nature of participation and the option to withdraw at any time. To protect patient confidentiality, all personal data were anonymized, securely stored in password-protected files, and access was limited to authorized personnel only. Data protection measures were in place, including encryption and compliance with relevant data protection laws, ensuring that patient information was kept secure. Ethical oversight throughout the study was maintained by the CHAG Ethical Review Committee, guaranteeing that patient privacy, safety, and rights were upheld at all stages of the research.

CHAPTER FOUR

RESULTS

4.0 SOCIO ECONOMIC CHARATERISTICS

In this study, most of the participants were female (68.4%). More than 35% of subjects were between 29-38 years old and about 61.7% were married or in consensual union. More than 90.0% of participants have had formal education and about 58.0% were in full-time employment. About 94% of those studied reported having valid NHIS national health insurance card that made them eligible to access healthcare at subsidized cost. Regarding monthly net income, the largest proportion of participants (44.0%) reported an income of ≤GHS500, followed by 17.10% with an income of ≥GHS2100. Among those undergoing anesthesia, pregnancy and obstetric complications were dominant underlying health conditions accounting for 37.8%, followed by fractures and gynaecological conditions (20.7%). Participants were primarily from the Eastern Region (52.3%), followed by Volta Region (21.8%). The majority resided within 60km of the healthcare facility (77.7%). Household size varied, with 52.85% having 2-4 members and 44.6% having 5-9 members. The district facilities were predominantly located in Asuogyamang/Denkyembour (26.9%) and New Juaben North (21.2%).

Table 1.0 Demographic Characteristics of Patients

	Frequency (N=193)	Percentage
Gender		
Female	132	68.39
Male	61	31.61
Age		
≤5yrs	5	2.59
6yrs-10yrs	6	3.11
11yrs-17yrs	6	3.11
18yrs-28yrs	47	24.35
29yrs-38yrs	69	35.75
39yrs-48yrs	24	12.44
≥49yrs	36	18.65
Marital Status		
Married	119	61.66
Single	60	31.09
Divorced	7	3.63
Widowed	7	3.63
Household Size		
2-4members	102	52.85
5-9members	86	44.56
≥10members	5	2.59

Table 1.1 Socioeconomic Characteristics

	Frequency(N=193)	Percentage
Educational Status		
No formal education	15	7.77
Basic education	91	47.15
Secondary education	54	27.98
Tertiary education	33	17.10
Employment Status		
Unemployed	58	30.05
Part time	23	11.92
Full time	112	58.03
Patients with Valid NHIS		
No	11	5.70
Yes	182	94.30
Monthly Net Income		
≤GHS500	85	44.04
GHS500-GHS1000	32	16.58
GHS1000-GHS1500	25	12.95
GHS1500-GHS2000	18	9.33
≥GHS2100	33	17.10
Health Condition Status		
Fractures and Gynaecological Conditions	40	20.73
Hernias and Hernia-related Conditions	26	13.47
Pregnancy and Obstetric Conditions	73	37.82
Uterine Conditions	25	12.95
Other Surgical Conditions*	29	15.03
District Facility is Located		
Abuakwa north	24	12.44
Denkyembour	52	26.95
Kwahu Afram plains north	18	9.33
Kwahu west	18	9.33
Lower Manya Krobo	33	17.1
New Juaben North	41	21.24
New Juaben South	7	3.63
Region of Resident		
Ashanti Region	25	12.95
Brong-Ahafo Region	3	1.55
Eastern Region	101	52.33
Greater Accra	19	9.84
Northern Region	2	1.04
Volta Region	42	21.76
Western Region	1	0.52
Distance to Facility (in Km)		
≤60km	150	77.72
61-120km	21	10.88
≥121	22	11.40

**Ruptured Appendix, Hydrocele, Breast cancer Non assuring FHR, Achilles tendonitis, Deep laceration, Amputation of middle finger, Dermoid cyst post auricular, Pyogenic granuloma, Goitre, Acute Appendicitis, Ovarian Torsion, Gestational hypertension, Intestinal obstruction, Severe Anaemia with incomplete abortion.*

4.1 MEAN UNIT COST OF EACH ITEM PER TYPE OF ANESTHESIA

The assessment of mean unit costs for items utilized in different anesthesia types showed notable differences. In descending order of magnitude, the unit of items used in general anesthesia (n=27), were GHS24.8 for spinal needle, GHS35.3 for, Endotracheal (ET)Tube, and GHS9.5 for syringe and needle. For regional anesthesia (n=157), the spinal needle cost wasGHS26.9, the ET tube was not utilized, and the syringe and needle cost GHS9.2. In local anesthesia (n=9), neither the spinal needle nor the ET tube was used, but the syringe and needle cost GHS11.3. These results show the unit cost of medical devices vary by anesthesia type (Table 2.0).

Table 2.0 Mean Cost of Each Item per Type of Anesthesia

General (n= 27)		Regional (n=157)		Local (n=9)	
Item	**Unit Cost (GHS)**	**Item**	**Unit Cost (GHS)**	**Item**	**Unit Cost (GHS)**
Spinal Needle	24.75	Spinal Needle	26.99	Spinal Needle	0
ET Tube	35.25	ET Tube	0	ET Tube	0
Syringe and Needle	9.5	Syringe and Needle	9.20	Syringe and Needle	11.33

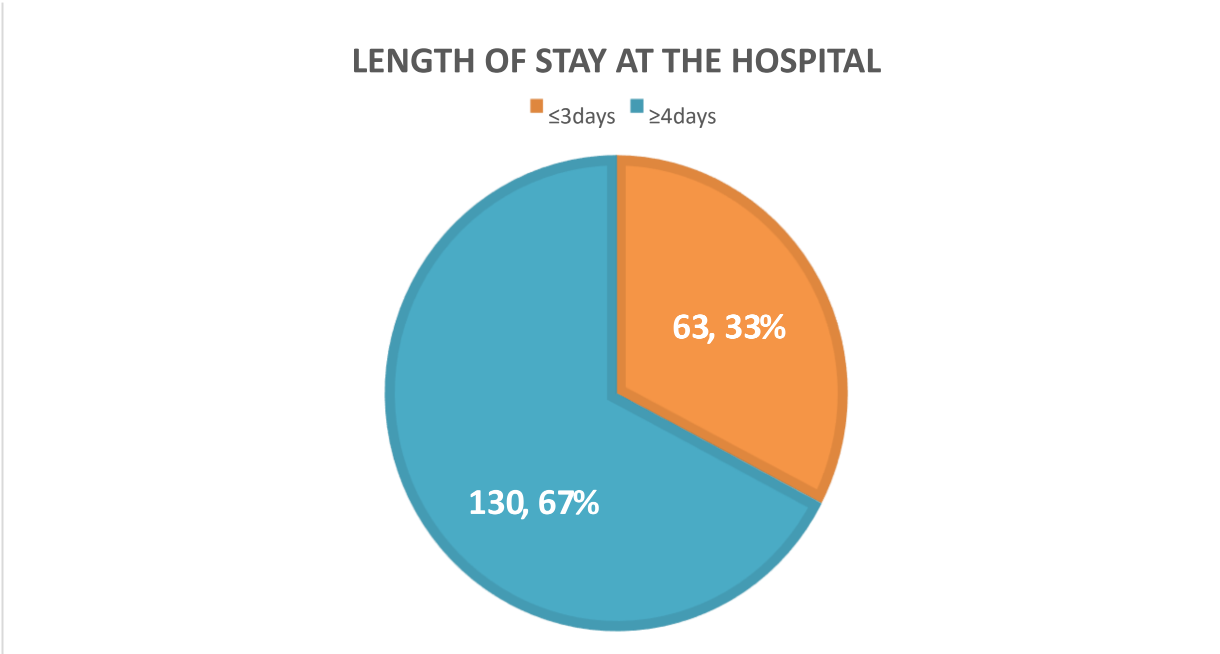
4.2 ESTIMATED LENGTH OF STAY

Among the 27 patients receiving General anesthesia, the mean length of hospital stay was 7 days (95% CI: 4.66-9.34). For the 157 patients administered regional anesthesia, the mean hospital stay duration was 7.5 days (95% CI: 6.29-8.75). Nine patients receiving local anesthesia had an estimated mean hospital stays of 1.5 days (95% CI: 0.88-2.23) and shorter than those receiving general and regional anesthesia. Overall, the estimated mean total length of hospital stays for the three cohorts combined was 7.2 days (95% CI: 6.11-8.23). An estimated p-value of 0.0652 indicate no statistical significance in LOS between groups (Table 3). Figure 1 shows, 63 patients, or 33% of the total number of patients, had stays of three days or less, while a larger number of patients (n=30 patients), constituting 67%, stayed four days or more.

Table 3.0 Information on the Mean Length of Stay Per the Type of Anesthesia

	Types of anesthesia				P-Value
	General (n=27)	**Regional (n=157)**	**Local (n=9)**	**Total (N=193)**	
Mean length of hospital stays.	7.0 (95% CI: 4.66-9.34)	7.5 (95% CI: 6.29-8.75)	1.5 (95% CI: 0.88-2.23)	7.2 (95% CI: 6.11-8.23)	0.0652

Figure 1.0, Distribution of Length of Stay of Patients



4.3 DIRECT COST ESTIMATES FOR ALL THREE TYPES OF ANESTHESIA

The first objective of this study is to analyse the direct cost associated with anesthesia to inform the public regarding what to expect in term of the economic burden and to make a case for financial protection to insulate people experiencing poverty from increased out of pocket healthcare cost spending. For those underwent General anesthesia, the estimated mean cost of drug was GHS59.44 (95%CI: 6.85125.73), while for regional anesthesia, it was GHS105.382 (95%CI: 19.84-190.93). There was no reported cost for local anesthesia. The composite difference in mean estimate was not statistically significant (P = 0.765). Those who underwent regional anesthesia incurred cost related to diagnostics and the estimated mean cost was GHS27.713 (95%CI: -11.4966.91). For those who underwent regional anesthesia, the estimated mean consultation cost was GHS10.637

(95%CI: 5.3815.89) compared to a no consultation cost for the remaining two types. Those who underwent both general and regional anesthesia incurred a transportation cost with a mean cost of GHS2.296 (95%CI: -1.19-5.78) and GHS9.191 (95%CI: 1.84-16.54), respectively. Only those who underwent regional anesthesia incurred other direct costs with a mean cost of GHS49.618 (95%CI: 11.72-87.51). The differences in mean costs were not statistically significant (P = 0.677). The estimated mean total direct cost for those who underwent regional anesthesia amount to GHS202.54 (95%CI: 63.36341.73), followed by GHS81.370 (95%CI: -11.90-174.63) for those who underwent general anesthesia and no cost for those who underwent local anesthesia.

Table 4 Direct Cost Estimates for all three Types of Anesthesia

	Types of anesthesia				
	General (n= 27)	**Regional (n=157)**	**Local (n=9)**	**Total (N=193)**	**P-Value**
Mean cost of drugs	59.44	105.38	0	94.04	0.77
Mean cost of diagnostics	0	27.71	0	22.54	0.81
Mean cost of consultation	0	10.64	0	8.65	0.17
Mean cost of transportation	2.30	9.19	0	7.80	0.63
Mean other direct costs*	19.63	49.62	0	43.11	0.68
Mean total direct cost	81.37	202.54	0	176.15	0.62

4.4 INDIRECT COST OF ANESTHESIA DUE TO PRODUCTIVITY LOSS

Objective 2 of this study evaluate the indirect cost due to productivity loss (which includes hospital stay and recovery days and not only the days of the surgical procedure) attributable to anesthesia. Out of 193 participants studied, 117 were gainfully employed and the majority (103) underwent regional anesthesia. The mean number of workdays lost due to anesthesia was highest for those who underwent regional anesthesia (10.4 days), followed by general anesthesia (8.2 days), and lowest for local anesthesia (0.8 day). The lost working days correspond to an estimated mean cost of GHS1128.9) for those who underwent regional anesthesia, GHS924.2 for general anesthesia, and GHS527.3 for local anesthesia.

Table 5 Indirect Cost of Anesthesia Due to Productivity Loss

	Types of anesthesia				
	General (n= 27)	**Regional (n=157)**	**Local (n=9)**	**Total (N=193)**	**P-Value**
Number of participants working for income	10	103	4	117	
Mean number of lost working days due to anesthesia	8.2	10.417	0.75	9.897	0.274
Mean indirect cost due to anesthesia	924.222	1128.873	527.333	1072.192	0.285

*"Mean lost working days" include hospital stay, recovery days, time taken off for both the anesthesia procedure and the subsequent recovery period.

4.5 FACTORS ASSOCIATED WITH THE COST OF ANESTHESIA

Objective 3 examined the factors associated with the cost of anesthesia using a negative binomial regression, the result in Table 6 show that three factors associated significantly with the cost of anesthesia. They included other surgical condition (p=0.048), household size of 5-9 members (p=0.011), and those who were married at the time of the data collection (p=0.053). Together, the model explained about 10% of the variations in the estimated mean total cost of anesthesia, suggesting several unobserved variables accounted for how much it cost patients to undergo anesthesia in the selected CHAG facilities.

Table 6 Negative binomial regression of factors influencing the cost of Anesthesia.

Both	Coef.	Std. Err.	Z	P>Z	[95	% Conf. Interval]
Duration of Stay at Hospital						
≥4days	-0.211608	0.1807962	-1.17	0.242	0.565962	0.142746
Age						
6-10years	0.4035336	0.6199893	0.65	0.515	0.811623	1.61869
11-17years	0.390907	0.6555816	0.6	0.551	0.894009	1.675823
18-28years	0.3656367	0.5097213	0.72	0.473	0.633399	1.364672
29-38years	0.3800513	0.5315926	0.71	0.475	0.661851	1.421954
39-48years	0.5144954	0.5775745	0.89	0.373	0.61753	1.646521
≥49years	0.1247647	0.5144527	-0.24	0.808	1.133073	0.883544
Region						
Brong Ahafo	0.6867448	0.6511095	1.05	0.292	0.589407	1.962896
Eastern Region	0.2856208	0.2614287	1.09	0.275	-0.22677	0.798012
Greater Accra	0.0108092	0.3578688	-0.03	0.976	0.712219	0.690601
Northern Region	0.1671836	0.7619081	0.22	0.826	1.326129	1.660496
Volta Region	0.5610296	0.3093608	1.81	0.07	0.045306	1.167366
Western Region	0.8501024	0.7616551	-1.12	0.264	2.342919	0.642714

Gender						
Female	0.1059613	0.2443148	-0.43	0.665	0.58481	0.372887
Health condition						
Hernias and Hernia-related Conditions	0.0642078	0.3185668	-0.2	0.84	0.688587	0.560172
Other Surgical Conditions	0.6338508	0.3205593	-1.98	0.048	1.262136	-0.00557
Pregnancy and Obstetric Conditions	0.4980491	0.3399733	-1.46	0.143	1.164384	0.168286
Uterine Conditions	0.010406	0.3900516	0.03	0.979	-0.75408	0.774893
Household size						
5-9members	0.4249392	0.1681465	-2.53	0.011	0.7545	-0.09538
≥10members	0.2138038	0.4852827	-0.44	0.66	-1.16494	0.737333
Distance to hospital						
61-120km	0.1759667	0.3540901	0.5	0.619	0.518037	0.869971
≥121	0.4045036	0.2742005	-1.48	0.14	0.941927	0.13292
Education Level						
Basic education	0.2891827	0.3475794	0.83	0.405	0.392061	0.970426
Secondary education	0.1444641	0.3434244	0.42	0.674	0.528635	0.817564
Tertiary education	0.4451096	0.3954857	-1.13	0.26	1.220247	0.330028
Marital Status						
Married	0.3999381	0.2070221	1.93	0.053	0.005818	0.805694
Divorced	0.5359925	0.4782861	1.12	0.262	-0.40143	1.473416
Widowed	0.0890157	0.4488894	0.2	0.843	0.790791	0.968823

CHAPTER FIVE

DISCUSSION

5.0 Introduction

The study examined the costs attributable to anesthesia in CHAG hospitals in the Eastern region of Ghana and evaluate the factors associated with the costs to inform prospective patients, society and policymakers about the economic burden of anesthesia.

5.1 Direct Cost of Anesthesia Services

From the analysis of the data, the estimated mean direct cost of anesthesia varies depending on the type of procedure performed and correspond to the unit cost of items or hospital resources consumed. For instance, it cost each patient about GHS121.00 more to performed regional anesthesia than general anesthesia. These results relate with the findings of Zhou (2016). However, in their study type of anesthesia was found to be statistically significant with direct cost of anesthesia. In addition, Addo-Atuah et al. (2015) also found that medication which is determined by the type of anesthesia was significantly associated with the direct cost of anesthesia.

The mean cost of diagnostic services did not associate significantly with the end point cost in this study. This finding is different from what Gao et al. (2022) reported that the cost of laboratory investigations is significantly associated with the direct patient cost of anesthesia. The differences and similarities in findings are not surprising because the unit cost of hospital resources use is not the same across geographic settings.

In the Ghanaian context, the findings on direct costs have important implications for both the National Health Insurance Scheme (NHIS) and the financial sustainability of CHAG hospitals. Since NHIS reimbursement structures often bundle anesthesia into surgical procedure tariffs, the additional costs borne by patients for regional anesthesia could lead to inequitable access, especially among rural and low-income populations. A study by Oppong et al. (2018) highlighted persistent challenges in NHIS coverage of ancillary costs, which suggests that patients undergoing regional anesthesia may still face substantial out-of-pocket expenditure. This is significant because affordability is a key determinant of access to essential surgical care in Ghana (Alhassan et al., 2016).

Furthermore, the resource intensity of regional anesthesia, such as the need for additional medications, monitoring, and specialist input suggests that CHAG hospitals may need to consider cost-containment strategies. These may include adopting standardized drug protocols, strengthening procurement systems to reduce drug price variations and integrating cost-effective alternatives into routine practice. Internationally, similar recommendations have been made by Bainbridge et al. (2017), who argued that rationalized drug use and efficient supply chain management can substantially reduce the financial burden of anesthesia without compromising patient safety.

Thus, the present findings underscore a broader policy challenge: how to balance quality of care with financial protection. Without NHIS adjustments to capture the real costs of different anesthetic methods, CHAG hospitals may face financial strain and patients may experience catastrophic healthcare expenditure.

5.2 Indirect Cost of Anesthesia Services

From the analysis of the data, the study reported a mean of 8.2 workdays lost due to general anesthesia, consistent with previous research, underscoring the importance of considering individual patient variables and surgical contexts when evaluating productivity outcomes. According to Tandon V., et al. in 2021, the indirect costs associated with general anesthesia have yielded mixed findings. Some studies indicate that general anesthesia may result in longer recovery periods and more substantial productivity loss compared to regional or local anesthesia. Conversely, other research has not identified significant differences in return-to-work rates or postoperative functional recovery.

Recent studies by Memtsoudis *et al.* 2019 emphasized that regional anesthesia could potentially reduce postoperative pain, shorten recovery times and enhance patient satisfaction. However, their study reported a mean of 10.4 workdays lost due to regional anesthesia, which is unexpectedly high. This suggests a need for further investigation into factors such as surgical complexity, postoperative complications, and patient-specific characteristics affecting recovery.

The significantly lower mean number of workdays lost due to local anesthesia (0.8 day) is consistent with evidence indicating minimal disruption to daily activities and swift return to work. Research into the indirect costs of local anesthesia consistently demonstrates shorter recovery periods and reduced productivity loss compared to more invasive anesthesia methods (Gornall, B.F., et al., 2015). Nevertheless, the estimated mean cost of GHS527.3 for patients undergoing local anesthesia may still pose a financial challenge for some individuals, highlighting the need to consider both direct and indirect expenses in economic assessments.

These findings underscore how anesthesia choice profoundly affects productivity loss and indirect costs for surgical patients. However, the higher mean number of workdays lost among patients receiving regional anesthesia necessitates further exploration of potential factors contributing to extended recovery times in this cohort.

The findings on productivity loss further highlight the hidden economic burden of anesthesia. In Ghana, where a significant proportion of the workforce is employed in the informal sector, loss of workdays has direct consequences for household income and poverty. The mean of 8.2 days lost under general anesthesia and particularly the unexpectedly high 10.4 days lost under regional anesthesia in comparative studies, suggest that surgical recovery has implications beyond the hospital setting.

For families reliant on daily wages, this period of inactivity can translate into lost income, reduced household consumption and even difficulties in financing postoperative care. This aligns with a study by Aryeetey et al. (2016), which emphasized that indirect costs often exceed direct medical costs in low- and middle-income countries (LMICs), amplifying the economic burden of healthcare.

The minimal productivity loss under local anesthesia (0.8 day) provides evidence for encouraging its use in suitable cases. Wider adoption could reduce not only household-level income shocks but also broader economic inefficiencies at the societal level. However, as noted in this study, the mean direct cost of local anesthesia (GHS527.3) still presents a barrier for some patients. This paradox, low productivity loss but relatively high direct cost-indicates the need for policymakers to integrate cost-subsidy mechanisms for local anesthesia into NHIS benefit packages.

Taken together, these findings suggest that anesthesia choice is not only a clinical decision but also an economic one, with implications for household welfare, national productivity and social protection policies. Future studies in Ghana should therefore adopt a societal perspective in economic evaluations, incorporating both direct and indirect costs into cost-effectiveness models.

5.3 Factors Associated with the Cost of Anesthesia Services

The finding of this current study revealed type of surgical cases is significantly associated with the cost of anesthesia. Similarly, a previous study found type of anesthesia to be a factor that influences cost of anesthesia (Fecho et al., 2008). This is evident because, anesthesia varies with type of surgery procedure required and affects the cost of anesthesia.

Again, it was noted from this study that household size of 5-9 members was found to be significantly associated with cost of anesthesia. Even though none of the articles reviewed included household (family) as a factor associated with cost of anesthesia, this association found by the current study can be linked to a factor associated with indirect cost of anesthesia and require further studies in that regard.

Duration of hospital stay was seen not to be associated with cost of anesthesia. This finding does not associate with the findings of a previous study where it was found that, length of hospital stay was significantly associated with cost of anesthesia (Li et al., 2011).

The result of this study further indicated that age was not associated with cost of anesthesia. Contrary, age had been recorded as a risk factor that is likely to influence perioperative ASA classification, increase risk of perioperative morbidity and mortality and by extension increase cost of anesthesia (Fecho et al., 2008).

The association of household size with anesthesia cost introduces an important socio-economic dimension rarely explored in the literature. Larger households (5–9 members) may face increased indirect costs due to the redistribution of household labor, caregiving responsibilities and increased dependency ratios during periods of illness and recovery. This finding is novel in the Ghanaian context and warrants further research to better understand how family structure influences the economic burden of surgical care.

From a policy standpoint, household size could be a proxy for vulnerability to financial hardship. If larger households experience disproportionately higher costs, NHIS and CHAG hospitals may need to design targeted financial protection mechanisms, such as social support packages or family-based insurance models. This resonates with global calls by the World Health Organization (WHO, 2019) to strengthen financial risk protection in health systems by recognizing household-level determinants of healthcare expenditure.

The non-association of age and hospital stay with anesthesia costs in this study also highlights the complexity of cost determinants. While international evidence suggests that older patients and longer hospital stay typically increases anesthesia-related costs, this was not observed in the current study. Possible explanations include differences in patient selection, perioperative management practices, or sample composition. However, this divergence also points to the need for Ghana-specific cost models rather than wholesale adoption of international assumptions.

Finally, the findings emphasize the contribution of this study to the growing body of literature on the economics of anesthesia in LMICs. By identifying unique factors such as household size and contextualizing cost differences in the Ghanaian healthcare system, the study provides evidence that can inform NHIS reimbursement reviews, hospital budgeting frameworks, and health financing reforms aimed at equitable access to surgical care.

The cost analysis study was hindered by inadequate equipment for anesthesia services at some facilities, such as Hawa and SDA hospitals, which affected the accuracy of cost estimates. Time constraints posed a challenge in conducting a comprehensive cost analysis of anesthesia services, potentially impacting the reliability of cost findings. A two (2) or more years prospective study can be conducted. Low patient volume at certain hospitals reduced the sample size for cost analysis, potentially affecting the generalizability of cost estimates for anesthesia services in the Eastern Region of Ghana.

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.0 Conclusion

The cost analysis of anesthesia services in selected CHAG hospitals in the Eastern Region of Ghana reveals a complex interplay of factors that hinder access to surgical care for rural and underserved populations. The high cost of anesthesia services, lack of clear reimbursement policies and limited financial resources converge to create a perfect storm that intensifies healthcare disparities. By examining the economic cost of anesthesia services, this study exposes the underlying dynamics that continue these disparities and highlights the need for a multifaceted approach that addresses the financial, structural and behavioral barriers to affordable surgical care. Ultimately, this research demonstrated that cost analysis is a critical tool for informing healthcare policy and practice and underscores the importance of prioritizing access to affordable anesthesia services as a vital component of equitable healthcare delivery.

The cost analysis of anesthesia services in selected Christian Health Association of Ghana hospitals in the Eastern Region highlighted several important findings. Though the type of anesthesia did not show a statistically significant difference in costs, the expenses associated with medication choices between general and regional anesthesia were notable. The research also found that the type of surgery significantly impacts anesthesia costs, with household size emerging as an unexpected yet significant cost factor. Unlike previous studies, this research found no association between the duration of hospital stay, patient age, and anesthesia costs.

Additionally, regional anesthesia when administered potentially reduces pain and enhances satisfaction, it resulted in a higher average number of workdays lost compared to general and local anesthesia. These results underscore the importance of customized cost assessments and further investigation into factors affecting recovery times, particularly for regional anesthesia, to optimize costs and improve patient outcomes.

The significance of these findings lies in their contribution to addressing the challenges of affordable anesthesia services such as surgical care in Eastern Region and Ghana at large. By identifying the key factors of anesthesia costs, this research informs healthcare policy and practice, enabling the development of targeted strategies to reduce costs and improve patient outcomes. Moreover, this study's insights into the factors influencing recovery times can guide the development of personalized post-operative care plans, reducing the economic burden on patients and their households. Ultimately, this study demonstrated the critical role of cost analysis in ensuring equitable access to surgical care, making a meaningful impact on the lives of individuals and communities in Ghana.

6.1 Recommendation

CHAG Facilities in the Eastern Region Can:

1. Anesthetists can establish effective protocols for medication use to reduce anesthesia expenses.

2. Improve assessments to identify factors that may extend recovery times, especially with regional anesthesia.

3. Future studies should further explore indirect costs and recovery-related factors associated with different anesthesia types, especially regional anesthesia, to provide deeper insights for policy and practice. In addition, hospital-based research units should be established to continuously assess cost variations and generate evidence for cost-effective decision-making.

6.2 Limitations

1. The cost analysis study was hindered by inadequate equipment for anesthesia services at some facilities, such as Hawa and SDA hospitals, which affected the accuracy of cost estimates. 2. Time constraints posed a challenge in conducting a comprehensive cost analysis of anesthesia services, potentially impacting the reliability of cost findings. A two (2) or more years prospective study can be conducted.

3. Low patient volume at certain hospitals reduced the sample size for cost analysis, potentially affecting the generalizability of cost estimates for anesthesia services in the Eastern Region of Ghana.

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APPENDICES

Cost Analysis of Anesthesia Services in CHAG Hospitals

PARTICIPANT INFORMATION LEAFLET AND ASSENT FORM FOR MINORS LESS THAN 18 YEARS

Study background.

Dear respondent, I am a student at the University of Ghana, school of public health. I am undertaking a research project to solicit information on THE COST ANALYSIS OF ANESTHESIA SERVICES IN SELECTED CHRISTIAN HEALTH ASSOCIATION OF GHANA (CHAG) HOSPITALS WITHIN THE EASTERN REGION, of GHANA. Your valuable insights will contribute to a better understanding of the factors affecting anesthesia costs, ultimately enhancing healthcare services in the region.

The questionnaire is designed purely for research purposes only. Views and opinions will be kept confidential, and respondents can be assured that this information will never be disclosed to a third party.

Your valuable insights will contribute to a better understanding of the factors affecting anesthesia costs, ultimately enhancing healthcare services in the region.

Thank you for your participation.

ASSENT AND PARENTAL CONSENT FORM

Statement of person obtaining informed consent:

I, ______________________________________have fully explained this research to ____, ***a minor participant****, who has read and understood all the purpose, risk and benefits of this study. When applicable, I have also explained, in detail, same information to his/her caregiver/relative in the presence of the participant.*

DATE: ______________________________ SIGNATURE: ______________________________

Statement of person giving consent:

I, ______________________________ fully understand the purpose, risks, and benefits of this research, and I have also asked for *advice from my caregiver/relative responsible for my care at the hospital*. I understand that my participation is voluntary, and I can choose not to participate in the study. If I choose to participate, I will keep a copy of this assent form as evidence with my name and signature/thumb print on it.

DATE: ___________________ SIGNATURE/THUMB PRINT: ___________________

WITNESS' NAME: ______________________________________

WITNESS' SIGNATURE: ________________________________

CAREGIVER'S INFORMATION LEAFLET AND CONSENT FORM

Study background.

Dear respondent, I am a student at the University of Ghana, school of public health. I am undertaking a research project to solicit information on THE COST ANALYSIS OF ANESTHESIA SERVICES IN SELECTED CHRISTIAN HEALTH ASSOCIATION OF GHANA (CHAG) HOSPITALS WITHIN THE EASTERN REGION, of GHANA. Your valuable insights will contribute to a better understanding of the factors affecting anesthesia costs, ultimately enhancing healthcare services in the region.

The questionnaire is designed purely for research purposes only. Views and opinions will be kept confidential, and respondents can be assured that this information will never be disclosed to a third party.

Your valuable insights will contribute to a better understanding of the factors affecting anesthesia costs, ultimately enhancing healthcare services in the region.

Thank you for your participation.

Statement of person obtaining informed consent:

I, ______________________________________ have fully explained this research to ______________________________________, ***a caregiver of a patient included in this study,*** and have given him/her sufficient information about the study, including that on procedures, risks and benefits, to make an informed decision.

DATE: ______________________ SIGNATURE: ________________________________

Statement of person giving consent:

I have read the information of this research or have had it translated into a language I understand. I have also talked it over with the interviewer to my satisfaction. I understand that my participation is voluntary, and I can freely choose not to participate without any problem or reason. If I choose to participate, I will keep a copy of this consent form as evidence with my name and signature/thumb print on it.

NAME OF PARTICIPANT: ____

DATE: ____________________ SIGNATURE/THUMB PRINT: ____________________

WITNESS' NAME: ____

WITNESS' SIGNATURE: _________________________________

PARTICIPANT QUESTIONNAIRE

Dear respondent, I am a student at the University of Ghana, school of public health. I am undertaking a research project to solicit information on THE COST ANALYSIS OF ANESTHESIA SERVICES IN SELECTED CHRISTIAN HEALTH ASSOCIATION OF GHANA (CHAG) HOSPITALS WITHIN THE EASTERN REGION, of GHANA. Your valuable insights will contribute to a better understanding of the factors affecting anesthesia costs, ultimately enhancing healthcare services in the region.

The questionnaire is designed purely for research purposes only. Views and opinions will be kept confidential, and respondents can be assured that this information will never be disclosed to a third party.

Your valuable insights will contribute to a better understanding of the factors affecting anesthesia costs, ultimately enhancing healthcare services in the region. Thank you for your participation.

Information: District: ……………………………. Community: ……………………………..

Hospital Name: ……………………………. Date: …………………………….

Patient Name: ……………………………. Patients Tel. Number: ……………………

Section A: Socio-Economic Characteristics

1. Patient ID: …………………………….
2. Date of admission: …………………………….
3. Date of discharge: …………………………….
4. Age of patient: …………………………….(in years)
5. Area patient is from (residence): …………………………….
6. Gender of Patients: a) Male b) Female
7. What is patient type of disease condition (Health Status)? …………………………….
8. Monthly net income of patient: ……………………………. GHS
9. Educational level of patient: a) No formal education b) Basic education c) Secondary education d) Tertiary education
10. Do you have a valid health insurance cover? A) Yes B) No

11. Employment Status: a) full-time (Government / Self-employed) b) part-time c) unemployed
12. Marital Status: a) Single b) Married c) Divorced d) Widowed
13. Household Size: …………………………
14. Distance of area of patients to the hospital: …………………………….

Section B: Direct Cost of Anesthesia

1. What is the magnitude of surgery? (Main surgeries are more complicated, take longer, have higher risks, and affect deeper tissues or organ systems. Small treatments that affect superficial tissues or single organs recover faster and are safer.) a) Major b) Intermediate c) Minor
2. Type of Anesthesia: a) General b) Regional c) Local
3. Type of equipment used for surgery? ……………
4. Length of stay by location (record length of stay in each type of unit, including zeros). If length of stay is 1–11 hours write ½ day. If 12–24 hours, write 1 day.

Type of room	**Length of stay (days)**
Outpatient clinic	
Pediatric Surgical ward	
Intensive care unit or special baby unit	
Male Surgical Unit	
Female Surgical Unit	
Emergency room	
VIP	
Other specify	

5. What is the patient's preoperative anesthesia consultation cost in cedis? …………………………
6. Type of illness: ……………………………………….
7. Were any of these other special services used? (If "YES" but no quantity is stated, write

"missing" in last column.)

Type		Unit of measure where applicable	Quantity
Ambulance services	Yes / No		
Special diet	Yes / No		
Specialist consultations	Yes / No		
Intravenous fluids	Yes / No		
Cardiopulmonary resuscitation	Yes / No		
Other	Yes / No		

8. Did you take a diagnostic test? A) Yes, I took a test b) No diagnostic Tests

9. If yes, what is the cost of perioperative diagnostic tests ordered for patient? (Tick and state total cost, include any other test not listed below)

Tick	Type	Quantity	Unit cost
	Full blood count		
	Hb/Haemoblobin		
	Blood culture		
	Sensitivity		
	Antigen test		
	ELISA/Rapid test for HIV		
	Radiology – computer tomography (CT scan)		
	Radiology – Ultrasound		
	Blood chemistry test (glucose)		
	Blood chemistry (Electrolytes)		
	Other (specify)		

10. What are the preoperative medications prescribed by anesthetist and the cost of each including blood transfused? (kindly state the drug and the cost against it in cedis)

Preoperative Medications/blood	**Cost (in cedis)**

11. What extra medications and blood were used intraoperatively in addition to the routine medications for the type of anesthesia given? Kindly state the indications for the extra medications used.

Medication/blood	**Cost**	**Indication**

12. What are the cost associated to the post-operative medications and blood ordered by anesthetist and its indications.

Medications blood	**Cost (cedis)**	**Indications**

Section C: Indirect Cost of Anesthesia

1. Do you have paid work? Yes / No 2.

What is your main occupation?

3. How many hours a week do you engage in paid work?
4. How many days a week do you work?
5. How much income does this main occupation generate in a month? GH₵
   (If income received is by-day or weekly, calculate the monthly figure)
6. How long have you stayed away completely from your occupation due to your current health condition? (Only count the working days in the past 4 weeks)
7. In case you are able to attend to your work physically post-discharge or remotely while in the hospital or at home has your productivity level changed? Yes / No
   If YES, at what capacity are you able to work? (1 to 10) 1 = I was not able to do any work 5= I work half my capacity 10= I work at full capacity.
8. Do you have a secondary occupation? YES / NO If YES, state the type of occupation
   ………………………..
9. How much income does your secondary occupation generate in a month? GH₵
10. Have you received financial help from Relatives, Friends, Insurance or Pension fund over the period of illness?
11. (If YES, indicate the source and state the amount) GH₵
12. How long did it take you to get to the hospital from your home, including the journey time and waiting for transport? (Indicate time in minutes)
13. What kind of transport did you use to come to the hospital? In case of multiple means of transportation during this trip, please tick only the transportation that was used for the longest distance. A) Car b) Bus c) Motorbike d) Bicycle e) By foot f) Taxi g) Ambulance h) Other, specify
14. If you paid for transport to come to the hospital, how much did you pay?
    ____

(Put 0 if no payment was made)

15. After arrival at the hospital, how long did you wait before you were attended to by a doctor/nurse? _______ (in minutes)
16. Before visiting this facility, did you seek help from any other provider/health facility? Yes/No
17. If yes, state how much it cost you for drugs, tests, consultation and other financial costs? (List all the facility visited, then ask the costs of each item for each place visited, one at a time

Expenditure/ Facility	**Private hospital/clinic**	**Public hospital/clinic**	**Pharmacy**	**Traditional healer**	**Friend/ relative**	**Other Specify**
Drug						
Diagnostic tests						
Consultation						
Transport						
Other costs						
Total						

18. Did you use the health insurance in the previous facility? a) Yes b) No
19. If YES, how much of the total cost incurred before visiting this facility was covered by health insurance? GHS_______

20. Where did the money come from to pay for the expenses of the health condition? A) Cutting down on other expenses b) Borrowing c) Selling assets d) Using savings e) Asking donations from friends and relatives f) Other, specify...............

PATIENT RELATIVE OUT-OF-POCKET COSTS QUESTIONNAIRE

1. Patient ID: ……………………………….
2. Age of caregivers: …………………………….

3. Gender of caregivers: ……………………………
4. Date of birth: …………………………..
5. Informed consent date: ………………………
6. Relationship to the patient: a) Mother b) Father c) Sister d) Brother e) Spouse f) Grandparent g) Other relative h) Friend i) Other (specify)
7. How long did it take you to get here from your home (including the journey time and any waiting for transport)? (Indicate time in minutes)
8. What kind of transportation did you use to bring your relative to this hospital or clinic? In case of multiple means of transportation during this trip, please tick only the transportation that was used for the longest distance a) Car b) Bus c) Bicycle d) Ambulance e) Motorbike f) Taxi g) By foot h) Other, specify …..
9. If you paid for transportation to bring the relative to the hospital or clinic, how much did you pay? __________ (put 0 if no payment was made)
10. How many trips did you or other household members make to visit your relative? (Total numbers of round trips)
11. What kind of transportation did you use to come to this hospital or clinic to visit your relative? (It concerns the last transportation used to visit your sick relative) a) Car b) Bus c) Bicycle d) Ambulance e) Motorbike f) Taxi g) By foot h) Other, specify
12. If you paid for transportation, how much did you pay to visit this health-care facility? (Round trip, one person)
13. Are you losing some income for being here today? Yes/No
14. If you weren't here today, what would you be doing? (Multiple responses allowed.) a) Nothing b) Housework c) Looking after my children d) Working (specify) e) Other (specify) f) Don't know
15. How much income have you or other family members lost as a result of taking care of your relative instead of working? ____________________________ (Put 0 if nothing and 999 if don't know.)
16. What is the total number of people in the household where the patient live?

___________ Adults ____________ Children

____________ 18–28 yrs ____________ 0–5 yrs

____________ 29–38 yrs ____________ 6–10 yrs

____________ 39–48 yrs ____________ 11–17 yrs

____________ 49+ yrs

17. What are the total expenses of the household where the patient lives?

Item/ Amount	Per day	Per week	Per month
Food			
Education			
Rent			
Household items			
Medical / Health			
Total			

ETHICAL CLEARANCE LETTER

CHRISTIAN HEALTH ASSOCIATION OF GHANA (CHAG) RESEARCH DEPARTMENT - INSTITUTIONAL REVIEW BOARD (IRB)
21 JUBILEE WELL STREET, LABONE, ACCRA. TELEPHONE: 0202904777. EMAIL chagirb@chag.org.gh

22nd January 2024

ETHICAL CLEARANCE

CHAG IRB PIN: **CHAG-IRB01082023**

On **18th January 2024,** the Christian Health Association of Ghana (CHAG) Institutional Review Board (IRB) reviewed and approved your protocol detailed as follows,

TITLE OF PROTOCOL: **Cost Analysis of Anesthesia Services in Selected Christian Health Association of Ghana Hospitals in the Eastern Region of Ghana.**

PRINCIPAL INVESTIGATOR: **Esther-Roberta Cosmas-Nyaunu**

Please note that a final review report must be submitted to the Board at the completion of the study. Your research records may be audited at any time during or after the implementation.

Any modification of this research project must be submitted to the IRB for review and approval prior to implementation.

Please report all serious adverse events related to this study to CHAG-IRB within seven days verbally and fourteen days in writing.

This certificate is valid till **30th January 2025**. You are to submit annual reports for continuing review.

Signed by: ....

Mr. Okyere Boateng
(CHAG IRB Chairman)

HE ADMINISTRATOR
INSTITUTIONAL REVIEW BOARD
CHRISTIAN HEALTH ASSOCIATION OF GH.

https://sites.google.com/view/chag-research/institutional-review-board