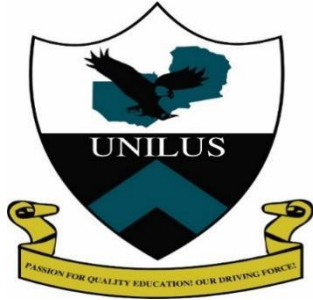




**UNIVERSITY
OF
LUSAKA**

**SCHOOL OF BUSINESS STUDIES, ECONOMICS AND
MANAGEMENT**

**ANALYZING THE EFFECTIVENESS OF ZAMMSA'S LAST MILES DISTRIBUTION
OF MEDICINES AND MEDICAL SUPPLIES THROUGH REGIONAL HUBS**

**A DISSERTATION SUBMITTED TO THE SCHOOL OF BUSINESS, ECONOMICS
AND MANAGEMENT, UNIVERSITY OF LUSAKA IN PARTIAL FULFILLMENT OF
THE AWARD OF THE BACHELOR OF SCIENCE IN PURCHASING AND SUPPLY
MANAGEMENT.**

By

SIMUCHUMBA RODNEY

BPS23222783

© 2025

DECLARATION

This academic study is my original work and it has not been shared for any academic consideration in any university or learning institution of higher education.

Signature

A handwritten signature in black ink, appearing to read 'Ronba', written on a light gray rectangular background.

Date: 25th November 2025

This dissertation proposal has been presented for examination with my approval as the University Supervisor

Signature:

A handwritten signature in black ink, appearing to read 'Digo', written on a light gray rectangular background.

COPYRIGHT

The information given in this work is not permitted to be reproduced by anyone other than the author.

ABSTRACT

This study examined the impact of sustainable procurement practices on procurement effectiveness at ZAMMSA in Zambia. As a key driver of Zambia's economic development, the health sector relies heavily on efficient procurement systems to enhance operational performance and profitability. Grounded in stakeholder theory, the research emphasized the importance of engaging diverse stakeholders to implement procurement strategies that align with environmental, social, and economic objectives. While sustainable procurement is increasingly recognized worldwide as essential for resilience and competitive advantage, its influence on procurement effectiveness in Zambia remains underexplored. This study addresses that gap by analyzing ZAMMSA's adoption of sustainable procurement and its outcomes.

The objectives were threefold:

To assess the relationship between sustainable procurement practices and procurement effectiveness.

To determine the extent of their impact.

To explore the role of stakeholder collaboration in advancing sustainable procurement within the health sector.

Using a descriptive research design and a mixed-method approach, data were collected from 40 respondents and analyzed with SPSS software. Results showed that ZAMMSA has gained significant benefits from sustainable procurement. Environmentally conscious supplier selection, waste reduction initiatives, and ethical sourcing have improved operational efficiency, minimized supply chain disruptions, reduced costs, and strengthened supplier relationships.

The study recommends that ZAMMSA enhance its cost-benefit analysis tools to highlight the long-term savings and broader advantages of sustainable procurement. Addressing the challenge of high upfront costs through clear financial evidence can secure decision-maker support and build a stronger business case for sustainable initiatives. Overall, this research provides valuable insights for Zambia's health sector, underscoring the role of sustainable procurement in achieving operational effectiveness and reinforcing stakeholder engagement as a cornerstone of sustainable industrial practices.

ACKNOWLEDGMENTS

My profound gratitude is extended to my capable supervisor for her commitment and provision of academic assistance during this research endeavour. Her dedication and timely input are much appreciated. May she be richly blessed by the good Lord.

TABLE OF CONTENTS

DECLARATION	i
ABSTRACT.....	iii
ACKNOWLEDGMENTS	iv
LIST OF TABLES AND FIGURES.....	viii
CHAPTER ONE	1
BACKGROUND OF THE STUDY	1
1.0 Introduction.....	1
1.1 Zambia Medicines and Medical Supplies Agency (ZAMMSA)	1
1.2 Statement of the Problem.....	2
1.3 Research Objectives.....	3
1.3.1 Specific Objectives	3
1.4 Research Questions.....	3
1.5 Hypotheses.....	4
1.6 Scope of the Study	4
CHAPTER TWO	5
LITERATURE REVIEW	5
2.0 Introduction.....	5
2.1 Non-Empirical Review	5
2.2 Empirical Review.....	6
2.2 Gaps in existing literature	13
2.3 Theoretical and Conceptual Framework.....	13
2.3.1 Transaction Cost Theory	13
2.3.2 Resource-Based View Theory	14
2.3.3 Institutional Theory.....	14
2.4 The Conceptual Framework.....	15

CHAPTER THREE	16
RESEARCH METHODOLOGY	16
3.0 Introduction.....	16
3.1 Research Design.....	16
3.2 Target Population.....	17
3.3 Sampling Procedure	17
3.4 Sampling Size	17
3.5 Sources of Data	18
3.5.1 Primary Data	18
3.5.2 Secondary Data	18
3.6 Data Analysis	19
CHAPTER FOUR.....	19
PRESENTATIONS OF FINDINGS	19
4.0 Introduction.....	19
CHAPTER FIVE	26
DISCUSSION OF FINDINGS	26
5.0 Overview.....	26
5.1 Analysis and Discussion of Findings.....	26
5.1.1 To assess the effectiveness of ZAMMSA's regional hub model in ensuring last-mile delivery of medicines and medical Supplies	26
5.1.2 To establish the influence of last-mile logistic on timely delivery of medicines and medical Supplies	26
5.1.3 To identify key logistical challenges affecting last-mile distribution of medical supplies at ZAMMSA.	27
5.1.4 To establish potential strategies for optimizing last-mile distribution and improving supply chain efficiency at ZAMMSA.....	28
4.2 Conclusion	28
4.3 Recommendations	29

4.4 Implication of the Study.....	30
REFERENCES	31
APPENDIX.....	34
A: QUESTIONNAIRE	34

LIST OF TABLES AND FIGURES

TABLES

- 4.1 Respondents age distribution
- 4.2 Respondents department
- 4.3 Respondents years of experience
- 4.4 How often sustainable procurement is considered in departments
- 4.5 Ratings of sustainable procurement practices implementation
- 4.6 Sustainable procurement practices and cost savings
- 4.7 Impact of sustainable procurement practices
- 4.8 Extent of adoption of sustainable procurement practices
- 4.9 Collaboration with suppliers and sustainable practices
- 4.10 Importance of sustainable procurement practices

FIGURES

- 4.1 Respondents gender
- 4.2 Extent of procurement effectiveness
- 4.3 Stakeholder collaboration influence on sustainable procurement practices

CHAPTER ONE

BACKGROUND OF THE STUDY

1.0 Introduction

This study examines the effectiveness of last miles distribution of medicines and medical supplies through Regional Hubs at ZAMMSA. The supply of medical products through regional hubs has emerged as an active research area, attracting significant interest from scientists and clinicians over the past five years. Its rapid growth has been driven by urbanization, population growth, the rise of e-commerce, changing consumer behavior, technological innovation, and growing concerns about sustainability. Although definitions vary, back-end is generally understood as the final stage of the supply chain, from the final distribution point to the intended recipient location. It is often described as one of the most expensive, inefficient, and environmentally damaging parts of the supply chain, with estimates suggesting that it accounts for 13–75% of total supply chain costs, depending on the factors involved. Performance is affected by flap density, delivery windows, congestion, drug sharing, and size and weight of drugs. Thus, a deeper understanding of this current situation is needed to improve economic, environmental and social welfare.

Despite significant contributions to last-mile logistics research, the field remains fragmented with differing disciplinary perspectives. Previous studies have focused on specific topics such as innovation, e-commerce and omnichannel marketing applications, logistics models, and other vehicle-based approaches to urban distribution. In order to provide a comprehensive and clear overview, this study conducts a systematic literature review to synthesize existing knowledge and provide additional insights into last-mile logistics. The review aims to define the components of last mile logistics and provide a framework for classifying and analyzing the literature.

1.1 Zambia Medicines and Medical Supplies Agency (ZAMMSA)

ZAMMSA is a statutory body established under the Zambia Medicines and Medical Supplies Act 2019. It is mandated to procure, store and distribute medicines and medical supplies to all public health facilities on behalf of the Government of Zambia. As a body with permanent representation and full legal personality, ZAMMSA's functions include: a) Procuring, storing, and distributing medicines and medical supplies; b) Stockpiling and rebranding of medical supplies; c) Establishing

and maintaining an effective, cost-effective procurement and distribution system; d) Ensuring timely availability of medicines in public health institutions; e) Establishing a robust inventory management and security system across the Ministry and Regions; f) Supporting policy, planning, and supply planning for health institutions; g) Establishing a national storage, packaging, and distribution network; f) Entering into agreements with government and international agencies for the production of medical supplies; h) Regular reporting to the Ministry of Health on procurement performance and expenditures; j) Exchange information with stakeholders at the regional, national, and international levels; k) Establish internal quality assurance systems to ensure compliance and product integrity; l) Assist health institutions in developing a supply chain management system; and m) Advise the Minister on policies related to procurement, storage, and distribution.

The law also established a Board to oversee ZAMMSA's strategic direction, financial management, policy guidance, and performance review. In addition, a Medicines and Medical Equipment Fund was created to facilitate procurement for public health institutions.

The movement of medicines and medical equipment through the Regional Hubs—especially essential items such as blood—represents the need for rapid delivery within ZAMMSA. Although costly, this is an important factor that contributes to operational efficiency and the overall efficiency of the supply chain (Rashidzadeh et al., 2024).

This study, therefore, seeks to assess the effectiveness of the distribution of medicines and medical supplies by ZAMMSA through the Regional Hubs.

1.2 Statement of the Problem

The global demand for efficient and reliable last-mile distribution systems has intensified, driven by the rapid expansion of e-commerce and the need to serve geographically dispersed customers. Optimizing last-mile logistics has become essential for improving distribution efficiency and meeting the evolving requirements of modern supply chains. However, transportation visibility remains a critical factor influencing the effectiveness of last-mile delivery, warranting deeper investigation and consolidation of existing literature. This area continues to face significant challenges, and ZAMMSA is no exception.

This include such challenges such as delivery delays, stock-outs, inadequate infrastructure, and limited accessibility hinder last-mile performance. Ensuring timely and equitable distribution of medicines and medical supplies to all health facilities is vital for strengthening healthcare outcomes. This study seeks to evaluate the efficiency, challenges and possible improvements in ZAMMSA's last mile distribution through its regional hubs.

It is from this background that the researcher is carrying out a study to assess the effectiveness of last Miles distribution of medicines and medical Supplies through Regional Hubs at ZAMMSA.

1.3 Research Objectives

The main research objective is to analyse the effectiveness of ZAMMSA'S last miles distribution of medicines and medical supplies through Regional Hubs

1.3.1 Specific Objectives

- 1) To assess the effectiveness of ZAMMSA's regional hub model in ensuring last-mile delivery of medicines and medical Supplies
- 2) To establish the influence of last-mile logistic on timely delivery of medicines and medical Supplies from ZAMMSA
- 3) To identify key logistical challenges affecting last-mile distribution of medical supplies at ZAMMSA.
- 4) To establish potential strategies for optimizing last-mile distribution and improving supply chain efficiency at ZAMMSA

1.4 Research Questions

- 1) How effective is ZAMMSA's regional hub model in last-mile distribution of medicines and medical Supplies?
- 2) How does last-mile logistic affect timely delivery of medicines and medical Supplies at ZAMMSA the timeliness of medical supply delivery?
- 3) What logistical challenges hinder the efficient distribution of medical supplies to health facilities?

- 4) What strategies can enhance the efficiency of last-mile distribution and improving supply chain efficiency at ZAMMSA?

1.5 Hypotheses

- 1) H1: ZAMMSA's regional hub model significantly improves the efficiency of last-mile medical supply distribution.
- 2) H2: Last-mile logistic has a direct impact timely delivery of medicines and medical Supplies.
- 3) H3: Logistical challenges such as infrastructure and supply chain disruptions negatively affect last-mile delivery efficiency.

1.6 Scope of the Study

This study investigated the impact of last mile distribution of medicines and medical supplies through regional hubs of ZAMMSA, one of the fastest growing key players in the supply of medicines and medical equipment in Zambia. It also assessed some factors; both internal and external, that influences the operation of this organization.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter provides a literature review related to the topic under study. This review helps to focus the study and establish what other scholars have written about the research objectives. It begins with findings from previous studies, followed by a discussion of the theories relevant to this study, from which the theoretical framework was developed.

2.1 Non-Empirical Review

Globally, last-mile logistics has emerged as a growing area of research, attracting significant interest from scholars and practitioners over the past five years (Cárdenas et al., 2020). A well-organized supply chain for vaccines, medicines, and other healthcare products is essential for the functioning of healthcare systems. However, in many developing countries, healthcare supply chains face persistent challenges that negatively affect healthcare delivery (Yadav, 2019).

Transportation is a critical component of logistics, ensuring the smooth movement of goods and services from origin to destination (Tseng et al., 2023). Companies such as Coca-Cola and pharmaceutical companies such as Johnson & Johnson, Novartis, and Bayer rely heavily on robust transportation systems to support their operations (Tseng et al., 2023). Advances in logistics and management concepts have increased cargo capacity, delivery speed, efficiency, and energy efficiency, making transportation an integral part of logistics operations.

In healthcare, delivering goods to the delivery point (DDP) and ensuring that they reach the last mile is critical to product availability (Yadav, 2013). In countries such as South Africa, Zimbabwe, and Nigeria, trucks are often used for last-mile delivery to urban areas, while in rural areas; livestock must be driven across floodplains to reach remote areas. Recently, drones have been used to deliver medicines to areas in the Drakensberg agricultural region of South Africa (Yadav, 2015).

The delivery process from the final delivery point to the recipient's home or collection point is often referred to as the "last mile" (Gevers et al., 2018). In healthcare, last-mile delivery goes beyond physical delivery. Medicines are delivered to the end user, while processing information

flows back to distributors (Village Reach, 2018). Programme managers at the national level need accurate consumption data to inform purchasing and reordering decisions. However, this approach faces challenges, including limited access to communication technology and SDPs, inadequate training of health workers in data collection and reporting, and difficulties in coordinating health services and reporting requirements.

Several studies, such as that of (Edwards, McKinnon, and Cullinane, 2020; Yadav, 2021; Dubey and Sivanandan, 2022; Nakagawa and Beale, 2022), have found that primary distribution of medicines and healthcare products in Africa is reliable and efficient. However, these studies have not examined secondary distribution. They have highlighted internal operational challenges, such as reliance on internal vehicles, which often lead to high costs and low utilization. Poor road conditions have been identified as barriers to effective last-mile delivery in many African countries. It is important to note that these studies have not provided quantitative evidence on the impact of last-mile delivery models on health outcomes. In Zambia, a qualitative study by Yadav (2012) found that inadequate delivery fleets and poor road networks were making last-mile delivery expensive. Based on this framework, this study seeks to determine whether last-mile delivery policies have improved efficiency and expanded access to essential medicines and supplies at the last mile, and also identifies existing challenges. By addressing these challenges, this study seeks to contribute to the availability of information in the distribution system and strengthen public trust in the management of healthcare systems and facilities.

2.2 Empirical Review

2.2.1 The effectiveness of ZAMMSA's regional hub model in ensuring last-mile delivery of medicines and medical Supplies

Last-mile delivery is a crucial stage in supply chain management, moving goods from distribution centers to end consumers, making it a critical component of logistics operations (Hsiao et al., 2018). Its importance has increased with the rise of e-commerce and omni-channel retailing, requiring a strategic approach to address modern challenges (Olson et al., 2019). The last mile is often considered the most expensive, inefficient, and environmentally harmful part of the distribution system, underscoring the need for targeted improvements to improve overall performance (Hsiao et al., 2018).

The last mile segment of health supply chains has consistently been identified as the most complex and failure prone stage in ensuring availability of medicines and medical supplies, particularly in low and middle income countries (LMICs). Literature highlights that fragmented distribution systems, weak transport infrastructure, and limited coordination between central and peripheral levels often result in stock outs and delayed deliveries at health facilities. Multi tier and hub and spoke distribution models have therefore been proposed as structural solutions to these challenges, by decentralizing storage and positioning regional hubs closer to service delivery points. Evidence from literature based models indicates that regional hubs can reduce delivery lead times, improve responsiveness, and mitigate geographic barriers that undermine traditional centralized medical store systems (Bakkabulindi, et al., 2024).

According to a study by Ndoye (2018) a core strength of the regional hub model lies in its ability to improve distribution efficiency through intermediate warehousing and structured transport routes. Studies examining multi tier distribution frameworks show that regional hubs serve as consolidation points that enable more frequent and predictable deliveries to peripheral health facilities. This configuration reduces transport distances for last mile distribution and allows for better route planning and scheduling, especially in rural and hard to reach areas. Literature reviews and supply chain analyses further emphasize that hub and spoke systems enhance coordination among stakeholders and support standardized operating procedures, which are essential for maintaining supply chain reliability in resource constrained settings.

Empirical evidence from public health programs also demonstrates that regional hub models contribute to reduced stock outs and improved product availability at the facility level. Experiences documented under informed push and direct delivery systems show that when regional hubs are responsible for monitoring consumption data and replenishing facilities, visibility across the supply chain improves substantially. Such models have been shown to shift logistical responsibilities away from clinical staff, allowing health workers to focus on service delivery while trained logistics personnel manage inventory and distribution. These findings suggest that regional hubs play a critical role in strengthening last mile performance by integrating data capture, inventory control, and transport management (Kar and Jenamani, 2025).

The effectiveness of regional hub models is further reinforced by their role in enhancing resilience and adaptability of health supply chains. Literature from vaccine and essential medicines supply systems indicates that regional hubs enable faster redistribution of stock during demand fluctuations, disease outbreaks, or supply disruptions. For example, analyses of national vaccine supply chains with multiple regional hubs show improved continuity of supply and reduced vulnerability to central level bottlenecks. Regional hubs also facilitate the adoption of digital tools for tracking, cold chain monitoring, and performance management, which are critical for safeguarding the quality and timeliness of medical supplies delivered to the last mile (Amuta, et al. 2024).

Despite these advantages, the literature also cautions that the success of regional hub models is highly context dependent. Several studies note that inadequate financing, weak governance structures, and insufficient transport capacity can undermine hub performance if not addressed systematically. Furthermore, the establishment and maintenance of regional hubs require sustained investment in infrastructure, human resources, and information systems. As such, the literature converges on the view that regional hub models are most effective when embedded within broader supply chain strengthening efforts, including policy alignment, data driven decision making, and partnerships with private logistics providers (Prashant, et al., 2015).

2.2.3 The Influence of Last-Mile Logistics on the Timely Delivery of Medicines and Medical Supplies

Last-mile logistics refers to the final stage of the supply chain where medicines and medical supplies are delivered from distribution centers to health facilities or end users. Literature consistently identifies this stage as the most complex and vulnerable segment of healthcare supply chains, largely due to infrastructure limitations, high delivery costs, and coordination challenges. Efficient last-mile logistics is critical for ensuring the timely availability of essential medicines, as delays at this stage can directly compromise patient outcomes and health system performance. Studies highlight that even when upstream procurement and warehousing function effectively, weaknesses in last-mile delivery often result in stock-outs and service disruptions at health facilities (Mwanaumo et al., 2023; GHSC-PSM, 2023).

Timeliness in the delivery of medicines is strongly influenced by transportation infrastructure, route planning, and delivery frequency at the last mile. In many low- and middle-income countries, poor road networks, long travel distances, and seasonal disruptions significantly delay deliveries to peripheral health facilities. Research conducted in sub-Saharan Africa demonstrates that reliance on road transport, combined with inadequate vehicle availability, leads to inconsistent delivery schedules and extended lead times for essential medicines (Project Last Mile, 2019; Humanitarian Logistics Association, 2023). These challenges are particularly pronounced in rural and hard-to-reach areas, where health facilities may experience prolonged stock-outs despite adequate national-level inventory.

Another critical dimension emphasized in the literature is the handling of temperature-sensitive medicines, such as vaccines and biologics, during last-mile distribution. Maintaining cold chain integrity requires reliable transport, appropriate packaging, and real-time monitoring, all of which are difficult to sustain in resource-constrained settings. Empirical evidence from Uganda shows that inefficient last-mile delivery systems contribute to delayed vaccine delivery and frequent cold chain breaches, undermining immunization programs. However, the introduction of improved last-mile models, such as informed push systems, has been shown to significantly reduce delivery lead times and improve on-time receipt of vaccines at health facilities (Bakkabulindi et al., 2024).

Technological innovations and alternative delivery models are increasingly discussed as solutions to last-mile challenges. Literature highlights the growing use of real-time tracking, route optimization software, and performance monitoring systems to enhance delivery reliability and accountability. Additionally, innovative approaches such as drone deliveries have demonstrated the potential to drastically reduce delivery times in remote areas by bypassing poor road infrastructure. Evidence from several African countries indicates that drone-supported last-mile logistics can ensure rapid delivery of blood, vaccines, and emergency medicines, thereby improving responsiveness in critical care situations (Leedom, 2024; GEODIS, 2024).

Overall, the literature underscores that effective last-mile logistics is not merely an operational concern but a public health imperative. Timely delivery of medicines and medical supplies depends on coordinated transport systems, skilled human resources, appropriate technology, and supportive policy frameworks. Strengthening last-mile logistics has been shown to reduce stock-outs, improve service continuity, and enhance health outcomes, particularly in underserved communities.

Consequently, scholars and practitioners advocate for sustained investment in last-mile delivery systems as a strategic priority for achieving equitable access to essential medicines and strengthening healthcare systems in developing countries (Mwanaumo et al., 2023; GHSC-PSM, 2023).

2.2.4 Key Logistical Challenges Affecting Last Mile Distribution of Medical Supplies at ZAMMSA

Despite its importance, the last mile faces many challenges. Other challenges include traffic congestion, security risks, high delivery costs, and inadequate logistics systems, all of which contribute to inefficiencies and high operational costs (Mogire et al., 2022). In humanitarian and disaster relief settings, the transformation of the last mile is even more evident, as fragile and scarce resources require robust logistics solutions (Noyan et al., 2016).

The Zambia Medicines and Medical Supplies Agency (ZAMMSA) plays a central role in the procurement, storage, and distribution of medicines and medical supplies to public health facilities across Zambia. Literature consistently identifies last-mile distribution as one of the most challenging components of ZAMMSA's mandate due to operational, infrastructural, and coordination constraints. Empirical research assessing ZAMMSA's last-mile logistics indicates that transportation inefficiencies, combined with limited delivery alternatives, significantly hinder timely and reliable delivery of medical supplies to health facilities, particularly in rural and hard-to-reach areas.

Transportation and infrastructure limitations emerge as dominant logistical challenges in the literature. Studies show that ZAMMSA largely depends on road transport, which is vulnerable to poor road conditions, long travel distances, and seasonal disruptions. Mwanaumo et al. report that inadequate transport capacity and reliance on a mixed fleet of in-house and outsourced vehicles often lead to delivery delays and operational inefficiencies. Similarly, national supply chain assessments highlight that difficult terrain and poor accessibility to peripheral facilities increase lead times and complicate delivery scheduling, thereby affecting consistent medicine availability at the last mile.

Planning and coordination challenges further constrain last-mile distribution performance at ZAMMSA. Literature indicates that manual transportation planning and limited use of real-time

data historically resulted in underutilized vehicles, fragmented delivery routes, and incomplete deliveries. A case study by Chemonics documents that ZAMMSA's reliance on experience-based planning contributed to inefficiencies and delayed deliveries before the introduction of optimized routing tools. These findings suggest that weak coordination between warehouse operations, transport planning, and third-party logistics providers undermines the effectiveness of last-mile distribution.

Information visibility and supply chain integration are also widely cited as critical challenges. Research focusing on ZAMMSA's supply chain operations identifies incomplete tracking visibility and limited integration of logistics management information systems as barriers to effective last-mile execution. Chopo and Mutono-Mwanza report that gaps in tracking and feedback mechanisms restrict ZAMMSA's ability to monitor deliveries, respond to disruptions, and ensure accountability across the distribution network. These information gaps increase the risk of delayed deliveries, stock-outs, and inefficient resource allocation at the facility level.

In addition, institutional capacity and resource constraints continue to affect last-mile logistics at ZAMMSA. Literature highlights challenges related to insufficient trained logistics personnel, constrained funding, and inadequate storage and fleet infrastructure, all of which limit the agency's ability to consistently meet last-mile delivery requirements. National-level assessments emphasize that addressing these constraints requires sustained investment in human resources, infrastructure, and data-driven decision-making to strengthen last-mile performance and improve medicine availability nationwide.

To address these challenges, researchers and practitioners are exploring new and advanced solutions. For example, transportation visibility systems are being implemented to streamline operations, improve distribution efficiency, and reduce costs. In addition, sustainability initiatives such as electricity supply for transportation and carbon footprint measurement are being used to reduce environmental impacts and promote environmentally friendly transportation methods (Saenz-Esteruelas et al., 2016). Organizations can increase resilience by improving distribution practices and using advanced technologies, especially in response to crises such as the COVID-19 pandemic (Pahwa and Jaller, 2023).

Transportation visibility plays a key role in improving last-mile efficiency. By providing real-time information about the movement of goods and assets, visibility systems enable organizations to track, monitor, and manage shipments more effectively, improving operational efficiency and customer satisfaction. Rashidzadeh et al. (2021) emphasize that visibility leads to faster decision-making, allowing companies to anticipate problems, improve routes, and ensure on-time deliveries (Hübner et al., 2016). Understanding the logistics process also fosters stronger collaboration among supply chain stakeholders, enabling them to adapt rapidly to changing needs and challenges (Olson et al., 2019). In addition to operational benefits, logistics visibility also contributes to better supply chain planning and management. It improves delivery accuracy, reduces lead times, and improves order fulfillment efficiency (Banyai, 2018). Real-time monitoring facilitates coordination between multiple stakeholders, reduces delays, and increases trust (Serrano-Hernandez et al., 2021). In addition, visibility tools provide valuable data-driven insights, enabling organizations to analyze performance indicators, identify bottlenecks, and implement continuous improvement plans. This analytical capability transforms last-mile delivery from a reactive process to a proactive system (Rafael et al., 2023).

Furthermore, transportation visibility has been identified as a key element for sustainability and environmental responsibility in last-mile logistics. By monitoring and analyzing transportation data, organizations can identify opportunities to reduce fuel consumption, reduce carbon emissions, and optimize delivery routes (Tan et al., 2019). Improved visibility facilitates the implementation of environmentally friendly practices, such as improving energy efficiency and reducing greenhouse gas emissions, thereby supporting sustainable practices in last-mile distribution (Oliveira et al., 2017). In addition, visibility can help to adopt alternative delivery methods, including electric vehicles and bicycles, which promote energy efficiency and reduce the environmental impact of last-mile operations (Xu et al., 2022).

Alexander and Takawira (2023) conducted a systematic review of the literature on transportation safety and recent trends using the PRISMA framework for structured analysis. Their findings revealed that last-mile processing, while essential to the supply chain, still faces challenges such as resource constraints, infrastructure vulnerabilities, and environmental issues. With the rise of e-commerce and omni-channel retailing, last-mile optimization has become imperative to ensure product availability and accessibility. The review highlights the role of transportation security in

addressing these challenges through realistic routing, route optimization, and improved stakeholder coordination. Furthermore, technological innovations, particularly artificial intelligence and blockchain, are key elements that provide predictive analytics and transparent transactions.

2.2 Gaps in existing literature

Although research on last-mile logistics and transportation visibility has expanded considerably, several gaps remain (Shukla et al., 2022). One of the notable weaknesses is the limited focus on integrating emerging technologies such as Artificial Intelligence and Blockchain with security tools to improve last-mile efficiency (Li et al., 2020). While some studies recognize the potential of these technologies, there are no comprehensive investigations into their practical application and measurement on processing efficiency. Another gap is the evaluation of last mile distribution effectiveness in the healthcare sector. Previous studies have not examined the performance of the last batch of medicines and medical materials (Wei et al., 2018). Furthermore, there is a lack of research that specifically examines the last Miles logistic in Zambia context to provide a comprehensive understanding on this topic. Investigating novel strategies to improve the transportation of medicines and medical supplies in the long term can help increase the efficiency of last-mile logistics in emergency response situations. Hence, this study aims to bridge these gaps.

2.3 Theoretical and Conceptual Framework

The theoretical review provides an insight on the accepted rules, principles and procedures for understanding and explaining key aspects of the topic of study. These theories are vital to this as they served as a basis for formulating a conceptual framework for this study.

2.3.1 Transaction Cost Theory

Transaction cost theory explains why companies prefer to outsource certain activities to external providers rather than performing them internally. According to McIver (2009), a company will continue to expand as long as its activities can be performed more cost-effectively internally than through outsourcing. Williamson (2008) further argues that transaction costs arise whenever a good or service is transferred across a technologically separate interface. In other words, each

transfer between production stages requires new technical capabilities, which generates additional costs.

Many factors contribute to transaction costs, including opportunistic behavior, the search for accurate price and quality information, bounded rationality, environmental uncertainty, and firm-specific assets. These factors can significantly increase external transaction costs, making outsourcing more expensive and difficult to control. This means that if companies perceive environmental uncertainty to be high, they may choose not to outsource or exchange resources with the environment (McCarthy and Anagnostou, 2004).

2.3.2 Resource-Based View Theory

To improve operational performance, the theory states that an organization must ensure the efficient combination and flow of the right types of resources from its environment (Barney & Clark, 2007). The resource-based approach focuses on explaining the conditions that require resources to achieve sustained competitive advantage. This will help determine how ZAMMSA uses its resources, such as storage facilities, fleet, and technology, to achieve efficiency in last-mile delivery.

2.3.3 Institutional Theory

Institutional theory argues that organizations take on specific forms because they are based on cultural values and norms that shape assumptions about how activities should be organized (Tolbert & Zucker, 2006). It has become an important approach for examining diverse organizational phenomena (Frumkin & Galaskiewicz, 2004). This theory emphasizes that institutional actors operate in an environment defined by both formal and informal rules. Therefore, organizational actions and processes are not only functional but also symbolic, as actors attempt to justify and legitimize their decisions within a broader social context (Dacin, Oliver, & Roy, 2007).

According to Scott (2001), organizations are structured around three pillars—cultural-cognitive, normative, and regulatory elements—that, together with related activities and resources, provide stability to social life. Through these forces, organizations adopt standardized practices that adapt them to the expectations of their institutional field. In this sense, institutional theory suggests that

organizational fields are structured by powerful influences, which force organizations to conform to prevailing norms and practices.

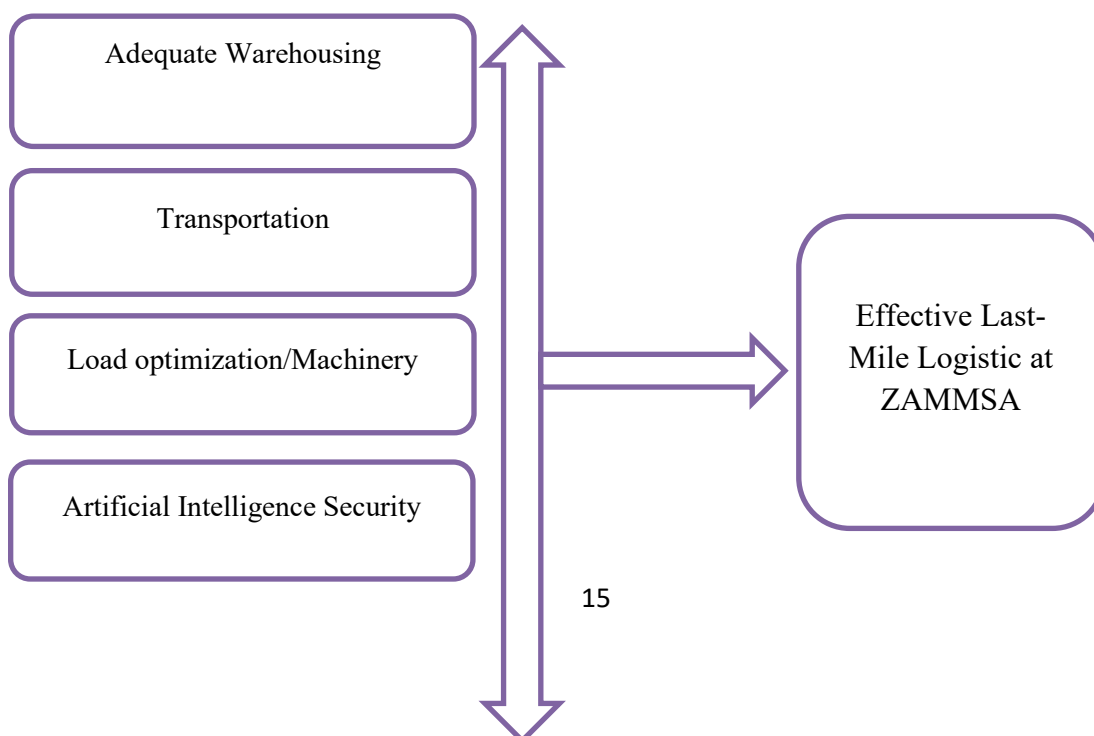
Therefore, the adoption of practices such as strategy implementation is highly dependent on legitimacy. Legitimacy issues motivate organizations to adopt practices that are consistent with the dictates of their institutional environment (Soltani, 2005). Institutions are governed not only by formal organizations and arrangements that convey authority, but also by culture, which gives meaning to customary and traditional practices. They are also further embedded in individuals and form social and legal structures of identity (Friedland and Alford, 1991).

Institutional theory is particularly relevant to public sector organizations, which are often considered to be more vulnerable to institutional pressures than profit-oriented firms (Frumkin and Galaskiewicz, 2003). Within this study, institutional theory provides a useful framework for understanding how public institutions emulate each other in adopting practices such as internal audit procedures. In addition to the previously identified barriers and facilitators, an untested possibility remains that institutional drivers, whether normative, cognitive, or regulatory, may encourage or discourage organizations from adopting supply chain practices. This theory will be used to understand how policies, regulations, and external forces influence the model of distributing medical supplies at ZAMMSA.

2.4 The Conceptual Framework

Independent Variable

Dependent Variable





Procurement

Source: (Aurthor, 2026)

The above conceptual framework illustrates the interaction between independent and dependent variables. The dependent variables included adequate storage, transportation, independent equipment, cargo optimization/machinery, artificial intelligence, security and procurement as independent variables, while effective last-mile logistics is the dependent variable. This implies that when ZAMMSA has adequate storage, transportation, independent equipment, cargo optimization/machinery, artificial intelligence, security and procurement, it will promote effective last-mile logistics.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

Research methodology provides a structured overview of the steps and procedures used to obtain facts relevant to a particular study. The following components are considered in this study: research design, research area, target population, sample and sampling methods, data collection instruments and procedures, time frame, data analysis methods, and ethical considerations.

3.1 Research Design

This study adopted a mixed methods approach, combining quantitative and qualitative methods. A descriptive research design was considered appropriate because it allowed the researcher to observe a phenomenon in its natural and unchanging environment. This design facilitated the integration of qualitative and quantitative data collection methods, resulting in efficiency compared to purely experimental approaches. Furthermore, it enabled in-depth investigation of individuals, groups, or institutions to identify variables and examine relationships that influence current behaviours or conditions. As a result, the researcher was able to generate detailed and comprehensive data on the identified problem.

3.2 Target Population

The study was conducted at ZAMMSA in Lusaka, where a total of 58 employees from the departments of related to this study. The site was chosen because ZAMMSA is a key government agency facing logistical challenges in the distribution of medical supplies in Zambia, making it an ideal source of relevant data. Additionally, conducting the study at this location is both cost-effective and practical.

3.3 Sampling Procedure

A combination of purposive and simple random sampling was used in this study. Purposive sampling was used to select senior employees, as they were considered to have key information relevant to the study due to their positions in the organization. Systematic random sampling was applied to subordinate staff in different departments, ensuring that all employees had an equal chance of being selected.

This mixed approach was convenient, enabling the researcher to identify appropriate respondents while minimizing bias. Purposive sampling ensured access to informed participants, while simple random sampling enhanced representativeness and reduced predictability in responses. Together, these methods addressed the limitations of each technique, resulting in valid and comprehensive findings.

3.4 Sampling Size

The sample size included officers and logistics managers from ZAMMSA in Lusaka, regardless of gender or age.

Below is the formula used to arrive at the sample size:

Formula; $n = N \div (1 + N(e^2))$

Where; n is the sample size

N is the study population

e is the precision set at 0.05

Total population is 58

Total=

$$n = 58 / 1 + 64 (0.05)^2$$

$$58 / 1 + 58 (0.0025)$$

$$58 / 1.16$$

Total sample size = 46

A sample of 46 respondents was used, 10 were from senior staff (those in management) while 36 from subordinate workers. Reasons for choosing this sample size are: the institution has limited numbers of staff in logistics; it is cost effective; manageable; and adequate in generation of data.

3.5 Sources of Data

Data collection is referred to as the accumulation of specific evidence that enabled the researcher to properly analyze the results of the activities of his research design and procedures (Singh, 2016). The main purpose of data collection is to answer the research questions. In this regard, the study used primary and secondary data.

3.5.1 Primary Data

Data for this study were collected and analyzed using a quantitative approach. A semi-structured questionnaire served as the primary instrument for gathering information. This instrument was selected because it is widely considered effective for quantitative research, allowing for both structured responses and the flexibility to gain additional insights. Primary data refers to information obtained directly from direct sources, such as surveys, interviews, or experiments, that is collected specifically for the research project (Stephanie, 2018).

3.5.2 Secondary Data

Secondary data were obtained from textbooks, institutional files, online sources, academic journals, reports, websites, and other relevant documents. This included a comprehensive review of existing literature to identify what other scholars and practitioners had written on the topic under study.

3.6 Data Analysis

The data collected through a semi-structured questionnaire were initially checked for consistency, consistency, accuracy and completeness. The data were edited as necessary and the responses were coded to facilitate analysis. Quantitative data were analyzed using computer software and statistical tools such as Microsoft Excel and Statistical Package for the Social Sciences (SPSS). Techniques such as the chi-square test and Pearson correlation coefficient were used to examine the relationships between variables. Descriptive statistics including means, frequencies and percentages were used to summarize and interpret the data. For qualitative data, thematic analysis was used to identify recurring patterns, themes and insights. Observations were also included to provide contextual understanding and uncover general trends relevant to the study.

CHAPTER FOUR

PRESENTATIONS OF FINDINGS

4.0 Introduction

This chapter presents the findings of the research. It ranges from the background information of the respondents and other findings related to the topic of study. This was guided by the specific objectives.

Work Experience

Table 1: Percentage distribution of work experience

Work experience	Frequency	Percent
Less than 5 years	8	20
5 – 9 Years	20	50
10 – 14 years	6	16
15 years and above	6	14
Total	40	100

Source: (Author, 2025)

Table 3 above shows how respondents worked based on their work experience. 50% of respondents reported having 5-9 years of work experience, 20% reported having less than 5 years of work experience, 16% reported having worked for 10-14 years, and 14% reported having worked for 15 or more years. This means that the majority of respondents had worked between 5 and 14 years.

Education level

Table 2: Percentage distribution by education level

Age range	Frequency	Percent
Tertiary Certificates	5	13
Diploma	9	23
Degree	20	50
Masters Degree	6	15
Total	40	100

Source: (Author, 2025)

Table 4 shows the results on the highest level of education attained by the respondents. It was found that 50% of the respondents had completed university, 23% had completed a diploma, 13% had higher education and only 6% had a master's degree. According to these results, the majority of the participants in the study had a bachelor's degree.

Type of transportation system

Table 3: Percentage distribution by type of transportation system

Education Level	Frequency	Percent
Vehicle types such as ambulances procured through the Constituency Development Fund (CDF)	6	11
Own fleet	12	22
Hub-and-spoke model	14	26
Support from partners	6	11
Third-party logistics (3PL)	16	30
Total	54	100

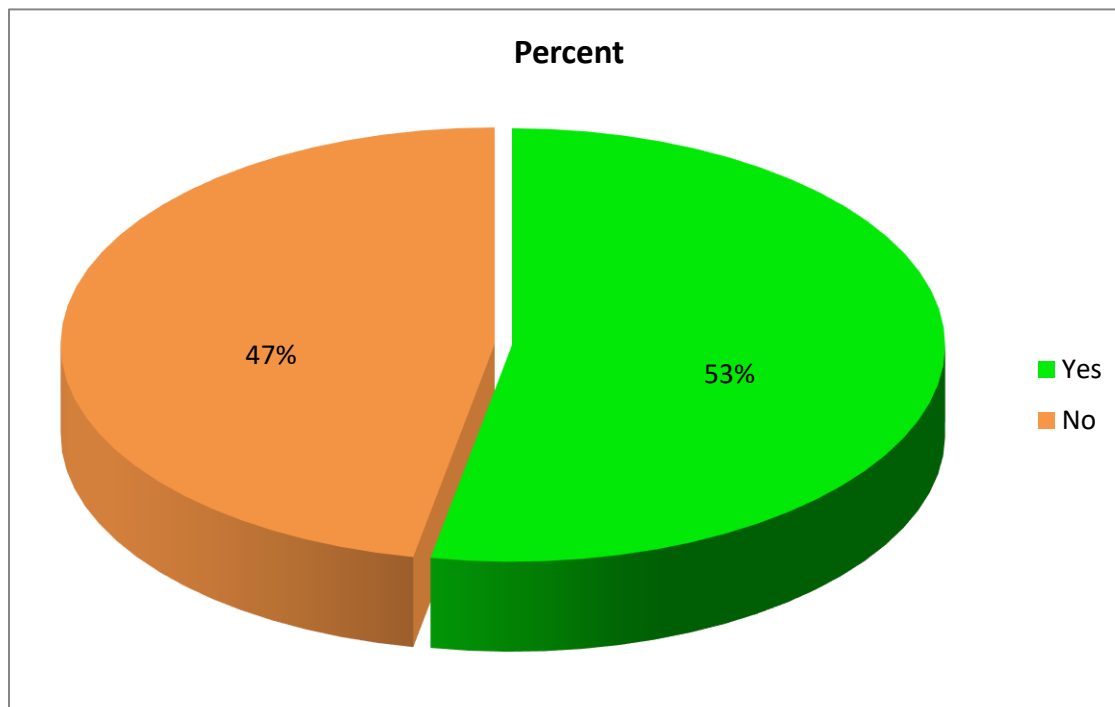
Source: (Author, 2025)

Table 4 above shows the results based on the highest education level achieved by respondents. It was found that 30% of respondents used third-party logistics (3PL) and 26% used a hub-and-spoke model. Furthermore, 22% of respondents mentioned owning their own fleet, while 11% mentioned

vehicles such as ambulances obtained from Constituency Development Funds (CDF) and vehicles obtained from partner partners.

Whether the current last-mile logistic practice is effective in improving the efficiency of service delivery of medicine and medical supplies

Figure 1: Percentage distribution by whether the current last-mile logistic practice is effective in improving the efficiency of service delivery of medicine and medical supplies



Source: (Author, 2025)

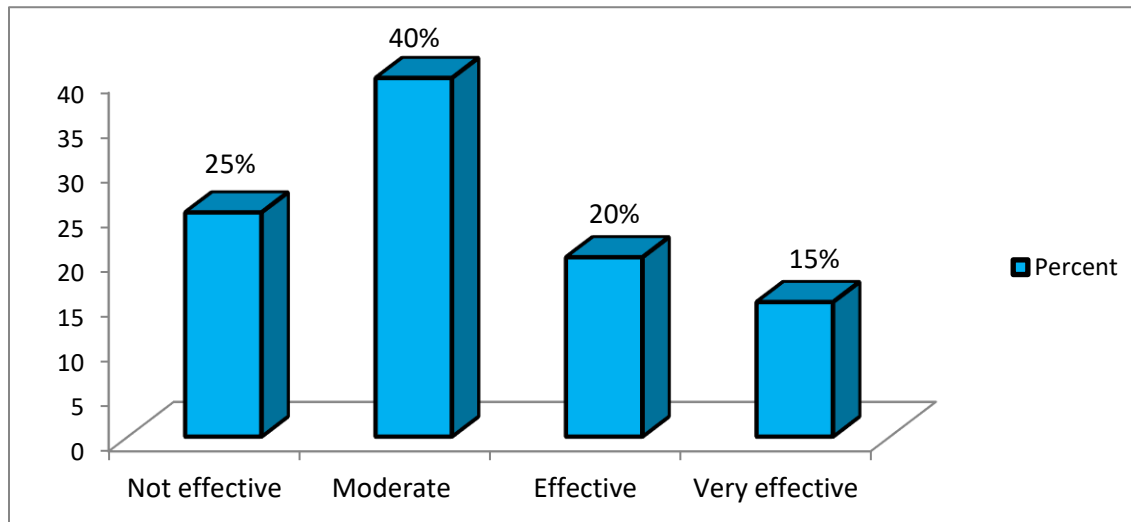
The figure above shows that 53% of the respondents agreed that the current last-mile logistic practice is effective in improving the efficiency of service delivery of medicine and medical supplies, whereas only 47% of the respondents disagreed.

Effectiveness of last-mile logistic on timely delivery of medicine and medical supplies

The figure below shows the distribution of the effectiveness of last-mile logistics in the timely delivery of medicines and medical supplies. It was found that 40% of respondents said last-mile logistics was moderate, 25% reported it was not effective, while 20% said last-mile logistics was

effective, and finally, 15% said last-mile logistics failed in the timely delivery of medicines and medical supplies.

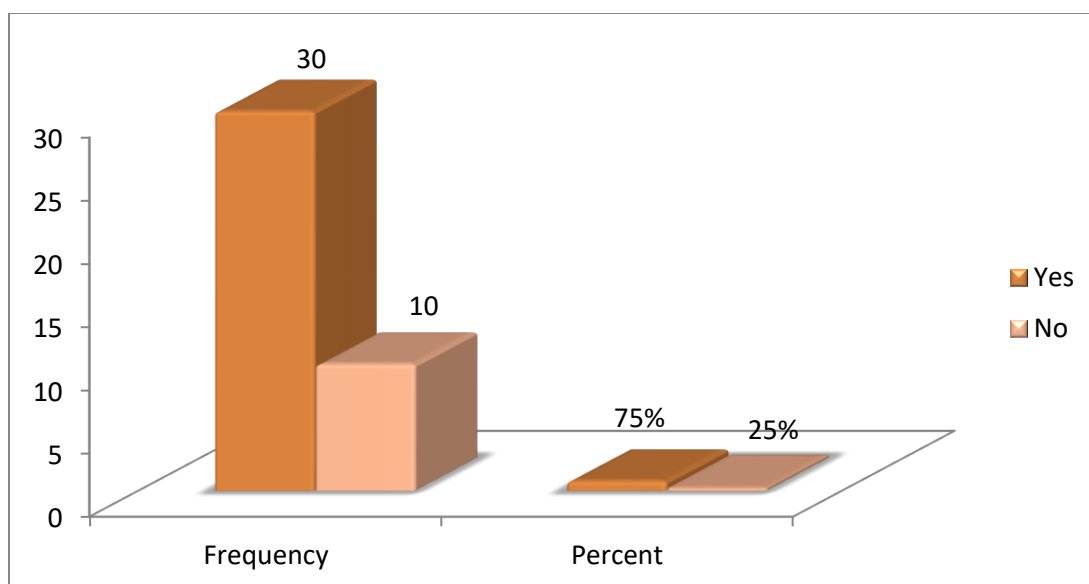
Figure 2: Percentage distribution of effectiveness of last-mile logistic



Source: (Author, 2025)

Whether last-mile logistic has an influence on timely delivery of medicine and medical supplies

Figure 3: Last-mile logistic having an influence on timely delivery of medicine and medical supplies



Source: (Author, 2025)

From the figure above it can be seen that 75% of the respondents attested that whether last-mile logistic has an influence on timely delivery of medicine and medical supplies, whereas 25% disagreed. This means that the majority of respondents believed that last-mile logistics had an impact on the timely delivery of medicines and medical supplies.

Factors affecting last-mile distribution of medical supplies

Table 4: Factors affecting last-mile distribution of medical supplies

Factors	Frequency	Percent
Unfavorable policies and laws and strong political influence prevent governments from investing in transportation and distribution systems.	35	8%
Opaque procurement practices and supply chain management.	37	8%
Inadequate national infrastructure, for example, power, inland access (roads, rail), and accessible waterways.	45	10%
Poor preparation of tender procurement and contract terms.	39	9%
Lack of trust (low support) in the transportation and distribution system by the public and government.	37	8%
Disconnection between transportation and logistics stakeholders, for example, ZAMMSA and the Ministry of Health, management, and staff.	40	9%

Delays and challenges in international delivery of medicines due to interlining agreements and customs clearance.	43	10%
Inadequate investment in research and development, human capacity building, and human capital formation.	41	9%
Low ICT integration in last-mile operations, inadequate ICT infrastructure, and poor interconnections.	41	9%
Lack of effective communication among the supply chain team impacts supply chain management.	13	3%
Lack of proper recordkeeping and documentation impacts supply chain management.	13	3%
Political interference impacts supply chain management.	32	7%
Inadequate skilled manpower in transportation and logistics.	26	6%
Total	442	100%

Source: (Author, 2025)

Respondents were asked to identify key factors affecting last-mile delivery of medical supplies. The findings revealed several challenges: 10% of respondents cited inadequate national infrastructure, including electricity, inland access (road and rail), and navigable waterways. They also highlighted delays and challenges in international delivery of medicines due to interlining agreements and customs clearance. 9% of respondents pointed to poor preparation of tender procurement and contract terms, inadequate investment in research and development, limited human capacity building, and low integration of ICT in last-mile operations. Inadequate ICT infrastructure and poor interconnectivity were also mentioned. In addition, 8% of respondents identified unfavorable policies and laws, strong political influence that restrict government investment in transportation and distribution systems. 6% of respondents emphasized the need for effective communication within the supply chain, while 3% cited lack of communication between supply chain teams and poor record-keeping and documentation practices as challenges.

Strategies for optimizing last-mile distribution and improving supply chain efficiency

Table 5: Percentage distribution on how can last-mile logistic be improved in timely delivery of medicine and medical supplies in public sector

Strategies	Frequency	Percent
Implementing advanced route optimization	32	27

Leveraging technology like AI and real-time tracking and explore alternative delivery methods for hard-to-reach areas, investigate using drones or other innovative transport solutions to deliver critical supplies quickly	29	24
Collaboration with other businesses and incorporating sustainable transport can also reduce costs and enhance performance	17	14
Invest in improving rural road infrastructure and maintaining a diverse fleet of vehicles to handle different terrains and conditions	12	10
Offering alternative delivery options such as click-and-collect and smart lockers	12	10
Minimize waste from expired or damaged goods by improving storage conditions and implementing a first-in, first-out (FIFO) stock rotation system	6	5
Using micro-fulfilment centres	12	10
Total	120	100

Source: (Author, 2025)

In the table above respondents were asked to indicate measures that can be to put in place to improve last-mile logistic to enable timely delivery of medicine and medical supplies in public sector. Out of 120 responses obtained, 27% indicated implementing advanced route optimization, followed by 24% of the responses who pointed to leveraging technology like AI and real-time tracking and explore alternative delivery methods for hard-to-reach areas, investigate using drones or other innovative transport solutions to deliver critical supplies quickly. Additionally, 14% of the responses attributed to collaboration with other businesses and incorporating sustainable transport can also reduce costs and enhance performance, while 10% each alluded to using micro-fulfilment centres, investing in improving rural road infrastructure and maintaining a diverse fleet of vehicles to handle different terrains and conditions, and offering alternative delivery options such as click-and-collect and smart lockers respectively.

CHAPTER FIVE

DISCUSSION OF FINDINGS

5.0 Overview

This chapter discussed in the findings according to the research specific objectives. It also compared the findings to the studies done by other scholars.

5.1 Analysis and Discussion of Findings

5.1.1 To assess the effectiveness of ZAMMSA's regional hub model in ensuring last-mile delivery of medicines and medical Supplies

The first specific objective was to assess the effectiveness of the ZAMMSA model in ensuring last-mile delivery of medicines and essential medicines. The study revealed that there are a variety of transportation modes that agencies use to ensure delivery of medicines and last-mile supply of necessary medicines. These include the 3PL) providers of the 3P, and essential medical supplies for the last few years, with their own fleets, other types of vehicles such as ambulances provided by the Constitutional Development Fund (CDF) and vehicles from support partners. The study found that while the last mile delivery method used in ZAMMSA is effective in improving service delivery, the method is considered ineffective in ensuring timely delivery of medicines and essential medical supplies.

4.1.2 To establish the influence of last-mile logistic on timely delivery of medicines and medical Supplies

From the second specific objective it was found last-mile logistic had influence on timely delivery of medicines and medical supplies. This can be demonstrated by the results obtained where 75% of the respondents agreed that both sources have an impact on the delivery of medicines and essential items to the latter. Working with a last mile logistics system ensures transparency and accountability and prevents legal and financial risks. For example, a last mile logistics system improves flexibility, and efficiency in the production of medicines and medical supplies. It improves supplier relationships, helps reduce medicines and medical products fraud and speeds up the business of medicines and medical products.

These findings are consistent with the findings of (Hsiao et al., 2018) who pointed out that distribution and supply chain decision-making is an important process that involves the delivery of products from distribution centers to end customers, serving as an integral part of the entire supply chain.

4.1.3 To identify key logistical challenges affecting last-mile distribution of medical supplies at ZAMMSA.

The third objective sought to address the main logistical challenges affecting the final distribution of medicines in ZAMMSA. The study's findings revealed various challenges related to the final distribution of medicines in ZAMMSA. These challenges stem from delays and challenges in international rail deliveries due to a lack of international agreements, the elimination of railways, and domestic access to adequate national infrastructure, such as electricity, roads, and waterways. Other challenges include inadequate preparation for the procurement of low-cost materials and contract terms, lack of investment in research and development, human capacity building, and human capital development, and a lack of ICT connectivity in last-mile services, poor ICT infrastructure, and poor ICT connectivity. For example, the distribution of medical supplies for low-cost materials is affected by political and legal circumstances and strong political influences preventing governments from entering into transportation and distribution systems, inconsistent procurement practices and distribution system management, and a lack of trust in the system and the system's transportation and distribution personnel. Furthermore, political involvement in food system management, a lack of effective communication among food system stakeholders, and a lack of proper records and records related to the food system are highlighted.

These findings are consistent with Mogire et al. (2022), which found that road congestion, security challenges, high shipping costs, complex logistics, unreliable physical clearance requirements for business expansion, and travel were among the major barriers to achieving a sustainable delivery service. These findings are consistent with a study by Yadav (2022), which found that Zambia lacks a delivery fleet for essential medicines and supplies and has a poor road network, making last-mile delivery expensive.

4.1.4 To establish potential strategies for optimizing last-mile distribution and improving supply chain efficiency at ZAMMSA

The final objective focused on establishing strategies to optimize last-mile delivery and improve supply chain efficiency, including implementing advanced route optimization, using micro-fulfillment centers, leveraging technology like AI and real-time tracking, and providing alternative delivery options. There's also a need to collaborate more closely with other businesses, and incorporating sustainable transportation can reduce costs and increase performance.

These results are consistent with a study by Raphael et al. (2023), who argued for the implementation of real-time shipment and asset tracking to facilitate better coordination between multiple stakeholders involved in the delivery process, resulting in more efficient operations and reduced delivery delays at the final stage. The ability to track shipments enables companies to make data-driven decisions.

4.2 Conclusion

The objective of this study was to analyze the effectiveness of ZAMMSA's distribution of medicines and medical supplies at the endpoint through regional hubs. It is noted that in addition to its own aircraft and vehicles such as ambulances procured from the Constituency Development Fund (CDF), ZAMMSA also used other transportation methods in endpoint logistics such as third party logistics (3PL) and partner assistance. The current endpoint logistics methods were found to be moderately effective in improving the efficiency of delivering medicines and medical supplies. Some of the factors affecting endpoint logistics include political interference, inadequate national infrastructure, inadequate ICT integration and lack of effective communication among the supply chain team.

However, it should be noted that last mile logistics significantly affects the timely delivery of medicines by directly affecting delivery speed, product integrity and patient access to treatment. Efficient last-mile logistics, driven by optimized routes, real-time tracking, and robust technology, ensures the rapid and safe delivery of temperature-sensitive medications, improving patient outcomes and building trust. Conversely, poor logistics can lead to delays, compromised medications, and increased healthcare costs. Last-mile logistics has a significant impact on the

timely delivery of medications, as it directly impacts delivery speed, product reliability, and patient access to treatment. Efficient last-mile logistics, driven by optimized routes, real-time tracking, and robust technology, ensures the timely and safe delivery of temperature-sensitive medications, improving patient outcomes and building trust. Conversely, poor logistics can lead to delays, compromised medications, and increased healthcare costs.

4.3 Recommendations

Based on the above, the reviewed literature, and the study findings, the researcher made the following recommendations:

- i. Strengthen and standardize the regional hub distribution model: ZAMMSA should further strengthen its regional hub model by standardizing delivery schedules, improving coordination between hubs and health facilities, and clearly defining roles between in house fleets, 3PL providers, and partner-supported transport to enhance consistency and timeliness of last mile deliveries.
- ii. Invest in advanced route optimization and real-time tracking systems: The Agency should scale up the use of data-driven route optimization tools and real-time tracking technologies to improve delivery planning, reduce lead times, enhance transparency, and support timely decision-making across the last mile distribution network.
- iii. Improve national transport and ICT infrastructure integration: ZAMMSA, in collaboration with government and development partners, should advocate for and support investments in road infrastructure, reliable electricity, and ICT connectivity to address structural barriers that negatively affect last mile logistics, especially in rural and hard-to-reach areas.
- iv. Enhance human capacity and institutional coordination: Continuous capacity building for logistics and supply chain personnel should be prioritized, focusing on last mile logistics management, ICT use, and performance monitoring, while strengthening communication and coordination among supply chain stakeholders to reduce inefficiencies and delays.
- v. Promote policy consistency and reduce political interference in logistics operations: Clear, transparent, and standardized procurement and distribution policies should be enforced to

minimize political interference, improve trust in the supply chain system, and ensure that last mile logistics decisions are driven by operational efficiency and public health needs rather than external influence.

4.4 Implication of the Study

This study has implications for clinicians, policymakers and future researchers. For policymakers, this study revealed that institutions involved in the last-mile distribution of medicines and medical supplies require government support in terms of improved ICT and transport infrastructure to enable smooth functioning. For researchers, this study highlighted the problems encountered in the last-mile distribution of medical supplies. It will be interesting for researchers to conduct a more studies outside the scope of this study, as it was only based in ZAMMSA.

REFERENCES

- Akbari, M. & Hopkins, J.L. 2022. Digital technologies as enablers of supply chain sustainability in an emerging economy. *Operations Management Research*, 15(3-4):689-710.
- Allen, J., Piecyk, M., Piotrowska, M., McLeod, F., Cherrett, T., Ghali, K., Nguyen, T., Bektaş, T., Bates, O., Friday, A., Wise, S. & Austwick, M.Z. 2018. Understanding the Impact of Ecommerce on Last-Mile Light Goods Vehicle Activity in Urban Areas: The Case of London. *Transportation Research Part D Transport and Environment*, 10.1016/j.trd.2017.07.020
- Amuta, M. A. et al. (2024). *A multi-tier distribution model for enhancing last-mile delivery efficiency in rural healthcare logistics*. IRE Journals.
- Amuta, M. A. et al. (2024). *A multi-tier distribution model for enhancing last-mile delivery efficiency in rural healthcare logistics*. IRE Journals.
- Bakkabulindi, P. et al. (2024). *Improving the last mile delivery of vaccines through an informed push model in Uganda*. *PLOS Global Public Health*. <https://doi.org/10.1371/journal.pgph.0002647>.
- Bakkabulindi, P., Wafula, S. T., Ssebagereka, A., Sekibira, R., Mutebi, A., & Isunju, J. B. (2024). *Improving the last-mile delivery of vaccines through an informed push model in rural Uganda*. *PLOS Global Public Health*, 4(10). <https://doi.org/10.1371/journal.pgph.0002647>
- Banyai, T. 2018. Real-Time Decision Making in First Mile and Last Mile Logistics: How Smart Scheduling Affects Energy Efficiency of Hyperconnected Supply Chain Solutions. *Energies*, 10.3390/en11071833
- Banyai, T. 2018. Real-Time Decision Making in First Mile and Last Mile Logistics: 15(3-4):689-710.
- Chemonics International. (2023). *Optimizing last-mile distribution in Zambia: A ZAMMSA case study*. [\[chemonics.com\]](https://chemonics.com)
- Chopo, G., & Mutono-Mwanza, B. G. (2024). *Analysis of challenges of the medical supply chain: A case of Zambia Medicines and Medical Supplies Agency*. *MJAR Journal*. [\[mjar.singh...cation.com\]](https://mjar.singh...cation.com)
- GHSC-PSM. (2023). *Driving last-mile solutions to ensure access to public health commodities*. USAID Global Health Supply Chain Program. <https://www.ghsupplychain.org>

- Golan, M. S., Trump, B. D., Cegan, J. C., & Linkov, I. (2021). *The vaccine supply chain: A call for resilience analytics*. Springer.
- Hsiao, Y.-H., Chen, M.-C., Lu, K. & Chin, C.L. 2018. Last-Mile Distribution Planning for Fruit-and- Vegetable Cold Chains. *The International Journal of Logistics Management*, 10.1108/ijlm-01-2017-0002
- Hubner, A., Kuhn, H. & Wollenburg, J. 2016. Last Mile Fulfilment and Distribution in Omni-Channel Grocery Retailing: A Strategic Planning Framework. *International Journal of Retail & Distribution Management*, 10.1108/ijrdm-11-2014-0154
- Humanitarian Logistics Association. (2023). *Last-mile delivery and access to healthcare*. <https://www.humanitarianlogistics.org>
- Kar, B., & Jenamani, M. (2025). *Optimizing a multimodal hub-and-spoke network for vaccine distribution during healthcare emergencies*. *Journal of Humanitarian Logistics and Supply Chain Management*.
- Kar, B., & Jenamani, M. (2025). *Optimizing a multimodal hub-and-spoke network for vaccine distribution*. *Journal of Humanitarian Logistics and Supply Chain Management*.
- Leedom, M. (2024). *Drones deliver humanitarian aid in Africa*. Think Global Health. <https://www.thinkglobalhealth.org>
- Mogire, E., Kilbourn, P.J. & Luke, R. 2022. *The Last Mile Delivery Problem: A Kenyan Retail Perspective*. *Acta Logistica*, 10.22306/al. v9i4.329
- Mwanaumo, E. T., Kabwe, D., Mutono-Mwanza, B. G., & Misheng'u-Mwanaumo, E. (2023). *Assessing the last-mile delivery logistics of medicines and medical supplies in Zambia*. IEOM Society Proceedings. <https://ieomsociety.org>
- Mwanaumo, E. T., Kabwe, D., Mutono-Mwanza, B. G., & Misheng'u-Mwanaumo, E. (2023). *Assessing the last-mile delivery logistics of the Zambia Medicines and Medical Supplies Agency*. IEOM Society Proceedings. [\[researchgate.net\]](https://www.researchgate.net)
- Ndoye, T. (2018). *Informed Push Model of Supply Chain Management: A Meta-Analysis*. Reproductive Health Supplies Coalition.
- Noyan, N., Balcik, B. & Atakan, S. 2016. A Stochastic Optimization Model for Designing Last Mile Relief Networks. *Transportation Science*, 10.1287/trsc.2015.0621

- Olsson, J., Hellström, D. & Pålsson, H. 2019. Framework of Last Mile Logistics Research: A Systematic Review of the Literature. *Sustainability*, 10.3390/su11247131
- Pahwa, A. & Jaller, M. 2023. Assessing Last-Mile Distribution Resilience Under Demand Disruptions. *Transportation Research Part E Logistics and Transportation Review*, 10.1016/j.tre.2023.103066
- Prashant, Y. et al. (2015). *Health product supply chains in developing countries*. Health Systems & Reform / JSTOR.
- Project Last Mile. (2019). *Optimising last-mile delivery in public health in Africa*. <https://www.projectlastmile.com>
- Rafael, A.-A., Roel, G. & Dewulf, W. 2023. Strategic Multi-Echelon and Cross-Modal CO₂ Emissions Calculation in Parcel Distribution Networks: First Step Toward a Common Language. *Transportation Research Record Journal of the Transportation Research Board*, 10.1177/03611981221149431
- Rashidzadeh, E., Molana, S.M.H., Soltani, R. & Hafezalkotob, A. 2021. Assessing the Sustainability of Using Drone Technology for Last-Mile Delivery in a Blood Supply Chain. *Journal of Modelling in Management*, 10.1108/jm2-09-2020-0241
- Saenz-Esteruelas, J., Figliozzi, M., Serrano, A. & Faulin, J. 2016. Electrifying Last-Mile Deliveries: A Carbon Footprint Comparison Between Internal Combustion Engine and Electric Vehicles. 10.1007/978-3-319-39595-1_8
- USAID GHSC-PSM. (2024). *Zambia National Supply Chain Assessment Report*. [\[ghsupplychain.org\]](https://ghsupplychain.org)
- Weber, A.N. & Badenhorst-Weiss, J.A. 2018. The Last-Mile Logistical Challenges of an Omnichannel Grocery Retailer: A South African Perspective. *Journal of Transport and Supply Chain Management*, 10.4102/jtscm.v12i0.398
- Wei, Q., Li, L., Liu, S. & Shen, Z.J.M. 2018. Shared Mobility for Last-Mile Delivery: Design, Operational Prescriptions, and Environmental Impact. *Manufacturing & Service Operations Management*, 10.1287/msom.2017.0683

Xu, J., Li, X., Pan, Y. & Du, M. 2022. Satisfaction of Logistics Dispatchers Who Use Electric Tricycles for the Last Mile of Delivery: Perspective From Policy Intervention. *Sustainability*, 10.3390/su14137638

APPENDIX

A: QUESTIONNAIRE

Section A: Respondents Demographic Data

1. How long have you worked for your institution?

.....

2. What is your highest level of education attained?

a) Secondary () b (Diploma () c1) Degree d) Masters Degree ()

b) PhD () f) Other

Section B: Assess the effectiveness of ZAMMSA's regional hub model in ensuring last-mile delivery of medicines and medical Supplies

3. State some of the type of transportation system used in executing of works in your institution?

.....

.....

.....

.....

4. Do you think the current last-mile logistic practice is effective in improving the efficiency of service delivery of medicine and medical supplies?

a) Yes () b) No ()

5. How would you rate the effectiveness of last-mile logistic on timely delivery of medicine and medical supplies?

a) Very effective () b) Effective () c) Less effective () d) Not effective ()

Section C: Establish the establish the influence of last-mile logistic on timely delivery of medicines and medical Supplies

7. From your experience do you think last-mile logistic has an influence on timely delivery of medicine and medical supplies? Explain:

.....

.....

.....

.....

.....

.....

.....

8. In a scale of 1-5, *1-Strongly Agree, 2-Agree, 3-Neutral, 4-Disagree, 5- Strongly Disagree*. Indicate the level of agreement regarding the following statements:

	Influence of last-mile logistic on timely delivery of medicines	Tick				
		1	2	3	4	5
a	Effective last-mile logistic practices ensures accountability and transparency					
b	Effective last-mile logistic prevents legal and financial risk					

c	Effective last-mile logistic improves flexibility in service delivery of medicine and medical supplies					
d	Effective last-mile logistic improves service delivery in terms of quality					
e	Effective last-mile logistic improves supplier relationship					
f	Effective last-mile logistic helps to reduce fraud in medicine and medical supplies					
g	Effective last-mile logistic speeds up transaction involved in managing medicine and medical supplies					
	Others specify:					

Section C: Logistical challenges affecting last-mile distribution of medical supplies

9. Rate the following factors affecting last-mile distribution of medical supplies by ticking.

	Challenges	Rating (Please Tick)	
		Yes	No
a)	Unfavourable policies and legislation and strong political influence limiting governments from investing in the transportation and delivery system		
b)	Non-transparent procurement practices supply chain management		
c)	Insufficient national infrastructure, for example, electricity, Inland accessibility (roads, rail), accessible water ways		
d)	Poor preparation of tender procurements and contract terms and conditions		
e)	Loss of trust in the transportation and delivery system by the public and government (low buy-in)		
f)	Disconnect between transport and logistics stakeholders, for example, ZAMMSA and MoH, management and employees		
g)	Lack of proper records keeping and documentation affects supply chain management		
h)	Insufficient investment in research and development, human capacity building and human capital building		
i)	Low ICT integration in last mile operations, insufficient ICT infrastructure and poor interconnectivity		

j)	Lack of effective communication among the supply chain team affects supply chain management		
j)	Delays and challenges with international deliveries of medicines due to interlining agreements and customs duty clearance		
k)	Low/insufficient skilled manpower in transport and logistics at ZAMMSA		
l)	Political Interferences affects supply chain management		
	Others specify:		

Section D: Establishing potential strategies for optimizing last-mile distribution and improving supply chain efficiency

10. How can last-mile logistic be improved in timely delivery of medicine and medical supplies in public sector?

.....

.....

.....

.....

.....

.....

.....

.....

Thank you for your cooperation