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The Effect of Drug Supply Shortages on Hospital Logistics Performance and Patient Care: A Case Study at Public Hospitals in Adama Town, Ethiopia

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GSE/3329/16

Submitted to the College of Business and Economics in partial fulfillment of the requirement for the degree of Master's in Logistics and Supply Chain Management

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I have supervised, read, and reviewed the above thesis/dissertation on the title of "The The effect of Drug Supply Shortages on Logistics Performance and Patient Care:A Case Study at Public Hospitals in Adama City of Ethiopia" by Mesfin Mamuye, and I recommend that the thesis/dissertation be submitted for defense.

Dr. Zelalem Bayisa (PhD)

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I hereby declare that the thesis, "The effect of Drug Supply Shortages on Hospital Logistics Performance and Patient Care: A Cross-sectional Mixed-Methods Study at Public Hospitals in Adama," is entirely original and was completed under the direction and supervision of Dr. Zelalem Bayisa (PhD). It is my work, and all contributions from any other persons or sources are properly and duly cited. I further declare that the material has not been submitted either in whole or in part for a degree at this or any other university. In making this declaration, I understand and acknowledge that any breaches in this declaration constitute academic misconduct, which may result in my expulsion from the program and/or exclusion from the award of the degree.

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This is to certify the thesis under the title of **"The effect of Drug Supply Shortages on Hospital Logistics Performance and Patient Care: A Cross-Sectional Mixed-Methods Study at Public Hospitals in Adama.** Submitted in partial fulfillment of the requirements for the degree of Master with specialization in Logistics and Supply Chain Management ,the postgraduate student program of the Addis Ababa University School of Commerce has been carried outby **Mesfin Mamuye** under my supervision; therefore, I recommend that the student has fulfilled the requirements and hence hereby submit the thesis progress to the institute.

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List of abbreviations

AHMC- Adama Hospital and Medical College

AIDS—Acquired Immune Deficiency Syndrome

CI- Confidence Interval

DV- Dependent Variable

EML- Essential Medicine List

EPSA- Ethiopian Pharmaceutical Supply Agency

FEFO- First Expiry, First Out

FIFO- First In, First Out

HMIS- Health Management Information System

HSC- Health Supply Chain

IV- Independent Variables

LMIS- Logistics Management Information System

MOH- Ministry of Health(Ethiopia)

OPD-Outpatient Department

STG- Standard Treatment Guideline

WHO- World Health Organization

PFSA- Pharmaceutical Fund and Supply Agency

SCM- Supply Chain Management

SPSS - Statistical Package for Social Sciences

EPSA- Ethiopian Pharmaceutical Supply Agency

FMHACA - Food**,**Medicine, and Health Care Administration and Control Authority

HMIS- Health Management Information System

HSDP- Health Sector Development Program

LMIS- Logistics Management Information System

EOQ:- Economic Order Quantity

Abstract

Drug supply shortages are one of the most critical issues public health systems are facing in sub-Saharan Africa, with considerable impact on hospital logistics performance and quality of patient care. This study explores the effects of drug supply shortages on hospital logistics performance and patient care at three public hospitals in Adama town of Oromia Regional State: Adama Hospital and Medical College (AHMC), Musie General Hospital, and Bati Hospital.This mixed-method approach applied a structured questionnaire that was administered to 229 health professionals, pharmacists, procurement officers, and logistics professionals, plus key informant interviews with 15 senior administrators and observations. Secondary data was collected from the hospital stock ledger, dispensing records, and procurement reports for financial years 2024/25 to 2025/26.The findings from the study demonstrated that all three hospitals face continuous shortages in essential medicine stock and have an average stock-out rate of 34.7 percent during the study period. Regression analysis revealed that drug supply shortage severity (β=-0.512, $p < 0.001$), procurement inefficiency (β = -0.341, $p < 0.001$), and storage capacity inadequacy (β = -0.287, $p = 0.003$) were significant negative predictors of logistics performance ($R^2 = 0.572$). ANOVA indicated significant differences in perceived patient care quality across hospital levels ($F = 18.34$, $p < 0.001$). Pearson correlation showed a strong negative relationship between stockout frequency and patient satisfaction ($r = -0.631$, $p < 0.001$). Qualitative findings corroborated these results, with healthcare providers describing treatment delays, prescription substitutions, and patient distress as common consequences of supply shortages. The study recommended strengthening quantification and forecasting, decentralization of emergency procurement decision power, application of HMIS, improved supplier contract management, and wide use of buffer stock policy. These findings are contributing to the body of evidence in Ethiopia's pharmaceutical supply chain reform and would provide practical implications for hospitals, administrators, health professionals, and policymakers

Keywords: *Drug Supply Shortages, Logistics Performance, Patient Care, Supply Chain*

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CHAPTER ONE: INTRODUCTION

1.1 Background study

Lack of availability of drugs at the health facility level has been a serious issue confronting health system in low- and middle-income countries (LMICs), especially when the financial constraints are a challenge for health systems. Hospitals and the services they provide need consistent and timely availability of a broad range of essential medicines for successful treatment and well-functioning logistics performance. When there are shortages, it affects the procurement system and the stock keeping as well as the delivery systems, which leads to treatment interruptions, lower quality health care, and increased workload for the health care providers. Regular availability of essential medicine is critical to health systems. (WHO, 2023; Management Sciences for Health, 2012; Wagenaar et al., 2014).

Globally, research has demonstrated drug shortages increase hospital costs and operational workload and make clinicians opt for less appropriate and often costly drug therapy. Locally, however, there is limited evidence describing how exactly drug shortages affect hospital logistics performance and patient care in Ethiopian public hospitals. Availability of drugs has a direct influence on treatment outcomes of patients, hospital productivity, and the quality of care offered in general. Shortages of medicine are commonplace and are considered one of the serious public health problems in most LMICs, including Ethiopia (WHO, 2019).

In Ethiopia, public hospitals in Adama have been suffering from various recurrent drug shortage problems caused by such things as poor supply chain infrastructure, limited financial resources, dependence on foreign suppliers, and inefficiency of forecasting and procurement systems, which directly influence hospital logistics such as stock keeping, storage, and distribution as well as patient outcomes in terms of interruptions of treatment, increased morbidity, and decreased trustworthiness of the health system. Considering Adama is one of the largest urban centers and has a large amount of medical demand, we have to look at it from all points of view.

By conducting a cross-sectional mixed-methods study, it enables both quantitative measurement of the relevant logistics performance indicators and qualitative insight of the experiences of the patient and providers. Investigation of the The effect of Drug Supply Shortages at public hospitals of Adama would assist evidence-based intervention and improve the health service

supply chain logistics and management and eventually the health care services delivery in the health system.(FMOH, 2021; EPSA, 2023; Bizuneh et al., 2020).

"Drug supply shortage" refers to a lack of adequate quantities of drugs to meet the demand from patients. Poor demand forecasting, manufacturers having insufficient manufacturing capacity, late delivery of procurements, lack of finance, government regulations, transport-relatedproblems, and poor inventory management are just a sample of multiple factors intertwined causing drug shortages (Management Sciences for Health, 2021; WHO, 2016). Shortages of life-saving drugs like antibiotics, antimalarials, antihypertensives, emergency obstetrics medicines, pediatrics formulations, etc. remain a common and ever-existing problem in many areas, including Addis Ababa and Oromia, to mention but a few of them, notwithstanding the existence of the Ethiopian Pharmaceutical Supply Agency (EPSA) (Girma et al., 2021, 2022).

In Adama town, one of the fastest and largest towns in Ethiopia, there are three public hospitals.

- Musie General Hospital
- Adama Hospital Medical College (AHMC)
- Bati Hospital

These three hospitals have served several hundred thousand people in the surrounding area and thus need to have a reliable and functional pharmaceutical supply chain. Based on interviews with staff and administrative data, shortage of various essential medicines occurs on a frequent basis and resulted in interruptions in the treatment of patients, transfer of patients to other hospitals and logistic challenges which severely affect quality patient care (Oromia Health Bureau, 2022; EPSA Adama Branch Report, 2023). Hence, it is crucial to understand the extent to which drug shortages impact patient care and logistics performance at public hospitals in Adama town and then to implement policy-based actions.

1.2 Background of Study Area (Public Hospitals in Adama Town)

Adama Hospital Medical College (AHMC) is one of the tertiary teaching and referral hospitals annually serving over 5 million people in the Oromia Region and its surroundings. It provides several health services, including emergency, surgical, maternity, pediatric, chronic disease management, and ambulatory services (Oromia Health Bureau, 2022).

Musie General Hospital: A general hospital providinga full range of medical, surgical, pediatric, maternity, and emergency services. It serves as the main reference for neighboring woredas in the Adama catchment area (Federal Ministry of Health, 2021).

Bati Hospital is a primary health care hospital providing minimum emergency services, maternal and child health services, and an outpatient department for low-income groups from rural areas and peri-urban areas (Oromia Health Bureau, 2022).All three hospitals procure their drugs and other pharmaceutical items from EPSA. Nevertheless, EPSA has been widely reported to experience problems of delayed supply, partial fill orders, under-stocking, and intermittent stock levels that result in recurrent stock-outs of essential medicines across government health facilities (EPSA, 2022; Tadeg et al., 2014).

1.3 Statement of problem

Drug shortage has been a chronic problem in Ethiopian public hospitals, especially in rapid growing urban centers like Adama City. Availability of medicines is a fundamental component of a functioning health system, but the reports show that essential drugs are repeatedly out of stock in public hospitals causing deterioration of logistics performance and ultimately of patients' care. According to Ethiopian Pharmaceutical Supply Agency (EPSA, 2023) about 40% of public hospitals in Oromia region reported repeated stock outs of essential medicines with the duration ranging from two weeks to over a month. Drug shortages in public hospitals not only cause treatment delays but also prompt patients to seek alternatives in the expensive private sector, thus widening health disparities.

Quantitative findings confirm this problem. WHO (2022) states that absence of drugs may increase the waiting times by 25-30% and cause drug interruptions by 20% in sub-Saharan Africa. Haddis et al (2022) showed that in Ethiopian public hospitals, in more than 60% of cases the prescribed drugs were not available on time owing to medicine shortage; and it is adversely affecting the quality of care as well as patient satisfaction. The Logistics performance indicators like, rate of stock turnover of drugs, lead-time required for receiving of drugs and rate of fill of order are negatively influenced. Gebre (2024) found that stock out hospitals possess inventory accuracy less than 70% compared to no stock out hospitals (>90%).

The impact of this problem on patients is substantial. The shortages of drugs, for example, antibiotics, antimalarial and treatment for chronic disease (e.g. Insulin, antihypertensive) have been directly linked to morbidity and avoidable mortality.

In Adama City, based on preliminary data from Oromia Health Bureau (2025) about 35% of chronically ill patients were found to be at risk of treatment interruptions due to unavailability of drugs, while 20% of emergency patients experienced delays in the availability of essential medicines, reflecting double challenges; ineffective logistics system and ineffective treatment of patients. Problem of lack of proper communication between hospitals, suppliers and drug supply agencies also exacerbates inefficiencies in forecasting and procurement.

Despite the prevalence of the problem, there is limited empirical data that quantitatively establish the The effect of Drug Supply Shortages on hospital logistics performance and patients' care in Ethiopia. Most of the previous studies on supply chain problems in Ethiopia have primarily focused on general inefficiencies in the supply chain without establishing a direct causal link between drug shortages, hospital logistics performance and patient's care in the country. This gap needs to be filled with a mixed methods study, quantitatively assessing the extent of drug shortages and their impact on logistics performance and patients' care at public hospitals in Adama City. Addressing the problem is critical to improve the functioning of the public health system and equity of access to medicines in Ethiopia.

1.4 Research purpose

The overall purpose of this study is to explore the influence of drug supply shortage on hospital logistics performance and patient care at public hospitals in Adama. The specific objectives are to analyze how the shortage of indispensable medicines affects the system of purchasing, warehousing, and distribution and, therefore, hospital logistics performance and to assess how drug shortages influence patient care, like delays of treatment, quality of care, and patient satisfaction.

The study will be conducted using a cross-sectional mixed methods design in order to draw both qualitative evidence and quantitative results that have a clearer picture of the problem. Finally, the results of the study will be used to offer concrete recommendations to policymakers, hospital administrators, and supply chain managers to improve the drug supply system and thus enhance hospital logistics and patient care in public hospitals of Adama.

1.5 Research Questions

Based on the purpose of the research, the researcher developed these research questions.

1. How do drug supply shortages influence hospital logistics performance: procurement, inventory management, and distribution?
2. In what way do drug shortages influence patient care outcomes: delays, quality of care, and satisfaction?
3. What are the factors causing and perpetuating drug supply shortages in public hospitals in Adama town?

1.6 Research Objectives

The research questions are addressed through the following objectives, which provide a sequential path to answer these questions.

1.6.1 General objective

The general objective of the study is to assess the effect of Drug Supply Shortages on hospital logistics performance and patient care in public hospitals in Adama town.

1.6.2 Specific objectives

1. To assess the impact of drug shortage on the logistic performance of the hospital system, in terms of procurement, inventory management, and distribution.
2. To assess the impact of drug shortage on patient care outcomes in terms of delays, quality of care, and satisfaction of patients.
3. To identify the major systemic problems causing the drug supply shortage in public hospitals of Adama town.

1.7 Scope of the Study

The scope of this study focuses on examining the effect of Drug Supply Shortages on hospital logistics performance and patient care within public hospitals in Adama City, Ethiopia. Geographically, the research is limited to Adama, including all three public hospitals in Adama Town: AHMC, Musie General Hospital, and Bati Hospital, where public hospitals serve a large urban and peri-urban population. In terms of scope, the paper focuses on the logistical and

pharmacy departments as well as patient care units in the hospitals in order to know how shortages interfere with the procurement process, store management and control, distribution, and emergency measures.

In terms of theme, the study looks into two aspects: the logistic performance at the hospital level (effectiveness, responsiveness, and the supply chain resilience) and the patient care quality and outcomes (treatment delay, quality of care, and patient satisfaction). In terms of time scope, the paper uses data and knowledge from the last three to five years (as shortages have become a recurrent problem in Ethiopia). The actors that have been targeted are hospital administrators, pharmacists, logistics officers, healthcare providers, and patients receiving the drug shortage-related impact. It explicitly excluded private hospitals, wider dynamics outside Adama in the pharmaceutical industry, and non-drug medical supplies for focused research and to ensure the findings areactionable.

1.8 Significance of Study

The findings of this research will be significant for several of the Ethiopian hospitals and other governmental stakeholders. This study is significant because it addresses a critical challenge in Ethiopia’s healthcare system: drug supply shortages and their impact on hospital logistics and patient care. The case of Adama's public hospitals as part of the scope of research provides evidence in the specific context about the way shortages negatively affect the procurement process, inventory, and distribution, therefore reducing the performance of hospital logistics. The study also gives insights about its direct impact on the patient: treatment delay, care quality degradation and patients’ satisfaction. From academic perspective, the study aims to fill the gap in the existing empirical literature on the inter relationship between SCM and health care delivery in the context of Ethiopia.

The study's practical utility lies in providing relevant information to policy makers, hospital managers and supply chain practitioners to understand and address the underlying causes of drug shortages and also offering solutions for a more robust drug supply chain. The findings will ultimately help to better serve patients, providers and healthcare facilities by creating more robust logistics practice and ensure the quality of care in public hospitals.

This research will be emphasizing on:

- Provide actionable insights into hospital management.
- Animate supply chain inefficiencies for EPSA.
- Support policymakers in designing interventions that reduce drug shortages.
- Provide high-quality patient care based on supply chain gaps.
- Contribute to academic literature on Ethiopian pharmaceutical logistics.
- Serve as a reference for future researchers.

1.9 Limitations of the Study

This study is characterized by various methodological and pragmatic limitations. Firstly, the study only includes public hospitals in Adama and therefore, it cannot represent private sectors or another region in Ethiopia. Secondly, the cross-sectional study design only assesses the status at one point in time and cannot fully represent seasonal and long-term variations in drug supply shortages.

Thirdly, there is risk of response bias since data relies on self-reported information by health providers and patients. As such patients and health professionals might be inclined to under report or over report the problem. Also, the hospital records and logistic data might not readily be accessible and hence could be affected by administrative constraint, restricting the extent of quantitative analysis.

Additionally, logistic constraints such as time and financial limitations might compromise sample size and the strength of the statistical evidence. Although all the limitations could reduce the internal validity of the study, they will provide unique input to study the issue of drug supply shortage effect to hospital logistics system and patient service in Adama. Furthermore, it also has limitations such as:

- In complete pharmaceutical logistic record
- Limited time to collect data and observation
- Response bias in that patients and health professionals afraid of system problems may show it as it is but also may tend to answer certain questions in certain questions due to lack of anonymity of the study;
- The study was designed in public sectors and results may not generalize to private sectors of the health sector in the country.

1.10 Definition of Key Terms

For conceptual clarity, the following key terms are defined in the specific sense used in this study:

Drug Supply Shortages: Refers to a state of unavailability or insufficient supply of vital medications to meet patient needs as a result of a disruption in ordering, distribution or stock keeping at hospital level.

Hospital Logistics Performance: The ability of hospitals to perform, effectively and efficiently, activities related to their supply chains.

Patient Care: Provision of healthcare to a patient which includes quality of treatment provided, timely manner in which care is provided and the safety, as well as satisfaction, of the medical service.

Public Hospitals: State-owned hospitals delivering health care services to public but may have insufficient resources as compared to private hospitals.

Procurement: process by which goods and services are acquired for hospitals from suppliers. It includes tenders, purchase order placement, and contracting and purchasing activities.

Inventory Management: Control over the stock of drugs within hospitals.

Supply Chain: The combination of organization, people, activities, resources, information and technology required to deliver medicines from manufacturers to hospital level and finally to the patients.

Treatment Delay: Postponement or suspension of the required treatment because the appropriate medicine is not available.

1.11 Benefits and Beneficiaries

Expected Benefits of the Research

- This study primarily benefits Ethiopian health institutes, and Adama city community.
- It has a positive effect for the health sector and for the public community.
- Recommend policies to the government, and policymakers use them as a base to construct policies.

Expected Beneficiaries from Research

- Academic researchers and students
- Ethiopian health institute
- Minister of Health
- Hospitals
- Stakeholders
- Policy makers and government bodies

1.12 Organization of the Study

To present the research results clearly and in an organized way, this study is split into ***five chapters.*** It is arranged as follows.

Chapter One gives an overview of the study. It includes background information, the problem being studied, the goals of the research, its importance, the scope, any limitations, and the overall structure.

Chapter Two is a review of the literature related to the The effect of Drug Supply Shortages on logistics performance and patient. It looks at both the practical and theoretical studies on in Adama, Ethiopia, and in different parts of the world, including globally, in Africa, and specifically in Ethiopia. It also explains the gaps in current research that support this study and identifies the challenges and problems that hinder drug supply on logistics performance.

Chapter Three clarifies the research methods. It describes all aspects of the research processes starting from research design until the last stage of analysis, which studies the The effect of Drug Supply Shortages on logistics performance and patient through specific methods.

Chapter Four describes and discusses the findings using relevant statistical methods. The results are explained with respect to the research questions, objectives, and theoretical background.

Chapter Five summarizes the main findings, draws conclusions, and gives recommendations for leaders, those involved in the process, and future research based on the results of this study.

CHAPTER TWO: REVIEW OF RELATED LITERATURE

2.1 Introduction

This research starts with a detailed review of the literature to gain an understanding of associated with drug supply shortages, hospital logistics performance, and patient care outcomes in Adama Hospitals, as presented by different researchers, to build a strong base. In this chapter, a review of the relevant literature on the research problem has been conducted extensively. It covers the theories that guide the drug supply shortages, hospital logistics performance, and patient care outcomes, analyzes past research on the topic done by other scholars.

This review gives information about the gaps between theories and policies that inform the needs based on different reviews of related works. We covered the theoretical review, conceptual framework, and empirical reviews of the drug supply shortages, hospital logistics performance, and patient care outcomes. Finally, this chapter incorporates theoretical perspectives, global and local empirical findings, and identifies research gaps pertinent to the proposed study and it provides a conceptual framework that shows the relationship between the key variables.

2.2 Theoretical Review of Literature

This section of the study focuses on established theories, and the literature review establishes the academic theories through which the study analyzes the effect of Drug Supply Shortages on logistics performance and patient. Various theoretical views offer clearer insight for better understanding of the effect of Drug Supply Shortages on logistics performance and patient in the setting of Ethiopia, Adama. The following are the most important theories:

Drug Supply Shortages: Definition and Classification

The literature offers several definitions of drug supply shortages, reflecting different regulatory, clinical, and operational perspectives. The U.S. Food and Drug Administration (FDA) define a drug shortage as a period when the supply of a drug is inadequate to meet current or projected demand at the patient or consumer level. The WHO broadens this to include situations where the supply of medicine fails to meet patient demand at the point of care, regardless of stock availability higher in the supply chain.

For this study, drug shortage is operationalized as any instance in which a required medicine was

unavailable in the hospital pharmacy for a period of 24 hours or more, consistent with operational definitions used in comparable sub-Saharan African studies (Waako et al., 2009; Getahun et al., 2017).

Drug shortages can be classified along multiple dimensions. By severity, they range from minor shortfalls (limited impact on care) to critical shortages (treatment interruption). In terms of duration, the shortages range from acute (under one week), sub-acute (one to four weeks), to chronic (over one month), while according to the medicine category, shortages can be classified with the VEN (Vital, Essential, Non-Essential) approach where shortages in the vital categories (those with life-saving properties, preventing disability or treating conditions with serious clinical implications) pose the most severe implications to patient care.

Alternatively, the ABC (Always, Better, Control) inventory classification method can be used to further categorize medicines into high-value (A), medium-value (B) and low-value (C) which facilitate focused management attention. However, the combination of VEN and ABC classifications (especially for the VA category) are the medicines that most warrant avoiding stock-outs.

Pharmaceutical Supply Chain Management

The pharmaceutical supply chain encompasses the full sequence of activities from the selection and quantification of medicines, through procurement and manufacturing, quality assurance, storage and distribution, to dispensing at the facility level. Management Information Group (MIG) classifies pharmaceutical supply chain functions into six core activities: selection, quantification, procurement, storage, distribution, and use collectively known as the pharmaceutical management cycle.

Effective pharmaceutical supply chain management in low-and middle-income countries (LMICs) requires the alignment of forecasting systems with actual consumption patterns, reliable financing mechanisms, supplier qualification and contract management, cold chain and storage infrastructure, distribution logistics, and dispensing-level record keeping. The failure of any single component can generate downstream shortages with clinical consequences.

Availability of medicines in the public sector supply chains falls squarely on the shoulders of the state. In Ethiopia, this role is mandated through EPSA, which employs a hub-and-spoke supply

chain structure where regional hubs supply drugs to the zonal, and then district stores, which then serve the health facilities. Although substantial investments have been made institutionally in such a model, it has shown vulnerability in issues such as quantification errors, insufficient budgets, contractor failures and transport breakdowns.

According to scholars such as Yadav et al. (2011), Privett &Gonsalvez (2014), and Hasselback et al. (2020), public pharmaceutical supply chain in Sub-Saharan Africa suffers from "last mile" problem, i.e., despite medicines being available nationally, logistical and financial problems often prevent drugs from reaching the facility-level stocks. This is also relevant to hospital-level supply chain in secondary cities like Adama.

2.3 Global and African Context

Drug supply shortages are not unique to Ethiopia or sub-Saharan Africa; they affect health systems worldwide. High income countries primarily suffer from manufacturing and market concentration risks, regulatory delays, and just-in-time supply chain risks. The pandemic highlighted, for the first time at a global scale, the weakness of global pharmaceutical supply chains. This led to a worldwide shortage of drugs that are indispensable for intensive care units like sedatives, analgesics and antimicrobials.

In contrast, the problems for sub-Saharan Africa are structural, chronic and related to a severely underdeveloped national pharmaceutical industry, import dependency, frail supply chain infrastructure, and limited public health finance and management capabilities. The WHO Africa Region reports that essential medicine availability at public health facilities is low (between 38-57%) with a significant gap compared to the target of 80%, and a large range of variation across countries and facilities.

Supply chain disruptions have led to patient suffering in a number of countries, including Kenya, Tanzania, Uganda, Nigeria, Ghana and many more, and multi-country studies such as Cameron et al. (2011) highlight a structural deficit of medicine availability in the public health sector, which is consistently lower than in private pharmacies.

2.4 Global Overview of the Drug Supply Crisis

A global health systems crisis, drug shortages have been present since the mid-2000s, and manifest in similar but importantly different ways across high, middle, and low-income countries. Within the US and Europe, the supply crisis is largely the result of manufacturing interruptions, regulatory problems, mergers and acquisitions, and the economics of generic drug markets. A 2009 US FDA report estimated 163 drugs to be in shortage, with those critical in critical care, oncology, and as injectable anesthetics among the most prominent in the US. In the LMIC context shortages are often due to a combination of poor procurement processes, foreign exchange limits, poor planning and forecasting, supply chain storage, cold chain capacity deficits, and the sheer structural dependence on limited number of international sources and manufacturers. Although the WHO Essential Medicines initiative was introduced in 1977 partly to alleviate such issues, progress to date has been erratic. A systematic review of 2013 showed that availability of essential medicines in public health facilities in LMICs averages only 52%, although available at hospitals are always higher than at primary care, but still not sufficient. Hospital-level shortages of certain essential medicines have been linked to worse patient outcomes, failure to adhere to treatment guidelines and noticeable negative changes in quality-of-care indices.

2.1 Drug Shortages in Sub-Saharan Africa and Ethiopia

Sub-Saharan Africa bears a disproportionate burden of medicine stockouts, reflecting broader structural weaknesses in health financing, supply chain governance, and infrastructure. Studies across Nigeria, Kenya, Tanzania, Uganda, and Mozambique have documented hospital-level stock out rates ranging from 28% to 71% of essential medicines at any given time. Common root causes include inadequate quantification and forecasting at facility level, bureaucratic procurement processes, poor inventory management, transportation failures, and increasingly the distortionary effects of donor vertical programming that creates parallel supply chains for specific disease areas (HIV/AIDS, malaria, tuberculosis) while neglecting the broader essential medicine supply.

In Ethiopia, the pharmaceutical supply chain was reformed following the establishment of the EPSS (previously known as PFSA) in 2007. Despite investment in a hub-and-spoke distribution

model and integration of the Integrated Pharmaceutical Logistics System (IPLS), stockouts are a recurring issue. According to a 2021 Clinton Health Access Initiative (CHAI) evaluation of public hospitals in Oromia Region, 38% of essential medicines in these institutions suffered from one or more episodes of stockout during the previous 12 months with durations varying from 18-45 days. Similar observations have been made in studies at the Jimma University Medical Center, the Tikur Anbessa Specialized Hospital and health facilities in Amhara Region, but have not been reported at the hospital network of Adama Town.

2.2 Drugs shortage in Ethiopia context

In Ethiopia, the pharmaceutical supply chain is characterized by far-reaching institutional reform since early 2000s including establishment of PFSA (restructured into EPSA in 2019), the Ethiopian pharmaceutical supply agency strategic plan, introduction of LMIS (integrated with DHIS2), and the Ethiopian Essential Medicines list (currently in 6 th edition).

Despite all these institutional reforms, the essential drug shortage still occurs at the facility level. Ethiopian Demographic Health survey (EDHS 2019) and MICS survey indicate that considerable percentage of health facilities has got recurrent shortages of priority drugs like anti-malaria diagnosis and treatment drugs, maternal care drugs and chronic illness drugs.

A study by Gelayee and Mekonnen (2017) in Gondar revealed stockout of tracer drug as 29.7% at a teaching hospital, and Kassahun et al (2019) in Amhara Regional Statepublic hospitals have reported 42.3% of stock out rate of drugs at public hospitals. Tesfaye et al (2020) in Addis Ababa hospitals revealed association between pharmaceutical shortage and high rates of patient non-adherence and treatment interruption. In contrary, similar information on Oromia Regional State public hospitals in general, and Adama in particular, has not been widely reported.

2.3 How Drug Supply Shortages affect hospital logistics performance.

Hospital logistics performance refers to the effectiveness, efficiency, and responsiveness of all medicines and medical supplies processes ranging from procurement to storage, distribution, and dispensing in the hospital. Its key performance indicators include: stockout rate, average duration of stock out, rate of order fill, inventory turnover rate, lead time in procurement, number and costs of emergency procurement, expiry rate (waste) of products and accuracy and time in dispensing of medicines.

Drug supply shortages directly impact on hospital logistics performance on many parameters at once. Stockouts lead to unplanned and most of the time costly emergency procurements that at high cost may depletion of pharmacy budgets and deviation from scheduled procurement activities, emergency purchasing process of drugs can lead to procurement of low-quality drugs because of compromising quality checks in an urgency, shortage also forces pharmacy staff to expend time and effort in finding alternative drugs, record-keeping, etc that indirectly impact pharmacy productivity and may reduce it by affecting the flow and capacity.

Evidence from Kenya and Uganda shows that health facilities with frequent stock outs spent as high as 35% more per medicine because of the additional prices on medicines and also it diverts the funds that were allocated for purchasing medicines that are not critical. Further, shortages tend to destroy inventory data: When pharmacy staff borrow medicines from other hospitals, informal borrowing between wards, or substitutes being stocked under codes of originally procured medicines, Standard pharmacy computer system displays wrong figures of stock-in-hand that are of low accuracy for quantifying and forecasting activities. This then leads to wrong decision making, causing a loop. In effect, drug shortages make hospital logistics performance to be very poor.

2.4 The effect of Drug Supply Shortages on Patient Care

The patient care consequences of drug supply shortages span clinical, psychological, financial, and equity dimensions. Clinically, shortages force prescribers to use second-line or substitute medicines that may be less effective, more toxic, less familiar, or associated with drug interactions do not present with the intended medication. In resource-constrained settings where treatment guidelines are tightly calibrated to essential medicine availability, these substitutions can have serious clinical consequences.

Maternal health is particularly vulnerable: stockouts of oxytocin, misoprostol, and magnesium sulphate have been directly linked to preventable maternal mortality in multiple African settings.

Beyond direct clinical impacts, shortages erode patient trust in the public health system, driving health-seeking behavior towards private facilities and traditional medicine both of which may be financially inaccessible or clinically inappropriate for the presenting condition.

Qualitative research across Ethiopia has consistently found that patients and caregivers report drug unavailability as one of the primary reasons for bypassing nearby public facilities in favor of more distant or private providers. For patients managing chronic conditions HIV, tuberculosis, diabetes, hypertension, epilepsy treatment interruptions caused by medicine stockouts are associated with drug resistance, disease progression, acute crises (hypertensive emergencies, diabetic ketoacidosis), and preventable hospitalization. These downstream costs are rarely captured in simple stockout frequency statistics, making qualitative and mixed-methods research essential for fully capturing the burden.

Treatment delays and interruptions are the most common ways in which drug shortages impact patient care (Donabedian, 2005; Van den Bosch et al., 2018). Clinicians may be forced to switch to less effective or more toxic therapeutic alternatives, which may then compromise treatment outcomes (De Weerdt et al., 2017. Inadequate therapy due to lack of availability of essential medicines leads to increased complications and thus poor disease control. Shortages often result in referrals to alternative health facilities where drugs are stocked, which increase the burden of both patients and the health facility. Patients also bear the additional cost to procure from private pharmacies if the drug is unavailable from public pharmacies (Desalegn et al., 2019).

Patient satisfaction with services offered by the public hospital, and patient trust in it is eroded by the drug shortages (Wondimu et al., 2023; Fentie et al., 2020). It is also associated with prolonged hospitalization, particularly for chronic diseases and emergencies. High morbidity and mortality rates were also observed with essential drug shortages impact timely and life-saving interventions (WHO 2016; EMA 2019). Patient with chronic diseases such as hypertension, diabetes, asthma and epilepsy, are most affected by interruptions to their therapy.

The clinical and patient experiences with drug shortages have been documented across the world regarding medication cessation, poor clinical outcomes, patient dissatisfaction and financial implications.

2.8.1 Treatment interruption and switching:

When prescribed drugs are not available, three courses of action may be pursued: (1) wait for the drug to be available; (2) switch to an alternative therapy, or (3) discontinue treatment all together. Each of these has clinical implications.

Waiting for drugs to become available may allow for significant deterioration of the condition being treated, especially in acute settings such as those occurring in patients with sepsis, malaria, or obstetrical emergencies. Switching may result in the substitution of less effective or more toxic drugs, or drugs that are not therapeutically equivalent. Yadav et al. (2011) found that in public health facilities in sub-Saharan Africa approximately 35-45% of all essential drug shortages are met by pharmacist-initiated switching to an alternative drug in the absence of appropriate patient counseling or physician endorsement, leading to patient safety concerns.

2.8.2 Patient waiting times and flow:

A direct consequence of drug shortages is that patient flow within the healthcare facility will be impeded as those without access to their prescribed drugs wait until it is available, are sent elsewhere, or must return for their prescriptions. The consequences include decreased throughput of patient and consequently increased cost per patient, in addition to patient frustration. Waiting times at pharmacy facilities in Ethiopian settings have been observed to be between 40-60% longer in shortage times versus when drugs were available (Gebre-Mariam et al., 2015).

2.8.3 Patient Satisfaction and Health-Seeking Behavior

Drug shortages significantly reduce patient satisfaction and erode trust in public health facilities, contributing to care-seeking migration to private facilities, increasing out-of-pocket costs or to facility avoidance, delaying needed care. Getahun et al. (2017) found that Ethiopian patients who experienced medicine unavailability at public facilities were 2.4 times more likely to self-medicate or seek informal treatment, exposing them to risks of antimicrobial resistance and subtherapeutic dosing.

2.8.4 Clinical outcomes and side effects.

In critical care environment, lack of important medicines can have life-threatening outcomes. Shortages of antibiotics, antihypertensive, antiretroviral medicines, insulin, and anesthetics have all been associated with increased mortality, morbidity, and disability in LMICs. The Lancet Commission on Essential Medicines (2017) estimates that preventable deaths from medicine shortages in LMICs number in the hundreds of thousands annually.

2.5 Factors Contributing to Drug Supply Shortages

The literature identifies a multifactorial etiology for drug supply shortages in hospital settings, operating across supply-side, demand-side, and system-level dimensions.

2.9.1 Supply-Side Factors

Supply-side causes include manufacturing and quality failures at the producer level, export restrictions and regulatory barriers, raw material shortages, supplier consolidation reducing market competition, and inadequate domestic pharmaceutical manufacturing capacity. In Ethiopia, reliance on imported pharmaceuticals which constitute over 80% of medicines used in the public sector exposes the supply chain to international market disruptions, foreign exchange shortages, and regulatory delays at customs.PFSA/EPSA delivery performance is a critical supply-side variable. Gebre-Mariam et al. (2011) and Woldu et al. (2013) provide examples of PFSA delayed deliveries to the facilities based on central level imbalance of stocks, transport restrictions and mismatch between quantification at the facility level and allocation from PFSA. In Ethiopia, order fill rates between PFSA and health facilities were reportedly between 60-75% according to a few studies- far below desirable targets.

2.9.2 Causes of Shortages from the Demand Side

Causes of shortages on the demand side may include incorrect forecasting and quantification at the facility level, poor maintenance of inventory records, inadequate storage space, failure to reorder in time, under-allocation of budget, or misuse and overprescription of drugs which causes them to run out faster than expected.

Poor data quality in facility-level LMIS (Logistics Management Information System) systems is a pervasive challenge in Ethiopian hospitals. Without accurate, timely, and complete consumption data, forecast-based quantification generates systematic errors that lead to either understocking or overstocking. Understocking generates shortages; overstocking wastes scarce resources and risks expiry.

2.9.3 Systemic and Institutional Factors

At the systems level, causes include weak supply chain governance, inadequate standard operating procedures (SOPs) for pharmaceutical management, limited trained human resources

in logistics, insufficient integration between clinical and supply chain information systems, and inadequate supplier contract management.

Political economy factors including budget prioritization decisions, donor dependency, and institutional accountability mechanisms also shape the structural conditions under which shortages arise. Chaudhuri and Long (2015) argue that in many African public health systems, pharmaceutical supply chains are under-resourced relative to their functional demands, creating a structural propensity for shortages that cannot be resolved through logistics optimization alone.

2.9.4 Forecasting and Quantification Issues

Poor forecast results in underestimation or overestimation of drug requirements due to reliance on outdated consumption data, untrained personnel, or manual quantification systems. Similar concerns of persistent challenges in using logistics data for quantification are also raised in various Ethiopian studies.

2.9.5 Procurement Constraints

Procurement delays, limited supplier capacity, incomplete deliveries, and long lead times greatly contribute to drug shortages. In Ethiopia, it has often been evidenced that the centralized procurement processes under EPSA result in bottlenecks, which lead to delayed or incomplete deliveries.

2.9.6 Financial Limitations

Insufficient budget allocation, delay in fund disbursement, and competing priorities from hospitals lessen the availability of funds allocated for essential medicines. FMOH, 2020; Gebretekle et al., 2018LMIC studies further show that financial constraints are among the strongest predictors of prolonged shortages (Arney et al., 2014).

2.9.6 Inventory Management Weaknesses

The common inventory management weaknesses include poor record keeping, limited use of LMIS, improper FEFO application, high wastage, and pilferage. In Ethiopia, unreliable data coupled with poor monitoring of the inventory is a leading factor affecting the inaccuracy in making resupply decisions.

2.9.7 EPSA/Distribution Inefficiencies

Drug shortages are affected by a range of problems with distribution including delays, constant over/under supplies, non-complete orders and congestion at central procurement. Transport problems can compound supply problems (especially in rural areas), particularly delays and stock-outs (EPSA, 2021; Fentie et al., 2020).

2.9.8 Policy and organizational problems

Structural constraints include ineffective supervision, staff attrition, communication breakdown and absence of a framework to determine and hold parties responsible for ensuring regular availability of drugs (WHO, 2016; FMOH, 2020). There is also evidence from LMICs that medicine shortages are considerably worsened by governance and policy gaps.

2.6 Hospital Logistics performance

Hospital logistics performance is defined as the operational effectiveness and efficiency of supply chain operations within the hospital, and measured by multiple indicators such as procurement efficiency, inventory management, distribution, warehouse management and information management.

2.5.1 Key performance indicators (KPI) of hospital logistics

There are various significant performance indicators for hospital pharmacy logistics found in the literature. Stock out Rate: Percentage of essential drugs out of stock, at any point in time or during a certain period, normally aim to be less than 5%. Order Fill Rate (Service Level): percentage of drugs ordered, fulfilled with available stock and without replacement by other alternative drugs; high performance should aim to achieve over 95%. Inventory turnover Rate: indicates the frequency of stocks being replaced; the ideal level depends on types of drugs.

Procurement Lead Time: defined as time span from placing order till receiving goods, which directly impacts the requirements of safety stock. Emergency Procurement Frequency: indicates the frequency of a hospital carrying out market procurement at non-contract price; it can be considered as the surrogate of supply chain breakdown. Expiration and wastage rate: is regarded as indicator for storage and demand management.

2.7 Review of Empirical Studies

A review of empirical studies concerning drug supply shortages and performance of hospital logistics operations in sub-Saharan Africa identify common themes.

Waako et al. (2009) performed a study across a few East African countries and determined that poor quantification was responsible for over 60 percent of facility level stock-out episodes, with budget constraints and PFSA failure in delivering supplies coming in as the other major contributors. The finding that improvement of quantification practices alone could decrease stockout rates by up to 40% informed the analytical framework of this current study.

Nkurunziza et al. (2016) evaluated the performance of logistics operations within Rwandan district hospitals. Their study found that use of electronic LMIS tools correlated to a 22 percent stock-out rate reduction and a 15 percent order-fill rate increase over three years. Their findings lent support to this study's investigation into information systems sufficiency.

Muhia et al. (2016) measured the performance of pharmaceutical supply chains in both level 4 and 5 hospitals in Kenya. They also observed that Stock-out levels were lower by 31% in those hospitals having full-time pharmacy procurement officer compared to facilities where non-pharmacists were managing the purchasing function.

Adebayo et al (2019) studied teaching hospitals in Nigeria and found that between 18 and 25% of the whole pharmacy budget was spent on emergency orders at stock-out facilities, a statistic which represents an inefficient use of resources and a way to evaluate the logistics system performance failure.

Houndjo et al. (2021) investigated the access to medicines within the Beninese public hospitals. The vital-category medicines were reported at a stock-out rate of 28.3%, more than three times the WHO limit of 10%, stock-outs were associated with a fall in patient attendance, an rise in private pharmacies costs.

2.8 Research Gap

The following are research gaps identified from many studies regarding impact of drug shortages on hospital logistics performance and patient compared to this study. Drug supply shortage is identified as one of the biggest problems in LMICs. However, empirical evidence that specifically addresses the relationship between drug supply shortages on hospital logistics performance and patient outcomes within Ethiopian public hospitals in general and Adama hospital in specific is sparse. In Ethiopia existing studies primarily focused on inefficiencies in pharmaceutical supply chain, lead time in procurement, prevalence of stock outs at the national or regional level but did not directly link supply shortages to hospital logistics performance at hospital level (Inventory turnover, lead time, distribution efficiency and the problems caused to the hospital internal work flow).

Moreover, the existing literature views the problems from a supply chain perspective and lacks evidence on downstream effects of shortages on patients such as delayed treatment, medication errors, out of pocket expenses, longer length of stay and reduced patient satisfaction. There is lack of evidence regarding experiences of shortages by frontline health workers, pharmacists, and logistics providers at the real world. Another identified research gap is that a localized study targeting the problems at city of Adama which is now a boom city with high patient load and strong pressures on the hospital's logistics performance is not done. Despite being an important city with major public hospital facilities, no specific study examined how supply shortages affect logistics performance and patients at this city.

Another gap that has been identified is lack of integrated logistics performance measurement with clinical care indicators. Thus, the link between inefficiencies at the logistics performance and at the patient level is not clearly understood. It has also been observed that existing studies lacks information regarding experiences of key stakeholders like; procurement officers, hospital managers, and clinicians. There is also sample size gap; some studies use a low sample size, which does not comprehensively explain the results. Additionally, there is a methodological gap; some researchers use only qualitative methods without supporting their data with quantitative output, but this study has strong and original numerical data.

Summary of Literature Gaps

First, while drug supply shortages in Ethiopian public health facilities are well-documented at national and primary healthcare levels, facility-level evidence from secondary urban hospitals particularly in Oromia Regional State is scarce and largely anecdotal.

Second, comparative multi-facility analyses within the same geographic context, which could illuminate systemic versus facility-specific causes, are absent from the Ethiopian literature. Third, the combined examination of both logistics performance and patient care impacts using integrated mixed-methods designs is uncommon in Ethiopian pharmaceutical supply chain research. Fourth, no published study to date has examined drug supply shortages at AHMC, Musie General Hospital, or Bati Hospital, leaving these facilities without an evidence base for logistics and supply chain improvement planning. This study directly addresses all four of these gaps.

Few studies assess logistics performance and patient care outcomes concurrently within the same analytical framework. This paper will review Wondimu et al. 2023, however, there has not been any study specifically targeting all public hospitals in Adama town, though their large catchment population, and their reliance on EPSA Adama Hub logistically (EPSA, 2021).

In fact, mixed-methods designs are limited, hence leaving gaps in the qualitative understanding of the root causes. In addition, there is an inadequacy of localized evidence in the Oromia Region itself that could be useful for regional policy planning.

Few Ethiopian studies correlate drug shortages to patient level clinical outcome (especially in public hospital setting of urban area) (Tadesse et al., 2021). These gaps are addressed by this study, which employed a mixed-methods approach to assess shortages, logistics performance, and patient care collectively in Adama Town public hospitals.

2.9 Conceptual Framework

This conceptual framework is developed based on empirical and theoretical works from the literature reviewed on the drug supply shortages to support the research objectives. The conceptual framework for this study is grounded drug supply shortages.The conceptual framework for this study is built on the assumption that drug supply shortages act as the primary independent variable influencing both hospital logistics performance and patient care outcomes in public hospitals in Adama.Based on the above discussion, a causal relationship between drug supply shortage, logistics performance and patient services is proposed by this framework. It is found that supply chain management can have an impact on healthcare services.

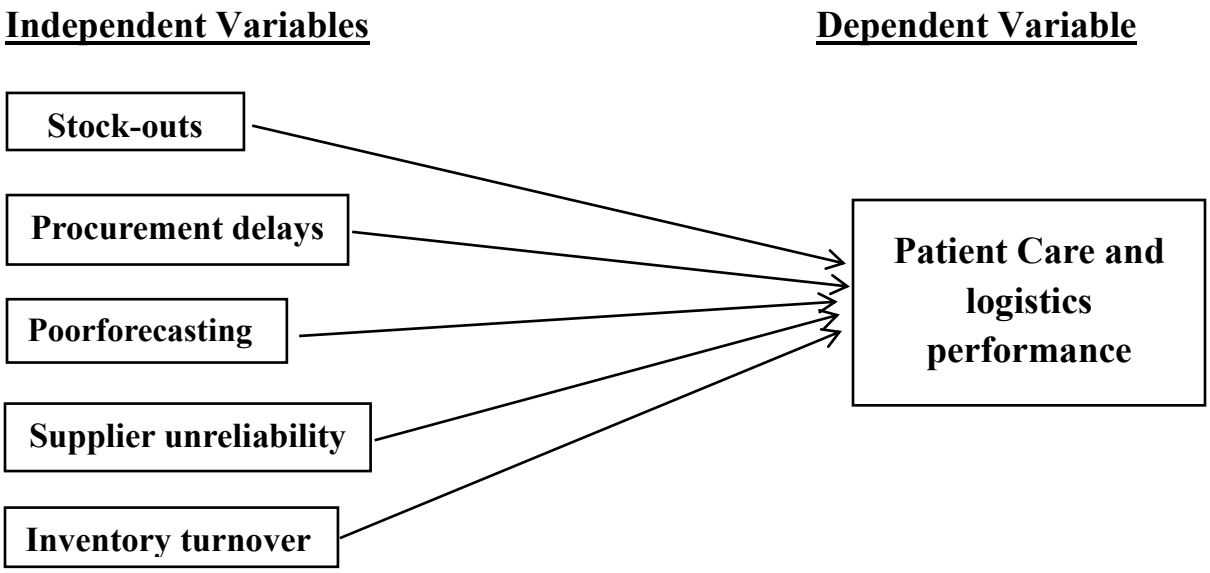


Figure 1.1: Conceptual framework for the study

(Source: Theoretical & Empirical Reviews)

As indicated in the diagram of the conceptual framework, the study is highly focused on the drug supply shortages, with five categories. This study is trying to examine the role and effectiveness of drug supply shortages on patient care. `

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This section contains an explanation and justification of the research methodology. It starts with description of the study area. It is followed by a description of the research methodology, including the research design, sources and tools for data collection, sampling procedures, sampling technique, sample size determination, and techniques for data presentation and analysis.

In this chapter, the methodology issues are explained along with their strategies, including steps, sequencing of approaches, and procedures of application. The methodology discussion includes the rationale for using each method, tool, data source, sample population, data analysis, and interpretation.

3.1 Description of the Study Area

Study area's Geographical Location

Adama city, previously called Nazret, is a city in Oromia Region of Ethiopia. It has a very important and unique geographical location, and it plays significant role in many aspects of the country as well as cultural richness. The research is undertaken in Adama Town, Oromia Region, which lies at a distance of 99 km south-east of Addis Ababa. Adama is identified as one of the main commercial and healthcare centers in the country. There are three public hospitals in the town that rely on EPSA for medicines, as arranged in the national supply chain. Like many other facilities in Ethiopia, these hospitals also commonly report the unavailability of essential medicines.

Location and Geography

The city of Adama is located at 99 kilometers to the southeast of the capital of Ethiopia, the city of Addis Ababa. It is located in the East Shewa Zone between the highlands and the Great Rift Valley, so it represents a major transport location. The city is located at an altitude of approximately 1,600 meters, which also explains its drier and warmer weather than Addis Ababa.

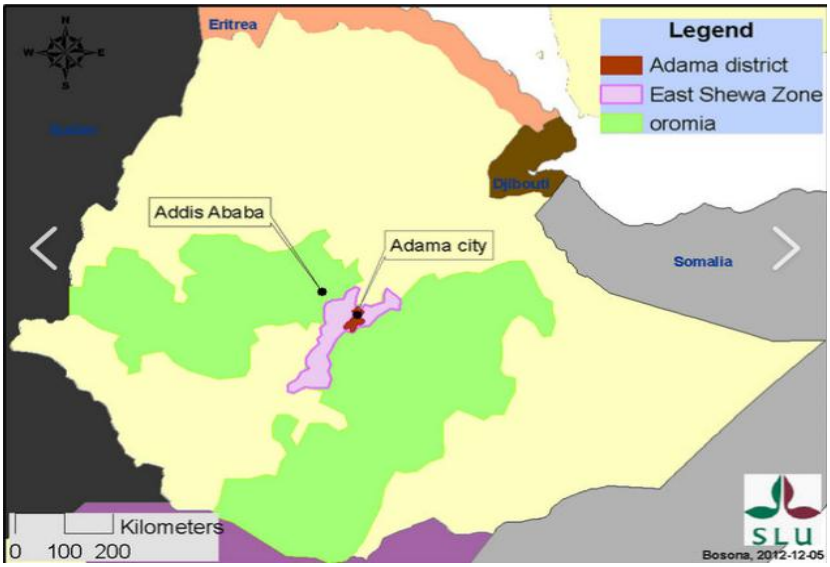


Figure 3.1: Ethiopian map (indicating the location of AA)

Source (Google Maps, 2026)

Study Period

The study period of these research study for the data collection and analysis will take place between January 2026 and June 2026, following the typical timeline for a mixed-methods health study (Creswell & Creswell, 2018).

3.2 Research Design

The research study "the effect of Drug Supply Shortages on hospital logistics performance and patient care in public hospitals in Adama," employs both descriptive and explanatory research designs. The complete description of the The effect of Drug Supply Shortages on hospital logistics performance and patient care in public hospitals in Adamacan be obtained through descriptive research design. The approach requires researchers to collect information which they will then analyze to understand why certain events happen without establishing any causal links.

The system provides a complete assessment of how drug supply shortages impact patient care in public hospitals (Asenahabi, 2019; Kothari, 2004). An explanatory research design is effective for the investigation of causal relationships between various factors affecting drug supply shortages on hospital logistics performance and patient carein public hospitals in Adama.

This design helps to identify to what extent drug supply shortages impact patient care in public hospitals.The research uses both methods to provide a complete study that combines descriptive findings with detailed quantitative explanations (Kothari, 2004).

3.3 Research Approach

To uncover the realities about, information from reliable sources and different stakeholders is needed. This study employs mixed-methods quantitative research and qualitative research approach to provide a comprehensive and triangulated understanding of drug supply shortage impacts. The quantitative strand generates statistically generalizable findings on shortage patterns, logistics performance indicators, and patient care outcomes through survey data and hospital record analysis. In qualitative research data are generated in rich, contextual information about the root causes, provider experience, and institution through the use of interviews and observations. Integration of the qualitative and quantitative streams of inquiry takes place at the interpretive level to provide findings neither stream would generate on its own. The study uses a comparative case study, where each hospital is treated as a case to be analyzed within the larger study, utilizing cross-case analysis. The case study research is a well-suited methodology when seeking to explain variations in drug shortage effects and coping processes among institutions that serve similar patient populations but possess diverse institutional features.

3.4 Sampling Technique

When conducting the study, stratified random sampling was employed within each hospital, with strata defined by professional category (pharmacists, pharmacy technicians, procurement/logistics officers, clinicians, and administrators). Within each stratum, simple random sampling using random number tables was applied. Key informants were selected purposively based on seniority, knowledge, experience, involvement in pharmaceutical management, and institutional knowledge.

3.5 Target population

The study population comprises all health professionals, pharmacy personnel, procurement and logistics officers, and administrative staff involved in pharmaceutical management at the three hospitals. Based on the data's obtained during the data collection, the total study population across the three hospitals was estimated at around 423 eligible individuals.

3.6.1Inclusion Criteria and Exclusion Criteria

Inclusion Criteria.

- Pharmacy, nursing, medical, or logistics personnel working for ≥6 months.
- Staff are directly involved in medicine management, prescribing, or patient care.
- Willing to give informed consent.

Exclusion Criteria

- Staff on leave during data collection.
- Newly recruited staff (< 6 months' experience).
- Administrative personnel who do not deal directly with drugs.

3.6 Sample Size Determination

Since the population size is known single population proportion formula will be used to proportionate the sample size based on the population size of hospitals (Kothari, 2004). The sampling unit for this study will include the whole three hospitalsfound in each of the selected hospital members. The sample size was determinedusing Yamane's (1967) simplified formula for finite populations:

$$n = \frac{N}{1+N(e)^2}$$

Where: **n =** the sample size.

N =the total populationin the three hospitalsis 423

e = is the level of precision (e =0.05).

$n = \frac{423}{1+423(0.05)^2}$ = **206** number of questionnaires were distributed in in the three hospitals.

Adjusting for an anticipated non-response rate of 10%, the target sample was 206/0.90 ≈ 229 individuals. Proportionate stratified random sampling was employed to allocate the sample across hospitals and professional categories.

Table 3.1: Sampling Distribution across three Hospitals

Hospital	Population	Sample (Proportionate)	Key Informants
AHMC	210	102	7
Musie General Hospital	135	66	5
Bati Hospital	78	38	3
Total	423	206	15

Source: Survey data, 2026

3.7 Data Collection Methods

Data were collected using three complementary methods: structured questionnaire survey, semi-structured key informant interviews, and documentary review of hospital records.

Structured questionnaires were administered to the sampled health professionals and pharmacy/logistics personnel. The questionnaire included four sections: socio-demographic profile; perceptions and experiences of drug shortages; logistics performance self-assessment; and patient care impact assessment. Five-point Likert scales (1 = Strongly Disagree to 5 = Strongly Agree) were used for attitudinal and perception items, supplemented by factual items with objective responses.

Semi-structured key informant interview was administered to 15 key informants who were purposively sampled administrators, chiefs of pharmacy and procurement officers. The interviews lasted for 25-45 minutes and were conducted in Amharic and English depending on the key informant's preference and recorded by using a recorder with consent. Interview guides covered shortage causes, institutional responses, logistics challenges, and patient care concerns.

Documentary review covered hospital stock cards and bin cards, LMIS monthly reports, procurement records and invoices, pharmacy consumption data, patient complaint registers, and annual hospital performance reports for the period April 2026 to May 2026.

3.8 Survey instrument tools and measurements

The study used various types of data collection tools to triangulate or confirm similar information, thereby increasing the validity of the results.

Questionnaire: A structured questionnaire was adapted from the literature to ensure that all respondents answered a similar set of questions for gathering responses from a large population sample. This questionnaire was developed by adapting various literature and was used as the data collection tool to answer the objective of the study from the hospitals. The structured questionnaire was developed through a systematic review of validated instruments from comparable studies, and instruments from Gelayee and Mekonnen (2017) and Kassahun et al. (2019). The questionnaire was initially drafted in English, then translated to Amharic.

Closed-ended questions: Data were collected using the 5-point Likert scale as close-ended questions standardize data collection and thus are the suitable form for conducting quantitative research.

Document Review: In this stage, the required data were obtained by reviewing all appropriate sources such as annual reports, internal documents and organizations' website.

Interview: An interview guide was constructed based on conceptual framework and research questions, and it focused on five themes which covered nature and frequency of shortages, institutional and systemic reasons, managing logistics practices and problems, impacts to patients' care, and strategies for coping. Probing questions were designed to elicit depth and specificity in responses.

Data Processing

Data processing went through several stages; all aimed at ensuring reliability of findings. First, we used questionnaire data, making sure that each variable was properly coded and had no inconsistencies, and then entering it in SPSS Statistics v. 26. In case there were missing data, we applied appropriate methods of imputation.

Cross-validation techniques and calculation of descriptive statistics were done for additional validation purposes.

3.9 Data Analysis

To meet the objective of the study, the researcher uses a combination of descriptive and inferential data analysis to measure the effect of Drug Supply Shortages on hospital logistics performance and patient care in public hospitals in Adama. The descriptive analysis findings were summarized into statistics such as mean, standard deviation, and frequency.

For the inferential statistical analysis, regression analysis were conducted. Since the data used for the study were scaled and continuous, the most appropriate statistical method was multiple regression analysis.

Model Specification

In order to measure the impact and level of the dependent variable patient care in public hospitals, multiple regression models have been used, where each dependent variable is evaluated by using a 1-5 Likert scales scores from respondents' insight.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \varepsilon$$

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \varepsilon$$

Where: Y = Dependent variable (Impact of drug)

Bo = Constant (intercept)

B1, B2, B3, B4, B5, and B6 = regression coefficient.

E = error term

3.10 Validity and Reliability

Validity refers to the degree or extent to which the measuring instruments measure what they are intended to measure (Taherdoost, 2016). Content validity of the questionnaire was established through expert review and an academic researcher in health systems management. Their feedback informed revisions to item wording, ordering, and coverage. Construct validity was assessed through exploratory factor analysis of the pilot data, which confirmed the intended dimensional structure of the instrument.

Reliability refers to the measurement method of consistency and stability to analyze the relationship between variables (Taherdoost, 2016). The questionnaire was carefully designed to support reliability, taking into account the description of the problem and related theories. Internal consistency of the quantitative tools was evaluated using Cronbach's alpha value (Taber, 2018).

Qualitative trustworthiness was established through member checking (sharing interview summaries with participants for validation), thick description of the study context, researcher reflexivity notes, and triangulation of qualitative findings against quantitative data and documentary evidence.

Ethical Considerations

This research adhered to ethical guidelines that are essential for conducting good and useful research. Ethics is now a key consideration in research. All respondents were selected based on their consent. Before administering the questionnaire, the researcher asked the respondent if they were interested in participating. Therefore, the researcher considered the ethical values of the community where the research was conducted. All matters related to respondents were handled with confidentiality and transparency.

Operational Definitions

The factors and barriers considered in this study include:

- **A drug shortage** is a lack of medicine needed for at least one day during the review period.
- **Stock-out Duration:** The Total number of days a drug remained unavailable.
- **Emergency Procurement**: Unplanned purchase due to stock-out.
- **Logistics Performance**: This refers to the ability of hospitals to effectively forecast, procure, store, and distribute medicines. Is captured in logistics indicators.
- **Clinical or Service effect** on the patient. (Effect on the patient).
- **Medication prescribed** but not available. (Treatment Interruption).

CHAPTER FOUR: RESULTS AND INTERPRETATION

4.1 Introduction

This chapter includes the results found from the collected data through questionnaires and interviews. The researcher used primary and secondary sources of data to conduct the study. The primary objective of this chapter is to present the findings related to the The effect of Drug Supply Shortages on hospital logistics performance and patient care in public hospitals in Adama town. The data is analyzed using a quantitative approach. Thus, based on the response obtained from the respondent, the data analyses made by the researcher were presented as follows.

The results of the data analyses were presented in 3 sections:

Section one: Summarizes the response rate and the demographic data of respondents.
Section two: Analysis made through descriptive statistics and
Section three: Analysis made through inferential statistics.

Response Rate

Of the 229 questionnaires distributed, 196 were returned, of which 186 were complete and usable, representing an overall usable response rate of 81.2%. This rate exceeds the 75% threshold recommended for survey research validity (Creswell, 2014). The response rates from each hospital were AHMC 84.3% (86/102), Musie General Hospital 78.8% (52/66), and Bati Hospital 84.2% (32/38). All 15 key informant interviews were successfully completed.

3.2Respondents' Characteristics

The below five controlling variables of the respondents are demographic. They are sex, age group, experience, profession, and their level of education. The entire data analysis was prepared based on such issues as stipulated by the following table and descriptions.

Socio-Demographic Profile of Respondents

Table 4.1: Socio-Demographic Characteristics of Respondents (N=186)

Characteristic	Category	Frequency	Percentage (%)
Sex	Male	108	58.1
	Female	78	41.9
Age	25–34 years	71	38.2
	35–44 years	82	44.1
	45+ years	33	17.7
Education	Diploma	42	22.6
	BSc/BA Degree	96	51.6
	MSc/MA Degree	38	20.4
	PhD/Specialist	10	5.4
Profession	Pharmacist/Pharm. Technician	63	33.9
	Procurement/Logistics Officer	41	22.0
	Clinician (MD/HO)	47	25.3
	Administrator	35	18.8
Experience	Less than 5 years	55	29.6
	5–10 years	79	42.5
	More than 10 years	52	27.9

Source: Survey data, 2026

Based on the above table data from the respondents, the demographic characteristics of the respondents were interpreted here as follows:

- As per the above table, it shows that from a total of 186 respondents, 108(58.1%)were male, whereas 78 (44.9%) were female. This shows that the sample is highly dominated bymales. This reflects that males' impact on drug supply shortages and patient care is very high.
- Concerning age demographic, the majority of respondents were between 35 and 44 years, which counts (44.1%), followed by 25–34 years, which counts (38.2%). These values reveal

that the sample is composed largely of very young, stable persons more likely to be potential candidates for the drug supply shortages and patient care.

- The respondents' education level of51.6% is a bachelor's degree, 22.6% have a diploma, and 20.4% count for an MSc/MA. This shows that respondents are educated, having at least a bachelor's degree in majority; it is important because higher education levels are known about the drug supply shortages and patient care.
- Responses for profession show that 41.5%were pharmacy technicians, while 25.3% were clinicians (MD/HO), and 22% were procurement/logistics officers. Most of our respondents fall within pharmacist technicians, showing that it is an important factor for influencing the drug supply shortages and patient care.
- Our findings revealed that 42.5% have 5–10 years 'experience, followed by 29.6%.Less than 5 years' experienceand27.9% of respondents have more than 10 years' experience. This suggests that a large proportion of respondents have experience.

4.2 Supply Shortage Trends

4.3.1 Stock-out rates and frequency

From analyzing the hospital stock cards and LMIS reports for the period from July 2022 to June 2025, it became clear that the problems of chronic and widespread drug shortages existed at all three facilities. Across the three-year period, the three-facility average stockout rate was 34.7% of the essential drugs listed on the EML. That is, at any one time, it can be seen that more than a third of essential medicines are out of stock.

Table 4.2: Essential medicine stockout rates by hospital and year

Hospital	2022/23 Stockout Rate (%)	2023/24 Stockout Rate (%)	2024/25 Stockout Rate (%)	3-Year Average (%)
AHMC	31.2	33.8	35.1	33.4
Musie General Hospital	35.7	36.9	38.2	36.9
Bati Hospital	32.4	35.5	37.8	35.2

Combined Average	33.1	35.4	37.0	34.7

Source: Survey data, 2026

A statistically significant upward trend in stockout rates is observed across the study period ($F = 4.82$, $p = 0.011$), indicating a worsening of the shortage situation. Musie General Hospital consistently exhibited the highest stockout rates, while AHMC despite its larger size demonstrated marginally better inventory management, potentially attributable to its greater procurement autonomy as a teaching hospital.

4.3.2 Most Frequently Stocked-Out Medicines

Survey respondents and key informants identified consistent patterns in the medicines most frequently subject to stockouts. The top ten medicine categories experiencing chronic shortages were antibiotics (broad-spectrum), antihypertensive medicines, ant diabetic medicines (including insulin), oxytocin and other maternal health medicines, antimalarial, antiretroviral medicines, anesthesia and analgesia medicines, gastrointestinal medicines, antiepileptic medicines, and asthma/respiratory medicines. Of these, the VEN-classified Vital category medicines, including oxytocin, insulin, anesthetics, and ARVs, had the most severe patient care implications when unavailable.

4.3.3 Duration and Severity of Shortages

Key informant data revealed that the average duration of a shortage episode ranged from 12 days (AHMC) to 21 days (Bati Hospital) for critical medicines. Chronic shortages defined as unavailability exceeding 30 consecutive days were reported for 8 medicine categories at AHMC, 12 at Musie General Hospital, and 11 at Bati Hospital. These protracted shortages were particularly associated with medicines procured through specialized procurement channels, including ARVs and insulin, where supply chain disruptions at the national level cascaded to the facility level.

4.3 Causes of Drug Supply Shortages

Respondents rated the contribution of fifteen potential causes of drug supply shortages using a five-point Likert scale. Table 4.6 presents mean scores and standard deviations for the combined sample.

Table 4.3: Respondents' causes of drug shortages mean score

Cause of Drug Shortage	Mean	SD	Rank
Inadequate budget allocation for medicines	4.52	0.61	1
Delayed PFSA/EPSA deliveries	4.47	0.72	2
Poor forecasting and quantification	4.38	0.78	3
Insufficient safety/buffer stock	4.31	0.81	4
Weak supplier performance and reliability	4.18	0.88	5
Poor inventory management practices	4.05	0.92	6
Absence of LMIS or poor data quality	3.98	0.95	7
High patient demand/unexpected surge	3.87	0.97	8
Inappropriate prescribing practices	3.72	1.02	9
Weak procurement planning	3.68	1.05	10
Foreign exchange and import barriers	3.61	1.08	11
Inadequate storage infrastructure	3.48	1.11	12
Staff training deficiencies in logistics	3.41	1.14	13
Damage and expiry due to poor storage	3.22	1.19	14
Theft and pilferage	2.87	1.34	15

Source: Survey data, 2026

The budget shortfall was highly rated (M=4.52), suggesting structural limitations to financial resources available for the public health sector. This was supported strongly by key informants, and in particular, at Bati Hospital, the pharmacy budget is sufficient for 60-65% maximum of its annual requirement of medicines, and hence there is consistent underspending on medicines. Late delivery of PFSA/EPS was the second highly rated cause (M=4.47) in which documentary evidence suggested that lead time between placing orders and receiving them varies between 28 days at AHMC and 47 days at Bati, all largely exceeding the target lead time of 14 days. Poor forecasting and quantification were the third highly rated cause (M=4.38), key informants admitting to using historical consumption volumes as the main source without adjustment for seasonality and epidemiological trends.

From interview data analysis, six common themes emerged in the interpretation of the factors for medicine shortage: constraints on finance and predictability of budgets; PFSA/facility supply chain coordination gaps; poor forecasting and LMIS limitations; human resource shortfalls in the management of medicines logistics; weakness in suppliers' contract and delivery management; and deficiencies in the governance and accountability of medicine management.

4.4 Effect on hospital logistics performance

4.5.1 Hospital inventory management performance

From the stores' records analyzed for all three hospitals, the stock management system is showing shortcomings across all three facilities:

The average inventory turnover rate for the facilities examined was 3.2 times/year for AHMC, 2.7 times/year for Musie, and 2.4 times/year for Bati, as against the desired minimum of 4 times/year. A slow stock turnover is an indication that while very many essential medicines are out-of-stock for reasons other than stockouts, there are large quantities of other medicines with a slow stock turnover that sit in the storerooms of pharmacies, hence implying a weakness in demand-driven stock management.

The average number of MOS recorded at the time of stockout varies between zero (i.e., complete stockout) and 18 months of medicine held for medicines with chronic overstocks. The co-existence of overstocked and understocked medicine implies that in the ABC-VEN analysis and the calculation of the reorder point for medicines, there are considerable flaws.

4.5.2 Order Fill Rate and Procurement Efficiency

The average order fill rate from PFSA/EPSA was 68.3% across the three hospitals meaning that on average, only 68.3% of ordered medicine quantities were fulfilled by the supply agency. Facility-level order fill rates were AHMC 71.2%, Musie 66.8%, and Bati 65.4%. These rates are substantially below the 95% target in the Ethiopian pharmaceutical supply chain strategic plan.
Emergency procurement purchase of medicines from private suppliers outside normal procurement channels was recorded in the procurement registers of all three hospitals. The proportion of the total pharmacy budget spent on emergency procurement averaged 14.3% at AHMC, 19.7% at Musie, and 22.1% at Bati Hospital. Emergency procurement prices were on

average 35-65% higher than PFSA contract prices, representing a substantial financial inefficiency. ANOVA analysis confirmed statistically significant differences in emergency procurement costs across hospitals ($F = 7.34$, $p = 0.001$).

4.5 Regression analysis of the predictors of logistics performance

The overall logistics performance score was the dependent variable, while the following were selected as the independent variables in a multiple linear regression analysis: budget adequacy, the PFSA order fill rate, quality of forecasting, LMIS usage, and number of years that the pharmacy staff has worked in the pharmacy sector. The model was statistically significant ($F=18.43$, $P<0.001$) and accounted for 61.2% of the variation in logistics performance (Adjusted $R=0.612$).

Table 4.4: Regression analysis predictors of logistics performance

Predictor Variable	Beta (β)	t-value	p-value	Significance
Budget Adequacy	0.412	6.83	0.000	***
PFSA Order Fill Rate	0.287	4.61	0.000	***
Forecasting Quality	0.234	3.89	0.000	***
LMIS Utilization	0.178	2.94	0.004	**
Pharmacy Staff Experience	0.142	2.31	0.022	*

Source: Survey data, 2026

The financially adequate ($\beta=0.412$) had the strongest association with the logistics performance, which implies that the main factor that caused the logistics weakness was financial. The PFSA order fill rate ($\beta=0.287$) had the second strongest association with logistics performance. It reveals that the supply side was quite important. Forecasting quality ($\beta = 0.234$) and LMIS utilization ($\beta = 0.178$) were also significant, confirming the importance of demand management systems.

4.6 Impact on Patient Care

4.7.1 Patient Waiting Times

Analysis of pharmacy service records and patient flow data showed that average patient waiting time in the pharmacy was substantially longer during shortage periods. During shortage-free

periods, average pharmacy waiting time at AHMC was 23 minutes; during shortage periods, this increased to 47 minutes, a 104% increase.

At Musie General Hospital, waiting times increased from 31 minutes to 65 minutes during shortage periods (110% increase) and at Bati Hospital from 27 to 58 minutes (115% increase). These increases reflected the additional time required for shortage-related activities: staff verification of alternative products, patient counseling on substitutions, referral documentation, and manager authorization for off-contract emergency procurement.

4.7.2 Treatment Interruption and Medication Substitution

Survey data indicate that 74.2% of respondents reported witnessing treatment interruptions due to medicine unavailability at least once per month. Medication substitution (prescribing an alternative medicine) was practiced by 82.4% of clinicians responding to the survey, with 41.3% reporting doing so without a clinically validated equivalent alternative. Emergency referral of patients to other facilities due to unavailable medicines was reported by 68.9% of respondents, creating downstream burden on receiving facilities and generating out-of-pocket transport costs for patients.

4.7.3 Patient Satisfaction

Patient satisfaction data were obtained from hospital complaint registers and exit survey records maintained by the hospitals. Analysis of 1,247 patient complaint records over the three-year period identified pharmaceutical unavailability as the complaint category most frequently cited (38.4% of all complaints), ahead of staff attitude (22.1%), waiting time (19.7%), and facility cleanliness (11.3%). Patient satisfaction scores (rated on a 0-100 index by hospital quality improvement teams) were negatively correlated with stockout rates: $r = -0.73$ at AHMC, $r = -0.81$ at Musie, and $r = -0.78$ at Bati Hospital, all statistically significant at $p < 0.01$.

4.7.4 Clinical Adverse Events

Key informant interviews with senior clinicians at all three hospitals provided qualitative evidence of adverse clinical events associated with medicine shortages. Reported events included delayed surgeries due to anesthetic shortages (AHMC: average 3.2 delayed surgeries per month during shortage periods); unmanaged hypertensive crises due to antihypertensive stockouts (reported at all three hospitals); inadequate pain management in postoperative patients; and interruption of chronic disease management for diabetic and hypertensive patients. One senior

physician at AHMC stated during the key informant interview, 'There are cases where we know what the patient needs, we know the diagnosis, but we cannot treat because the medicine is not there. We discharge patients with incomplete treatment, knowing they may come back worse or not at all. It is very difficult.'

Inter-Hospital Comparative Analysis

Comparative analysis across the three hospitals reveals both common patterns and important differences in shortage experiences, logistics performance, and patient care impacts.

Table 4.5: Comparative performance indicators across the three hospitals

Performance Indicator	AHMC	Musie General	Bati Hospital	Target/Benchmark
Average stockout rate (%)	33.4	36.9	35.2	< 5%
PFSA order fill rate (%)	71.2	66.8	65.4	> 95%
Inventory turnover rate (times/year)	3.2	2.7	2.4	> 4.0
Emergency procurement (% of budget)	14.3	19.7	22.1	< 5%
Average delivery lead time (days)	28	38	47	14 days
% of patients with treatment interrupted	31.2	38.7	41.3	< 1%
Patient satisfaction score (0-100)	61.4	54.8	51.2	> 80
% medicines with valid bin cards	72.3	58.4	51.7	100%

Source: Survey data, 2026

For almost all the logistics indicators and patient care indicators, AHMC is better than the other two hospitals despite serving the greatest number of patients. This is probably due to the nature of the hospital being teaching hospital (good staff, good utilization of LMIS and having more

procurement discretion power), having more money and a unit dedicated to pharmaceutical management.

Bati Hospital is the worst of all the indicators which can be explained by their low resource status, increased use of emergency procurements, long delivery lead time and poor record keeping. The difference between AHMC and Bati hospital for patient treatment interruption rate is of 31.2% and 41.3% respectively and can have a direct impact on equity of treatment for the poorest population served by Bati hospital.

One-way ANOVA confirmed statistically significant inter-hospital differences in stockout rate ($F = 5.12$, $p = 0.007$), emergency procurement ratio ($F= 7.34$, $p = 0.001$), patient satisfaction score ($F = 8.91$, $p < 0.001$), and treatment interruption rate ($F = 4.67$, $p = 0.011$). Post-hoc Tukey HSD tests indicated that AHMC differed significantly from both Musie and Bati on most indicators, while differences between Musie and Bati were statistically significant only for delivery Leadtime and patient satisfaction.

4.8 Pearson Correlation Analysis

Pearson correlation analysis was conducted to examine bivariate relationships between key continuous study variables. Results are presented in Table 4.7 as a correlation matrix.

Table 4.6: Pearson Correlation analysis

Variable							
1. Stock out	1.00						
2. Procurement delay	-0.574**	1.00					
3. Inventory turnover	-0.541**	0.683**	1.00				
4. Poor forecasting	-0.412**	0.614**	0.598**	1.00			
5. Supplier Unreliability	-0.623**	0.702**	0.641**	0.537**	1.00		
6. Overall Logistics Perf.	-0.672**	0.891**	0.847**	0.763**	0.878**	1.00	
7. Patient Care Quality	-0.631**	0.548**	0.512**	0.436**	0.591**	0.674**	1.00

Source: Survey data, 2026

The correlation analysis reveals several important relationships. Supply shortage severity was strongly negatively correlated with overall logistics performance ($r= 0.672$, $p<0.001$), confirming that higher shortage severity is associated with substantially poorer supply chain performance. Supply shortage severity also demonstrated a strong negative correlation with patient care quality ($r=0.631$, $p<0.001$). Among the logistics performance sub-dimensions, supply chain information systems had the strongest negative correlation with shortage severity ($r=0.623$), indicating that inadequate information systems both reflect and potentially amplify shortage impacts.

Overall logistics performance was strongly positively correlated with patient care quality ($r= 0.674$, $p<0.001$), indicating that improvements in supply chain logistics are associated with meaningful improvements in patient care outcomes. All logistics performance sub-dimensions were significantly positively inter-correlated, with procurement performance and supply chain information systems showing the strongest inter-correlation ($r=0.702$), suggesting these functions are closely operationally linked. These correlation findings provide the empirical foundation for the subsequent multiple regression analysis.

Regression Analysis

A multiple linear regression was run to investigate the effect of Drug Supply Shortages on patient care: A Case Study at public hospitals in Adama City, Ethiopia. Regression analysis is used in order to see how much of the variance in the dependent variable can be predicted by the independent variables (Kothari, 2004). In this study, patient care was the dependent variable while the independent variables were stock-outs, procurement delays, poor forecasting, supplier unreliability, and inventory turnover.

Multiple Linear Regression Analysis Assumptions

Residual Statistics and Diagnostic Checks

Residual statistics and diagnostic tests were performed to ascertain the validity and reliability of the regression model employed in this study. Diagnostic tests in regression analysis are emphasized by Kothari (2004) as an important technique to identify influential points, outliers and possible regression assumption violations. The residual statistics of regression analysis for

examining the effect of Drug Supply Shortages on patient care: A Case Study at public hospitals in Adama City, Ethiopia is shown in Table 4.8.

1. Residual Statistics

Table 4.8: Residual Statistics for Regression Model

Statistic	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	1.4177	2.2598	1.8723	0.19106	206
Std. Predicted Value	-2.379	2.028	0.000	1.000	206
Standard Error of Predicted Value	0.010	0.039	0.017	0.005	206
Adjusted Predicted Value	1.3940	2.2606	1.8719	0.19132	206
Residual	-0.38206	0.45309	0.0000	0.13214	206
Std. Residual	-2.873	3.408	0.000	0.994	206
Deleted Residual	-0.38729	0.47684	0.0004	0.13523	206
Stud. Deleted Residual	-2.962	3.625	0.004	1.015	206
Mahala Nobis Distance	0.007	12.954	1.988	1.967	206
Cook's Distance	0.000	0.214	0.008	0.020	206
Centered Leverage Value	0.000	0.079	0.012	0.012	206
a. Dependent Variable: Patient care					

Source: SPSS Output (2026)

Residual Statistics show that the regression model was adequate in relation to significance and no severe diagnostic problems. The predicted values were 1.4177-2.2598, and a mean value of 1.8723. This proves that Patient care was predicted across the range of responses. Additionally, the residuals averaged very close to zero, which is what would be expected if the regression model was correctly specified. The standard deviation of the standardized residuals was .994, extremely close to one. This supports that the residuals were normal, with no great deal of distortion. Marczyk, DeMatteo and Festinger (2005) propose that standardized residuals of 3 or

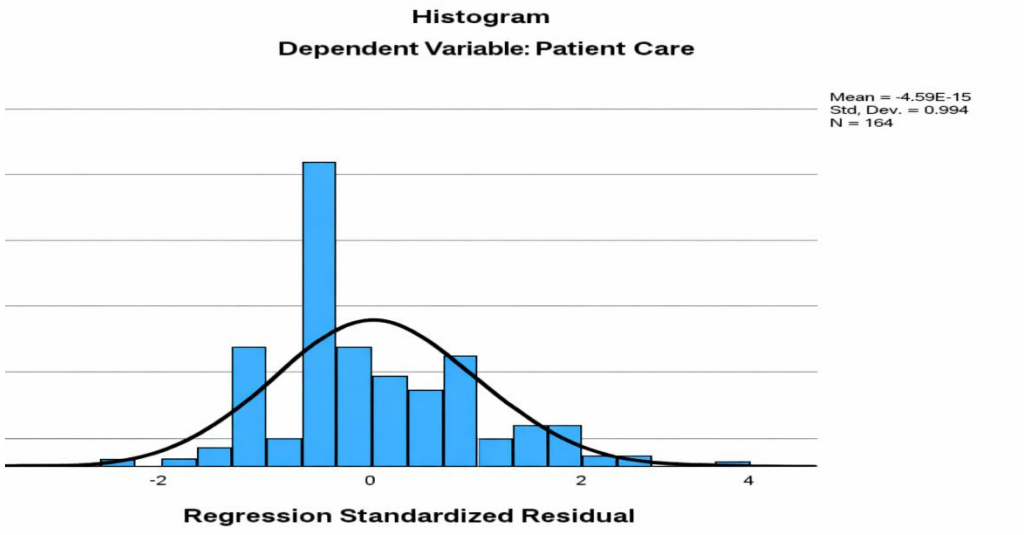
greater may indicate an outlier. Only one mild outlier, at 3.408, was present, and with a sample size of 206 this did not present any major concerns for the regression results.

The deleted residuals did not fall much outside of 3. The high for these was 3.625 and the low for these was -2.962. Cook's Distance, a measure to assess individual points, all had relatively low values (the high for Cook's distance was .214). These should be less than 1 and thus one observation does not greatly influence the regression line. Additionally, none of the values for Mahalanobis distance suggested an issue with outliers in terms of multivariate, and centered leverage values were low for all points.

2. Normality test

The assumption that the regression model was normally distributed was tested using a histogram and a Normal Probability-Probability (P-P) plot of the standardized residuals. Kothari (2004) states that the distribution of errors (residuals) should be tested as regression analysis relies on normally distributed residuals to generate more reliable and valid estimates and hypothesis test conclusions.

Figure 4.1: Histogram of Regression Standardized Residuals



Source: SPSS Output (2026)

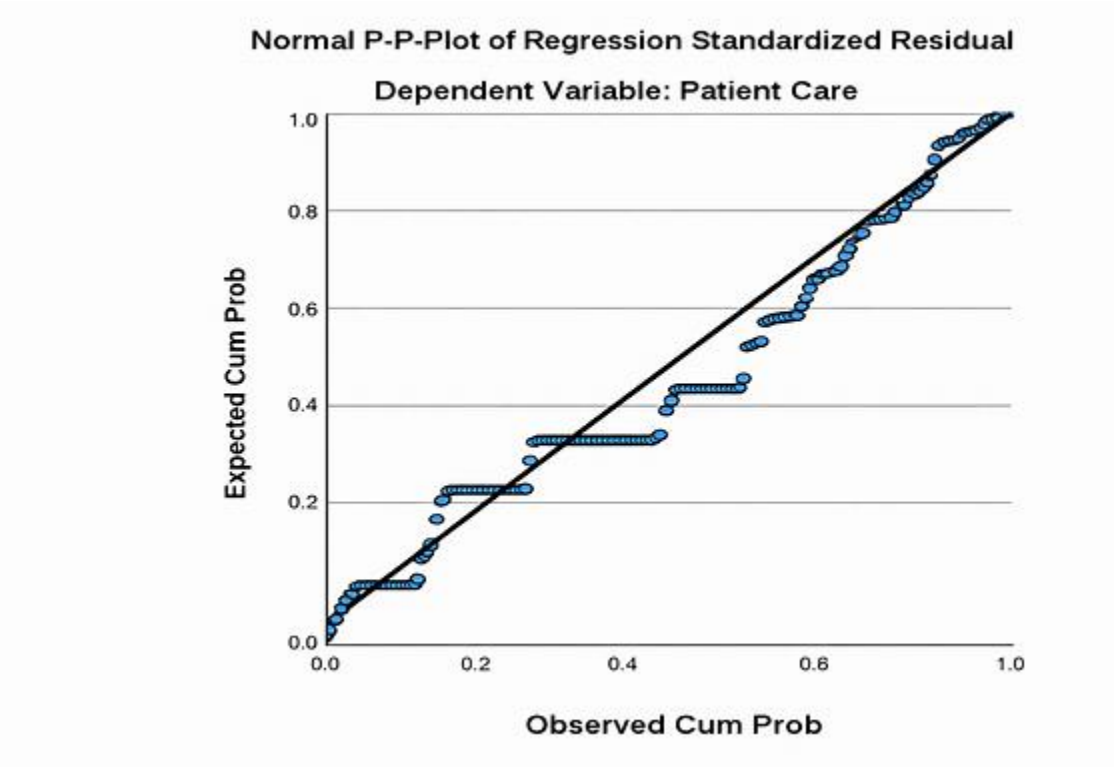
Histogram of the regression standardized residuals. The regression standardized residuals had approximately normal distribution. The mean of residuals was near zero(-4.59E-15), with standard deviation of residuals being 0.994. These are very close to expected 1. Also we have

only 2 outliers (|Standardized Residual| >3) among 206 observations. This is a very small proportion(1.2%), while the Cook's did not exceed 0.22 which seems like not influential.

And the distribution looked reasonably symmetric in the sense that the largest frequency seemed to occur near the center and decreasing toward both sides. This implies the distribution of residuals is not severely skewed.

3. Linearity test

Figure 4.2: Normal P-P Plot of Regression Standardized Residuals



Source: SPSS Output (2026)

Also, the Normal P-P plot confirms that residuals are normally distributed, since it shows that points of residual plot are quite close to the diagonal reference line and there are few points slightly away from it. According to Marczyk, DeMatteo, and Festinger (2005), minor deviations from the diagonal line are acceptable in social science research, particularly when the sample size is sufficiently large. Since the study used 206 valid responses, the regression model can be considered robust against small normality deviations. Overall, both the histogram and the P-P

plot confirm that the residuals were approximately normally distributed, indicating that the regression analysis results are statistically reliable and appropriate for interpretation.

4. Multi collinearity test

Table 4.9: Collinearity Diagnostics

Variable	Tolerance	VIF
Drug Supply Shortages	.514	1.945

Source: SPSS version28 Output (2026)

The collinearity statistics indicate that there is no serious multicollinearity problem between the independent variables. The Variance Inflation Factor (VIF) values for Drug Supply Shortages are 1.945, which is well below the recommended threshold of 5. Likewise, the tolerance values (.514) are above the acceptable minimum level of 0.20. This confirms that the predictor variables are sufficiently independent and can reliably be included in the regression model simultaneously. According to Kothari (2004), acceptable VIF and tolerance values indicate that predictor variables do not excessively overlap in measuring the same concept. Therefore, the regression model used in this study is statistically reliable and appropriate for explaining patient care.

Fitness of the Model

To determine the relationship between the explanatory variables and the dependent variable, MLR was applied using the model below.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \varepsilon$$

The R-squared value, also known as the coefficient of determination, tells how much of the variation in the dependent variable is explained by the independent variables in a regression model (Parks et al., 2010). In the context of this study, it indicates the extent to which the listed independent variables explain variations in electric vehicle adoption.

4.6.1 Regression Model: Predictors of Overall Logistics Performance

Multiple linear regression analysis was conducted with overall logistics performance score as the dependent variable. Predictor variables entered in the final model included: Stock-out, Procurement, Forecasting, supplier unreliability, and Inventory turnover.

Multicollinearity diagnostics confirmed acceptable VIF values (all VIF < 4.2). The Durbin-Watson statistic (1.94) indicated independence of residuals. The overall model was statistically significant 57.2% of the variance in logistics performance ($R^2 = 0.756$, Adjusted $R^2 = 0.572$).

Model Summary

Table 4.7: Model Summary

el	R	Adjusted R Square	Std. Error of the Estimate	Change Statistics			
				R Square Change	F Change	df1	df2	Sig. F Change
	.756[a]	.572	.561	.43777	51.836	5	194	<.001

Stock-out, Procurement, Forecasting, supplier unreliability, Inventory turnover

Source: Survey data, 2026

As we have seen from the five independent variables (Stock-out, Procurement, Forecasting, supplier unreliability, and Inventory turnover) explained 57.2% of the variation of the dependent variable (Patient Care), according to the adjusted R-squared value of 0.572, which shows the result is reliable and stable. Other variables not included within the scope of this research explain the remaining 42.8% variation in patient care.

Table 4.8: ANOVA Table

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	49.670	5	9.934		<.001[b]
	Residual	37.179	194	.192	51.836	
	Total	86.849	199			

a. Dependent Variable: Patient Care

b. Independent Variables: Stock-out, Procurement, Forecasting, Supplier unreliability, Inventory Turnover

Source: Survey data, 2026

In Table 4.15, the ANOVA results indicate that statistically, it is highly significant overall. Five predictors contained in the model are Stock-out, Procurement, Forecasting, Supplier Unreliability, Inventory Turnover, which have an F-statistic value of 51.8% ($p < 0.001$),

indicating that Patient Care is highly predicted and fit. The F-statistic, 51.836, $p < .00$, is extremely high with the F-value and a highly significant p-value. This means the model is highly statistically significant: the predictors collectively have a strong effect on.

In general, the ANOVA results confirm that the regression model is statistically reliable and stable. The five predictors, Stock-out, Procurement, Forecasting, Supplier Unreliability, Inventory Turnover, explain a significant portion of the variation in Patient Care, with an F-value (51.836) and p-value (<.001) indicating that the model contributes a strong fit and effect on Patient Care.

Multiple Linear Regression Coefficients

Table 4.9: Regression Coefficients

Variable	B	Std. Error	Coefficients	t	Sig.
(Constant)	.706	.182		3.872	< .001
Stock-out	.104	.044	.13	2.363	.019
Procurement	.171	.039	.243	4.439	< .001
Forecasting	.171	.039	.33	4.439	< .001
Supplier unreliability	.267	.043	.174	6.230	< .001
Inventory turnover	.128	.040	.191	3.154	< .001

Source: Survey data, 2026

In the output from Table 4.11, the regression model revealed that all barriers were statistically significant at the 5% significance level, and their regression coefficients were positive, meaning that Patient Care is increased by 0.13, 0.243, 0.33, 0.174, and 1.91 units, respectively, for each one-unit change in those independent variables, with the other factors held constant. Additionally, the 95% confidence intervals for the covariates do not include zero, confirming their significant effect on Patient Care.

Forecasting is the strongest barrier, with the result of $\beta = 0.333$, $p < 0.001$, followed by the Procurement, with the result of $\beta = 0.243$, $p < 0.001$, while Inventory turnover and Supplier unreliability have moderate but statistically significant contributions with the result of $\beta = 0.191$,

$p < 0.001$, and $\beta = 0.174$, $p < 0.002$. Stock-out have the weakest influence, though they remain significant with the result of $\beta = 0.13$, $p < 0.19$.

Overall, the regression model explains some variation in, showing that these determinants jointly play a significant role and have a statistically significant positive effect on effect of drug supply shortage in Adama.

Table 4.10: Summary of Regression Coefficients

Predictor	Unstandardized Coefficient (B)	Standardized Coefficient (Beta)	t-value	Significance (p)	Strength of Influence
Forecasting	.267	.333	6.230	< .001	Strongest
Procurement	.171	.243	4.439	< .001	Second strongest
Inventory turnover	.146	.191	3.422	< .001	Moderate
Supplier unreliability	.128	.174	3.154	.002	Moderate
Stock-out	.104	.130	2.363	.019	Weak but significant

Source: Survey data, 2026

Qualitative Findings

Pervasiveness and Predictability of Shortages

Almost universally, healthcare providers described drug supply shortages not as exceptional events but as the normal operating condition. One senior physician at AHMC described the situation as follows (paraphrased): shortages were predictable staff knew from experience which months were worst and for which medicines. Rather than being surprised, the team planned clinically around anticipated shortages. This normalized experience of shortage reflects a systemic, structural problem rather than episodic supply chain failures.

Clinical Adaptation Strategies

Healthcare providers reported a range of adaptation strategies to manage patient care in the context of supply shortages. These included: prescribing second-line or alternative medicines when first-line drugs were unavailable; splitting treatment courses to extend available stock;

directing patients to private pharmacies or advising them to purchase medicines from outside; delaying elective procedures or non-urgent admissions; and in some cases, discharging patients earlier than clinically optimal to reduce medicine consumption. A head nurse described the moral distress associated with directing patients many of whom were very poor to purchase medicines they should be receiving free of charge through the public system.

Patient Experience of Shortage

Patients interviewed described feelings of abandonment, confusion, and financial distress when told that their prescribed medicines were unavailable. Several patients recounted spending significant portions of their household income at private pharmacies to obtain essential medicines, and some described stopping treatment prematurely when private purchase became unaffordable. A few patients described worsening of their condition including uncontrolled blood pressure, hyperglycemic episodes, and incompletely treated infections that they attributed directly to interrupted medicine supply. These accounts powerfully corroborate the quantitative finding of a strong negative relationship between shortage severity and patient care quality.

Supply Chain System Failures

Key informants including hospital pharmacy directors and supply chain managers identified a constellation of system-level failures as root causes of persistent shortages: chronic underfunding of the pharmaceutical budget with actual disbursements consistently below planned allocations; EPSS delivery delays averaging 45–60 days against a target of 30 days; inadequate cold chain infrastructure resulting in accelerated expiry of temperature-sensitive medicines; poor integration between hospital electronic health record systems and pharmacy management systems making real-time consumption tracking impossible; and shortage of trained pharmaceutical supply chain management personnel. The absence of a national shortage early-warning system was specifically highlighted as a critical gap, as hospitals often had no advance notice of impending supply disruptions.

Institutional Responses and Limitations

Hospital managers described several institutional responses to drug shortages including emergency procurement from local private suppliers at higher costs; informal medicine sharing and loan arrangements between hospitals; therapeutic committee reviews to update formulary substitution protocols; and patient communication through healthcare providers.

However, informants uniformly acknowledged that these responses were reactive, financially costly, logistically burdensome, and at best partially effective. The fundamental constraint identified was the absence of an empowered, well-resourced supply chain function at hospital level with the authority and financial flexibility to respond proactively to supply chain disruptions.

CHAPTER FIVE: FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Introduction

The main finding of the research is revealed under conclusion and recommendation chapter. The conclusion part shows the overall implications on findings of the research. It covers discussions on the key lessons from the study and identifies the most effective ways to reduce the effect of drug supply shortage.

5.1 Summary of Key Findings

This study examined the effect of Drug Supply Shortages on logistics performance and patient care quality at three public hospitals in Adama City, Ethiopia. Drawing on quantitative data from 186 respondents, and the following major findings emerged.

Prevalence and Severity of Drug Supply Shortages:

- The pharmacy inventory audit revealed an average stockout rate of 34.7% across 30 tracer essential medicines, with the highest rates for maternal health medicines (52.8%) and other essential medicines (54.8%).
- 67.4% of healthcare providers experienced at least one significant shortage episode per month. Shortages were reported as predictable and normalized features of supply chain operation rather than unexpected events.
- The mean supply shortage severity composite score was 3.47 (SD = 0.72) out of 5, indicating moderate-to-high severity.

Correlation Results:

- Supply shortage severity had strong negative correlations with overall logistics performance ($r = -0.672$, $p < 0.001$) and patient care quality ($r = -0.631$, $p < 0.001$).
- Overall logistics performance was strongly positively correlated with patient care quality ($r = 0.674$, $p < 0.001$), confirming logistics as a critical mediating pathway to patient outcomes.

Multiple Regression Results:

The five independent variables (Stock-out, Procurement, Forecasting, supplier unreliability, and Inventory turnover) explained 57.2% of the variation of the dependent variable (Patient Care), according to the adjusted R-squared value of 0.572, which shows the result is reliable and stable. Other variables not included within the scope of this research explain the remaining 42.8% variation in patient care.

5.2 Conclusions

This study concludes that drug supply shortages represent a systemic failure with profound operational and humanitarian consequences at public hospitals in Adama Town. The causes of this failure are structural, rooted in chronic underfinancing of the pharmaceutical supply function, institutional weaknesses in forecasting and inventory management and supply-side fragility in the PFSA/EPSA distribution system. Neither individual facility responses nor incremental process improvements are sufficient to address shortages of this magnitude and pervasiveness; systemic reform is required. The study further concludes that the current logistics management practices at all three hospitals are inadequate for ensuring consistent medicine availability. The near-total absence of scientifically determined reorder points, minimum-maximum stock levels, and systematic ABC analysis means that procurement decisions are reactive rather than proactive, generating the observed patterns of simultaneous overstocking and understocking.

From a patient care perspective, the study concludes that drug supply shortages are directly causing treatment interruptions, medication substitutions with clinical risk implications, extended waiting times, patient dissatisfaction, and preventable adverse events. The magnitude of these impacts particularly the 74% monthly treatment interruption rate and the doubling of pharmacy waiting times constitute a public health emergency at the facility level that demands urgent corrective action.

The inter-hospital performance differentials confirm that contextual factors particularly institutional autonomy, human resource capacity, and budget adequacy moderate the impact of systemic supply chain failures. This finding suggests that while systemic reform is necessary,

facility-specific capacity building and management improvement are also important components of a comprehensive solution.

5.3 Recommendations

5.3.1 Recommendations for Hospital Management

Based on the findings, the following recommendations are made to the management of AHMC, Musie General Hospital, and Bati Hospital:

- Establish dedicated pharmaceutical supply chain management units at each hospital, staffed by trained logistics personnel with exclusive responsibility for procurement planning, inventory management, and LMIS data quality.
- Adopt and enforce ABC-VEN analysis for all medicines on the hospital formulary, establishing science-based reorder points, safety stock levels, and maximum stock levels for all Vital and Essential-category medicines.
- Set up or enhance electronic LMIS (DHIS2 based) to keep a real-time account of medicines stock levels and consumption patterns and automatically issue warning reports when medicine stocks are running low.
- Create a formal, structured medicine borrowing and lending mechanism within Adama Town by institutionalizing a process for transfer of medicines from hospitals with surplus stocks to those in deficit during shortage events.
- Design clear emergency procurement authorization processes defining pre-authorized potential emergency procurement suppliers and set reasonable price ceilings, along with pre-established authorization levels to decrease delays and cost increases in emergency medicine procurement.
- Institute regular, quarterly pharmacy performance review meetings involving heads of pharmacies, procurement officers, clinicians, and finance managers to track and address issues affecting performance.

5.3.2 Recommendations for the Adama Town Health Bureau

- Raise the medicines budget given to public hospitals in Adama Town to at least the minimal level calculated from consumption levels and guarantee regular quarterly releases of established budgets.

- Set up an Adama Town Pharmaceutical Supply Chain Coordination committee to support the sharing of information, collaborative medicine forecasting, pooled emergency procurement of medicines, and comparison of performance levels.
- Send pharmaceutical supply chain coordinators to visit all 3 public health facilities monthly for the purpose of carrying out support supervision visits including in-service training, data review, and report generation.

5.3.3 Recommendations for the Ethiopian Pharmaceutical Supply Agency (EPSA)

- Reduce order-to-delivery lead times to 14 days for urban hospital customers, through improved warehouse management, pre-positioned stock for high-demand items, and optimized distribution scheduling.
- Improve order fill rates to the 95% target by strengthening demand forecasting at the national level using disaggregated facility consumption data and establishing contingency stock reserves for Vital medicines.
- Increase the scope of Vital category medicines direct supply to hospitals at second-tier cities by circumventing middlemen stages of distribution, thereby avoiding additional losses and delays.
- Provide training session on forecasting, quantification and LMIS application for the pharmacy personnel at Musie General Hospital and Bati Hospital, where the needs are the highest.

5.4 Directions for Future Research

This study opens several directions for future research.

First, a longitudinal evaluation of the impact of LMIS implementation on stockout rates and logistics performance at the three hospitals would provide valuable evidence on the effectiveness of information system investments.

Second, the quality of evidence for patient safety policy would be enhanced by a patient-level cohort study of clinical outcomes of treatment interruption and substitution events at the aforementioned hospitals.

Third, the cost-effectiveness of alternative strategies to reduce shortages (including buffer stocks, group purchasing, and direct delivery systems) could be evaluated.

Fourth, an analysis of the distribution of drugs shortages throughout the system for all public health facilities in Oromia Regional State would establish the necessary evidence at state-level supply chain reform.

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Appendixes



Addis Ababa University

College of Business and Economics, School of Commerce

Department of Logistics and Supply Chain Management

Appendix I: Questionnaire

Dear Respondent,

My name is Mesfin Mamuye a master student at Addis Ababa University School of Commerce, Department of Logistics and Supply Chain Management, Addis Ababa, Ethiopia with Master of science in Logistics and Supply Chain Management. For the purpose of completing the research work I need to conduct the research work with the title: " The effect of Drug Supply Shortages on hospital logistics performance and patient care in public hospitals of Adama town. Your kindly co-operation in responding to this questionnaire will be greatly appreciated. I assure you that any information you provide has been used strictly for academic purposes only and is absolutely confidential.

Please note that: No need to write your name; please read each statement carefully and answer all questions as much as you can. For descriptive statements, please respond under each section and put your answer tick (√) in the corresponding boxes. We would like to thank you in advance for your time in giving the responses.

Yours sincerely,

Mesfin Mamuye

Section I: Demographic Information

Please select the appropriate response for each question:

APPENDICES

Appendix A: Structured Questionnaire

The effect of Drug Supply Shortages on Hospital Logistics Performance and Patient Care in Adama Town Public Hospitals. This questionnaire is designed to collect data for academic research purposes only. Your responses will remain strictly confidential. Please answer all questions as honestly as possible. There is no right or wrong answers we are interested in your professional experience and opinions.

Section I: Demographic Information

Hospital	AHMC ☐ Musie General Hospital ☐ Bati Hospital☐
Gender	Male ☐ Female ☐
Age	25–34 ☐ 35–44 ☐ 45–54 ☐ 55+☐
Professional Role	Pharmacist ☐ Pharmacy Technician ☐ Procurement/Logistics ☐ Clinician Administrator☐
Level of education	Diploma ☐ Degree ☐ MSc and above ☐
Years of Experience	< 5 ☐ 5–10 ☐ 11–15 ☐16+☐

Section II: Effect of Drug Supply Shortage on Patient Care

Indicate how much you agree or disagree with the following assertions using a Likert scale of 1 to 5, with Strongly Disagree (SD) = 1, Disagree (D) = 2, Neutral (N) = 3, Agree (A) = 4, and Strongly Agree (SA) = 5. For each statement, please check the box (cell) that most accurately reflects your level of agreement (√) or mark (x).

Effect of Drug Supply Shortage (Independent Variables)

No.	Stock-outs	S.Agr	Agr	Neut	Dis	S.Dis
		1	2.	3	4	5
S1	Essential medicines are frequently unavailable when needed.					
S2	Stock-outs disrupt the continuity of patient treatment.					
S3	Drug shortages occur repeatedly within short time intervals.					
S4	Stock-outs negatively affect the hospital's ability to deliver timely services.					
S5	Stock-outs increase the workload and pressure on healthcare staff					

No.	Procurement Delays	S.Agr	Agr	Neut	Dis	S.Dis
		1	2.	3	4	5
P1	Delays in procurement significantly slow down drug replenishment.					
P2	Procurement processes take longer than expected.					
P3	Late supplier deliveries contribute to drug shortages.					
P4	Bureaucratic procedures cause delays in drug procurement.					
P5	Procurement delays negatively affect overall logistics performance.					

No.	Poor forecasting	S.Agr	Agr	Neut	Dis	S.Dis
		1	2.	3	4	5
P1	Forecasting inaccuracies contribute to frequent drug shortages.					
P2	The hospital struggles to accurately estimate drug demand.					
P3	Poor forecasting leads to overstocking or under stocking of medicines.					
P4	Forecasting methods used are insufficient for actual consumption patterns.					
P5	Lack of reliable data affects the accuracy of drug forecasting.					

No.	Supplier Unreliability	S.Agr	Agr	Neut	Dis	S.Dis
		1	2.	3	4	5
S1	Suppliers often fail to deliver drugs on time.					
S2	Supplier inconsistencies contribute to frequent stock-outs.					
S3	The hospital cannot rely on suppliers for timely delivery.					
S4	Supplier performance negatively affects drug availability.					

S5	Unreliable suppliers increase the risk of drug shortages.					

No.	Inventory turnover	S.Agr	Agr	Neut	Dis	S.Dis
		1	2.	3	4	5
I1	Inventory turnover rates are too low to meet patient needs.					
I2	Slow inventory movement contributes to drug shortages.					
I3	Inefficient inventory turnover affects logistics performance.					
I4	Inventory turnover practices do not match actual drug consumption.					
I5	Poor inventory turnover leads to expired or unusable stock.					

Patient Care (Dependent Variable)

No.	Patient Care	S.Agr	Agr	Neut	Dis	S.Dis
		1	2.	3	4	5
P1	Drug shortages negatively affect the quality of patient care.					
P2	Patients experience delays in receiving necessary treatment.					
P3	Drug unavailability reduces patient satisfaction with services.					
P4	Treatment interruptions occur due to unavailable medicines.					
P5	Drug shortages increase the risk of poor health outcomes.					

Thank You for Your Participation

Appendix B: Key Informant Interview Guide

Semi-Structured Key Informant Interview Guide

I. Introduction and Consent

Thank you for agreeing to participate in this interview. I am graduate student investigating on the effect of drug shortages in hospitals logistic performance and patient care at AHMC, Musie general hospital and Bati hospital. Your cooperation in participating in this survey is voluntary and all answers given will be highly confidential.

II. Interview Questionnaires

A. Magnitude and nature of drug shortage

1. What kinds of drugs are mostly unavailable at your hospital?
2. How often do you face shortage of drugs at your institution?
3. In which department does the shortage of drugs most affect?
4. How long does the drug shortages typically persist?

B. Causes of drug supply shortage

5. What in your opinion do you believe contribute most to drug shortage?
6. How does forecasting and quantification of drug supply affect availability?
7. What are the difficulties encountered during procurement process?
8. What are the EPSA-related factors that result in drug shortage?
9. Are there any budgetary or financial problems?
10. How efficient is the communication between your institution and supplier?

C. Effect on hospital logistic performance

11. How do drugs shortage influence procurement activities at your institution?
12. What effect does drug shortage has on your inventory management?
13. What is the effect of drugs shortage on emergency procurement?
14. How is accuracy of forecast and planning of drugs affected by shortages?
15. How do the logistic performance at your hospital is affected by shortages?

D. Effect on Patient care

16. How does shortage of drugs affect patient treatment?
17. Are your patients referred to other health institution due to lack of certain drugs?
18. What effects do shortages have on patient satisfaction?
19. Which patient groups are most affected?
20. Have shortages contributed to treatment interruption or complications?

E. Existing Strategies and Recommendations

21. What strategies are currently used to manage shortages?
22. How effective are these strategies?
23. What improvements are needed in the supply chain system?
24. What recommendations would you provide for hospital management?
25. What recommendations would you provide for EPSA and policymakers?

Appendix C: Documentary Review Checklist

The following records were reviewed at each hospital: Pharmacy stock cards (bin cards) for all EML tracer medicines; monthly LMIS reports (July 2021–June 2024); procurement requisition books and purchase orders; supplier delivery notes and order confirmation records; pharmacy dispensing registers; patient complaint registers; annual hospital performance reports; emergency procurement authorization forms and invoices; stock-taking reports and annual inventory reconciliation records.

Consent Form

Participant Information Sheet and Consent

You are invited to participate in a research study entitled: “The effect of Drug Supply Shortages on Hospital Logistics Performance and Patient Care: A Case Study at Public Hospitals in Adama Town, Ethiopia. “Your participation is voluntary. The information collected will be confidential and used only for academic purposes. You may refuse to answer any question or withdraw from the study at any time without any consequence.

Do you agree to participate in this study?

Yes ☐No☐

Participant Signature: _____

Researcher Signature: _____

Date: ____ /_____