



COLLEGE OF HEALTH SCIENCES
SCHOOL OF PHARMACY, DEPARTMENT OF SOCIAL AND
ADMINISTRATIVE PHARMACY HEALTH SUPPLY CHAIN MANAGEMENT
MSC THESIS

INVENTORY MANAGEMENT PERFORMANCE ON EMERGENCY
MEDICINES IN FEDERAL HOSPITALS OF ADDIS ABABA, ETHIOPIA: A
MIXED METHOD APPROACH

By: Bisrat Bogale (B. Pharm)

Advisor: Dr. Mesfin Haile

Co advisor Mr. Alemayehu Teshale

June 2025

Addis Ababa, Ethiopia

**Inventory Management Performance on Emergency Medicines in Federal Hospitals of Addis Ababa,
Ethiopia: A Mixed Method Approach**

By: Bisrat Bogale (B.Pharm)

**A Thesis submitted to the Addis Ababa University, College of Health Science, Department of
Pharmaceutics and Social Pharmacy for the partial fulfillment of the requirements for the Master's
Degree in Health Supply Chain Management**

Advisor: Mesfin Haile (Phd)

Co -advisor Mr. Alemayehu Teshale

June 2025

Addis Ababa, Ethiopia

Addis Ababa University School of graduate studies

Certification statement

This is to certify that the thesis prepared by Bisrat Bogale entitled: Inventory management performance on Emergency Medicines in Federal Hospitals of Addis Ababa, Ethiopia: A Mixed method Approach and submitted in partial fulfillment of the requirements for the Master's Degree in Health Supply chain Management, complies with the regulation of Addis Ababa University and meets the accepted standards in terms of originality and quality

.

Signed by the examining Committee:

.....		 Thesis Advisor
Signature	Date	
.....		 Thesis Co-Advisor
Signature	Date	
.....		 Internal Examiner
Signature	Date	
.....		 External Examiner
Signature	Date	

Chair of Department or Graduate Program Coordinator

ACKNOWLEDGEMENT

My sincere gratitude goes to my supervisors, Dr.Mesfin Haile and Mr.Alemayehu Teshale for their invaluable guidance. My heartfelt thanks also go to school of pharmacy for granting me the opportunity to study on this topic. My acknowledgements also go to all the respondents and facility management for their support through contributing their time, insight and permission during data collection essential for my study. Finally, I extend my deepest appreciation to my parents, siblings and spouse for their constant support and patience during my academic journey and particularly during the research and preparation of this thesis.

ABSTRACT

Introduction: Emergency Medicines are medicines that are used for handling time sensitive Emergency care at facility and/or pre facility level for conditions until stabilization. The unavailability of emergency medications in emergency situations could impact patient outcomes. The absence of essential emergency drugs points to a weakness in emergency preparedness. Proper inventory management on emergency medicines is crucial for insuring the availability of life saving medicines in the health care settings.

Objective: This study aims to assess inventory management performance on emergency medicines in Federal Hospitals in Addis Ababa, Ethiopia.

Methods: An explanatory mixed study was conducted in six Federal Hospitals in Addis Ababa from January 2024 up to March 2024. The quantitative data was collected using interviewer administered semi structured and structured questionnaire and observational checklists. The qualitative data were collected through in depth interview to explain the challenges and way forward. The quantitative data was analyzed using SPSS version 24 and Excel spreadsheet. Chi-square test was used to determine the association between variables and Spearman's rho analysis was used to test correlation, the critical value ($p < 0.05$) and ($p < 0.01$) was considered significant respectively.

Result: The mean availability of emergency medicines was 63.5%, the mean day's duration of stock out was 51.07 days and the mean stock out rate was 55.61%. Mean percentage of updated bin card was 79.85%. The inventory accuracy rate for emergency medicines was 78.24%. While all facilities surveyed used report and requisition form for program medicine and bin cards, there were no report and requisition form for budget drugs, revealing inconsistent application of stock management tools across drug groups. Among submitted report 100% was timely reported 77.7% was complete and 72.2 % accurate. The total cost of expired medicines is 1,326,035.31 ETB birr. The mean Wastage rate was found to be 2.53%.

Key challenges include poor manual process, discrepancies in stock records and unreliable suppliers.

Conclusion: The findings show there were significant emergency medicines stock out across hospitals with some facility facing critical stock outs. Stock-outs of vital medicines highlight weakness in emergency preparedness. Despite the complete utilization rate of bin card there is a gap in inventory accuracy and bin card updating. Inventory accuracy and bin card updating and prioritization of vital drugs shows to be associated with emergency medicines availability. Inconsistent application of stock management tools and high wastage need attention. These financial losses from expired medication along with shortages indicate a series gap in inventory control, the overall adherence to storage standards is generally high. However, there are some areas where improvement is needed

Recommendations: Federal hospitals in Addis Ababa should Identify best practice and share through benchmarking, standardize inventory management tools across all federal hospital and across all Items category, conduct regular stock reviews and improve quality of data from logistic management information tools

Key words: Emergency medicine, Inventory management performance, Availability, inventory accuracy, stock out rate, wastage.

Table of content

Contents

ACKNOWLEDGEMENT	v
ABSTRACT	vi
CHAPTER ONE INTRODUCTION	1
1.1. Background of the study	1
1.2 Statement of the Problem	3
1.3. Significance of the study.....	5
CHAPTER TWO	6
LITERATURE REVIEW	6
2.1. Theoretical review	6
2.2. Empirical review.....	10
2.3. Conceptual framework.....	14
CHAPTER THREE	15
RESEARCH OBJECTIVES	15
CHAPTER FOUR.....	16
METHODS.....	16
4.1. Study Area.....	16
4.2 Research design	17
4.3 Population	17
4.4 inclusion Criteria	17
4.5 Data sources	18
4.6 sample size determination and sampling methods	18
4.7 Variables	18
4.8 Data collection procedures.....	19
4.9 Quality Assurance.....	20
4.10 data analysis and interpretation	20
4.11 Ethical considerations	20
4.12 Operational definitions.....	20
CHAPTER FIVE.....	22
RESULTS	22
CHAPTER SIX.....	44
DISCUSSIONS	44
CHAPTER SEVEN.....	49
CONCLUSION AND RECOMMENDATION	49
7.1 CONCLUSIONS	49
7.2 RECOMMENDATIONS	50
Reference	51
Appendices	57

Abbreviations

AaBET	Addis Ababa burn emergency trauma centre
ALERT	All African leprosy, tuberculosis, rehabilitation and training center
E.C :	Ethiopian Calendar
EFDA:	Ethiopia Food and Drug Administration
EPSS:	Ethiopia Pharmaceutical Supply Service
ETB:	Ethiopian Birr
FEFO:	First Expiring First out
FMOH:	Federal Ministry of Health
HC:	Health Centre
HCMIS	Health Commodity Management Information System
IPLS	Integrated Pharmaceutical Logistics Management System
IFRR:	Intra Report and Requisition Form
LMIC:	Low and Middle Income Countries
LMIS:	Logistic Management Information system
MNCH:	Maternity, New-born and Child health
ORS:	Oral Rehydration Salt
PHCUs:	Primary Health Care Unit
PHF:	Public Health Facility
PI:	Principal Investigator
RDF:	Revolving Drug Fund
RRF:	Report and Requisition Form
SRC:	Stock Record Card
SOP:	Standard operating procedure
TMs:	Tracer Medicine
UN:	United Nation
USAID:	United States Agency for International Development
WHO:	World Health organization

List of Table

Table1. socio demographic characteristics of study participant Federal Hospitals in Addis Ababa, Ethiopia, march2024.....	25
Table2.. inventory management practice Emergency medicine in Federal Hospital of Addis Ababa, Ethiopia, march2024.....	26
Table 3: the association of emergency medicines Availability with VEN categorization at Federal Hospitals in Addis Ababa Ethiopia march2024.....	31
Table 4. Availability and utilization of stock recording tools at Federal hospitals of Addis Ababa Ethiopia march2024.....	32
Table5. Wastage rate of medicines of emergency medicine within six months before study in Federal hospitals of Addis Ababa Ethiopia march2024.....	35
Table6.. Adherance to Good storage standard of emergency medicines in Federal hospitals of Addis Ababa Ethiopia march2024.....	38
Table 7. Descriptive analysis of the inventory management performance at Federal hospitals of Addis Ababa Ethiopia march2024.....	39
Table8. Result of nonparametric correlation analysis between variables such as training status, education level, years of experience and inventory management performance.....	40
Table9. Chi-Square Tests of association between Bin card accuracy updating and availability of emergency medicine.....	40
Table10. Chi-Square Tests for association between availability and wastage reduction.....	41
Table 11: Socio demographic characteristics of interviewee at Federal hospitals of Addis Ababa Ethiopia march2024.....	42

List of figures

Figure 1. conceptual frame work for the assessment of inventory management performance on emergency medicines at Federal hospitals of Addis Ababa Ethiopia march2024	15
Figure2 .Availability of emergency medicine in Federal hospital in Addis Ababa, Ethiopia, 2024.....	28
Figure3. mean days duration of stock out of Emergency medicines at Federal hospitals of Addis Ababa Ethiopia march2024	29
Figure4. Emergency medicines with high frequency of stock out across federal hospitals , In Addis Ababa Ethiopia march,2024.....	30
Figure5 percentage of emergency medicines with in VEN category.....	31
Figure6. bin card accuracy at Federal hospitals of Addis Ababa Ethiopia march2024.....	33
Figure7. bin card accuracy at Federal hospitals of Addis Ababa Ethiopia march2024.....	34
Figure8. Quality of (RRF) reporting tool at Federal hospitals of Addis Ababa Ethiopia march2024.....	34
Figure9. the performance of each Federal hospitals of Addis Ababa Ethiopia with regard to good storage practice at	38
Figure10. The main themes and subthemes of thematic analysis	45

CHAPTER ONE INTRODUCTION

1.1. Background of the study

Emergency care encompasses a wide range of medical, surgical, obstetric condition, injury, complication of pregnancy exacerbation of non-communicable diseases and acute infections .lack of timely emergency care can lead to preventable deaths, illnesses and expenses caused by sudden medical and traumatic situations. (WHO, 2018) Ethiopia, being a low- to middle-income country, faces significant numbers of deaths, illnesses and expenses caused by sudden medical and traumatic situations.

Effective healthcare delivery hinges on the Accessibility and availability of essential medicines, particularly in emergency situations (Hunie et al., 2020). Emergency medicines are drugs that require immediate administration in medical emergency and have the potential to sustain life and prevent further complications. These medicines are derived from essential medicines list (Sudan, 2015).

Inventory management refers to the strategic and systematic approach of regulating the stock quantities to align with the broader operational goals set by the organization (Alam et al., 2024).it encompasses various practices and systems aimed at maintaining adequate inventory levels with in storage facilities (Demizu, 2023). Key tasks in this domain include determining inventory needs, establishing replenishment procedure, monitoring items usage reconciling stock record and communicating inventory status (Baker et al., 2024). At its core, inventory management seeks to optimize stock levels to prevent both overstocking and stock outs, thus reducing related expenses (Baker et al., 2024).

Inventory management inefficiencies can lead to stock outs of life-saving drugs, jeopardizing patient care and potentially resulting in adverse health outcomes. Moreover, inadequate inventory control can lead to excessive carrying costs, wastage and inefficiencies in resource utilization. In health care setting, inventory accounts for current and liquid current asset. Its overall values have been increasing, driven by the expanding range and rising prices of pharmaceutical products (Hidayat et al., 2020). Federal Hospitals in Addis Ababa bear the responsibility of offering critical medical services to a vast and diverse population. However, the optimal management of emergency medicine inventory in these hospitals remains a challenge. In the context of a developing nation like Ethiopia, where healthcare resources are often constrained, efficient inventory management becomes even more imperative (Hunie et al., 2020). Addressing these challenges is vital not only for the well-being of patients but also for the overall efficacy of the healthcare system. In the context of health care inventory management combining quantitative metrics with qualitative narratives can reveal not only statistical trends but also the underlying factors contributing to those trends.

The qualitative components of the study allows researchers to capture the perspective of hospital staff, administrators and supply chain personnel, providing valuable context to the quantitative data, This comprehensive approach offers a nuanced view of inventory management challenges and open the door to innovative solutions that bridge the gap between theory and practice.

This research seeks to address the existing gap by thoroughly evaluating how emergency medicines are managed in terms of inventory with in Federal Hospitals located in Addis Ababa. The findings are expected to support improvements in inventory practices, helping to ensure that essential medicines are consistently accessible during emergency situations.

1.2 Statement of the Problem

Access to essential medicines is critical for reducing morbidity and mortality .However, a shortage of essential medications is the greatest obstacle to the effective health care delivery in public health facilities. This situation mostly occurs in African countries. An estimated 30% of people worldwide are thought to be without access to the essential medications needed to treat a variety of illnesses (Barasa N, et al., 2018).

The World Health Organization (WHO) has found that the availability of critical medications in African regions varies with a median availability of critical pharmaceuticals at 40% in the public sector and 78.1 % in the private sector (Wambui MC, 2017). African countries often face challenges in monitoring and ensuring critical medicine accessibility resulting in higher prices in the private sector and shortages in the public sector. Limited access to medications significantly contributes to increased illness and death rates, as well as reduced adherence to prescribed treatments (Obuaku C, 2014).

Stock outs of life saving drugs remain a significant issue in many low and middle income countries (LMICs), contributing to increased maternal morbidity and mortality (Kabera et al, 2024). Complexities with in the pharmaceutical supply chain remain a major barrier to the consistent availability and accessibility of essential, lifesaving medicines (Kebede et al., 2021). One of the key difficulties in managing pharmaceutical inventories is maintaining appropriate stock levels while minimizing losses. To address these challenges, targeted interventions are necessary to ensure that critical medicines are both available and usable, helping to reduce preventable losses (Gurmu et al., 2017)

Stock outs in hospitals in Addis Ababa are influenced by several critical factors within supply chain management. These factors include delays in supply, inadequate inventory management practices and insufficient data on stock levels, which collectively hinder the availability of essential medications (Sintayehu et al., 2022; Boche et al., 2020; Berhanemeskel et al., 2016).

Examining how emergency medicines are managed in inventory is essential to guarantee that critical, lifesaving drugs are available when urgently needed.(Alam et al., 2024; Demizu, 2023).by assessing inventory performance authorities can identify patterns of stock out and supply chain delay, enabling proactive solutions to prevent disruptions in emergency care .additionally ,evaluating current practice helps health care administrator improve policies and stock control strategy ,which can enhance the overall availability of emergency medicine .it ultimately supporting better public health outcomes (WHO2022). Improving inventory management can enhance access to medicines. Reaching this goal requires an assessment of the existing inventory management system by taking into account the specific institutional setting, outlining the expected performance standards, pinpointing

existing gaps and underlying issues and analyzing any shifts in performance overtime (EPSS, 2014).

In Federal Hospitals in Addis Ababa, procurement of medical commodities, instruments and reagents are primarily managed through the Ethiopian pharmaceutical supply service (EPSS) and the integrated pharmaceutical logistic system. However, all facilities have expressed concerns regarding the timeliness of medicines received through the pharmaceutical supply service (EPSS), which adversely impacts the continuous delivery and quality of healthcare services. This has led many inpatient and chronic outpatient patients to seek alternative sources, including private pharmacies within the country and abroad (FDRE FMOH, 2018).

The increasing incidence of trauma and time sensitive non-communicable diseases in Addis Ababa highlights the critical importance of establishing a stronger and adaptable emergency health care system (sultan et al., 2019). Federal hospitals ,as some of the largest and most resource intensive health institutions in the country , manages large numbers of health commodities and operates on large budgets .this makes the implementation of efficient and effective inventory management systems crucial for ensuring uninterrupted service delivery (Legese et al.,2022)

Although prior research has identified general challenges in health care inventory management in Ethiopia, such as issues in procurement distribution, storage and wastage there remains a significant gap in studies specifically addressing Emergency Medicines Inventory management in Federal Hospitals.

1.3. Significance of the study

This research seeks to address the existing gap by thoroughly evaluating how emergency medicines are managed in terms of inventory within Federal Hospitals located in Addis Ababa. By examining indicators such as stock out rates, medicine availability, record keeping practices, wastage, storage conditions and systemic challenges, it provides insight into current practices and gaps. Understanding the inventory management performance on emergency medicines is vital for identifying patterns of stock out and supply chain delays; Supporting proactive decision making to prevent emergency care disruptions, Informing policy improvement and inventory control strategies, Enhance access to emergency medicines, thereby improving public health outcomes (WHO, 2022; EPSS, 2014)

The findings are expected to support improvements in inventory practices, helping to ensure that essential medicines are consistently accessible during emergency situations and this research will contribute to more efficient inventory systems and strengthen Emergency Health care Delivery in Ethiopia.

CHAPTER TWO

LITERATURE REVIEW

2.1. Theoretical review

2.1.1 Overview of inventory management in health care

Medicines play a crucial role in the healthcare system. Beyond their therapeutic utility they are often considered by the public as the most tangible representation of healthcare and their availability is taken as an indicator of the quality and accessibility of health services (Sudan, 2015). Hospitals that have effective and strong medication management systems guarantee that the right medications are available year-round at fair prices, with no periods of stock-outs, through rational selection, quantification, procurement, storage, distribution and use. Many hospitals face significant challenges in their supply chain and pharmaceutical management systems, including limited resources and unclear policy guidelines, addressing these issues requires prioritizing the recruitments of well trained professionals equipped to handle medication management across all level of care (Iqbal et al., 2016).

Even a small number of stocks out of essential medicines can affect quality health care delivery. Stock-outs are a crucial indicator of health service preparedness and facilities lacking reliable and sufficient essential medicine availability are ill-equipped to deliver high-quality healthcare (World Health Organization 2012). As patients need more visits or referrals to obtain prescribed therapies, stock ruptures may not only affect the quality of patient care but also add to the strain of already overworked healthcare personnel (McDougal et al. 2012).

The stock out rate indicates whether a product is available or unavailable over a specific time period. It is a measure that evaluates how well a program or health facility can satisfy patient demand. Data from supervision records, LMIS records and physical inventories made during site visits can all be utilized to determine the stock out rate. It can be for items that are expected to be stocked at a particular facility or a single product across several facilities (MSH, 2010).

Inventory records play a central role in effective inventory management systems and may exist in either digital or paper based formats. Common tools used for tracking and documenting stock include the Intra Facility Report

and Resupply form (IFRR), The report and requisition form (RRF), bin cards and stock record cards. These various tools are collectively known as stock or inventory records. Because they capture every transaction related to individual items, these records serve as a crucial source of data for managing inventory efficiently. They offer data on orders, balances, suppliers, consumers, prices, issues and inventory receipts. Their contents are utilized to create and produce different reordering formulae and performance reports, respectively. Planning distribution and quantification depend on the information generated from them. Therefore, they must be available because they are vital to inventory management system (EPSS, 2015 and MSH, 2012).

Effective management of medicines and supplies is essential to minimize all forms of wastage, such as Excess inventory theft and expiration. Such losses directly impact the availability of medicines for patient, ultimately affecting the quality of health care service provided. Issues like insufficient or excessive stock levels, along with expired medications, often point to weakness in various supply chain functions ranging from selection and forecasting to procurement, storage, distribution and utilization (Kagashe et al., 2012).

Inventory management refers to the strategic and systematic approach of regulating the stock quantities to align with the broader operational goals set by the organization (Alam et al., 2024). It encompasses various practices and systems aimed at maintaining adequate inventory levels within storage facilities (Demizu, 2023). Key tasks in this domain include determining inventory needs, establishing replenishment procedure, monitoring items usage reconciling stock record and communicating inventory status (Baker et al., 2024). At its core, inventory management seeks to optimize stock levels to prevent both overstocking and stock outs, thus reducing related expenses (Baker et al., 2024).

Inventory management inefficiencies can lead to stock outs of life-saving drugs, jeopardizing patient care and potentially resulting in adverse health outcomes. Moreover, inadequate inventory control can lead to excessive carrying costs, wastage and inefficiencies in resource utilization. In health care setting, inventory accounts for current and liquid current asset. Its overall values have been increasing, driven by the expanding range and rising prices of pharmaceutical products (Hidayat et al., 2020). Efficient inventory management stands as a cornerstone of effective healthcare delivery. It ensures the timely availability of essential medical supplies while minimizing costs associated with overstocking and stock outs. Effective inventory management enables healthcare institutions to allocate resources optimally, provide uninterrupted patient care and contribute to cost savings. It involves the monitoring and maintenance of inventory levels while ensuring appropriate replenishment to fulfill client demand. Since inventory carries costs and has a direct impact on performance, the selection of the right inventory level is of paramount importance. Conversely, inadequate inventory levels can lead to stock outs and missed service opportunities (G. Priniotakis and P. Argyropoulos, 2018).

Visual technique, periodic and perpetual methods are Among the approach in pharmacy inventory management (Ayad K. Ali., 2011).the visual technique uses visually comparing the amount that have to be stocked with that at hand which was determined by the staff. Comparing the result will be used to make decision regarding ordering. In other case the periodic inventory management involves there will be regular pharmaceutical counting or physical inventory at specified interval and comparing the finding with the minimum stock requirement then the product will be ordered if the quantity of stock drop below the amount needed. On the other hand perpetual inventory management techniques which is the most effective way of managing inventory and computerized one which will continuously monitor the inventory at all time. With this approach the essential data are automatically update at all time by the software.

Pharmacists can also combine two of the stated approach that is perpetual with periodic methods and /orvisual methods, this will allow pharmacist to compare the computerized product quantity to be compared with actual stock for the correction of any variation if found in supply and demand, as well as the correctness of the pharmacy's financial records will be assessed and confirmed.

Medicines unavailability when required will compromise service which will also result in client dissatisfaction with the service provided and put the professionals through inconvenience. It will also significantly impacts patient's well-being, particularly if the product is a necessary life-saving one.

Ineffective inventory management may have also serious consequence on patient safety besides their financial impacts on overall pharmacy operations. Weekly stock reviews are advised to verify quantities, and monthly stock reviews are advised to look for products that have expired in order to improve patient safety. Another way to do this is by using software systems that notify the pharmacist when stocked products are about to expire or reach a crucial threshold quantity (Ayad K. Ali. 2011).

2.1.2 The role of information technology in the inventory management

The Idea of inventory management has been present since the dawn of civilization. Over the past century, the practice of inventory management has evolved, incorporating new instruments and technologies to support the process. Before the introduction of improved inventory record management and accounting system by ancient civilizations like Greeks and Egyptians trader relied on manual counting tallies to keep track of daily sales . These advancements in inventory management have significantly improved client satisfaction and reduced costs (V.S.S. Yadavalli & J.B. Munyaka, 2022).

Information technology are vital in the area of pharmacy inventory management and currently its being widely used in the developed nations. This Technology will add to the improvement of effectiveness and efficiency of inventory management techniques as well as methods for assessing inventory management. Among the technology used so far includes: device used to scan product package or shelf labels for periodic stock control or electronically submitting purchase order to via e-procurement. These days, practically every aspect of running a pharmacy involves technology, from product ordering and payment to procurement and storage. Pharmacists ought to take use of the newer technologies in their business to handle their drug inventory more effectively. The application of (RFID) radiofrequency identification tags is one example of amore up to date technology to enhance product distribution from the manufacturer to the pharmacies. These tags are designed to hold data regarding the pharmaceutical product from the time of manufacture until it is delivered to and taking down from pharmacy storage shelves. The technology in inventory management is making the inventory management method and its evaluation more precise and more accurate. Thus, this technology has to be applied in a pharmacy and pharmacists have to be equipped with the necessary training on its application. (Hidayat et al., 2020).

Predictive analytics has also been leveraged to optimize hospital inventory management. A study explored the application of machine learning and Convolutional Neural Networks to predict the availability of medicines in hospitals. These algorithms analyzed historical medicine usage data and incorporated external factors such as disease outbreaks and seasonal fluctuations to predict future demand. The implementation of these models was shown to improve the accuracy of medicine availability forecasts, enabling healthcare providers to make informed decisions regarding stock levels (U, et al., 2025).

The use of block chain technology in inventory management has also been explored. A block chain-based intelligent inventory management model was developed to prevent stock outs and improves the profits in the hospital supply network. This model uses internet of thing devices, block chain and cloud computing across the supply network, ensuring reliable cold chain monitoring and reducing transportation and storage costs. The model also incorporates a deep belief network to provide drug recommendations, further improving supply chain efficiency (Mishra, 2024).

It is obvious that the use of information technology in the pharmacy operation will improve the inventory management and its evaluation which will consequently minimize cost of acquiring and protecting against misuse because of theft. Besides this the potential for occurrence of medication error will be reduced when bar codes are introduced in pharmacy at the health care setting.

In the context of emergency medicine, inventory management becomes particularly critical. These medicines are indispensable for treating life-threatening conditions, and any disruption in their availability can have dire consequences. The effectiveness of inventory management directly influences a hospital's ability to respond to emergencies promptly and provide quality healthcare to patients.

2.2. Empirical review

2.2.1. Challenges of Medicines Inventory Management in Developing countries

Low income country often face unique challenges in managing medicines inventory. Limited infrastructure, inadequate storage facilities, supply chain complexities and insufficient resources can lead to imbalance in inventory levels. Furthermore, the unpredictable nature of emergency medical cases poses challenges in forecasting demand accurately. Ineffective management of emergency medicines inventory not only jeopardizes patient care but also strains the already constrained healthcare systems in these nations.

Poor communication and collaboration between departments hinder the identification of inventory trends and improvement efforts. A significant portion of medicines unavailability attributable to common inventory control techniques used for delivering medicines. Core competencies in inventory management and accurate demand forecasts are essential (Leung N-HZ, et al. 2016). Study done in western Africa Ghana shows that there were warehouse infrastructure inadequacy, as about 75% of the respondents affirmed to this statement. The lack of supplier bureaucratic procurement process high demand and supply imbalance lack of space at the warehouse and lack of essential data The lack of suppliers for some essential Commodities to be cause for inadequate supply of commodity at the health facility. (Vilbert A, et al., 2019).

Healthcare facilities in developing nations may fail to adhere to optimal storage standards due to limited storage capacity and inadequate management capabilities. According to the study conducted in sub Saharan African countries on the delivery of medications, only forty five percent of Health facilities fulfill requirement for storage condition (Atureca et al., 2017).

Previous research has underscored the need for effective inventory management in improving health care service and efficiency. Studies in South Africa reveal issue of stock outs and the resultant adverse effects on patient care, where 85.6% of medicines faced stock outs. The issue of over stocking, leading to wastage through expired medicines, revealing that 50.6% of medicines were overstocked and 15.2% of medicines were wasted due to

expiry. Additionally this finding highlights redistribution as an effective approach to balance supply and demand; reducing waste and alleviating stock out .overall the study reinforce the critical need for refined inventory management practices, echoing calls in the literature for better forecasting, inventory tracking and strategic redistribution to optimize pharmaceutical supply chains in healthcare settings (Mabizela et al., 2023).

Maternal mortality and morbidity among women in the developing world are primarily caused by unavailability of some critical medicines, such as emergency obstetric medicines, which are visible at many healthcare facilities. This condition is frequently linked to inadequate inventory control procedures. A survey conducted in ten Rwandan district hospitals found that the foundation of inventory management procedures for managing medications and medical supplies is maintaining current logistics management systems. The findings indicated that hospitals that routinely update their pharmaceutical management logistics systems had a 33.25 times higher likelihood of having their emergency obstetric medications on hand than hospitals that do not. The correct utilization of bin cards and computerized software played a significant role in minimizing the emergency obstetric drug stock out rate (88.9%). Furthermore, wastage has decreased by 79% because to the application of straightforward strategies such the min max inventory control technique (70%), which determines quantities to order by utilizing calculations based on historical consumption patterns. 18 months later, oxytocin had the fewest stock out average days (8), at 1.5 per cent. Misoprostol was the next most over stocked 367 days (67%), with magnesium sulfate injection experiencing the greatest stock out at 16 days (2.96) to 96 days (17.7%).sufficient supply chain staffing is crucial for enhancing inventory control procedures and medication accessibility in healthcare facilities. The finding also shows that effective pharmaceutical inventory management procedure on pharmaceutical have significantly impacted the availability of life saving (Kabera., 2022).

Mortality and morbidities can be greatly decreased with constant access to medications. However, a shortage of essential medications is the greatest obstacle to effective provision of service in the health care settings. This situation mostly occurs in African countries. An estimated 30% of people worldwide are thought to be without access to the essential medications needed to treat a variety of illnesses (Barasa N, et al 2018).

Quality of inventory management system is decisive to the success of health care delivery (Hani U, at al 2013)(Oballah D, et al 2015) However, stock-outs are the main reason for interruptions in health care services in developing nations including Ethiopia (Leung N-HZ, et al. 2016).

Even though the significant portion as high as forty percent of health care budget are spent on pharmaceutical there still remain challenges to the access to even the most essential medicines, One of the things that can be causing the issue is poor pharmaceutical inventory management, which can lead to irrational drug use, a financial

resource blockage, and/or a stockpile of necessary medications (Juhar, 2020).

Inaccurate record-keeping and the unavailability of essential medicines pose challenges in healthcare facilities. Issues related to transportation and supplier stock status further complicate inventory management systems thus reducing the availability of this essential medicine (Muzteba, 2014). The underutilization of the management information system in the logistic (LMIS) in developing nations like Ethiopia hampers the effectiveness of inventory management (Shewarega A, et al. 2015). Another study conducted in Ethiopia identifies budget constraints, a shortage of human resources, and an excess of drugs with short shelf life as the primary barriers to efficient inventory management (Gurmu et al., 2017). Inventory management practices are influenced by various factors, including organizational and human issues, budget constraints and the pace of technology adoption (Ahmad, 2014).

2.2.2 Studies on Healthcare Inventory Management in Ethiopia

Ensuring the accessibility of emergency medicine is vital for universal healthcare, patient satisfaction. Efficient inventory management is a requirement to guarantee uninterrupted supply of critical medicines. A study in Ethiopia found that the average percentage availability of critical medicine was 79.17; the mean stock out rate was 41.67% over six month period. The hospital experience average stock out of vital medications for 31.7% over the past six months, with an average frequency of 0.7. the difference between the vital drug record count and physical count ranged from 0 to approximately 95% (Woldeyohanins AE et al., 2020).

Another study conducted on evaluating inventory management performance of tracer medicines in Ethiopia found that the inventory accuracy rate was 76% for hospitals and 72.5% for health centers with an overall mean stock out rate was 24.99%. While 93.3% of facilities updated bin card, only 25% met acceptable storage condition. Report quality was 88.8% 72.2% accurate and 75% complete. key challenges identified included shortage from supplier, price inflation, inadequate training and supervision and poor infrastructure. The study concluded that improvement in report quality, inventory accuracy, storage condition and logistic system are necessary (Gutesa et al 2024).

Effective pharmaceutical management is crucial across the entire supply chain to prevent shortages, medicine waste and financial losses that impact health care services. A study in Ethiopia revealed that 40.5% of the selected 400 bin card were not updated. only 28.5 % of bin card had properly submitted information. the average time a major critical drug was stock out 35.31 days with a mean stock out percentage of around 27.25%. On

average, 10.45% of medications were wasted, resulting in a loss of 174366.98 Ethiopian birr (ETB) with medroxyprogesterone accounting for over 65.74% of that loss (Gurmu et al., 2017).

Although the present-day supply chain in Ethiopia is computerized through logistic management information system (LMIS), only 33% of facilities have computerized LMIS system in place. Proper storage conditions are vital to pharmaceutical wastage due to environmental factor. Medication wastage at facility can lead to the loss of potentially lifesaving prescription and unnecessary disposal cost. Another study found that a significant portion of health care facilities' stores didn't meet adequate storage criteria, leading to waste due to expiration. The total cost of reproductive health medications wasted due to expiration was 357920.52 ETB, with a wastage rate of 8.04%. The highest wastage due to expiration was for the levonorgestrel 0.75mg tablet. Supply and demand imbalance were factors contributing to wastage due to expiration (Kebede et al., 2021).

Another study conducted at Dessie town Ethiopia shows the institutions' record keeping, storage condition of pharmaceutical and overall inventory management systems do not meet requirements. The main problems with these institutions were determined to be calculation error, recording error, improper stock level maintenance, lack of automatic recording, absence of wall thermometer, lack of humidity and fire control systems, lack of lockable cabinets, failure to use the FEFO storage technique and holding combustible with drugs (Bayked et al., 2021).

Another survey conducted in Gamo zone Ethiopia in 46 PHCUs found that inventory management performance was below standard with stock outs affecting 43% of medicines, 18% stock alignment with plans and the inventory accuracy rate was also found to be 78.5%, the availability of TMS was 78% and 72.3% of facilities met storage condition criteria. The finding also revealed there are positive correlations between availability of tracer medicines and factors such as Supplier order fills rate and report accuracy. Additionally, significant performance variations were observed between different types of PHCUs, with primary hospital and health centers performing better than health posts. The finding indicates that poor supplier performance, report quality and variation across PHCUs contribute to the sub-optimal inventory management and interruption in the availability of TMS (Alemu et al., 2023).

2.2.3 The Role of Mixed Methods in Addressing Complex Research Questions

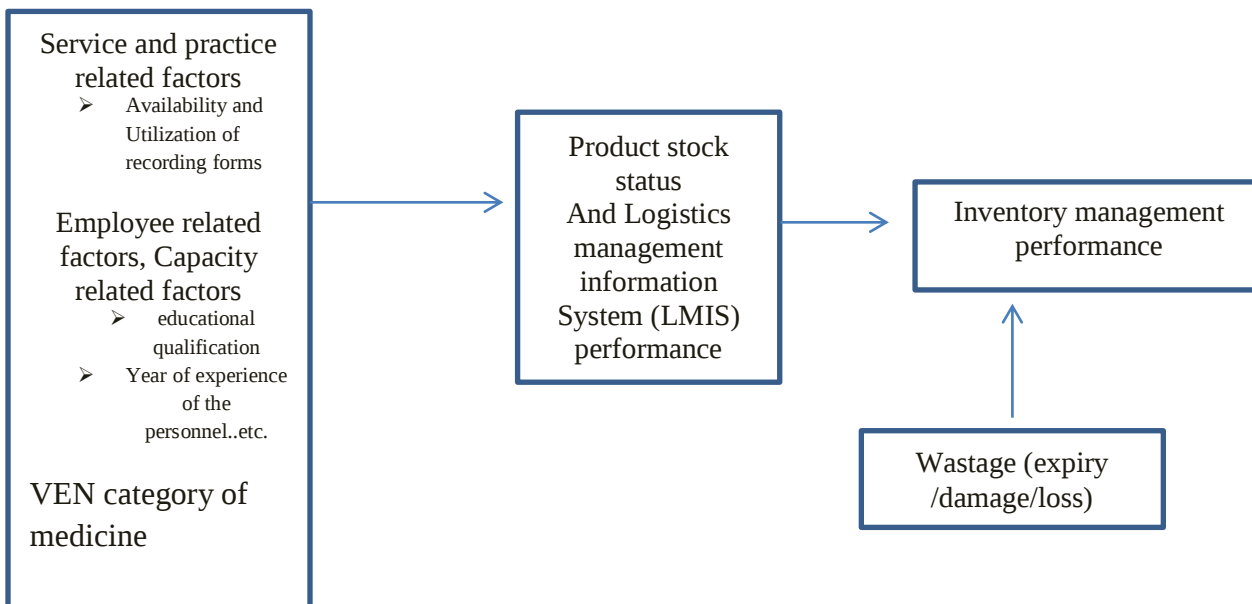
Mixed method research has gained prominence in addressing complex research questions that require multifaceted insights. In the context of health care inventory management, combining quantitative metrics with qualitative narratives can reveal not only statistical trends but also the underlying factors contributing to those trends. The qualitative parts of the study will allow researchers to capture the perspective of hospital staff,

administrators and supply chain personnel, providing valuable context to the quantitative data, This comprehensive approach offers a nuanced view of inventory management challenges and open the door to innovative solutions that bridge the gap between theory and practice.

By conducting thorough review of literature, this study aims to contextualize the inventory management challenges faced by federal hospitals in Addis Ababa, lay foundation for mixed method approach employed in the research. The integration of quantitative and qualitative methodologies will enable a comprehensive exploration of emergency medicine inventory management, leading to informed recommendations for improvement.

2.3. Conceptual framework

After sorrow review of literatures the following conceptual framework is designed.



Source: Adapted from (Kebede and Tilahun 2021; Gutesa et al., 2024),

Figure 1 Conceptual framework for assessing the inventory management performance of emergency medicines at Federal hospitals of Addis Ababa Ethiopia march2024

This conceptual framework visually illustrates the key factors influencing effective inventory management of emergency medicines. Drawing from the literature review and research findings, it highlights critical components such as availability, stock-outs, record-keeping and wastage. The framework enables researchers and healthcare professionals to systematically evaluate inventory management performance, identify gaps and develop strategies to optimize the availability of emergency medicines in federal hospitals. It also emphasize the importance of addressing inventory challenges within the context of a developing health care system

CHAPTER THREE

RESEARCH OBJECTIVES

3.1. General objective

To assess inventory management performance on Emergency medicines in Federal hospitals of Addis Ababa Ethiopia

3.2. Specific Objectives

1. To determine the availability of Emergency Medicine
2. To determine the stock out rate of Emergency Medicine
3. To assess stock recording practices of Emergency Medicine
4. To assess inventory accuracy of Emergency Medicine.
5. To evaluate the storage conditions of Emergency Medicines.
6. To determine stock wastage/expiry of Emergency Medicines
7. To identify the challenges faced during inventory management of Emergency Medicines.

CHAPTER FOUR

METHODS

4.1. Study Area

Ethiopia has an established pharmaceutical supply chain system that operates throughout the country. Federal Hospitals play a crucial role in healthcare logistics activities and are burdened with a substantial volume of pharmaceuticals for medical services.

The study took place in seven federal hospitals located in Addis Ababa, Ethiopia's capital. The city, divided into ten sub-cities and 116 districts, had a 2024 population estimate of 5.7 million. These Hospitals play a key role in delivering health services

Tikur anbesa Specialized Hospital (TASH), based in Addis Ababa and affiliated with Addis Ababa University, is a major referral and teaching hospital. It offers advanced care in fields like oncology, cardiology, neurology and more. TASH employs hundreds of health care professionals and nearly 1000 administrative staff. It serves as a training center for medical students and residents. The hospital's pharmaceutical budget for the year was 70 million birr

St. Paul's Hospital Millennium Medical College (SPHMMC) in Addis Ababa provides specialized care to patients nationwide, with over 700 beds and daily outpatient visits averaging 1,200. It offers services in internal medicine, surgery, pediatrics, OB /GYN and more. Around 75% of its patients receive care free of charge. The hospital also hosts a national kidney transplant center and a hemodialysis unit. Its annual pharmaceutical budget

ALERT Comprehensive Specialized Hospital in Addis Ababa is a leading center for leprosy, tuberculosis, trauma care and general medical services. Founded in 1965, it also serves as a training and research hub. The hospital employs around 2,000 staff, including 60 pharmacy professionals. It offers emergency, surgical and specialized care across various departments. During the study period, its pharmaceutical budget was 58 million birr

AaBET Hospital in Addis Ababa, affiliated with SPHMMC since 2015, specializes in trauma, emergency and burn care. It operates with over 200 beds and around 800 staff, including 22 pharmacy professionals. Key departments include emergency medicine, orthopedics, plastic surgery and neurosurgery. The Hospital also houses units for spinal care and physiotherapy. Its annual pharmaceutical budget was 23 million birr

St.Peter's Specialized Hospital in Addis Ababa, founded in 1958 as a TB training center, now offers diverse services including TB care, dermatology, surgery and cardiovascular treatment. It has 300 beds, 12 ICU beds and six operating rooms. Emergency care is available around the clock. The hospital employs 57 pharmacy professionals and had a pharmaceutical budget of 58 million birr during the study period.

Eka Kotebe General Hospital in Addis Ababa, established independently in 2020, focuses on mental health, COVID-19 care and general medical services. It has around 400 beds, including 40 ICU beds with 16 for mechanical ventilation. The staff includes over 130 nurses, 90 doctors and specialists across multiple fields. The hospital employs 48 pharmacy professionals. Its pharmaceutical budget during the study was 45 million birr.

4.2 Research design

An explanatory mixed design was employed to investigate and gain a deeper understanding of the phenomenon under study, enabling a more comprehensive description and explanation of the subject matter. This approach seeks to understand why certain events occur and aims to provide a full understanding of the topic. A sequential explanatory mixed-method study was utilized, combining a facility-based quantitative method, including the use of checklists and structured and semi-structured questionnaires, with a qualitative method to explain challenges. Data collection was taken place from January 2024 to March 2024.

4.3 Population

4.3.1 Source Population

The source population comprised all federal hospitals in Addis Ababa, focusing on healthcare professionals responsible for managing health commodity logistics. Additionally, all logistics documentation, transaction records and emergency medications from selected federal hospitals were examined to gather data for the study

4.3.2 Study population

Information was collected from selected federal hospital including store managers ,pharmacy heads, medical directors and leaders of drug supply management units .emergency medicines handled at these sites, along with chosen stock records (bin cards),reporting forms (RRF) and transaction documents (issuing vouchers) were analyzed.

4.4 inclusion Criteria

- Federal hospitals in Addis Ababa that have delivered comprehensive care for a minimum of one year.
- All relevant reporting and requisition forms (RRFs) and bin cards utilized in the previous six months

- Health professionals engaged in logistics management of medical commodities.

4.5 Data sources

Data collection involved structured and semi-structured questionnaires administered to pharmacy heads, store keepers and drug supply management staff. Qualitative insights were gathered through detailed face-to-face interviews. Relevant documents such as bin cards, stock record, essential drug lists and reports were reviewed to support the findings.

4.6 sample size determination and sampling methods

4.6.1 Sample size determination

Health facilities: out of seven federal hospitals in the capital, six were selected for this study.

Medicines: All emergency medicines specified for comprehensive and general hospitals, as listed in the Ethiopian emergency medicines list (FMOH/EFDA, 2021), were included. The total number of emergency medicines evaluated ranged between 100 and 124(see Appendices II). For medicines with multiple strengths, the forms available at the hospital were considered, as dosage substitutions are feasible.

Document review : Among the hospitals only five used reporting and requisition form (RRFs) in the past six months .for these, 3RRFs per two months from four hospitals and 1 RRF per month from one hospitals were reviewed. Additionally, 59 bin cards per hospitals were selected based on minimum availability in the last six months. Model22/19 forms and lists of expired products were also examined.

Professionals: Quantitative data collection included all personnel responsible for logistics activities in the selected hospitals ,along with all related RRFs, issuing vouchers(model 22) and receiving vouchers (model 19) from the past six months. Store managers from the selected hospitals also contributed data. For qualitative data 15 informants were purposely chosen: six Pharmacy heads, six drug supply chain unit leaders and three staff members from medical directors. Selection criteria included at least one year of service in their current roles and involvement in emergency medicine decision- making.

4.7 Variables

- **Dependent variables:**

- Inventory management performance: measured by combining product stock status and logistics management information system (LMIS) performance.
- Products stock status: includes availability and stock out rates.

- LMIS implementation performance: assessed through data accuracy, bin card updating, report submission rate, timeliness and completeness (completeness requires stock on hand, consumption and loss/adjustment data)

- **Independent variables :**

- Service and practice related factors: Availability and use of recording forms (available/not available; utilized /not utilized) and type of recording systems (manual/electronic).
- Employee factors: Educational qualification (diploma/degree or higher), years of experience (<1, 1-5, >5 years) and training status (trained/not trained).
- Medicine category: VEN classification (Vital Essential, Non-essential).

4.8 Data collection procedures

Quantitative Phase: Two trained pharmacy technicians collected the required data using semi-structured questionnaires and checklists. Stock record accuracy was verified by comparing bin cards against physical inventory counts on the visit day. Products availability was determined through physical counts in the store and dispensaries. To assess stock-out durations over the past six months, investigators reviewed transaction records on stock/bin cards and consulted dispensary coordinators for recall information. Days with zero stock during each stock out episode were recorded. Storage conditions were evaluated by observing facility storage areas against predefined criteria. Inventory management performance was measured using tools adapted from the logistic indicator assessment tool (LIAT) and emergency medicine availability was checked during visits. Staff perceptions of inventory management were gathered through a 10-item likert scale questionnaire, translated into Amharic and back –translated to English for accuracy.

Qualitative Phase:

In-depth, face to face interviews were held with key decision –makers involved in emergency drug inventory management. Participants were chosen based on their experience and roles in managing inventory. Open –ended questions with probing prompts explored challenges and practices in managing emergency medicines. The principal investigator conducted the interviews after obtaining oral informed consent and ensuring confidentiality. Manual thematic analysis was applied to the qualitative data by coding response, grouping

similar codes and forming key themes. Pilot interviews were conducted beforehand to refine questions and promote detailed responses

4.9 Quality Assurance

To ensure validity, data collection tools were pilot-tested in one facility to detect ambiguities and improve content. Reliability was measured using Cronbach's alpha, yielding a strong internal consistency of 0.82. For qualitative data, pilot testing helped refine questions and triangulation of participant perspectives was used to enhance validity and minimize bias.

4.10 data analysis and interpretation

Quantitative data were checked for completeness in excel, then analyzed using SPSSv23 and excel with descriptive statistics, chi-square tests and spearman's correlation. Results were presented in tables, charts and texts. Qualitative data underwent manual thematic analysis, with codes grouped into themes to extract key insight. This explanatory research aimed to uncover patterns in emergency medicine inventory management across federal hospitals

4.11 Ethical considerations

Ethical approval was obtained from Addis Ababa University's school of pharmacy (ERB/SOP562/16/2023) and permission from participating hospitals were informed about the study purpose assured of confidentiality and participation was voluntary. Data were anonymized in all reports.

4.12 Operational definitions

Inventory management: coordinated sourcing, storage and distribution of stock to ensure the right products are available at the right time and place at optimal cost (Tarne, B, 2007).

Inventory management performance: measured by product availability and LMIS functionality

Emergency medicine: drugs classified by FMOH/EFDA (2021) for use at general and comprehensive hospitals.

Emergency care: timely health care for acute conditions, spanning pre-hospital to critical care (WHO, 2023).

Product availability: Medicines with non-zero stock in store and dispensary on the survey day.

Stock out (past 6 months): Medicine considered out of stock if bin cards or records show zero balance; where unavailable, recall and other records were used.

Stock out rate: percentage of facilities experiencing stock outs over six months.

LMIS Utilization: Use of manual or electronic forms recording emergency medicines transactions

Timely reporting: submission of reports with 10 days after the reporting month to EPSS.

Inventory accuracy: No discrepancies between bin card and RRF balances are $\geq 20\%$.

Storage condition: rated good if 80% or more of storage standards (e.g., temperature, humidity) are met

Wastage Rate: Acceptable if below 2%; calculated as $(\text{value of wasted items} \div \text{total value of opening stock plus received items}) \times 100$ (HSTPII, 2020)

CHAPTER FIVE

RESULTS

5.1 Socio demographic characteristics of the study participant

The study Hospitals include a mix of tertiary level hospitals and secondary level hospitals, providing a comprehensive view of inventory management practices across different types of healthcare institutions. Among these Federal Hospitals, 2 were Secondary level Hospitals and 4 were tertiary level Hospitals. As indicated in table1, a total of 49 pharmacy professionals were identified as working in the drug supply management units of the studied hospitals, averaging approximately eight pharmacy professionals per Hospital.

Table1. Socio demographic characteristics of study participant at federal hospitals in Addis Ababa, Ethiopia, march 2024.

SN	Variables		frequency	Percentage
1.	Types of Hospitals (n=6)	Tertiary level Hospital	4	83.3
		Secondary level Hospital	2	16.6
2.	Professionals under DSM unit(n=49)	Pharmacist (B. Pharm)	39	79.5
		Health supply chain management specialist (MSc)	9	18.3
		Druggist	1	2
3.	Sex (n=49)	Female	13	26.5
		Male	36	73.4
4.	Experience at current position in years (n=49)	<1	6	12.2
		1-5	32	65.33
		>5	11	22.4
5.	Trainings taken by DSM unit(n=49)	HCMIS	40	81.6
		IPLS	28	57.1
		Others,(Inventory Management)	12	24.4

Pharmacists (B Pharm) constitute the majority (79.5%) of the pharmacy professionals, followed by Health Supply Chain Management Specialists (MSc) at 18.3% and druggists at 2%. Among these professionals, 81.6% have received training on HCMIS (Health Commodity Management Information System), 57.1% on IPLS (Integrated Pharmaceutical Logistics System) and 24.4% on general inventory management.

5.1.2 The inventory management practice of emergency medicines at Federal hospitals of Addis Ababa Ethiopia march

All surveyed hospitals exclusively used the consumption method to quantify emergency medicine while the morbidity method was not utilized. This reliance on usage patterns may hinder forecasting needs based on disease trends. Emergency medicines were predominantly supplied by the government entity (EPSS) and private suppliers with no reliance on donations, loans or transfers. While this centralized sourcing ensures consistency, diversifying suppliers could enhance flexibility and resilience in emergency scenarios.

The most common requesting and receiving frequency was bi-weekly (50%), followed by monthly (33.3%) and weekly (16.6%). Quarterly ordering was not reported. The average replenishment lead time was predominantly two weeks (83.3%), with a minority reporting less than one week (16.6%) (Table 2)

All hospitals utilized purchase request letters (100%) for ordering and reporting for RDF medicine while standardized forms such as the Report and Requisition Form (RRF) were used only for program pharmaceuticals. The lack of standardized forms suggests a less structured approach to inventory management which could affect data accuracy and decision-making. All facilities used the Intra Facility Requisition Report (IFRR).

Most hospitals (83.3%) reported having adequate storage capacity for emergency medicines, while 16.6% indicated inadequate storage. Addressing these storage gaps is essential to prevent potential shortages or disruptions. Physical inventory in dispensaries was conducted monthly (100%), while in stores, it was conducted quarterly (83.3%) and yearly (16.6%). Quarterly inventories in stores and monthly checks in dispensaries align with best practices, ensuring regular updates and minimizing discrepancies. However, reliance solely on annual inventories could lead to inventory inaccuracies if not supplemented by more frequent audits.

Table 2 Inventory management practice of emergency medicines in Federal Hospital of Addis Ababa, Ethiopia, March, 2024

SN	Variables		Frequency	Percent
1	Requesting and receiving period of emergency medicines (Stocking practice) for RDF product.	Weekly	1	16.6
		Bi-weekly	3	50
		Monthly	2	33.3
2	Requesting and receiving	Monthly	1	16.6

	period of emergency medicines (Stocking practice) for Program product.	Every two month	4	66.6
3	Average replenishment Lead time	Bi-weekly	1	16.6
		Monthly	5	83.3
4	Stock record forms used for reporting/ordering	Whenever needed	5	83.3
		IFRR	6	100
		Purchase Request Letter	6	100
5	Separate Storage capacity For emergency medicines	Adequate	5	83.3
		Not-adequate	1	16.6
6	Physical inventory period in the store and dispensary	Monthly Dispensary	6	100
		Quarterly Store	5	83.3
		Yearly	1	16.6

5.2. Product stock status

The following figure shows the percentage availability of emergency medicines across six federal hospitals in Addis Ababa, with hospital H5 having the highest availability at 82.1% and hospital H1 the lowest at 42%. Over all, this figure indicates varying levels of medicines availabilities across hospitals. Overall Average availability was 63.65% Hospital 5 (82.1%) and availability at Hospital 1 and Hospital 6 are below average, Hospital 2, Hospital 4 have with reasonably strong availability above the average

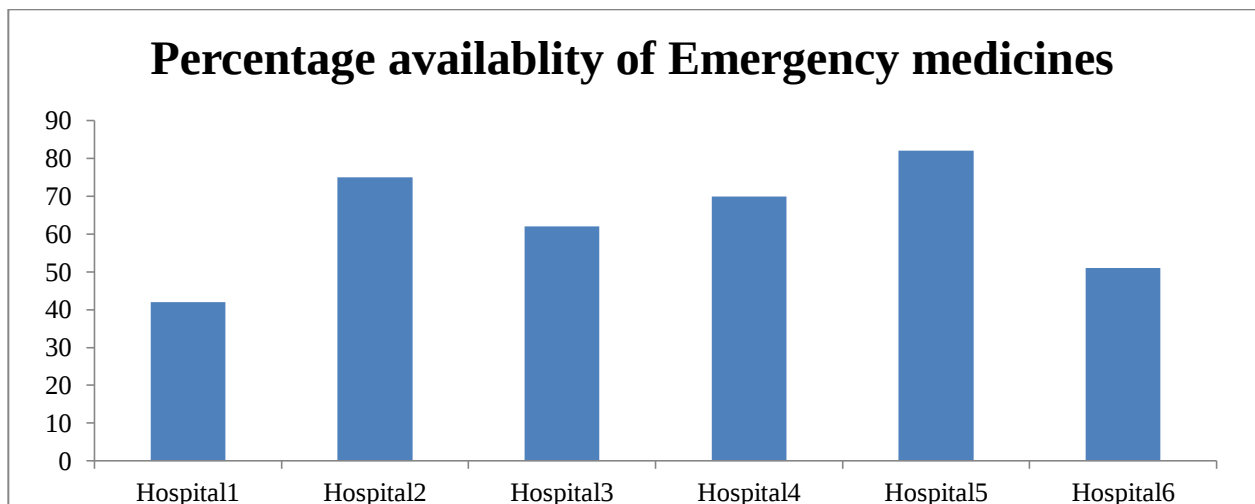


Figure2. Percentage Availability of Emergency Medicine across Federal hospitals of Addis Ababa Ethiopia march2024.

The maximum availability of A particular emergency medicines was (100%) for 16 emergency drugs, particularly for common treatment like Acetaminophen, adrenaline and insulin.

The minimum availability of A particular emergency medicines across any of the hospitals was (0%) for 12 emergency medicines like activated charcoal, naloxone and thiamine.

The mean availability of emergency medicine was 63.5% (maximum 82.1% and minimum 42%) Overall mean stock out rate was 55.61%. Medicines like activated charcoal, acyclovir injection, adrenaline injection and alcohol based hand rub were frequently out of stock at both levels .certain medicines, such as ketamine were stock out in secondary level hospitals but available in tertiary Hospitals.

5.2.2 Duration of Stock outs and Frequency of Stock outs of emergency medicines

Overall mean duration of stock out was 51.07 days in which hospitals Hospital 5 with 29.59 days duration of stock out showing better stock availability compared to others. Hospital 1 has the highest stock out duration when compared to others suggesting poor inventory practice. Hospital1 (85.44) days and Hospital 6(60.66) days shows longer duration of stock out ,Hospital 3, Hospital 4, Hospital 2, Hospital shows better duration of stock out compared to the mean..

The difference between the highest Hospital1 (85.44) days and lowest Hospital5 with 29.59 days was 55.85 days, showing significant variation in stock management performance across Hospitals

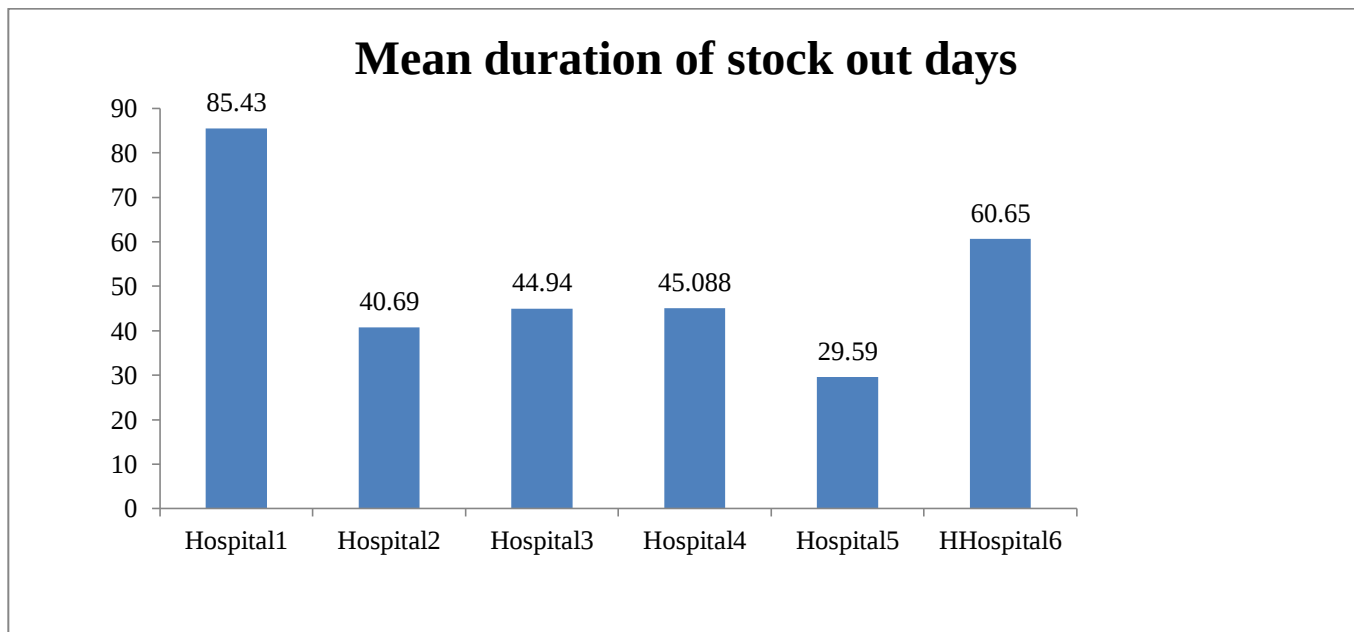


Figure3. The mean day's duration of stock out of Emergency medicine across Federal hospitals of Addis Ababa Ethiopia march2024

Stock-Out Duration varies across different hospitals and medicines. Medicine like Activated Charcoal Powder for reconstitution: 15gm/120ml, Adenosine Injection 3mg/ml, Nimodipin tablet30mg experience maximum duration of stock out across all hospital.

For some medicines, stock out frequency is higher than for the others. Emergency Medicines with Maximum mean frequency of stock out includes Methylprednisolone Acetate Injection (1.16), Azithromycin 500mg (1.33), Dexamethasone eye drop (1.5), Dextrose in Normal Saline Injection (1.5) and Omeprazole Powder for injection: 40 mg in vial (1.5).

Maximum duration of stock out was (180) days, the minimum days of stock out (0) day and the Mean frequency of stock out were 1.96.

Figure 4 illustrates that Sodium chloride (0.9), dexamethasone eye drop, dextrose in normal saline has highest stock out frequency. Several other emergency medicines like azithromycin, methylprednisolone and Metronidazole infusion also experienced frequent stock out, highlighting critical gap in inventory management. These life-saving medications can cure, halt, or prevent disease; ease symptoms, or help in the diagnosis of illnesses. Unavailability and insufficient inventory of these medicines will affect curing many diseases and saving lives.

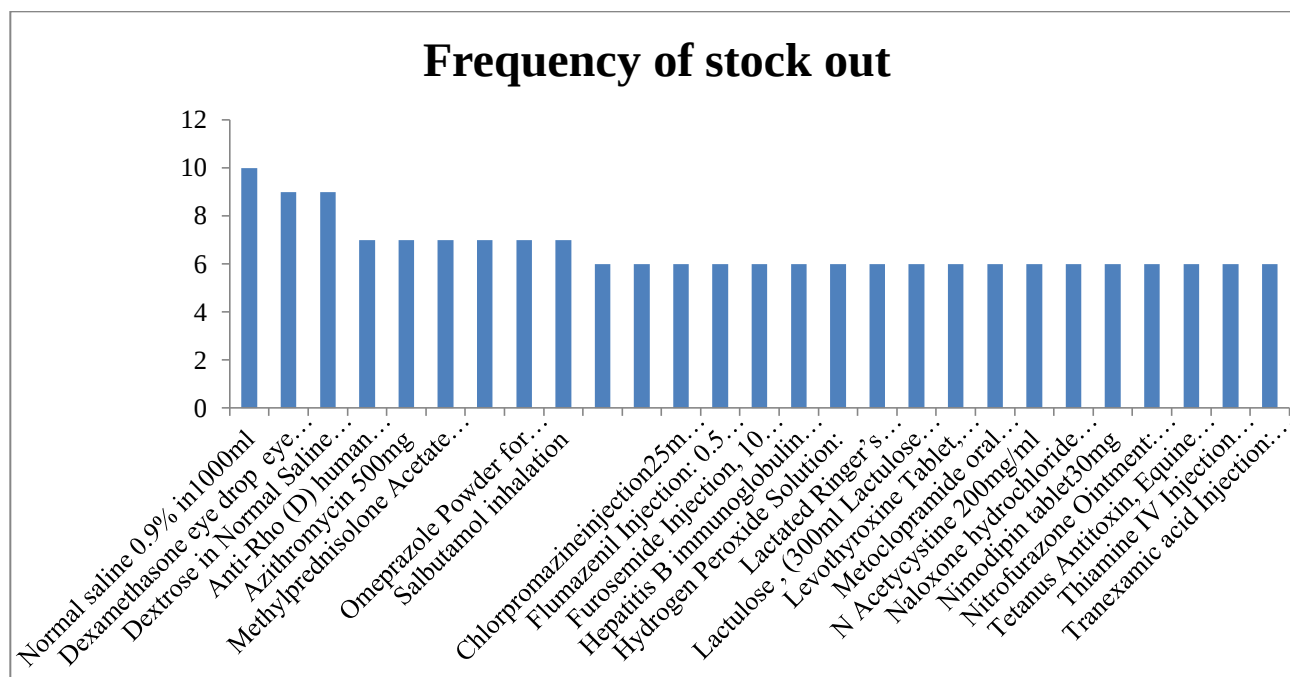


Figure4. Emergency medicines with high frequency of stock out across Federal Hospitals in Addis Ababa Ethiopia march 2024.

5.2.3 Reasons for Stock outs of emergency medicines

Expiry is a frequent reason for stock outs, especially for medicines like Adrenaline and Phytomenadione (Vitamin K). Stock out at the Source appears as a major factor for medicines like Calcium Gluconate, Dextrose in Normal Saline and Lidocaine. Some medicines Artesunate also experience stock outs due to No Client/Demand. The most prominent reason for stock outs is inadequate supply, affecting several medicines

5.2.4 VEN categorization of emergency medicines

Although Emergency medicines are by nature intended to be prioritized as vital or essential in the VEN system, this study found inconsistencies in their classification across health facilities. This variation may reflection local contextual decisions, but it also underscores the need for better alignments with national emergency medicines guidelines and regular capacity building on VEN classifications practices.

We found that the mean percentile of each category in the FML was (Vital) 48.39, (Essential) 34.09, (Less Essential) 7.73 and (Not available in the list) 9.01.

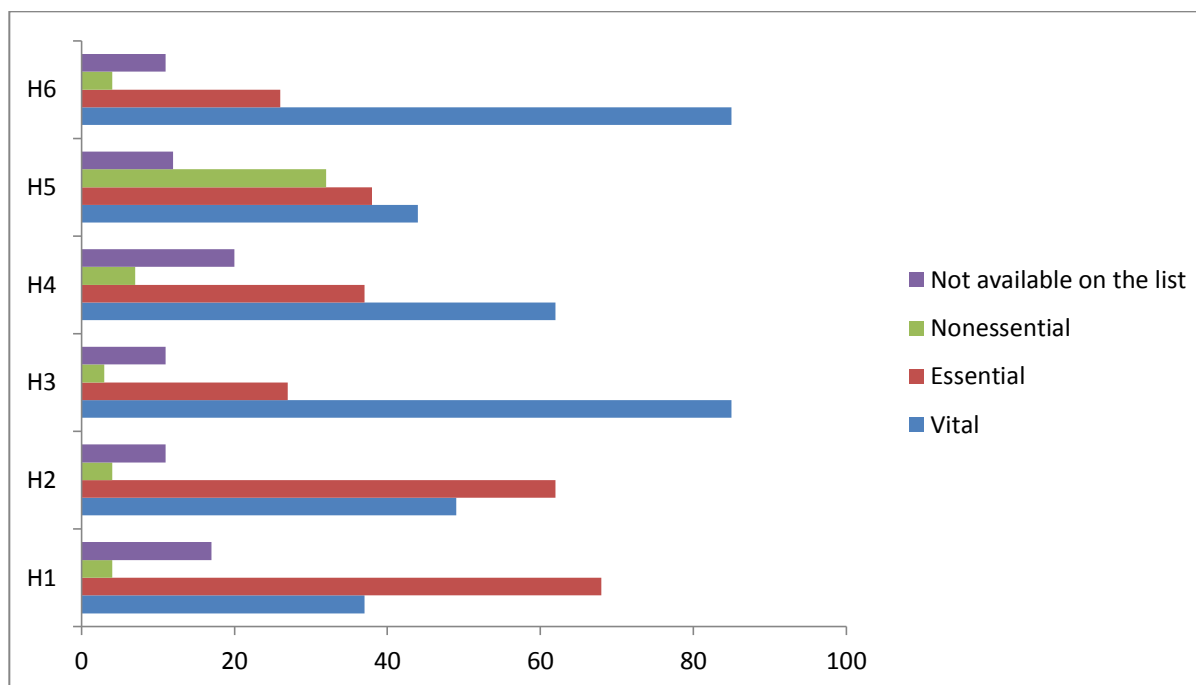


Figure5. Percentage of Emergency Medicine in VEN category in Federal hospitals of Addis Ababa Ethiopia march2024

The VEN categorization of emergency medicines shows that nearly half of the medicines (48.39) fall under the Vital category, showing the critical importance of these drugs in saving lives during emergencies .the essential category accounts for 34.09%,representing important medicines that are necessary but slightly less urgent than the vital ones. The less essential medicines make up a small portion at 7.73%, indicating they are not as crucial as in emergency care but still have some role. Notably, 9.01% of medicines were not available on the list suggesting the gap in the formulary that may need to be addressed to ensure comprehensive emergency preparedness. Overall, the distribution reflects a strong focus on ensuring availability of life saving and essential medicines, though the presence of unlisted items points to opportunity for improving the inventory system

We conducted Medicine level analysis by chi-square test with the objective of testing association between availability and VEN categorization.

Table3. The association of emergency medicines availability with VEN categorization at Federal hospitals in Addis Ababa Ethiopia march2024

Chi-Square Tests						
VEN categorization	Availability					
	Value	Df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	28.660 ^a	3	.000	.000		
Likelihood Ratio	27.593	3	.000	.000		
Fisher's Exact Test	27.586			.000		
Linear-by-Linear Association	25.993 ^b	1	.000	.000	.000	.000
N of Valid Cases	712					

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 17.70.

Statistical test: Chi-square

- **Test result:** $\chi^2 (3) = 28.66, p < 0.001$.
- **Decision:** since $p < 0.001$, which is less than 0.05, we reject the null hypothesis. There is a statistically significant association between VEN categorization of medicines and their availability. Vital medicines were more likely to be available compared to non-essential and essential medicines.

5.3. Stock Recording Practices on emergency medicines

Accurate and up-to-date stock records are essential for effective inventory management as they provide the foundation for calculating future needs. In this study, the availability and utilization of common stock recording tools for medicines, including those for Emergency were assessed. All surveyed facilities reported the use of Bin Cards, only 5 hospitals use report and Requisition form (RRF), all hospitals use Intra Facility report and Requisition form (IFRR) and only 4 hospitals use the Health Commodity Management Information System (HCMIS).

Table 4.Availability and utilization of stock recording tools at federal hospitals in Addis Ababa, Ethiopia, March 2024

SN	Stock	Available		Utilized		Total (number/%)
	Recording tools	Frequency	Percentage %	Frequency	Percentage5	
1	Bin card	6	100	6	100	6(100)
2	Stock card	2	33.3	2	33.3	
3	HCMIS(DAGU2)	4	66.6	4	66.6	
4	IFRR	6	100	6	100	
5	RRF	5	83.3	5	83.3	

The universal use of tools like Bin Cards and IFRR indicates strong adoption of inventory management practices across facilities. However, the relatively low utilization of Stock Cards (33.3%), incomplete adoption of HCMIS (66.6%) and RRF (83.3%) suggest areas for improvement.

5.3.2 Result of Bin Card Utilization and Updating for Emergency Medicines

Overall average per cent updated bin card was 79.85; Hospital5 with 94.6% updated bin cards is top performer and Hospital1 under performing with 65.46 % updated bin card. Half of the Hospitals are below the group average; Hospital 3, Hospital 6, Hospital 1

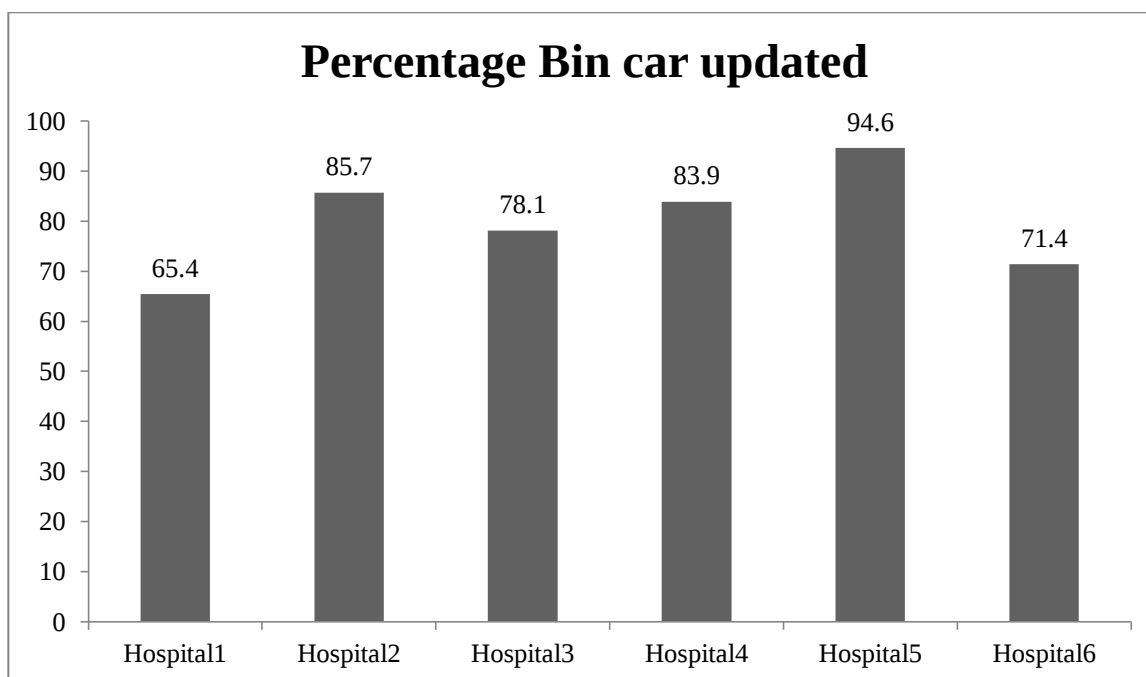


Figure 6: Bin card utilization and updating practice for Emergency Medicines at Federal hospitals of Addis Ababa Ethiopia march2024

In Hospital2, Hospital3, Hospital5, Hospital6 most emergency medicines (except a few like Alcohol based hand rub, Iodin and Lugol's solution) are both utilized and updated regularly, with high utilization and updating rates. In Hospital1 bin card utilization is generally lower compared to the other hospitals, with certain emergency medicines bin card not utilized at all in some cases. Updates on the bin cards for several medicines are also sparse.

Medicines like Acetaminophen, Adrenalin injection and ceftriaxone show full utilization and updating in all hospitals. Some medicines like (Amiodaron injection, bisacodyl tablet, Bupivacaine, etc) shows lower utilization and updating, especially in Hospital 1. Bin card for Alcohol-based hand rub and lugol's solution are not utilized in all Hospitals. Overall Hospital2, Hospital3, Hospital5, Hospital4 show better bin card utilization and updating practice compared to other where gaps in both usage and updates are more evident.

The following figure shows overall mean percentile of accurate inventory, inaccurate inventory and bin card not utilized was (78.24%), (11.58%) and (10.16%) respectively

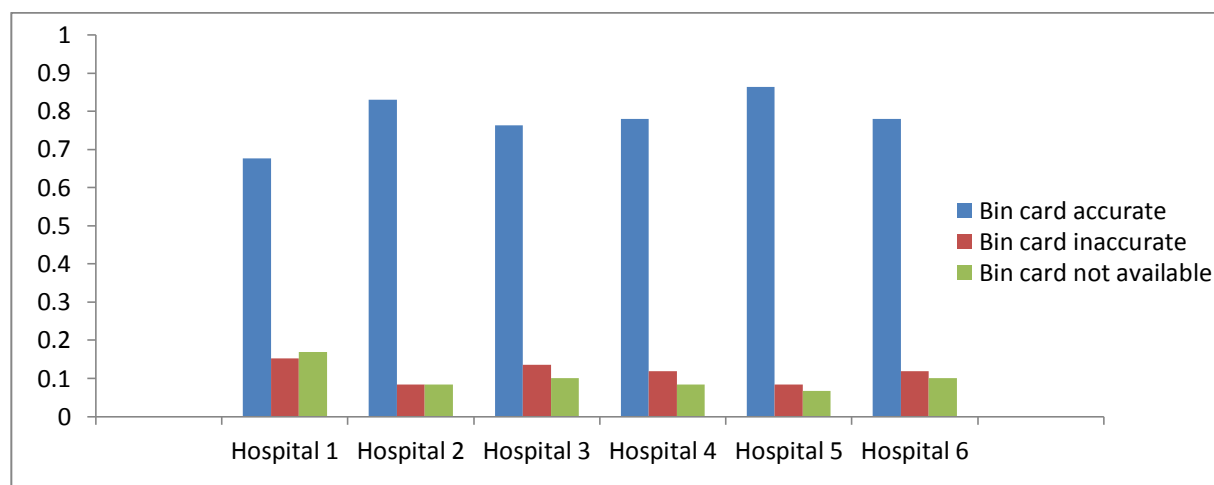


Figure7. Inventory accuracy rate for Emergency Medicines in Federal Hospitals in Addis Ababa Ethiopia March2024

The following figure illustrates Total Frequency of timely accurate and complete data was 18, 13 and 14 respectively.

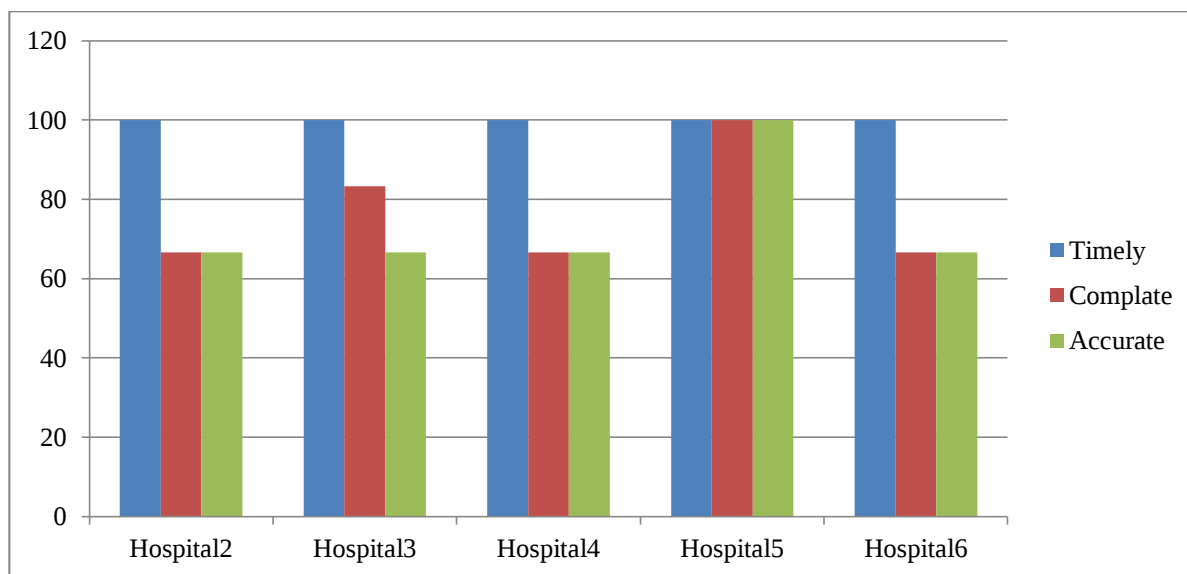


Figure8. Timeliness, completeness and accuracy of emergency medicines logistics report in Federal Hospitals in Addis Ababa Ethiopia March 2024.

5.4. Expiry and Wastage of Emergency medicines in federal hospitals of Addis Ababa Ethiopia march, 2024.

A total of twenty eight emergency medicines that had expired over the past 6 month were included in the analysis. The total cost of expired medicines is 1,326,035.31 ETB birr. The mean Wastage rate was found to be 2.53% calculated as $\text{Wastage rate (\%)} = \frac{(\text{value of wasted items})}{(\text{Total value of items at beginning} + \text{Total value of items received})} * 100$

$$(\text{Total value of items at beginning} + \text{Total value of items received})$$

High Cost of Expired Medicines: Sodium Bicarbonate Injection: 27,000 units, 244,620 birr Ketamine hcl Injection: 2,221 units, 174,459.6 birr Tramadol Injection: 10,198 units, 159,088.8 birr these medicines are among the highest in terms of both quantity and cost, indicating significant wastage. Constituting 18.33%, 13.15%, 11.99% of the total cost respectively. These medicines account for a large portion of the total cost due to their high unit cost and quantity. Lower-Cost Medicines with Expiry includes Fusidic Acid Ointment 2 units, 184 birr, in terms of cost; their impact is minimal compared to high-cost items. These items have minimal impact on the overall cost but are still part of the total expired cost. The high wastage rate of these commonly used medicines may indicate challenges in forecasting, overstocking or receipt of near expiry. Even if the analysis doesn't represent all medicines, due to difficulty in accessing data for unexpired emergency medicines, the finding highlights specific medicines that require improved stock management practice to reduce financial loss and ensure availability. analyzing the expiry proportion of these 28 medicines provide actionable insight for improving the inventory practice and inform targeted interventions.

Table5. Wastage rate of medicines of emergency medicine within the past 6 month before study period in Federal Hospitals in Addis Ababa, Ethiopia march 2024

SN	List of emergency Medicines	Unit	Unit cost(birr)	Expired (Qty)	Beginning balance +received during the period	Percentage Waste (%)	Percentage of cost (%)
1.	Adrenalin injection0.1mg/ml	Ampoule	45.9	650	32500	2	2.24
2.	Aminophylline injection	Ampoule	33.65	410	3500	11.71	1.04
3.	Atropine injection	Amp	3	200	7013	2.85	0.045
4.	Chlorpromazine 100mg	Tablet	1.75	30900	669600	4.61	4.07
5.	Chlorpromazine 25mg injection	Ampoule	30.2	200	6100	3.27	0.45
6.	Diazepam5mg/ml in 2 ml	Amp	35.36	1891	74156	2.55	5.042
7.	Digoxin injection	Ampoule	79	100	105	95.23	0.595
8.	Dopamine hydrochloride injection	Amp	32	520	17568	2.95	1.254
9.	Fusidic acid ointment	Tube	92	2	7686	0.026	0.013
10	Gentamycin injection	Ampoule	5.4	11000	3142878	0.349	4.47
11	Glucose 40%	Of 50	13.7	25	288445	0.008	0.02
12	Haloperidol5mg/ml	Ampoule	7.75	765	7524	10.16	0.447
13	Hydralazin2% injection	Ampoule	68	440	4443	9.90	2.256
14	Ketamine Hcl injection-50mg/ml in 10ml	Ampoule	78.55	2221	8289	26.79	13.15
15	Lidocain with adrenalin	Ampoule	17.1	1609	9542	16.86	2.07
16	Magnesium sulphate 20ml/mlin10ml	Ampoule	19.12	1050	4502	16.92	1.09
17	Metoclopramide drop	15ml	23.47	130	3486	3.72	0.23
18	Metoprolol tartaret 50mg	Tablet	1.5	52300	592500	8.82	5.91
19	Mifepreston	Tablet	22.4	2020	19116	10.5	3.41
20	Mifeproston+misoproston	Pk	102.3	460	35520	1.29	3.548
21	Paracetamol suppositry125mg	Strip	20	130	8040	1.61	0.19
22	Phenytoin 50mg	Of200	120	20	10266	0.19	0.18
23	Pyridoxin50mg	Of 50	44.9	427	27186	1.57	1.44

24	Sodium bicarbonate Injection:8.4%(50meq/50ml)	Vial	9.006	27000	231204	11.67	18.33
25	Sodium valproate200mg	Of 100	339.69	5	2100	0.238	0.128
26	Tetanus antitoxoid1500iu	Amp	81.2	1160	116136	0.998	7.103
27	Tramadol hydrochloride Injection, 50mg/ml	Ampoule	15.6	10198	170304	5.98	11.99
28	Tranexamic acid Injection: 100mg/ml in 10ml ampule	Vial	73.4	1660	10050	16.51	9.18

The reason for expiry of emergency medicine includes Irregular consumption/unpredictable pattern (38.46%), over supply of medicines (30.7%), receiving near expiry drugs (23%), Fail to practice FEFO/FIFO (7.6%).

5.5 Storage conditions of emergency medicine at federal hospitals of Addis Ababa Ethiopia march 2024.

Seventeen standards were assessed to determine the storage practice of medicines in federal hospitals in Addis Ababa. The result showed that on average 82.3% of these standards were adhered by the facilities (Max=100%, Min=50%).

The overall adherence to storage standards is 82.3%, indicating a generally high level of compliance. However, there are some areas where improvement is needed.

Table6. Adherence of federal hospitals to good storage standards of emergency medicines in federal hospitals in Addis Ababa, Ethiopia march 2024.

S. No	Standards	N=6	(%)
1	Products that are ready for distribution are arranged so that identification Labels and expiry dates and/or manufacturing dates are visible.	6	100
2	Products are stored and organized in a manner accessible for first to-Expire, first-out (FEFO) counting and general management.	5	83.3
3	Cartons and products are in good condition, not crushed due to mishandling. If cartons are open, determine if products are wet or Cracked due to heat/radiation	6	100
4	The facility makes it a practice to separate damaged and/or expired Products from usable products and removes them from inventory.	4	66.6
5	Cartons and products are protected from water and humidity.	6	100
6	Products are protected from direct sunlight.	6	100
7	Storage area is visually free from harmful insects and rodents.	5	83.3
8	Storage area is secured with a lock and key, but is accessible during Normal working hours; access is limited to authorized personnel.	6	100
9	Products are stored at the appropriate temperature according to product Temperature specifications.	6	100
10	Roof is maintained in good condition to avoid sunlight and water Penetration.	5	83.3
11	Store room is maintained in good condition (clean, all trash removed, Sturdy shelves, organized boxes).	3	50
12	The current space and organization is sufficient for existing products and reasonable expansion (i.e. Receipt of expected product deliveries for Foreseeable future).	4	66.6
13	Fire safety equipment is available and accessible (any item identified as Being used to promote fire safety should be considered).	3	50
14	Products are stored separately from insecticides and chemicals.	4	66.6
15	Products are stacked at least 10 cm off the floor.	6	100

16	Products are stacked atleast30 cm away from the walls and other Stacks.	3	50
17	Products are stacked no more than 2.5meters high.	6	100
Average		82.3	

The following figure shows the performance of each federal hospital with regard to good storage practices ($\geq 80\%$ to positive response criterion

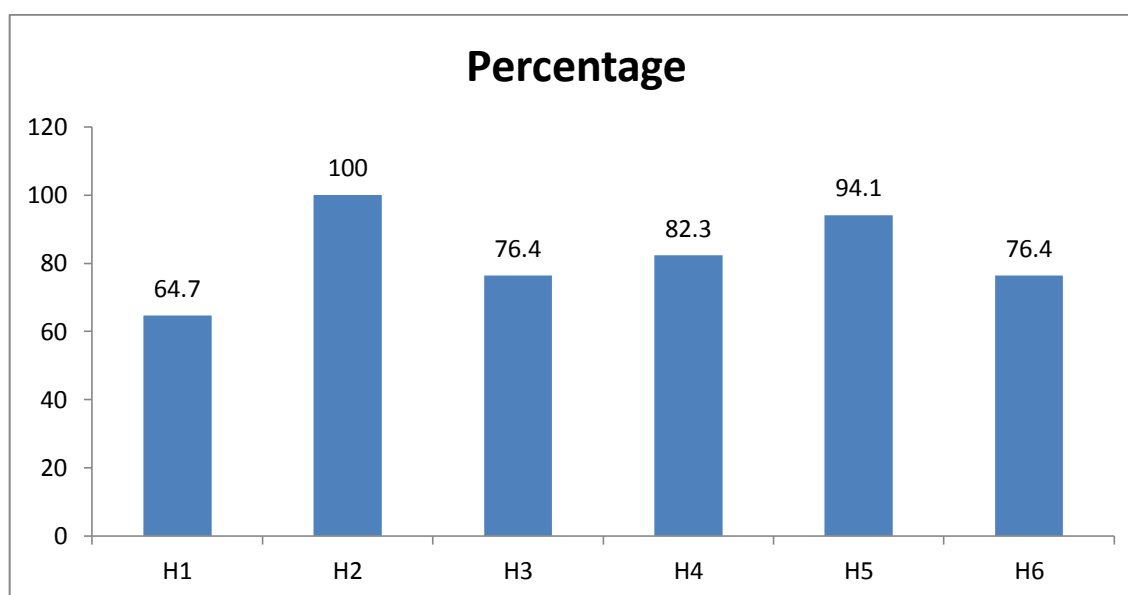


Figure 9 the performance of each Federal Hospitals with regard to good storage practices in Addis Ababa Ethiopia March 2024

5.6. Perceived Inventory management performance of emergency medicine and determinants

The perceived inventory management performance is generally positive, with high rating for inventory accuracy, user-friendliness and staff communication. However, significant concerns exist regarding stock outs and slow replenishment, both scoring low. Overall satisfaction with the system is moderate, reflecting a balance of strength and weakness in operational effectiveness

Table 7: Descriptive analysis of the Perceived Inventory management Performance on Emergency Medicines at Federal Hospitals of Addis Ababa Ethiopia march 2024

	N	Minimum	Maximum	Mean	Std. Deviation
The inventory system ensures that needed items are available when required.	49	2	4	3.3469	0.92536
Inventory records are accurate and up to date.	49	2	5	3.9592	0.81545
Stock outs (running out of items) are rare in this facility.	49	1	2	1.8163	0.39123
Inventory replenishment is done within an acceptable time frame.	49	1	2	1.7347	0.44607
The system effectively minimizes wastage or expiry of items.	49	2	4	3.7755	0.62133
The inventory management process is efficient and user-friendly.	49	2	5	4.2041	0.53927
Communication between inventory staff and users is smooth and effective.	49	3	4	3.9592	0.19991
Staffs are adequately trained to manage inventory effectively.	49	2	4	3.8367	0.55328
The inventory system supports overall organizational performance.	49	3	4	3.7959	0.40721
Overall, I am satisfied with the performance of the inventory system.	49	2	4	3.3265	0.82633
Valid N	49				

To examine the strength and direction of the relationship between variables such as training status, education level, years of experience and inventory management performance ,a Spearman`s rank order correlation analysis was conducted . Spearman`s rho was chosen instead of Pearson`s correlation because the variables involved are ordinal, not normally distributed and the sample size was relatively small (49) making it more appropriate for non-parametric data.

Table 8 Result of nonparametric correlation analysis between variables such as training status, education level, years of experience and inventory management performance

Correlations Spearman`s rho						
			Training status	Education level	year of experience	Inventory management performance
Spearman's rho	Training status	Correlation Coefficient	--	.169	.225	.070
		Sig. (2-tailed)	.	.246	.120	.633
		N	49	49	49	49
	Education level	Correlation Coefficient	.169	--	.439**	-.104
		Sig. (2-tailed)	.246	.	.002	.475
		N	49	49	49	49
	year of experience	Correlation Coefficient	.225	.439**	---	-.040
		Sig. (2-tailed)	.120	.002	.	.782
		N	49	49	49	49
	Inventory management performance	Correlation Coefficient	.070	-.104	-.040	--
		Sig. (2-tailed)	.633	.475	.782	.
		N	49	49	49	

**. Correlation is significant at the 0.01 level (2-tailed).

The education level variables, $p = (0.475)$ training status variables ($p = 0.633$) and years of experience variables ($p = 0.782$) were shown not to have statistically significant correlation with the outcome inventory management performance in this study.

Chi square test of association was conducted for the dependent variables such as Availability, bin card accuracy and wastage reduction effort variables with the objective of analyzing association between two variables the results is as follows.

Table9 Chi-Square Tests of association between bin card updating, accuracy and availability of Emergency Medicine.

Bin card accuracy updating practice	Availability					
	Value	Df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	26.700 ^a	1	.000	.000	.000	
Continuity Correction ^b	23.112	1	.000			

Likelihood Ratio	30.114	1	.000	.000	.000	
Fisher's Exact Test				.000	.000	
Linear-by-Linear Association	26.155 ^c	1	.000	.000	.000	.000
N of Valid Cases	49					

Test result: $\chi^2 (1) = 26.7$, $p=0.001$.

There is a significant association between bin card accuracy and availability status.

Decision: Since $p < 0.001$, which is less than 0.05, we reject the null hypothesis.

Table10. Chi-Square Tests for association between availability and wastage reduction

wastage reduction	Availability					
	Value	Df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.006 ^a	1	.940	1.000	.659	
Continuity Correction ^b	.000	1	1.000			
Likelihood Ratio	.006	1	.940	1.000	.659	
Fisher's Exact Test				1.000	.659	
Linear-by-Linear Association	.005 ^c	1	.941	1.000	.659	.350
N of Valid Cases	49					

- Test result: $\chi^2 (1) = 0.006$, $p=0.94$.

Decision: Since the $p=0.94$, which is greater than 0.05, we fail to reject the null hypothesis

There is no statistically significant association between wastage reduction practice and availability of emergency medicine. Wastage reduction level has little to no impact on the availability measure in this analysis.

5.7. Qualitative result

All around the world, acutely ill and injured people seek care every day. First contact health workers manage children and adults with medical, surgical and obstetric emergencies, including injuries, sepsis, heart attacks and strokes, asthma and acute complications of pregnancy.

Many proven health interventions are time dependent. Emergency care is an integrated platform for delivering accessible, quality and time-sensitive health care services for acute illness and injury across the life course. Integrated emergency care services facilitate timely recognition, treatment management and when needed, continued treatment of the acutely ill at the appropriate level of the health system. Over half of deaths and over a third of disability in low- and middle-income countries could be addressed by the implementation of effective emergency and critical care. Prioritizing an integrated approach to early recognition, resuscitation, treatment and prevention of complications from acute conditions reduces the morbidity and mortality from a wide range of diseases across the life course (WHO2023).

A total of 15 key informants were interviewed to assess the challenges faced in inventory management on emergency medicine in federal hospitals in Addis Ababa. 6 pharmacy directors, 6 supply chain management officers in these hospitals and 3 Staffs from medical director were interviewed. The results were categorized and analyzed thematically and presented as follows.

Table11 Socio-demographic characteristic of personnel interviewed at federal hospitals in Addis Ababa, Ethiopia, March 2024.

s.no	Variables		Frequency
1	Profession of interviewee	Pharmacist (B. Pharm)	12
		Physician	01
		Nurse	02
3	Sex	Female	3
		Male	12
4	Experience at current position in years	<1	1
		1-5	4
		>5	10

In this study two main themes and eight sub-themes were developed based on content analysis. The first themes was challenges related to inventory management of emergency medicines in federal hospital in Addis Ababa the sub –themes includes (1) Quantification related challenges, (2)Procurement related challenges, (3) Stock management related challenges,(4)Storage condition related challenges. The second themes were recommendations and way forward and the sub-themes were (1) Digitalization and Modern Technology,(2) Collaboration and coordination, (3) Human resource related, (4) Continuous improvement and Capacity building, (5) Accountability (figure 10)

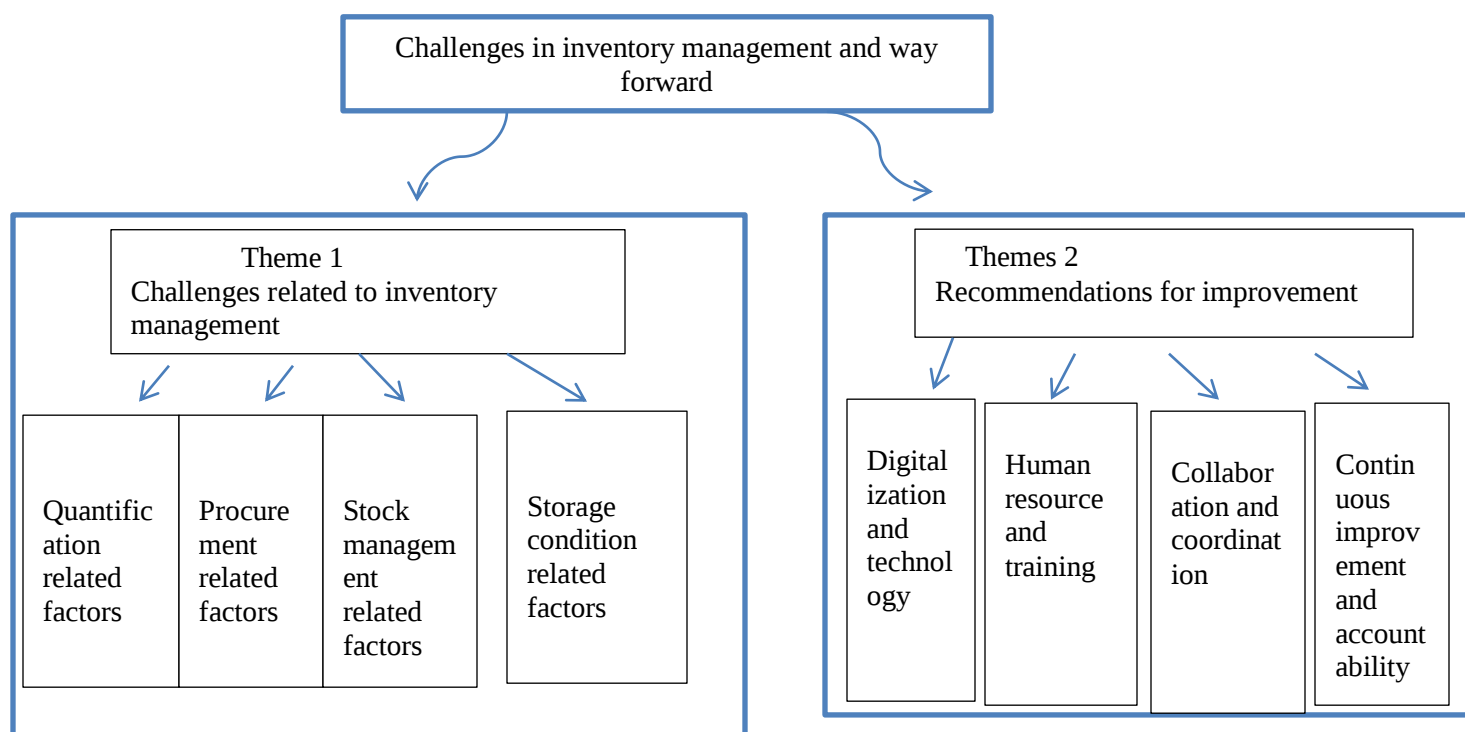


Figure10.The main themes and subthemes of thematic analysis

Theme1 challenges related to inventory management

- **Sub-theme1 Quantification related challenges :**

Almost all facilities use bin card for stock tracking, only four facility use DAGUE data base for quantification. For Demand projection some facilities consider a 10% increase for forecasting demand .Quantification is done generally but prioritize emergency medicines. Supply planning is done monthly considering the previous two month consumption .interview reports drug and therapeutic committee (DTC) is only partially functional and in some facilities Regular DTC meetings and expert estimation is used for new item quantities.

“Actually quantification are made for general it is only supply planning we prioritize emergency medicine ,we make every month for 2 month consumption .our mini DTC is partially functional we make supply

planning for those out of stock at EPSS but if for preforma we prioritize based on the need those product without which service interrupt like operating room (OR) medicine Laboratory supply and reagent and OR supply”(male pharmacist) .

- **Sub-theme2** Procurement related challenges

Prioritization: they focus on items critical to service continuity (e.g., Operating Room medicines laboratory reagents), Senior management advises allocating available budgets toward essential/emergency medicines. Forecasted demand far exceeds budget allocation; Demand forecasting is limited and mostly covers a quarter due to budget constraints.

What we forecast and our budget do not much last year we have 52 million but forecasted quantity was 280 million almost 1/6 of our demand through scientific way we could not much demand and supply it will only be for 1 quarter, leaving the budget issue to aside we prioritize for service medication like OR our senior management also suggest that available budget should be allocated to this item”(male pharmacist) .

The respondent says they use Different ordering methods based on sources to prevent stock outs. Ordering method is in fact proactive but the country supply system jam the proactivity so it will depend on the response of supplier not on facilities response and private supplier also terminate their contract that will affect timely access The lead time in fact was good if it is available it will only take 2 to 3days

“Our replenishment or ordering method different for different source because stock out at EPSS experience affects our ordering schedule we will go there every 2 or 3week also we request our demand they do not give as enough stock so we will not wait for 2 month supply protocol and we will look for private on those item“(male pharmacist).

Regarding appropriateness of the personnel all respond positively stating that they have Proper personnel with technical and theoretical background responsible for procurement.

Sub-theme3 Stock management related challenges:

Some facility Conducts stock status analysis every 6 months. Almost all facility encounters stock discrepancies due to manual work and data quality issues. Over stock are of program drug and some RDF they sometimes do not consider stock level when ordering if available at EPSS. They do not update stock status on daily base by store man.” *Our facility inventory management systems are 90 % electronic we summarize discrepancy some attribute it to DAGUE, human resource error during entry with mistaken unit will result wrong output .our inventory is also poorly conducted rechecking and Bin card updating practice is poor”(male pharmacist).*

Almost all facility Conducts ABC VEN analysis for classification but some do not update it. They said because there is no reliable supplier there consumption is not as such constant.

Sub-theme4 Storage condition related challenges:

Overall storage space is adequate in most facilities. Some facilities face shortage in storage space and shelving, Regarding Expansion Issues: Pharmacy storage often overlooked in facility expansion plans

“Our storage is not adequate other service keeps expanding but planning and expansion is rare in case of pharmacy” (Female physician)

Over all Inventory management of emergency medicine faces challenges due to supplier response times, contract termination, stock discrepancies from manual work ,data quality issues , a high work load in the ware house ,lack enough capacity building for inventory management ,lack of best practice sharing and lack of responsible personnel for daily perpetual inventory .key concern includes accountability for inventory discrepancies ,supplier unreliability and over stocking issue .

Theme 2 Recommendations and ways forward

Sub-theme1 Digitalization and Modern Technology: implement electronic inventory systems Use advanced inventory software for real time tracking for better data visibility and accuracy

Sub-themes2 Collaboration and coordination: interviewee Advocates for collaboration and coordination for improved inventory management and improve coordination among stakeholders for smoother supply chain management

Sub-themes3 Human resource related: Train warehouse staff on inventory management best practices. Increase staff to reduce workload and assign responsibility for daily stock monitoring. Warehouse have load of work human resource should be increased and responsible person for conducting perpetual inventory on daily basis should be assigned

Sub-theme4 Continuous improvement and Capacity building: There should be capacity building on how to manage inventory efficiently, sharing best experience on stock management. share best practice regularly and Respondent emphasizes accountability for inventory discrepancies. Adapt

Sub-theme5 Accountability:

Respondent emphasizes accountability for inventory discrepancies through enforcing responsibility for stock discrepancies

CHAPTER SIX

DISCUSSIONS

The unavailability of emergency medications in emergency situations could impact patient outcomes. The absence of essential emergency drugs points to a weakness in emergency preparedness. For emergency care to be effective, these medications must always be accessible. We found that, the average availability of emergency medicines was 63.5%.

The present finding was lower than previous studies conducted in Ethiopia, the study (Fentie et al., 2015) found that the mean availability of essential drugs was 91%, another study indicating a significantly better availability of critical medications was 79.17%, (Woldeyohanis et al., 2020), availability of 74.7% (Worku et al., 2020) and mean availability of 86% with a range of 25%–100% (Gutesa et al., 2024), an average availability of 62.5% of the key drugs in the public health facilities (David., 2007). However, a study conducted in Sudan in 2015 found that availability of 72.6% for lifesaving medicines which is closer to the results of our study. Another study finding show much better availability when compared to our finding, with 95.4 percent availability in Sierra Leone (UNFPA 2011). This significance difference might be due to a number of medicines and the number health facilities included and the other one include majorly program medicine which shows better availability. This study found that there is an association between stock out of emergency medicine and bin card record is updating and accuracy.

This was supported by our qualitative findings, where informants described poor inventory practice including delayed bin card updates and inaccuracies in stock records. For example, one pharmacist stated, *“our inventory is poorly conducted, rechecking and bin card updating is poor”* this underscore the role of weak stock management in causing medicines unavailability.

We found that the mean stock-out rate was 55.61%. This implies that roughly 55.6% of the emergency medications were, on average, unavailable at some point at each hospital. These results point to a worrying trend of unavailability, with roughly of emergency medications being unreliable. The implications of these shortages cannot be overstated, as prompt access to emergency medications is crucial for patient care and can have life-or-death consequences (Anghel et al., 2019). This availability discrepancy is consistent with findings from comparable hospitals in Sub-Saharan Africa (SSA), where stock-outs of emergency medications are common because of logistical difficulties, inadequate inventory control and noncompliance with procurement procedures (Mukundiukuri et al., 2020; Bizimana et al., 2020).

The maximum Duration of stock outs was (180) and minimum duration of stock out was (0) days Several medicines show a mean duration of stock outs of 180 days, which indicates a consistent Problem with

availability. We found that the mean duration of stock out was (51.07) days. The mean Frequency of Stock outs was (1.9). Our finding was comparable to Study in sudan (sudan,2015), which found an average stock-out duration of 69 days for lifesaving medicines, although it focused on a year-long period compared to the six-month window of current study.

Study by Fentie et al 2015 reported much shorter stock-out duration of 30.5 days over a six-month period, which is significantly better than the results found in current study reflecting better stock management practices and availability. Another study in Ethiopia indicated that the average stock-out rate was 26.2 (worku et al., 2020), with average time a major critical drug was out of stock was 35.31 days, with a mean stock out percentage of around 27.25% (Gurmu et al., 2017). This is shorter than the durations observed in our study, particularly for secondary level hospital, which faced stock-outs for longer periods on average.

A significant similarity with previous research can be found in the other study (Mukundiyukuri et al., 2020), which documented high rates of stock-outs for essential drugs in rural health centers in Rwanda. Notably, Our study's average stock-out duration of tertiary hospital (51.07) days approximately draws parallels to the duration reported in the work of (Kabera & Mukanyangezi, 2024) and which underscored the vital importance of robust inventory management and accurate stock monitoring for emergency obstetric drugs. Another result of study revealed with an average stock out rate of 41.67% over the past six months. The hospital experienced an average stock out of vital medications for 31.7 days in the previous six months, with an average frequency of 0.7. The difference between the vital drug stock record count and physical count ranged from 0% to approximately 95% (Woldeyohanins et al., 2020) Medicines like Adrenaline experience stock outs frequently. This high frequency indicates recurrent supply chain issues. Medicines such as Cimetidine and Propofol have zero occurrences of stock outs, implying better supply stability for these items.

Furthermore we found that inadequate supply as the main reason for stock-outs, medicines like Hydrocortisone. This is similar to the findings of Study in sudan (sudan2015), which pointed to factors like; poor information flow, limited financial coverage and lack of a quantification plan as contributors to stock-outs of lifesaving medicines in Sudan. The issue of inadequate financial resources was also highlighted as a barrier in both studies. *Even knowing our stocks are diminishing and items are stocked out we don't order because the budget will not be available on time* (male pharmacists).

In similar Study by (Worku et al., 2020), stock-outs were attributed to issues like the lack of trained personnel for medicine selection and poor documentation of stock records. Similarly, Study by Fentie et al., 2015 highlighted stock-out issues due to poor inventory management practices, though financial constraints and supply chain problems were less emphasized. literatures indicates that consistent inventory management

practices, such as the accurate use of stock cards and electronic inventory systems, are necessary measures being implemented in multiple healthcare settings to combat these chronic shortages (Kabera & Mukanyangezi, 2024; Kefale & Shebo, 2019).

Vital medicines are more likely to be available compared to essential or non-essential medicines. This finding directly addresses the objective of assessing emergency medicines availability, as it shows that vital medicines are prioritized and more readily available, showing the strength of the current system in this regard.

Interviews emphasized that procurement prioritizes only service items, such as operating room laboratory supplies, due to budget limitations. A pharmacist noted that only one-sixth of forecasted medicine demand was covered by available funds. This matches the quantitative evidence showing limited procurement coverage and a high frequency of stock outs, reflecting systemic underfunding.

Accurate and updated stock records are crucial for proper inventory management since they are input to calculate future needs. In this study, common stock recording tools were assessed for availability and utilization for emergency medicine and all facilities were found to use Bin card, IFFR and 5 hospital was using RRF. From our qualitative finding, the reason for hospital which was not using RRF was they don't manage program drugs and only 3 hospital was using HCMIS. Out of 18 RRF reviewed, Total Frequency of timely accurate and complete data was 18, 13 and 14 respectively, which shows a gap in Quality of RRF data that can ultimately affect Inventory management.

Bin Card was Available and utilized by all hospitals (100%). purchase request letter Utilized by all 100%. Bin cards are essential tools for managing inventory in hospitals. They help track the quantity and status of medicines, ensuring timely replenishment and reducing stock out. In this study, the bin card utilization rate was high for most products, with the majority of items showing a 100% utilization rate. There were no RRF for (RDF) budget pharmaceuticals was using purchase request letter which lack essential data indicates unstructured approach.

Bin cards were available in all hospitals, this suggests their critical role in inventory management. However, there was limited use of stock cards, RRF and variable use of HCMIS, indicating areas where further standardization might be beneficial.

We found that average bin card accuracy was 78.2% which is comparable with finding in Southern Ethiopia (77%) (Damtie et al., 2020). But higher than the finding in East Gojjam (63.8%) (Bekele et al., 2021) (worku et al., 2020). The accuracy of stock-keeping records was (56.7%), East Wollega (9.1%) (Tiye et al., 2018). Another study in Ethiopia revealed that 40.50% of the selected 400 bin cards were not updated. Only 28.50% of bin cards had properly submitted information (Gurmu et al., 2017). *‘Our inventory is also poorly conducted rechecking and Bin card updating practice is poor* (Male, Pharmacist). The issue of inaccurate

stock records seems to be a common theme across several studies, as similar study (Sudan 2015) also pointed out poor documentation and inventory management practices as key factors contributing to stock-outs. Another study however, did not provide direct information on inventory accuracy but highlighted

Discrepancies between physical and stock record counts ranging from 0% to 60% (Fentie et al., 2015). This suggests that inventory management practices were inconsistent across health facilities. Another finding from Uganda shows only 36% of the records that coincide with the physical counts of the drugs (David, 2007). Possible reasons for the disparity could be due to differences in sample sizes of medicine. Poor data quality, including bin card updating practices, stems from inadequate processes, lack of training and insufficient attention to data accuracy, leading to unreliable outputs in health information management systems (Kilkenny & Robinson, 2018)

Qualitative data points to widespread manual work, stock discrepancies and low digital system adoption. Most facilities used bin cards and only a few electronic tools HCMIS /DAGUE. This complements the quantitative findings that bin card accuracy averaged only 78.2% and that many RRF documents lacked complete or accurate data

The total cost of expired medicines is 1,326,035.31 ETB birr. High Cost of Expired Medicines: Sodium Bicarbonate Injection: 27,000 units, 244,620 birr Ketamine hcl Injection: 2,221 units, 174,459.6 birr Tramadol Injection: 10,198 units, 159,088.8 birr these medicines are among the highest in terms of both quantity and cost, indicating significant wastage. Constituting 18.33%, 13.15%, 11.99% of the total cost respectively. These medicines account for a large portion of the total cost due to their high unit cost and quantity.

The wastage rate was found to be 2.53%, which is beyond the national standard which is less than 2% underscores the inefficiency in current systems that not only diminish availability but also represent significant economic losses for healthcare institutions. This waste is potentially linked to overstocking, poor forecasting. In a similar study by (Fentie et al., 2015) recorded a monetary loss of 1337.6 USD due to the expiry of medicines, underlining a similar issue of inefficient stock management contributing to financial losses. Another Research conducted in Ethiopia shows on average, 10.43% of medications were wasted, resulting in a loss of 174,366.98 Ethiopian Birr (ETB), with Medroxyprogesterone accounting for over 65.74% of that loss (Gurmu et al., 2017).

Another study (sudan2015) did not specifically mention waste rates but identified poor storage conditions and irrational dispensing as contributing factors to stock-outs and inventory losses. The comparison of our finding with similar studies reveals that stock-outs and inventory management issues remain significant challenges across different healthcare settings in Ethiopia. The findings resonate with Anghel et al.'s highlighting that inventory-related inefficiencies can result in increased healthcare costs and reduced accessibility for patients (Anghel et al., 2019).

Additionally, the idea of waste management in healthcare environments comes to light as a crucial element with wide-ranging effects. Wastage rate are not just about economic loss; they represent a missed opportunity to deliver care to patients who may require those emergency medicines (Anghel et al., 2019). In order to guarantee preparedness in the event of an emergency healthcare facilities need to keep critical medications on hand as well as policies that promote acquisition and appropriate usage needed (Hardy et al., 2024). This viewpoint could be used in the hospital context to underline the imperative of designing a rational supply chain that minimizes waste while improving access.

Interviewees suggested that over stocking, coupled with poor consumption forecasting, led to this wastage, despite high demands in some areas. Though not all respondents explicitly mentioned medicines expiry, the themes of inefficient procurement and poor inventory oversight indirectly explain these outcomes.

Storage practice of medicines in federal hospitals in Addis Ababa was assessed with 17 standards. We found that on average 82.3% of these standards were adhered by the facilities (Max=100%, Min=50%). The overall adherence to storage standards is 82.3%, indicating a generally high level of compliance. However, there are some areas where improvement is needed. *“we don't have enough storage space specially when stocks are fully supplied besides it is not up to standard” (female pharmacist)*. Study conducted at Dessie town Ethiopia shows improper stock level maintenance, lack of automatic recording, absence of wall thermometers, lack of humidity and fire control systems, lack of lockable cabinets, failure to use the FEFO storage technique and holding combustibles with drugs. Additionally the institutions' storekeeping procedures were found to be inadequate (Bayked et al.2021). Our finding was better compared to the finding from study in Uganda where that only 10% of the warehouses had adequate storage for the drugs (David, 2007).

6.2 Limitation of the study includes unavailability of some emergency medicine as per EFDA list and small number of sample for inferential statistics and stock out recall bias. This study also does not include other public hospitals, private hospitals and health center in Addis Ababa.

CHAPTER SEVEN

CONCLUSION AND RECOMMENDATION

7.1 CONCLUSIONS

The stock-out of Emergency Medications like Adrenaline and Absence of antidote indicates inadequacies in Emergency preparedness. Sustainable supply of these drugs is a prerequisite for effective emergency care. The stock-out rates of emergency medicines at federal hospitals in Addis Ababa identified important areas that may influence patient care. Better inventory management and emergency plans are needed to guard against these eventualities to ensure life-saving medicines remain available. This study found that there is an association between stock out of emergency medicines and bin card record updating and accuracy. Another association was also found between VEN categorization and availability; vital medicines are more likely to be available compared to essential or non-essential medicines. Showing the strength of the current system in this regard

In this study, common stock recording tools were assessed for availability and utilization for emergency medicines and all facilities were found to use Bin card, IFFR and 4 facilities using HCMIS, However none was using RRF for RDF medicine. It was found that emergency medicine utilization of bin cards was high overall but variable with respect to updating practices. Addressing these inconsistencies through standardized procedures and enhanced staff training can improve inventory management and ensure that Emergency medicines are always available when needed. Continuous monitoring and additional investigation will assist in further improvising inventory practices with a boost to hospital resource utilization. The overall accuracy of the bin card data across the federal hospitals in Addis Ababa shows a reasonable level of accuracy but notable variations exist especially in Hospital 1. The exclusive use of the consumption method for quantification with lack of morbidity method may hinder forecasting its needs based on disease patterns. The wastage rate was found to be high, which underscores the inefficiency in current systems that not only diminish availability but also represent significant economic losses for healthcare institutions. The overall adherence to storage standards is generally high. However, there are some areas where improvement is needed.

Facilities managing emergency medicines face a complex mix of challenges from supply chain issues, manual processes and resource constraints. Despite these challenges, there is a clear effort to prioritize critical medicines and implement systematic inventory control practice like ABC VEN analysis.

Improvements will come from increased digitalization, capacity building, clearer accountability and better supplier coordination.

This study provides important information to guide public policies aiming to enhance availability of emergency medicines as evident in Ethiopia where availability is still a challenge. Given the significance of having emergency medications on hand at all times to enhance patient care, access to emergency medications necessitates ongoing monitoring. Therefore, strategies that reinforce the importance of access to emergency medicines are important to persuade governments to adopt measures that are able to effectively enhance access and improved inventory management.

7.2 RECOMMENDATIONS

The following are recommended as the solution to challenges in emergency medicines inventory management in Addis Ababa's Federal hospitals;

To all Federal hospitals in Addis Ababa Federal hospitals in Addis Ababa should Identify best practice and share through benchmarking or peer sharing, standardize inventory management: implement use of RRF for RDF items, improve quality of data from logistic management information tools, implement the use of electronic inventory management tool across the remaining, conduct regular stock reviews and better supplier coordination should be in place.

To Ministry of Health Enhancing customer and stakeholder satisfaction was among the objectives of Pharmaceuticals Supply Transformation Plan II (2020). Conduct regular follow up regarding the availability of emergency medicines and implement corrective action. MOH should increase digitalization, focused capacity building.

EFDA and EPSS should implement advanced notification system to better anticipate and manage stock out of emergency medicine .this will allow the EFDA,EPSS and health care provider to respond more effectively .through streamlining internal process, improve data tracking, use of science to detect early warning sign of stock out of emergency medicine.

Future Studies: Impact assessment: Investigating the impact occur due to stock-outs of emergency medicine on patients. These measures will help optimize inventory management and coordination with suppliers, resulting in the availability of emergency medicine and overall preparedness in healthcare.

Reference

- Abrha S, Tadesse E, Atey TM, Molla F, Melkam W, Masresha B, Gashaw S, Wondimu A. Availability and affordability of priority life-saving medicines for under-five children in health facilities of Tigray region, northern Ethiopia. *BMC Pregnancy Childbirth*. 2018 Nov 29;18(1):464. doi: 10.1186/s12884-018-2109-2. PMID: 30497441; PMCID: PMC6267819.
- Abu Zwaيدا T, Pham C, Beauregard Y. Optimization of Inventory Management to Prevent Drug Shortages in the Hospital Supply Chain. *Applied Sciences*. 2021; 11(6):2726. <https://doi.org/10.3390/app11062726>.
- Ahmad, K., Mohamed Zabri, S. and Mohamed, M.I.P. 2014. Inventory management practices among small and medium-sized retails enterprises. *Proceeding of the 3rd International Conference on Technology Management, Business and Entrepreneurship, Melaka, Malaysia*, pp. 344-350. number3
- Alam, M. K., Thakur, O. A. & Islam, F. T. (2024), Inventory management systems of small and medium enterprises in Bangladesh *Rajagiri Management Journal*, 18(1), 8-19
- American Society of Health-System Pharmacists ASHP Statement on Bar-Code Verification During Inventory, Preparation and Dispensing of Medications. *Am J Health Syst Pharm*. 2011 Mar 1;68(5):442-5.
- Anghel, L., Farcaş, A., & Oprean, R. (2019). An overview of the common methods used to measure treatment adherence, *Medicine and Pharmacy Reports*. <https://doi.org/10.15386/mpr-1201>
- Attacker.,2005. *Logistics and Supply Chain Management (1st Ed.)*, Himalaya Publishing House
- Aturaka SO, Abiodun O, Omotola O, Adebimpe WO, Imohi P, Okon O. In Cross River State, Nigeria, logistical issues connected with HIV/AIDS supply chain management. *American Journal of Health Research*. 2017;5(4):114-8.
- Aynoshe Adio Alemu, Teferi Gedif Fenta & Dawit Teshome Gebregeorgise(2023) Factors Affecting Inventory Management Performance of Tracer Medicines Across Primary Health Care Units, Gamo Zone, Southern Nations Nationalities and People's Region, Ethiopia, *Integrated Pharmacy Research and Practice*, 49-60, DOI: 10.2147/IPRP.S401888.
- Baker, S. R., Johnson, S., & Kueng, L. (2024), Financial returns to household inventory management. *Journal of Financial Economics*, 151, 103758
- Bekele A, Anbessa G. Logistics management information system performance of program medicines in public health facilities of East Gojjam Zone, Northwest Ethiopia: a cross-sectional study. *J Multidiscip Healthc*. 2021;14:81–89. doi:10.2147/JMDH.S286981

- Bizimana, T., Kayumba, P., & Heide, L. (2020). Prices, availability and affordability of medicines in rwanda. *Plos One*, 15(8), e0236411. <https://doi.org/10.1371/journal.pone.0236411>
- Chiumia, F., Muula, A., Chimimba, F., Nyirongo, H., Kampira, E., & Khuluza, F. (2023). Effect of antibiotic medicines availability on adherence to standard treatment guidelines among hospitalized adult patients in southern malawi. *Plos One*, 18(10), e0293562. <https://doi.org/10.1371/journal.pone.0293562>
- David nahamya assessment of essential drug management in the public Health facilities in Uganda 2007.
- Damtie T, Ibrahim A, Yikna B. Supply chain management performance of HIV/ AIDS commodities and factors affecting it at health facilities of SNNPRS of Ethiopia; from the perspective of achieving 90-90-90 Strategies. *Integr Pharm Res Pract*. 2020;9(11):11–21.doi:10.2147/IPRP.S228162
- Daniel Atnafu&AssefaBalda | Shaofeng Liu (Reviewing editor) (2018) The impact of inventory management practice on firms' competitiveness and organizational performance: Empirical evidence from micro and small enterprises in Ethiopia, *Cogent Business & Management*, 5:1, DOI: 10.1080/23311975.2018.1503219
- Darshan.U, Chinmaya.G.P, Harsh Abhinav, S.Varun Kumar, Deepak.R, Dr.Shanthi S.(2025) Predictive Analysis on Medicines Availability in Hospitals Using Machine Learning and Deep Learning Technique *International Journal For Multidisciplinary Research* <https://doi.org/10.36948/ijfmr.2025.v07i01.34911>
- Demizu, T., Fukazawa, Y., & Morita, H. (2023). Inventory management of new products in retailers using model-based deep reinforcement learning. *Expert Systems with Applications*, 229, 120256.
- Ethiopian food and drug authority Emergency Medicine List Second edition December, 2021 Addis Ababa,Ethiopia
- Ethiopian Pharmaceuticals Supply Agency (EPSA). Standard Operating Procedures (SOP) Manual for the Integrated Pharmaceuticals Logistics System in Health Facilities of Ethiopia. 2nd ed. Addis Ababa: Ethiopian Pharmaceuticals Supply Agency (EPSA); 2015.
- Ezezew, M., Yehualaw, A. &Demsie, D.G.(2023) Assessment of availability and challenges of WHO recommended priority life-saving medicines for under five-year children in primary public health facilities of Amhara region. *BMC Pediatr* 23, 395
- Federal democratic republic of Ethiopia ministry of health Assessment Report of Public Hospitals: For the Development of Public Private Partnership in Tertiary healthcare and High-End Diagnostic Services February 2018 Addis Ababa, Ethiopia
- Fentie et al., Availability of Essential Medicines and Inventory Management Practice in North West Ethiopia Volume 4, Issue 2, 2015; *Journal of PharmaSciTech*
- G Priniotakis and P Argyropoulos 2018 IOP Conf. Ser.: Mater. Sci. Eng. 459 012060

Ghazalba, A., Widodo, A., Tjahjono, B., & Firmansyah, G. (2024). Drug stock optimization at hospital depot using shuffle frog leaping algorithm (sfla). *Asian Journal of Social and Humanities*, 2(11), 2826-2838. <https://doi.org/10.59888/ajosh.v2i11.409>

Govender, T., Suleman, F., & Perumal-Pillay, V. (2021). Evaluating the implementation of the standard treatment guidelines and essential medicines list at a public south african tertiary institution and its associated primary health care (phc) facilities. *Journal of Pharmaceutical Policy and Practice*, 14(1). <https://doi.org/10.1186/s40545-021-00390-z>

Gutesa A, Jebena T, Kebede O. Inventory Management Performance for Tracer Medicines in Public Health Facilities of Southwest Shewa Zone Oromia Region, Ethiopia: A mixed study. *SAGE Open Med*. 2024 Sep 9;12:20503121241274041. doi: 10.1177/20503121241274041. PMID: 39263640; PMCID: PMC11388308.

Hardy, P., Gonzalez, M., Volerman, A., Salem, E., Amerson, N., Woolverton, N., ... & Pappalardo, A. (2024). Asthma policy in illinois: a survey of school nursing and staff knowledge and implementation patterns. *Public Health Nursing*, 41(4), 704-708. <https://doi.org/10.1111/phn.13337>

Hidayat R and Saleh I. The importance of inventory management in pharmaceutical practice. *Open Access Indones J Soc Sci* 2020; 3(1): 1–9.

Hunie M, Desse T, Fenta E, Teshome D, Gelaw M, Gashaw A. Availability of Emergency Drugs and Essential Equipment in Intensive Care Units in Hospitals of Ethiopia: A Multicenter Cross-Sectional Study. *Open Access Emerg Med*. 2020 Dec 1;12:435-440. doi: 10.2147/OAEM.S285695. PMID: 33293877; PMCID: PMC7719042.

Iqbal MJ, Geer MI and Dar PA. Medicines management in hospitals: a supply chain perspective. *Syst Rev Pharm* 2016; 8(1): 80–85.

Istiaque Ahmed Badhan, Moohtasim Haque Neeroj and Irfan Chowdhury (2024) “THE EFFECT OF AI-DRIVEN INVENTORY MANAGEMENT SYSTEMS ON HEALTHCARE OUTCOMES AND SUPPLY CHAIN PERFORMANCE: A DATA-DRIVEN ANALYSIS”, *Frontline Marketing, Management and Economics Journal*, 4(11), pp. 15–52. doi: 10.37547/marketing-fmmej-04-11-03

J.B. Munyaka^{1*} & V.S.S. Yadavalli² inventory management concepts and implementations: a systematic review *South African Journal of Industrial Engineering* Jul 2022 Vol 33(2), pp 15-36

Kabera and Mukanyangezi *BMC Health Services Research* (2024) 24:14 <https://doi.org/10.1186/s12913-023-10459-x>

Kagashe GAB and Massawe T. Medicine stock out and inventory management problems in public hospitals in Tanzania: a case of Dar Es Salaam Region. *Int J Pharm* 2012; 2(2): 252–259.

Kalkidan Worku et al., Availability of Essential Medicines and Inventory Management Practice at Public Health Centers in Bahirdar Town West Gojjam Zone, Amhara Region, Ethiopia, 2020.

Kebede, Oliyad&Anbessa, Gizachew&Feyissa, Dessalegn. (2021). Storage management and wastage of reproductive health medicines and associated challenges in west Wollega zone of Ethiopia: a mixed cross-sectional descriptive study. *BMC Health Services Research*. 21. 10.1186/s12913-021-06291-w.

Kefale, A. and Shebo, H. (2019). Availability of essential medicines and pharmaceutical inventory management practice at health centers of adama town, ethiopia. *BMC Health Services Research*, 19(1). <https://doi.org/10.1186/s12913-019-4087->

Kilkenny, M. F., & Robinson, K. (2018). Data quality: “Garbage in – garbage out.” *Health Information Management Journal*, 47(3), 103–105. <https://doi.org/10.1177/1833358318774357>

Legese N, Teshome D and Gedif T (2022) Inventory Management of Health Commodities in a Tertiary Teaching Hospital in Ethiopia. *Front. Pharmacol.* 13:763909.

Leung N-HZ, Chen A, Yadav P, Gallien J (2016) The Impact of Inventory Management on Stock-Outs of Essential Drugs in Sub-Saharan Africa: Secondary Analysis of a Field Experiment in Zambia. *PLoS ONE* 11(5): e0156026. <https://doi.org/10.1371/journal.pone.0156026>).

Li, Suhong& Ragu-Nathan, Bhanu& Ragu-Nathan, T.S. &SubbaRao, S., 2006. "The impact of supply chain management practices on competitive advantage and organizational performance," *Omega*, Elsevier, vol. 34(2), pages 107-124, April.

Mabizela, S., Nakambale, H.N. & Bangalee, V. Predictors of medicine redistribution at public healthcare facilities in King Cetshwayo District, KwaZulu-Natal, South Africa. *BMC Health Serv Res* 23, 1108 (2023). <https://doi.org/10.1186/s12913-023-10096-4>.

Management Sciences for Health (MSH). *MDS-3: Managing Access to Medicines and Health Technologies*. United States: Management Sciences for Health (MSH); 2012.

McDougal L, Moteetee MM, Mohai F, et al. Lesotho’s minimum PMTCT package: lessons learned for combating vertical HIV transmission using co-packaged medicines. *Journal of the International AIDS Society*. 2012; 15:17326. [PubMed: 23273267]

Mondo, S. N., Twum-Darko, M., Ansen, J., &Tengeh, R. K. (2022).Electronic inventory control systems as a competitive tool for e-retailers. *EUREKA: Social and Humanities*, (5), 51-65. <https://doi.org/10.21303/2504-5571.2022.002504>.

MSH 2010. *Health Systems in Action: An eHandbook for Leaders and Managers*, Cambridge, MA, Management Sciences for Health

Mukundiyukuri, J., Irakiza, J., Nyirahabimana, N., Ng’ang’a, L., Park, P., Ngoga, G., ... & Hedt-Gauthier, B. (2020). Availability, costs and stock-outs of essential ncd drugs in three rural rwandan districts. *Annals of Global Health*, 86(1). <https://doi.org/10.5334/aogh.2729>

Mursyid H, Ilma N. *Pharmaceutical Inventory Management Issues in Hospital Supply Chains*. 2013; 3(1):1-5.

Nemtajela, N. and Mbohwa, C. 2017. Relationship between inventory management and uncertain demand for fast moving consumer goods organizations.14th Global Conference on Sustainable

Manufacturing, GCSM, 3-5 October 2016, Stellenbosch, South Africa. *Procedia Manufacturing*, 8(1), pp. 699–706.

Nidhi Mishra – (2024) Blockchain-Based Intelligent Inventory Management for Hospital Supply Chain (HSC) with Deep Learning Techniques *Communications on Applied Nonlinear Analysis* ISSN: 1074-133X Vol 32 No. 2s(2025)

OpenAI (2024) *ChatGPT* (May 2024 version). Available at: <https://chat.openai.com> (Accessed: May 2024)

Rachmat Hidayat^{1*}, Mgs. Irsan Saleh² *Open Access Indonesia Journal of Social Sciences* Vol 3 Issue 1 2020

Republic of Sudan Federal Ministry of Health Directorate General of Pharmacy Statistics unit
Contributing factors to “stock out” of life- saving medicines, in governmental health facilities in the Sudan 2015-2016.

Survey of Availability of Modern Contraceptives and Essential Life-Saving Maternal and Reproductive Health Medicines in Service Delivery Points in Sierra Leone: VOLUME ONE – analytical report UNFPA 2011

Shewarega A, Dowling P, Necho W, Tewfik S, Yiegezu Y. Ethiopia: national survey of the integrated pharmaceutical logistics system. Arlington: USAID/DELIVER PROJECT, Task Order 4, and Pharmaceuticals Fund and Supply Agency (PFSA); 2015.

Sultan, M., Abebe, Y., Tsadik, A. W., Ababa, A., Yesus, A. G., & Mould-Millman, N.-K. (2019). Trends and barriers of emergency medical service use in Addis Ababa; Ethiopia. *BMC Emergency Medicine*, 19(1), 1–8. <https://doi.org/10.1186/S12873-019-0242-5>

Tadesse Gudeta Gurmu, AwolJemal Ibrahim. Inventory management performance of key essential medicines in health facilities of East Shewa Zone, Oromia Regional State, Ethiopia; 42(2):277291, 2017.

The Importance of Inventory Management in Pharmaceutical Practice

Tiye K, Gudeta T. Logistics management information system performance for program drugs in public health facilities of East Wollega Zone, Oromia regional state, Ethiopia. *BMC Med Inform Decis Mak*. 2018;18(1). doi:10.1186/s12911-018-0720-9

UN commission on life-saving commodities for women and children Commissioners’ Report September 2012.

V.W., Naliaka & Namusonge, G.S.. (2015). Role of Inventory Management on Competitive Advantage among Manufacturing Firms in Kenya: A Case Study of Unga Group Limited. *International Journal of Academic Research in Business and Social Sciences*. 5. 10.6007/IJARBS/v5-i5/1595.

Vilbert A, Makafui M. Assessing the challenges in supply chain of health commodities in the health industry. *Afr J Procure Logist Supply Chain Manag*. 2019;1(4):1–20.
WHO emergency care framework 2018.

Woldeyohanins AE et al. *Int J Sci Rep*. 2020 Sep;6(9):349-352).

Woo-Miles K. Evaluating Hospital Pharmacy Inventory Management and Revenue Cycle Processes: White Paper Guidance for Healthcare Internal Auditors. Costa Mesa, Deloitte, 2015.

World Health Organization. Service availability and readiness assessment (SARA): A methodology for measuring health systems strengthening. Geneva: 2012. Accessed November 7, 2013 from: http://www.who.int/healthinfo/systems/SARA_Overview-Presentation.pdf

World Health Organization. Access Links. Essential Drugs Monitor. 2001;30:2.

World Health Organization. Equitable Access To Essential Medicines: A Framework For Collective Action. WHO Policy Perspectives On Medicines. 2004;3:1–6

Quantitative data collection tool

Informed consent letter

ጠፍ ይሰጥልኝ፤ ስሜበስራትቦጋለ ነ። ኤምሲሲን በከፊልለማጂኦትለማደረገ ወጥናትበጠፍግብአትአቅርቦትስንሰለትስርዓትላይየዳሰሳጥናትአደርጋለሁ። ለአፋታኒ፣ ለድንገተመድሃኒትእናለንብረትአያያዝአፈፃፀምበአጠቃላይየተመረጠመድኃኒቶችመኖራቸውንእየተመለከትኩኑ ወ። እኔበአዲስአበባፊደራልሆስፒታልእየጎበኘሁሲሆንየእርስዎተቋምከተመረጠወየጠፍተቋምእንዲሁ ወ። የዚህጥናትዓላማለ፣ ለድንገተመድሃኒቶችየቁሳቁስአያያዝንመገምገም፤ ለድንገተመድሃኒቶችመሰንከወ። ይህየቁጥጥርጉብኝትአይደለምእናየግለሰብሠራተኞችአፈፃፀምእይገመገም። የዚህጥናትወጠቅለሚጥለከታቸውአካላትምከሮችንለመስጠትእናበአፈፃፀምመላይከፍተኛመቼሻያዎችንለማድረግመረጃይሰጣል። በዚህፋሲሊቲወስጥለአፋታኒ፣ ለድንገተመድሃኒቶችስለከምችትአያያዝአፈፃፀምሎጂስቲክስእንቅስቃሴኃላፊወንተከታታይጥያቂዎችንመጠየቅእፈልጋለሁ። በተጨማሪም፣ የተመረጠችንምርቶች፣ የአክሲዮንመዘገቦችን፣ የግብይትመዘገቦችን፣ የማከማቻ

ሁኔታን እና የድንገተኛ መድሃኒት መቅጠር እፈልጋለሁ።

Part I. Socio-demographic and practice setting information

Description of the federal hospital

1. Name of the Hospital_____
2. Location:_____ -3. Code_____
4. Types of the hospital
 - a. tertiary level hospital
 - b. Secondary level hospital
5. Number of pharmacy professional under the drug supply management unit?
 - a. Pharmacist_____ b. Druggist _____ c. MSc_____ -d. others, specify_____ -

Detail of personnel interviewed for this survey

6. sex
 - a. male b. female
7. Title of Profession/current position
 - a. store manager
 - b. supply chain officer
 - c. pharmacy department head
 - d. other _____specify
8. highest academic degree
 - a. Diploma
 - b. Bachelor degree
 - C. MSc
 - d. other_specify
9. Number of years of experience at the current position 9_____
10. have you taken training on IPLS or inventory management related ?
 - a. yes b.No

Part II. Inventory Management related questions

1. How are the quantities of emergency medicines determined ?
 - a. based on consumption data
 - b. based on morbidity data
 - c. do not know
 - d. other _____specify
2. Which supplier do your hospital use mostly to receive emergency medicines ?
 - a. government supplier (EPSS)a. Governmental supplier (EPSA)
 - b. private suppliers
 - c. hospital or health facilities by donation or loan
 - d. others _____specify
3. How often do you request and receive emergency medicines ?
 - a. weekly
 - b. biweekly
 - c. monthly
 - d. biannually
 - e. Annually
 - F. when ever needed

4.what is the average replenishment lead time for emergency medicines?

- a.1 week
- b.2 week
- c.2-4 week
- d. greater than one month

5. what stock record form do you use for reporting /reordering ?

a.RRF

IFRR

a. RRF

b. IFRRF

c. Other ____specify

6. How often do LMIS report sent to the higher level ? more than one answer is possible

- a. biweekly
- b. monthly
- c. annually
- d. anytime

.

7.do you think the existing storage capacity is adequate to handle all the quantity of emergency medicines needed in order to prevent stock outs?

A. yes

B.no

8. How often does the facility conduct physical inventory ?

- a. monthly
- b. every two month
- c. every three month
- d. every six month
- e. more than every six month

Part III. Inventory management performance related questions

1. Availability and utilization of stock recording tools

S.no	Stock recording tools	Available		Utilization		remark
		Yes	No	Yes	No	
1	Bin card					
2	Stock card					
3	HCMIS					
4	IFRR					
5	RRF					

2. Availability and stock out rate of emergency medicines in the last six months.

1.	LIST of emergency medicine	Managed in the facility Y/N	Available today? Y/N	Stock out in last 6 months? Y/N	Days out of stock	Frequency of stock out	Reason for stockout 1.Inadequate supply 2.Stock out at the source 3.Expiry 4.Delayed require 5.No client /demand 6.Lack of information
2.	Acetaminophen Injection: 1gm in 100ml						
3.	Acetaminophen Suppository: 125 mg, 250 mg Syrup: 120mg/5ml,250mg/5ml						
4.	Acetaminophen Tablet: 500mg,						
5.	Acetazolamide Tablet: 250mg,500mg						
6.	Acetylsalicylic acid Tablet: 81mg, 100mg,300mg						
7.	Activated Charcoal Powder: 15gm/120ml, 25gm						
8.	Acyclovir Powder for Injection: 250mg, 500mg						
9.	Capsule/Tablet: 200mg, 400mg						
10.	Adenosine Injection: 3mg/ml in 2ml						
11.	Adrenaline Injection: 0.1mg/ml, 1mg/ml						
12.	Alcohol based hand rub Solution: containing ethanol 80% V /V,Isopropyl alcohol 75% V/V						
13.	Allopurinol Injection: 50mg/ml,100mg/ml						
14.	Alteplase Powder for injection: 10 mg, 20 mg, 50 mg						
15.	Aminophylline Injection: 250mg/10ml						
16.	Amiodarone Injection: 50mg /ml						

17.	Ampicillin Injection: 250mg, 500mg, 1g						
18.	Anti-Rho (D) human Immunoglobulin Injection: 300mcg						
19.	Anti-tetanus human immunoglobulin Injection: 250IU/ml						
20.	Artesunate Injection: 60mg/ml						
21.	Atorvastatin Tablet: 20mg, 40 mg						
22.	Atropine Sulfate Injection: 1mg/ml, 100mg/ml						
23.	Atropine Sulphate Eye drops: 1%						
24.	Azithromycin Tablet: 500mg						
25.	Bisacodyl Suppository: 5mg, Tablet: 5 mg						
26.	Budesonide/formoterol Inhalation: 80/4.5, 160/4.5						
27.	Bupivacaine Injection: 0.25%, 0.5%						
28.	Bupivacaine Injection Injection: for spinal anesthesia: 0.5%						
29.	Captopril Tablet: 12.5mg, 25mg, 50mg						
30.	Caffeine citrate Injection: 20 mg/ Ml						
31.	Calcium gluconate Injection: 10%/10ml						
32.	Calcium chloride Injection: 100mg/ml						
33.	Carbetocine Injection: 100mg						
34.	Ceftriaxone Powder for injection: 500mg, 1gm						
35.	Cefazolin Injection: 1gm						
36.	Chlorhexidine Solution or gel: 0.12%, 4%, 7.1%						
37.	Chlorpheniramine Syrup: 2mg/5ml						
38.	Chlorpromazine Hydrochloride Injection: 25mg/ml						
39.	Chlorpromazine Hydrochloride Tablet: 100mg						
40.	Cimetidine Injection: 200mg/ml						
41.	Clopidogrel Tablet: 75mg						
42.	Cloxacillin Injection: 250mg, 500mg						

43.	Coagulation factor IX Powder for injection: 500 IU, 1000 IU						
44.	Coagulation factor VIII Powder for injection: 500 IU						
45.	Cyproheptadine Hydrochloride Syrup: 2mg/5ml, Tablet: 4mg, 10mg						
46.	Dantrolene Injection: 20 mg/ml Capsule: 25mg, 50mg						
47.	Deferoxamine Mesylate Powder for injection: 500mg						
48.	Desmopressin Injection: 4 mcg/mL, Nasal spray: 10 mcg						
49.	Dexamethasone Eye drops Suspension: 0.1%,						
50.	Dexamethasone Injection: 4mg/ml, 8mg/ml						
51.	Dextrose in Sodium chloride Injection: 5% 500ml, 1000ml:						
52.	Dextrose in water Injection: 5% 250ml, 1000ml: 40%						
53.	Diazepam Injection: 5mg/ml						
54.	Diclofenac Injection: 25mg/ml						
55.	Digoxin Immune (Fab Ovine) Digoxin-specific, antibody fragments Powder for Injection: 40mg						
56.	Digoxin Injection: 0.25 mg/ml						
57.	Diltiazem Injection: 25mg/5 ml						
58.	Dobutamine Powder for Injection: 250mg						
59.	Dopamine Injection: 40mg/ml						
60.	Enoxaparin Injection: 20mg/0.2ml, 40mg/0.4ml, 60mg/0.6ml, 80mg/0.8ml, 100mg/ml						
61.	Ergometrine Injection: 0.2mg/ml, Tablet: 2mg						
62.	Esmolol Hydrochloride Injection: 10mg/ml						
63.	Etomidate Injection: 20 mg/ml						
64.	Fentanyl Injection: 50mg/ ml						
65.	Flumazenil Injection: 0.5 mg/5 mL						
66.	Furosemide Injection: 10 mg/ml						
67.	Fusidic Acid Cream: 2%, Ointment: 2%						
68.	Gabapentin Tablet: 150mg, 300mg						

69.	Gentamicin Injection: 20mg/2ml,80mg/2ml						
70.	Glucagon Injection: 1mg/ml						
71.	Haloperidol Injection: 5mg/ml,50mg/ml,						
72.	Heparin Injection: 5000IU/ml						
73.	Hepatitis B immunoglobulin Injection:100IU/mL						
74.	Human anti-rabies Immunoglobulin Injection: 1500 IU/ml						
75.	Human Tetanus Immunoglobulin Injection: 1500 IU						
76.	Hydralazine Injection: 20mg/ml						
77.	Hydrocortisone Injection: 100mg, 200mg						
78.	Hydrogen Peroxide Solution: 3%						
79.	Hydroxyurea Capsule, 500mg						
80.	Hypertonic saline Injection: 3%						
81.	Hyoscine bromide Injection: 10mg/ml						
82.	Ibuprofen Injection: 10mg/ml,100mg/ml,						
83.	Ibuprofen Suspension: 100mg/ml,						
84.	Ibuprofen Tablet: 200mg,400mg						
85.	Insulin Soluble Injection: SC, IV 100IU/ml						
86.	Indomethacin Capsule: 25mgTablet: 100mg						
87.	Iodine Solution: 2% V/V						
88.	Iodine + Potassium Iodide (Lugol'sSolution)Solution: 5%+ 10%						
89.	Ipratropium bromide Aerosol: 20mcg/MD, 40mcg/MD inhalation,Ipratropium/ albuterolNebulizer: 20mcg/100mcg						
90.	Iron Complex Injection: 50mg/ml						
91.	IVIG (intravenous immunoglobulin						
92.	therapy) Injection: 10% (0.1g/ml), 50ml, 100ml, 200ml, 400ml						
93.	Ketamine Injection: 50mg/ml						
94.	Labetalol Injection: 5mg/ml,						

95.	Lactated Ringer's Injectable Solution: 1000ml						
96.	Lactulose Oral Solution: 10g/15ml						
97.	Levetiracetam Injection: 500mg						
98.	Levothyroxine Injection: 100mcg, Tablet: 100mcg, 50mcg						
99.	Lidocaine Hydrochloride, Injection: 0.5%, 1%, 2%, 5%,						
100.	Lidocaine Jelly: 2% in 30 ml Injection: 0.5%, 1%, 2%, 5%, Injection for spinal anesthesia: 5% in 2-mL Ointment: 5% in 10gm, Spray: 2%, 4%, 10 % in 80g						
101.	Lidocaine Hydrochloride + Adrenaline Injection: 1% + 1:200,000, 2%+1:200,000						
102.	Lidocaine hydrochloride (Cardiac) Injection: 5mg/ml, 10mg/ml, 20mg/ml						
103.	Liothyronine Injection: 10mcg/ml						
104.	Lipid emulsion Injection: 20% (200 to 500mL)						
105.	Magnesium Sulphate Injection: 50% , 10%						
106.	Mannitol Injection 20%, 500ml, 100g						
107.	Methimazole Tablet: 5mg, 10mg						
108.	Methyl prednisolone Injection: 40mg/ml, 80mg/ml						
109.	Metoprolol Tablet: 25mg, 50mg,						
110.	Metoprolol Injection: 1mg/ml, 5mg/ml						
111.	Metoclopramide Hydrochloride Drops: 0.2mg/drop,						
112.	Metoclopramide Hydrochloride Injection: 5mg/ml, 5mg/2ml						
113.	Metronidazole Intravenous Infusion: 5mg/ml in 100ml						
114.	Midazolam Injection: 1mg/ml, 5mg/ml						
115.	Misoprostol Tablet: 25mcg						
116.	Misoprostol + Mifepristone Tablet: 200mcg + 200mg						
117.	Morphine Sulphate Injection: 10 mg/ml,						

118.	Morphine Sulphate Oral Solution, 10mg/5ml						
119.	N-Acetylcysteine Injection: 200mg/ml						
120.	Naloxone hydrochloride Injection: 0.4mg						
121.	Navidoxine Tablet:25mg						
122.	Nifedipine Tablet: 20mg, 40mg						
123.	Neostigmine Injection: 0.5mg/ml, 2.5mg/ml						
124.	Nimodipine Tablet: 30 mg						
125.	Nitrofurazone Ointment: 30gm, 45gm						
126.	Nitroglycerine Infusion: 0.1mg/ml, 0.2mg/ml, 0.4mg/ml						
127.	Injection: 5mg/mg.Sublingual: 400mcg,						
128.	Noradrenaline Injection: 1mg/ml						
129.	Octreotide Injection: 50mcg/ml: 100mcg/ml						
130.	Omeprazole Powder for Injection: 40 mg						
131.	Ondansetron Injection: 2 mg/ml						
132.	Oral Rehydration Salt Powder: each sachet for 1 liter						
133.	Oxytocin Injection: 10unit/ml						
134.	Oxygen Pure Oxygen(medical gas)						
135.	PEG (Polyethylene glycol) Powder oral dose: 17gm						
136.	Pethidine Hydrochloride Injection: 50mg/ml						
137.	Phenobarbitone (Phenobarbital) Injection: 25mg/ml, 100mg/ml,						
138.	Phenobarbitone Tablet: 30mg,100mg						
139.	Phenylephrine Injection: 10mg/ml						
140.	Phenytoin Injection: 50mg/ml, 1000mg,						
141.	Phenytoin Tablet: 50mg, 100mg						
142.	Phosphonytoin Injection: 75mg/ml,						
143.	Physostigmine Injection: 1mg/ml						
144.	Phytomenadione (Vitamin K1) Injection: 1mg/0.5ml, 10mg/ml						
145.	Potassium chloride Infusion: 20meq, 40meq						

146.	Povidone Iodine Solution:10%V/V						
147.	Pralidoxime Chloride Powder for Injection: 1000mg/, Tablet: 500mg						
148.	Procainamide Hydrochloride Injection:100mg/ml						
149.	Propofol Injection 10mg/ml						
150.	Propranolol Tablet:40mg						
151.	Propylthiouracil Tablet: 50mg, 100mg						
152.	Protamine Sulphate Injection: 10mg/ml in 5ml :250mg (10mg/ml), 25ml						
153.	Pyridoxine Tablet: 25 mg, 50 mg, 100 mg, 250 mg						
154.	Rehydration Solution for Malnourished(ReSomal)						
155.	Salbutamol Oral Inhalation (aerosol): 0.1 mg/dose, 2mg/5mlNebulizer1mg/ml						
156.	Snake Venom Antiserum Polyvalent Injection: 10ml						
157.	Sodium bicarbonate Injection: 7.5% (40mEq/50ml in 50ml: 8.4%(50meq/50ml)						
158.	Sodium ChlorideInjection: 0.9%, 1000ml: 0.9% in 500ml,						
159.	Sodium Nitroprusside Powder for Injection: 50mg						
160.	Sodium Valproate Injection: 100mg/ml,						
161.	Sodium Valproate Tablet: 200mg, 500mg, Syrup, 200mg/5ml						
162.	Streptokinase Powder for Injection: 1.5 million IU						
163.	Sugammadex Injection: 100mg/ml						
164.	Suxamethonium Chloride Injection: 50mg/ml						
165.	Tetanus toxoid Injection: 40mg/ml						
166.	Tetanus Antitoxin, Equine Injection: 1,500IU						
167.	Tetracycline, Eye ointment: 1%						
168.	Thiamine IV Injection 100mg/ml						
169.	Thiopental Injection:500mg,1000mg						

170.	Tramadol hydrochloride Injection: 50mg/ml						
171.	Tranexamic acid Injection: 100mg/ml, 10ml						
172.	Tropicamide Eye drops: 1%						
173.	Vecuronium Bromide Powder for Injection: 10mg in a						
174.	vitamin B complex Injection:						
175.	Water for Injection Sterile water for Injection:5ml, 10ml 5ml,10ml						
176.	Zinc Sulphate Tablet: 10mg,20mg Oral liquid: 10mg/unit						

3. Stock record updating practice and accuracy

	Bincard utilizedY/N	BincardupdatedY/N	Bincard accurate
acetaminophen sup/syrup120mg/5ml, 250mg/5ml Suppository, 125 mg, 250 mg			
Acetaminophen , Tablet,100mg, 500mg			
Acetazolamide Tablet: 250mg			
Acetylsalicylic Acid Tablet, 300mg			
Adrenaline Injection: 0.1mg/ml, 1mg/ml			
Alcohol based hand rub Solution: containing ethanol 80% V /V,Isopropyl alcohol 75% V/V			
Aminophylline Injection: 250mg/10ml			
Amiodarone Injection: 50mg /ml			
Artesunate Injection: 60mg/ml			
Azithromycin Tablet: 500mg			
Bisacodyl Suppository: 5mg,Tablet: 5 mg			
Bupivacaine Injection: 0.25%, 0.5%			
Calcium gluconate Injection: 10%/10ml			
Ceftriaxone Powder for injection: 500mg, 1gm			

Cimetidine Injection: 200mg/ml			
Dextrose in Sodium chloride Injection: 5% 500ml, 1000ml:			
Dextrose in water Injection: : 40%			
Diazepam Injection: 5mg/ml			
Diclofenac Injection: 25mg/ml			
Digoxin Injection: 0.25 mg/ml			
Dopamine Injection: 40mg/ml			
Fentanyl Injection, 50mg/ ml			
Furosemide Injection: 10 mg/ml			
Fusidic Acid Cream: 2% Ointment: 2%			
Gentamicin (Access) Injection, 20mg/2ml,80mg/2ml			
Heparin Injection: 5000IU/ml			
Hydralazine Injection: 20mg/ml			
Ibuprofen Tablet, 400mg			
Insulin Soluble Injection: SC, IV 100IU/ml			
Iodine Solution: 2% V/V			
Iodine + Potassium Iodide (Lugol'sSolution): 5%+ 10%			
Ketamine Injection, 10 mg/ml in 20ml, 50mg/ml			
Labetalol Injection, 5mg/ml, 100mg/20ml			
Lactated Ringer's Injectable Solution: 1000ml			
Lidocaine Hydrochloride Injection, 0.5%, 1%, 2%, 5%			
Lidocaine Hydrochloride with adrenalineinjection			
Metoclopramide Hydrochloride Injection: 5mg/ml, 5mg/			
Metoprolol Tablet: 25mg, 50mg,			
Metronidazole Intravenous Infusion: 5mg/ml in 100ml			
Nifedipine Tablet, 20mg, 40mg			
Nimodipine Tablet: 30 mg			
Nitrofurazone Ointment: 30gm, 45gm			
Omeprazole Powder for injection: 40 mg in vial			
Pethidine Hydrochloride Injection: 50mg/ml			

Phytomenadione (Vitamin K1) Injection, 1mg/0.5ml, 10mg/ml in 1ml ampoule Tablet, 10mg			
Potassium chloride Infusion: 20meq, 40meq			
Povidone Iodine Solution:10%V/V			
Propofol Injection 10mg/ml			
Propranolol Tablet:40mg,10mg			
Salbutamol Oral Inhalation (aerosol): 0.1 mg/dose, 2mg/5mlNebulizer1mg/			
Snake Venom Antiserum Polyvalent Injection: 10ml			
Sodium bicarbonate Injection: 7.5% (40mEq/50ml in 50ml: 8.4%(50meq/50ml)			
Sodium Chloride Injection, 0.9% (Normal Saline), 1000ml; 0.9% in 500ml, 3% in 500ml; 0.45% sodium chloride (equivalent to Na+ 75 mmol/L and Cl- 75 mmol/L).			
Suxamethonium Chloride (Succinylcholine) Powder for injection, 50mg, 100mg, 500mg Injection, 50mg/ml			
Tetanus Antitoxin, Equine Injection: 1,500IU			
Thiopental Sodium Powder for injection, 0.5gm, 1gm in vial			
Tramadol hydrochloride Injection, 50mg/ml Tablet/Capsule, 50mg, 100mg			
Vitb complex injection			
Water for Injection In 2ml, 5ml, 10ml vial			

4. What do you think is the reason for stock out of items with frequent stock outs ? more than one answer is possible .

- inadequate supply from the source
- stock out at the source
- expiry of items
- untimely or delay of request
- lack/no client demand
- lack of information about the items weather it is available or not in the country
- others __specify

5. Stock wastage/expiry and value of Emergency medicines in the last six months

No	st of Product	Received	Wasted/ Expired	Unit cost in birr	Total cost	mark

--	--	--	--	--	--	--

6. What is/are the reason for the expiry/wastage of emergency medicines ?more than one answer is possible

- a. receiving near expiry drugs
- b. store room not sufficient
- c. fail to practice FEFO/FIFO
- d. over supply of emergency medicines
- e. delay of supply of medicines
- f. irregular consumption/unpredictable pattern
- g. other _____specify

7. Storage condition of medicines

no	standard	yes	no	mark
	Products that are ready for distribution are arranged so that identification labels and expiry dates and/or manufacturing dates are visible.			
	Products are stored and organized in a manner accessible for first to- expire, first-out (FEFO) counting and general management.			
	Cartons and products are in good condition, not crushed due to mishandling. If cartons are open, determine if products are wet or cracked due to heat/radiation.			
	The facility makes it a practice to separate damaged and/or expired products from usable products and removes them from inventory.			
	Cartons and products are protected from water and humidity.			
	Products are protected from direct sunlight.			
	Storage area is visually free from harmful insects and rodents. (Check the storage area for traces of bats and/or rodents [droppings or insects].)			
	Storage area is secured with a lock and key, but is accessible during normal working hours; access is limited to authorized personnel.			
	Products are stored at the appropriate temperature according to product temperature specifications.			
	Roof is maintained in good condition to avoid sunlight and water penetration.			
	Storeroom is maintained in good condition (clean, all trash removed, sturdy shelves, organized boxes).			
	The current space and organization is sufficient for existing products and reasonable expansion (i.e., receipt of expected product deliveries for foreseeable future).			
	Fire safety equipment is available and accessible (any item identified as being used to promote fire safety should be considered).			
	Products are stored separately from insecticides and chemicals.			
	Products are stacked at least 10 cm off the floor.			
	Products are stacked at least 30 cm away from the walls and other stacks.			

	Products are stacked no more than 2.5 meters high.			
--	--	--	--	--

Perceived Inventory Performance Questionnaire

1. Sex
 - a. Male b. Female
2. Highest academic degree
 - a. Diploma
 - b. Bachelor degree
 - c. MSc
 - d. Other_____specify
3. No of years of experience at your current position: _____
4. Have you taken any training on IPLS or inventory management related?
 - a. Yes b. No

Instructions:

Please indicate how much you agree or disagree with each statement below regarding the inventory performance on emergency medicines in your facility. Use the following scale:

1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree

No.	Statement	1	2	3	4	5
1	The inventory system ensures that needed items are available when required.					
2	Inventory records are accurate and up to date.					
3	Stock outs (running out of items) are rare in this facility.					
4	Inventory replenishment is done within an acceptable time frame.					
5	The system effectively minimizes wastage or expiry of items.					
6	The inventory management process is					

	efficient and user-friendly.					
7	Communication between inventory staff and users is smooth and effective.					
8	Staff are adequately trained to manage inventory effectively.					
9	The inventory system supports overall organizational performance.					
10	Overall, I am satisfied with the performance of the inventory system.					

The questionnaire items were adapted from the USAID/DELIVER projects logistics indicator assessment tool (LIAT) and contextualized to assess perceived performance of emergency medicines inventory management in federal hospitals in Addis Ababa Ethiopia.

Qualitative Questions for Pharmacy Director/DSM Manager, staff from medical Director of the Health Facilities

I. Interview guide for Pharmacy Director/DSM Manager, staff from medical Director

1. Sex

a. Male b. Female

2. Profession_____

3. No of years of experience at your current position: _____

Q1: Quantification and Procurement of Emergency Medicine

a. What types of quantification methods do you use for emergency medicines?

Do you utilize data generated at the warehouse during the quantification process? If yes, how is this data incorporated into the decision-making process?

b. What ordering method does your facility apply for the periodic replenishment of emergency medicines? Please describe the process, frequency, and any tools or systems used to manage ordering.

c. Who is responsible for procurement of emergency medicines?

Do you think the responsible person is appropriately qualified for this role? Why or why not?

d. How do you assess the lead time for your orders?

Do you experience delays or timely deliveries? How is this managed and evaluated?

Q2: Emergency Medicine Stock Management

a. Do you experience issues with stock-outs, overstocking, or stock wastage of emergency medicines at your facility?

If yes, what are the main contributing factors?

Which types of products are most prone to these issues?

b. How often do you conduct stock counts?

If stock counts are not regularly conducted, what are the reasons for this?

If stock counts are performed, how frequently do you reconcile the stock with records?

In the event of discrepancies, what are the possible reasons for them?

c. Have you classified your pharmaceuticals in the warehouse using methods such as the ABC or VEN matrix analysis?

If not, what are the reasons for not using these classification methods?

Q3: Storage Conditions

a. How adequate is your storage space for emergency medicines?

Does the current storage space meet the needs of your inventory, or are there space constraints?

b. Are the necessary equipment and resources available in your storeroom?

Do you have the required tools and equipment to maintain proper storage conditions (e.g., shelving, temperature control, inventory management systems)?

Q4: Recommendations for Improving Emergency Medicine Inventory Management Performance

a. What specific recommendations do you have to improve the performance on emergency medicine inventory management at your facility?

Please provide any insights or suggestions based on your experience or observations.