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Health Commodity Supply Chain Performance and Challenges at public Health Facilities in Addis Ababa City Administration: A Mixed Methods Study

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This is to certify that the thesis prepared by Robel Gursm, entitled: "*health commodity supply chain performance and challenges at public health facilities in Addis Ababa City Administration,"* and submitted in partial fulfillment of the requirement for the degree of master of science in health supply chain management complies with the regulations of the university and meets the accepted standards concerning originality and quality.

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Abstract

Background: Supply chain is a network of organizations that are involved through upstream, and downstream linkages in the different processes, and activities that produce value in the form of products and services in the hands of the ultimate customer. Performance measurement is the process of quantifying and comparing the efficiency and effectiveness of action with pre-seated goals by known standards. The efficient functioning of a health supply chain system is crucial for delivering quality health care service, and ensuring the availability of medicine and medical supplies.

Objective: This study aims to evaluate the performance of health commodity supply chain and to assess the challenges at public health facilities in Addis Ababa, Ethiopia.

Methodology: A facility based cross sectional an explanatory sequential mixed study design were employed from April to May 2024 in public health facilities of Addis Ababa, Ethiopia. The performance in relation to health supply chain was described and challenges of supply chain were explored. Both quantitative and qualitative data were collected. The quantitative data was collect using researcher administered semi structured questionnaire, document review and observational methods at public health facilities. The qualitative data was gathered through key informant interviews with the responsible professional. The quantitative data were entered and analyzed using SPSS version 25 and the results were presented using descriptive statistics. Whereas the qualitative part of the study was transcribed, summarized manually and analyzed using thematic analysis.

Result: Forecasting accuracy rate for key essential drugs for health centers under study was 62.35% and average order fill rate was 67.5%. Out of reviewed health centers RRF reporting rate was achieved 100%. Ethiopian pharmaceutical supply service was sending products to health facilities averagely within 19 days. Average wastage rate of the health centers under study was 1.24% and the availability of tracer drug was 89.18%. Only 47% of health centers met acceptable storage criteria and 71% of health facility under study had unfit for use medicine which was not disposed during last 12 month. Out of twenty-five key essential medicine assessed the overall stock out duration was 25.3 days. The main cause of poor health supply chain was shortage of supply at

Ethiopian pharmaceutical supply service and in market, lack of trained human resource, budget constraint, and transportation and waste disposal service limitation.

Conclusion and recommendation: In general the health commodity supply chain performance of those health facilities was found to be poor. Except for RRF reporting rate, inventory accuracy rate, and wastage rate which had relatively better results, the rest of the majority of the indicators were below the national standard which was confirmed by poor forecasting accuracy, order fill rate practices and poor storage condition and unfit for use practice. Availability and stock out of tracer medicines were the main problem for major health facilities. Limited competent human resource, inadequate management support and budget constraints, were other challenges for health facilities. Public health facilities should work together with stakeholders to ensure uninterrupted supply of key essential medicines.

Key Term: Health supply Chain, performance, public health facilities and challenge.

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Table of contents

Abstract iii

Acknowlegment ..... **Error! Bookmark not defined.**

List of Table ix

List of Figure x

Abbreviation and acronyms x

CHAPTER ONE 1

1. INTRODUCTION 1

1.1 Background of the Study 1

1.2 Statement of the Problem 3

1.3 Significance of the Study 4

1.4 Scope of the Study 5

1.5 Objective 5

1.5.1 General Objective 5

1.5.2 Specific Objective 5

1.6 Research Question 6

CHAPTER TWO 7

2. RELATEDLITERATURE REVIEW 7

2.1 Theoretical Literature Review 7

2.1.1 Definition of Supply Chain Management 7

2.1.2. The Importance of Health Supply Chain 7

2.1.3 Health Supply Chain Monitoring and Evaluation 8

2.2. Empirical literature review 9

2.2.1. Performance of Health Supply Chain System at Health Facilities 9

2.3 Conceptual Framework of the study 11

3. METHODS OF THE STUDY 13
3.1. Description of study area 13
3.2. Study Design 14
3.3 Research Approach 14
3.3.1 Quantitative Approach 14
3.3.2 Qualitative Approach 14
3.4. Population 14
3.5 Study Variables 14
3.6. Inclusion and Exclusion Criteria 15
3.7. Sampling Procedure and Sample size Determination 15
3.6. Data Source and Type 17
3.7. Data collecting Instruments 17
3.8. Data Quality Assurance 18
3.9. Methods of Data processing and Analysis 18
3.10. Ethical Consideration 18
3.11 Operational Definition 18
CHAPTER FOUR 21
4. Findings 21
4.1 Characteristics of health facilities and respondents 21
4.2 Forecasting Accuracy 22
4.3 Order Fill Rate 22
4.4 Inventory Accuracy Rate 23
4.5 RRF Reporting Rate 24
4.6 Average lead time 25
4.7 Average wastage rate 25

4.8 Tracer drug availability 27
4. 9: Good storage practice 29
4.10 Tracer drugs stock out duration 30
4.11 Disposal of unfit for use medicines 32
4.12 Factors contributing to the effectiveness and efficiency of health supply chain in public health centers 33
4.12.1 Supply chain performance determinant 33
4.12.2 Key informant interviews 35
CHAPTER FIVE 41
5. Discussions 41
6 .Strengths and limitations of the study 48
6.1 strength of the study 48
6.2 limitation of the study 48
7. Conclusion and recommendations 48
7.1 conclusion 48
7.2. Recommendation 49
Reference 50
7. ANNEX 55
Consent form to study Participants 55
ANNEX –II 56
Part- 1: General Information 56
Part 2- Health commodity supply chain system performance measures 57
Part – 3: In-depth Interview 65

List of Table

Table 1: Background characteristics of the respondents, Addis Ababa, June 2025 21
Table 2: order fill rate for RDF and program medicine of public health centers in Addis Ababa, June 2025. 23
Table 3: Inventory Accuracy of Health Centers in Addis Ababa city, June 2025..... 24
Table 4: wastage rate of public health centers in Addis Ababa city 26
Table 5: tracer drug availability of public health centers in Addis Ababa, Jun 2025..... 28
Table 6: Stock out duration of tracer medicine in public health centers Addis Ababa, Jun 2025 30
Table 7: response on public health centers supply chain performance..... 34

List of Figure

Figure 1: conceptual framework of health supply chain system performance and challenges at public health facilities. Adopted from (EMOH, M&E Framework) 12
Figure 2: Map of Addis Ababa with sub cities Ethio GIS (2022) 13
Figure 3 : Stratified sampling for health centers in Addis Ababa..... 16
Figure 4: forecast accuracy of public health centers in Addis Ababa Jun 2025. 22
Figure 5: Average lead time in days of health centers in Addis Ababa, Jun 2025 25
Figure 6: Availability of tracer medicine in public health centers of Addis A.. baba June 2025.28
Figure 7: % of acceptable storage of health centers in Addis Ababa city, Jun 2025..... 30
Figure 8: stock out of tracer medicines in (days) in public health center in Addis Ababa , Jun 2025 32
Figure 9: The main themes and sub-themes of the thematic analysis..... 36

Abbreviation and acronyms

BC:	Bin Card
DQA:	Data Quality Assessment
EML:	Essential Medicine List
EO:	Emergency Order
EPSA:	Ethiopian pharmaceutical Supply Agency
EPSS:	Ethiopian Pharmaceutical Supply Service
FDA:	Food and Drug Authority
FMOH:	Federal Ministry of Health
FSP:	Forecasting and Supply Planning
HCs:	Health Centers
HCMIS:	Health Commodity Management Information System
HMIS:	Health Management Information System
HSTP:	Health Sector Transformation Plane
IPLS:	Integrated Pharmaceutical Logistics System
KPI:	Key Performance Indicators
LIAT:	Logistic Indicator Assessment Tool
LMIS:	Logistics Management Information System
RDF:	Revolving Drug Fund
RDQAT:	Routin Data Quality Assessment Tool
RRF:	Request and Re-supply Form

SCM:	Supply Chain Management
SDUs:	Service Delivery Units
TD	Tracer Drug Availability
USAID:	United States Aid International Development
WHO:	World Health Organization

CHAPTER ONE

1. INTRODUCTION

This chapter presents the background of the study, problem of statement, objective of study, scope of the study, and significant of the study.

1.1 Background of the Study

Supply chain is a network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate customer. It also defined as a network of facilities and distribution options that performs the functions of procurement of materials, the transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers (USIAD, 2011).Supply Chain Management (SCM) is the strategic process of coordinating businesses within a supply chain to deliver a good or service to the end user in a competitive manner.

Healthcare supply chain management includes the movement of healthcare products and services to satisfy patient needs (Akinyeye, 2024). The degree of involvement of several stakeholders, the underlying unpredictability of the basic process, and the degree of customization of services provided make it a more dynamic and complicated system than the commercial supply chain (Jain *et al.*, 2010).One of the Sustainable Development Goals, the World Health Organization's (WHO) crucial principles, and the universal declaration of human rights is "promoting wellbeing and ensuring health lives for all at all ages" (WHO, 2016).

Health care cannot be provided without quality-assured, safe, and effective essential medications in a sufficient quantity at all times(WHO, 2016) (WHO,2019). In accordance with sustainable development goals, WHO has a framework for improving access to essential medicine that includes rational selection, sustainable finance, dependable health, and a supply of high-quality products (WHO, 2017).

The health supply chain system is essential in ensuring the availability of quality essential medicines and health Supplies.it encompass the planning, coordination and collaboration of staffs for all logistics management activities such as quantification, procurement, inventory management, transportation, data collection, and reporting. Access to quality essential health services and safe, effective, quality and affordable essential medicines and vaccines for all is essential for promoting health (Lugada *et al.*, 2022).

The performance management system comprises procedures that are essential to enhancing the efficacy and efficiency of the supply chain, such as determining metrics and data needs, setting goals, organizing, communicating, measuring, reporting, and providing feedback. Selecting measures carefully is necessary to avoid the system becoming crippled by an excessive amount of data and measures. Additionally, organizational procedures and capacity-building initiatives need to incorporate the metrics' analysis and application (Guide,2019). Performance measurement is the process of quantifying, comparing the efficiency, and effectiveness of action with pre-seated goals by known standards. The efficient functioning of a health supply chain system is crucial for delivering quality health care service and ensuring the availability of medicine and medical supplies (Damtie, Ibrahim and Yikna, 2020).

Majority of Ethiopian health supply chain system is passing through Ethiopian pharmaceutical supply service (EPPSS). It has its own inventory and stock replenishment policy for the respective level of facilities. Hospitals and health centers are order their program pharmaceuticals every two month directly or indirectly from EPSS (Bongasse *et al.*, 2020).

The health care system is severely affected by shortage of basic and lifesaving essential drugs and medical supplies. Majority of the population have no access of even to these essential drugs (USAID, 2011).

A number of stakeholders participate in the healthcare supply chain, which involves the movement of medical supplies. Because it impacts people's lives and involves a wide range of stakeholders, including political bodies, regulatory agencies, and insurance companies, it is an extremely complex process (Kapoor, Rb and Dadarwal, 2018).

The healthcare supply chain is a vital part of an operational health system, and a major factor in attaining the objectives of regional and national health security. Ensuring patients have constant

access to necessary medications is its primary goal. Effective and efficient supply chain management ensures that the necessary medications and services are provided at the right time, in the right quantities, at the right place, and at a reasonable cost (USAID/DELIVER, 2011).

Research on the performance and challenges of health supply chain system at public health facilities contributes to enhancing healthcare accesses, quality, and equity, particularly in resource limited settings. This study aims to investigate the performance of health commodity supply chain at public health facilities using monitoring and evaluation framework indicators for pharmaceutical supply chain prepared by ministry of health. Like forecasting accuracy, supplier fill rate, average lead time, stock out duration, wastage rate, percentage of facilities that maintain acceptable storage conditions, inventory accuracy rate, RRF, essential drugs availability and disposal of unfit for use medicine and address the challenges that hider their effective operation.

1.2 Statement of the Problem

The performance of health commodity supply chains in public health facilities is critical to ensuring the availability and accessibility of essential medicines and medical supplies. Despite the recognition of supply chain management as key component of health systems many public health facilities face significant challenges that hider their effectiveness in Ethiopia (Yadav, 2015). The initiatives implemented in the public health supply chain of the country led to improvements in the pharmaceutical supply chain management system's performance, particularly in EPSS's operations (Lesego *et al.*, 2023).

Public health facilities rely heavily on the timely delivery and availability of products from their primary suppliers to guarantee the quality of patient care; however r, evaluations carried out by various institutions and at various supply chain levels revealed frequent disruptions of necessary medications, which were ascribed to the discontent of patients, healthcare professionals, and the general public. The effectiveness of a health program's supply chain, which is critical to preserving the availability of medications and medical supplies, determines whether the program succeeds or fails. But inefficiencies can arise at any stage of the supply chain, resulting in pharmaceutical stock-outs, excessive expenses, and incomplete access, which can deny patients access to life-saving medications and undermine their faith in the medical system (WHO, 2017) (EPSS,2020).

Pharmaceutical supply chain management is a more comprehensive system that includes coordinated functions for efficient funding, governance, regulation, and logistics. Weaknesses that have been discovered must be fixed in order to achieve optimal system performance, which will provide safe, affordable, and effective pharmaceuticals at service delivery location going forward and achieve a number of desired health outcomes (Rahel and Kena, 2023).

Health facilities frequently encounter challenges in managing inventory effectively due to inadequate tools, training and data driven decision making. This leads to stock out of essential medicine, vaccine and medical supply, resulting in compromised patient care and increased morbidity and mortality. Health facilities face different logistical barriers, such as poor infrastructure, transportation network and lack of sufficient training in supply chain management practice, leading to inefficient handling of medical commodities inadequate staffing levels also contribute to increased workload. These challenges lead to delays in the delivery of medicine, medical supplies and service, affecting patient care and outcomes (Gurmu and Ibrahim, 2017).

Ministry of Health study status and performance of hospitals based on national monitoring and evaluation framework, but study does not cover health centers and never been conducted before while this study covers health centers in Addis Ababa city. Addressing the challenges and enhancing the performance of health supply chain at public health facilities is crucial for improving overall healthcare delivery. The performance of health commodity supply chain directly impacts patient care, treatment outcomes, and overall public health. Addressing these issues is vital to enhancing the resilience of health system, especially in resource- limited settings where the demand for reliable health service is high.

Hence, there is a need to assess the performance of public health facilities in terms of health commodities supply chain and related major challenges using monitoring and evaluation framework measuring tools for pharmaceutical supply chain in order to intervene for improvement.

1.3 Significance of the Study

The finding of this study will have a significant impact on the public health supply chain by informing different stakeholders about the current status of the supply chain performance. The study measured the performance level of health commodities supply chain and identifies the key

challenges that can affect the health supply chain management, and came up with appropriate recommendation that can help solve or minimize problems and challenges.

Moreover, the finding will also have practical benefits like, federal ministry of health, Ethiopian pharmaceutical supply services, sub city health offices health offices; and other nongovernmental organizations will easily identify some areas that need to improve in the process of health supply chain system. Furthermore, the study can also help for scholars and researchers to carry out more research on health supply chain management of the public health facilities.

1.4 Scope of the Study

This study is restricted to only public health centers in Addis Ababa city. The quantitative evaluation was based on national monitoring and evaluation framework only pharmaceutical supply chain indicators were evaluated. Each health facility was asked questions about the performance of health supply chain in their health facilities.

Regarding KPIs, the study focused on selected core KPIs, such as, availability of TD, budget constraints, stock management, transportation limitation, and waste disposal challenges were evaluated.

1.5 Objective

1.5.1General Objective

This study aims to evaluate the health commodity supply chain performance and challenges at public health facilities in Addis Ababa, Ethiopia.

1.5.2 Specific Objective

- To assess the health commodity supply chain performance at public health facilities in Addis Ababa.

- To identify key challenges in the health supply chain of public health facilities.

1.6 Research Question

1. What is the extent of health commodity supply chain performance at public health facilities in Addis Ababa?
2. What are the challenges associated with health supply chain performance of public health facilities in Addis Ababa city?

CHAPTER TWO

2. RELATED LITRATURE REVIEW

2.1 Theoretical Literature Review

2.1.1 Definition of Supply Chain Management.

According to the council of supply chain management professionals (CSCMP); Supply chain management encompasses the planning and management of all activities involved in sourcing and procurement and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies (USAID DELIVER, 2011).

Ensuring pharmaceutical security is the ultimate goal of the health sector supply. Patients must always be given the medications they need. An effective and efficient supply chain is necessary to guarantee pharmaceutical security and, eventually, satisfy consumer demand. By guaranteeing the appropriate products, in the right number, of the right quality, at the right place, at the right time, and at the right cost the , an efficient and successful supply chain satisfies client requests (Guide, 2019).

2.1.2. The Importance of Health Supply Chain

The backbone of healthcare delivery is supply chain management. This is due to the fact that the delivery of high-quality healthcare depends on the availability of medical supplies to patients at the appropriate times and in the appropriate quantities; otherwise, poor healthcare delivery is happen and create customer dissatisfaction (Mathur *et al.*, 2018).

Commodity security is mostly dependent on a well-functioning supply chain system, but it also requires funding, policy, and effort**.** They also aid in determining if a public health program is successful or unsuccessful. Decision-makers are increasingly focusing on supply chain optimization in both the private and governmental sectors since better logistics have significant, tangible benefits. Properly functioning supply chain system benefits public health facilities in

important ways by increasing program impact, enhancing quality of care and, improving cost effectiveness and efficiency (USAID/DELIVER, 2011).

2.1.3 Health Supply Chain Monitoring and Evaluation

Routine monitoring and evaluation of pharmaceutical supply chain enhance efficiency and effectiveness. Having monitoring and evaluation system ensures that the right product is delivered in the right quantity, right condition and at the right time. The M&E framework provides a foundation for performance monitoring and evaluation of the pharmaceutical supply chain, pharmacy service and medical device management of the country. The framework helps to monitor how program activities contributes to the achievement of effectiveness and efficiency of pharmaceutical supply chain management system, availability and quality of pharmacy services and improved medical device availability, utilization and management practices. The framework shows how inputs are reflected in outputs, outcomes, and impact. The framework also addresses indicator domains, data collection and reporting, analysis, interpretation, and dissemination and use. A comprehensive list of core indicators that capture three significant areas of the M&E framework, namely; Pharmaceutical Services, Supply and Medical Equipment Management, were developed (MOH., 2019).

2.2. Empirical literature

2.2.1. Performance of Health Supply Chain System at Health Facilities

According to study on Supply Chain Management Performance of HIV/AIDS commodities and factors affecting it at health facilities of Southern nation and nationalities people of region Ethiopia in under facility based cross sectional study design in 30 health facilities show that unsatisfactory data records, stock outs, interrupted reports, inaccurate inventory (Damtie, Ibrahim and Yikna, 2020).

The assessment of health supply chain system status and performance in Uganda conducted cross sectional study in 128 public and private-not-for-profit health facilities across 48 districts in Uganda. Less than half (42%) of health facilities had computer hardware. Most (84%) of health facilities were using a form of Logistics Management Information System with only (6%) were using the Electronic Logistics Management Information System. Just under a third (33%) of health information officers and (51%) of public health officers' positions were filled in the health facilities. Nearly (66%) of health facilities used supply chain data to support decision making. Most (84%) of health facilities reported stock outs of Essential Medicines and Health Supplies in the past 6 months. The main reasons for stock outs were (59%) a sudden increase in demand (40%) delivery gaps/delayed deliveries and (35%) discrepancies in orders and deliveries. Health facilities responded to stock outs through various means including (75%) redistribution (43%) purchased from a distributor, and (30%) placing emergency orders (Lugada *et al.*, 2022).

Based on supply chain management to improve availability of medicine in Tanzania evolution of performance and cost effects under non experimental pre-post study design compare the updating and new system The upgrades were associated with improvements in data use, accessibility, visibility, and transparency; planning, control, and monitoring; support for quantification; stock-out rates; stock-out duration; commodity expiry; and forecast error. The upgraded system was more costly, but it was also more efficient, particularly when adjusting for the performance improvements (Marquez et al., 2020).

A study conduct on inventory management performance of key essential medicine health facilities in East Shewa Zone, Oromia Region, Ethiopia Health facility based descriptive cross- sectional study on 20 public health facilities shows that mean stock out rate of key essential medicines was

around 27.25% with average stock out duration of 35.31 days. On average around 10.43% of medicines were wasted. Concerning storage condition only 5(25%) of the health facility have full filled good storage condition criteria. Budget constraints, human resource inadequacy, & over supply of near expiry date medicines were identified as major in inventory management challenges (Gurmu and Ibrahim, 2017).

Pharmacy professionals working in the health sector are still in limited supply, according to Ethiopian Pharmaceutical Supply Service's (EPSS) national IPLS review. Although significant efforts were made to train more pharmacy professionals, including pharmacy technicians and pharmacists, 15% of health institutions, including all health centers, lacked pharmaceutical professionals on staff. There are still gaps in IPLS and commodities management training despite high investments in pre-service, in-service, and most recently online training for a number of reasons (worker turnover, service expansion). On their pharmacy units, over 24% of hospitals and health centers lacked IPLS-trained personnel, with in-service training continuing to be the most popular training method (96%) (EPSA, 2020).

Study conducted in Mekelle Ethiopia showed 30.73% of essential medicine and tracers had stock out with an average stock out duration 54.38 days, the rates of wastage was 2.69%,acceptable storage condition was 46.67%, and average lead time was one month (Solomon, 2023).Another study conducted in South Gondar Ethiopia, The study found that the average inventory accuracy rate in the study area was 71.33 percent ±9.63, and the average rate of waste of specific health commodities was 1.59 percent ±1.25 in 2019/2020 and 1.78 percent ±1.33 in 2020/2021 (Tessema, 2023).

Facility-based descriptive study cross-sectional quantitative study conducted in public health facilities of West wollega Zone, Oromia Region, Ethiopia shows the average number of medications available was (61.30%), and the average stock-out period was 70.71 days. For 559 (78.40%) of the medications, bin cards were available, and 374 (52.45%) of these were accurate. Out of the 116 (84.06%) report submissions, 47 (40.52%) were submitted on time, 73 (62.93%) were complete, and 69 (59.58%) were correct. Inventory management issues were found to be related to suppliers, human resource shortages, administrative issues, and computer system deficiencies (Kebede and Tilahun, 2021). A mixed study conducted in public health facilities South

West shewa Ethiopia hospitals and health centers had inventory accuracy rates of 76% and 72.5%, respectively, for important critical medications. The overall mean stock out of the 25 critical medications that were evaluated was 24.99%. 93.3% of bin cards were updated on average. Only three of the study's medical facilities satisfied the acceptable storage requirements, and the facilities' reporting rate was found to be 88.8%. Stock outs were caused by a lack of supply at Ethiopian pharmaceutical supply agencies and on the market, as well as by a lack of skilled human resources, poor communication, and inconsistent budgets (Gutasa, 2022)A cross-sectional survey Gamo Zone SNNPR Ethiopia shows TMs' performance in inventory management across PHCUs falls short of expectations. According to the plan, the average stock is 18%, the stock-out rate is 43%, the inventory accuracy rate is 78.5%, and 78% of PHCUs are available. 72.3% of PHCUs that are visited meet the requirements for storage conditions. Performance in inventory management declines when PHCU levels rise (Alemu, Fenta and Gebregeorgise, 2023).

Both quantitative and qualitative study on analysis of pharmaceutical supply chain performance at public health facilities in Addis Ababa, Ethiopia shows stock out of 25 tracer drugs were 52% ,average wastage rate were 5.62%,and order fill rate for program and non-program products were 74.65 and 62.5% respectively, and the average lead time was 60 days (Tessema, 2018).A national baseline assessment on pharmacy services, pharmaceutical supply chain performance and medical equipment management in public hospitals shows report and requisition form(RRF) reporting rate hospitals in Addis Ababa was 94.3%,forecasting accuracy 46.9%,order fill rate for program and RDF products were 50.8% and 62.7% respectively, average lead time was 20.6 days, inventory accuracy rate was 70%,taracer drug availability was 94%,stock out duration 37.3 days, and meeting acceptable storage condition 87.2% (Survey, 2020).

2.3 Conceptual Framework of the study

External challenges

- Transport problem
- Budget shortage
- Work load

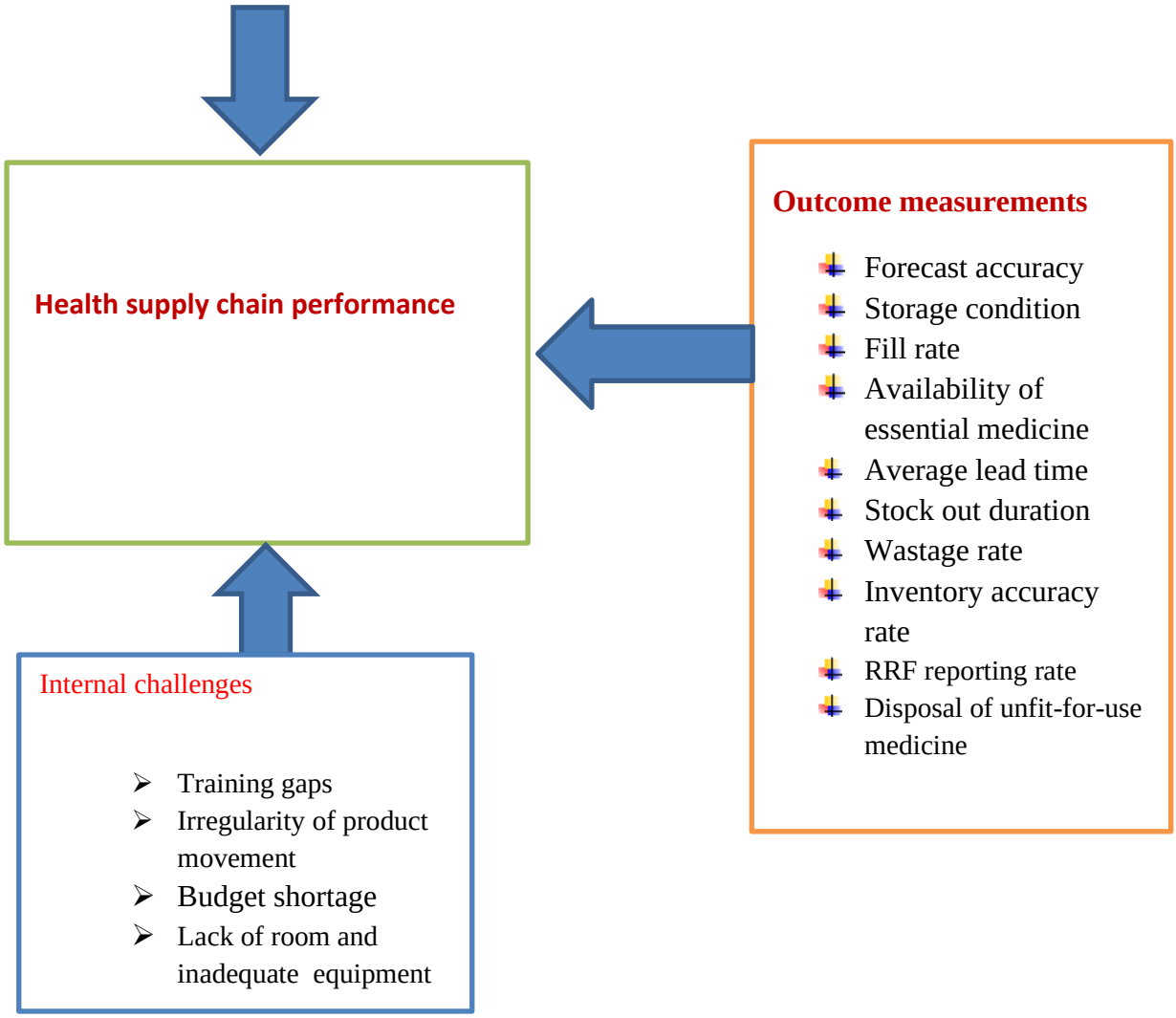

Figure 1: Conceptual Framework of health supply chain system performance and challenges at public health facilities. Adopted from (EMOH, M&E Framework)

CHAPTER THREE

3. METHODS OF THE STUDY

3.1. Description of study area

The study was conducted at selected public health facilities found in Addis Ababa city administrative. Ethiopia's capital, Addis Ababa, is home to 3,854,863 million people and has a total area of 540 km ^2. It is divided into eleven sub-cities with 124 woreda administratively. There are 102 HCs 6 regional hospitals and 7 federal hospitals. The public health center in Addis Ababa was the study's sites.

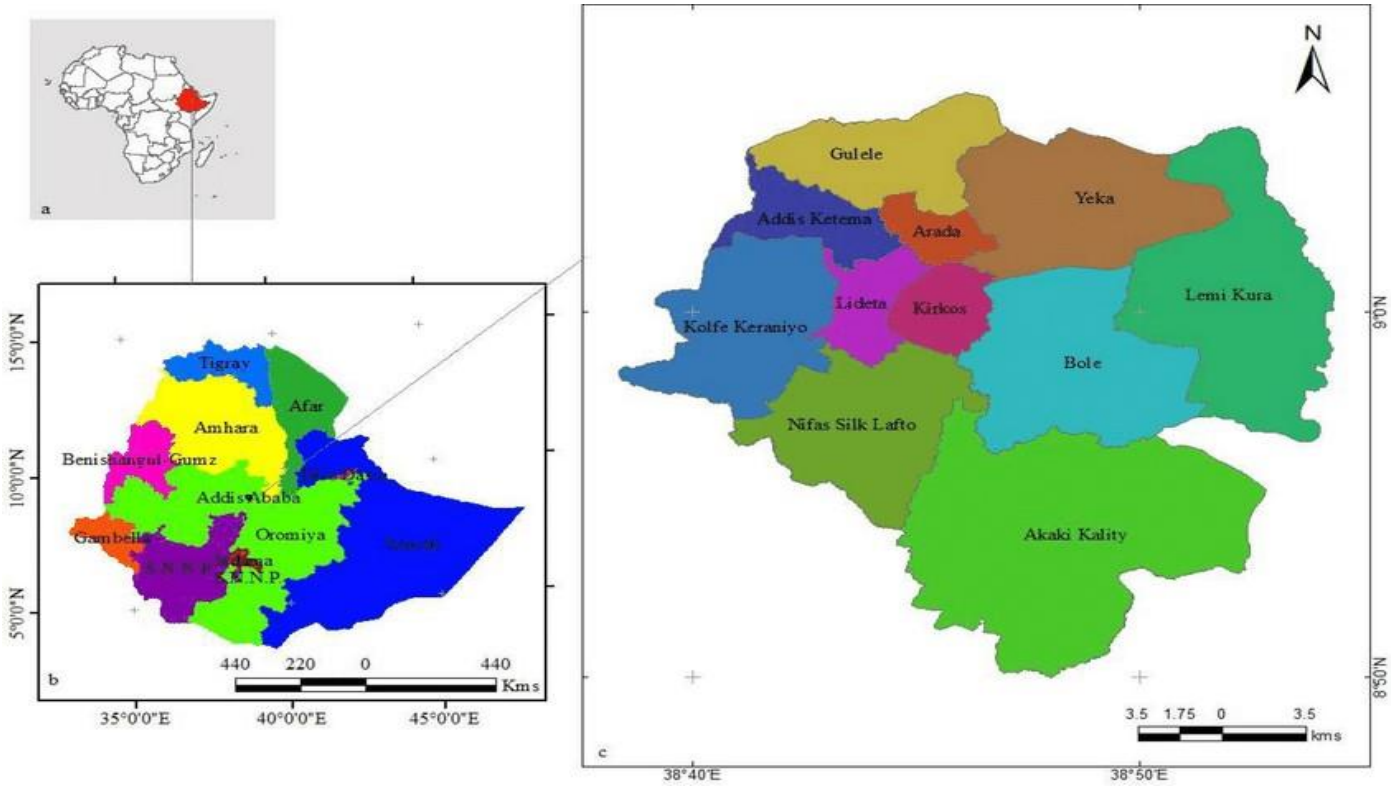

Figure 2: Map of Addis Ababa with sub cities Ethio GIS (2022)

3.2. Study Design

A facility based cross sectional an explanatory sequential mixed study design was conducted from April to May 2024 in public health facilities of Addis Ababa Ethiopia. The performance in relation to health supply chain was described and challenges of supply chain were explored.

3.3 Research Approach

3.3.1 Quantitative Approach

The quantitative data was collected using researcher administered semi-structured questionnaire. In addition, document review and observation were conducted using a checklist.

3.3.2 Qualitative Approach

Descriptive qualitative approach was used for this study. The qualitative data was collect using in-depth key informant interview method with, health center pharmacy store managers, Addis Ababa health bureau supply chain management officers, and EPSS managers.

3.4. Population

All public health facilities found in Addis Ababa city were a source of population while, the study populations were sampled public health centers providing healthcare services in Addis Ababa city, Addis Ababa health bureau managers, EPSS head office, and selected health professionals working in the sampled institutions.

3.5 Study Variables

Dependent variable

- Forecast accuracy
- Forecast accuracy
- Fill rate
- Availability of essential medicine
- Average lead time
- Stock out duration

- ❖ Wastage rate
- ❖ Inventory accuracy rate
- ❖ RRF reporting rate
- ❖ Disposal of unfit-for-use medicine

Independent variables

- ✓ Transport problem
- ✓ Budget shortage
- ✓ Work load
- ✓ Training gaps
- ✓ Irregularity of product movement
- ✓ Lack of room and inadequate equipment

3.6. Inclusion and Exclusion criteria

Inclusion:

- ✓ All public health centers public in 11 sub city in Addis Ababa.
- ✓ Health professionals' pharmacy head, drug supply managers, and store managers, Addis Ababa health bureau logistics officer, sub city officers, and EPSS logistics officers were include in the study for interview.

Exclusion:

- Public hospitals and private healthcare providers

3.7. Sampling Procedure and Sample size Determination

Stratified sampling was employed .Based on the level of the service, study site or population was divided into different groups including sub city health administration, health centers, and health office department. These groups were linked to each other through standard reporting system. Target study site from each group was determined proportionally and selected using lottery method. Then considering their active involvement in the monitoring and evaluation framework implementation, study participant from individual study site was selected purposively. So ,including Addis Ababa health bureau logistics officer, health center service delivery unit heads

including store manager, drug supply manager pharmacy heads, and EPSS officers, and 25 tracer medicines to be available at all service point based on Addis Ababa health bureau prioritized list were participated in the study the logistics indicator assessment tool (LIAT),which was prepared by USAID Deliver project, was used to determine the sample size of the health centers. The guideline is used collect quantitative data. The guideline is used to collect quantitative data related to the performance of health commodities and their availability at healthcare delivery institutions. Accordingly, the guidelines recommend having a minimum of 15% of the total health facilities under the study area to increase generalizability. The total public health center in Addis Ababa city was 102. Hence, 15% plus 5% non-responsive was consider, a sample size of 17. To ensure each level of health facility was adequately represented within the whole sample population of the study, health facilities were stratified into sub city and health centers. Then, using a stratified random sampling technique proportionate to size technique 17 health centers were selected and include in the study then by using lottery method select health centers from each sub city supplied with EPSS hubs.

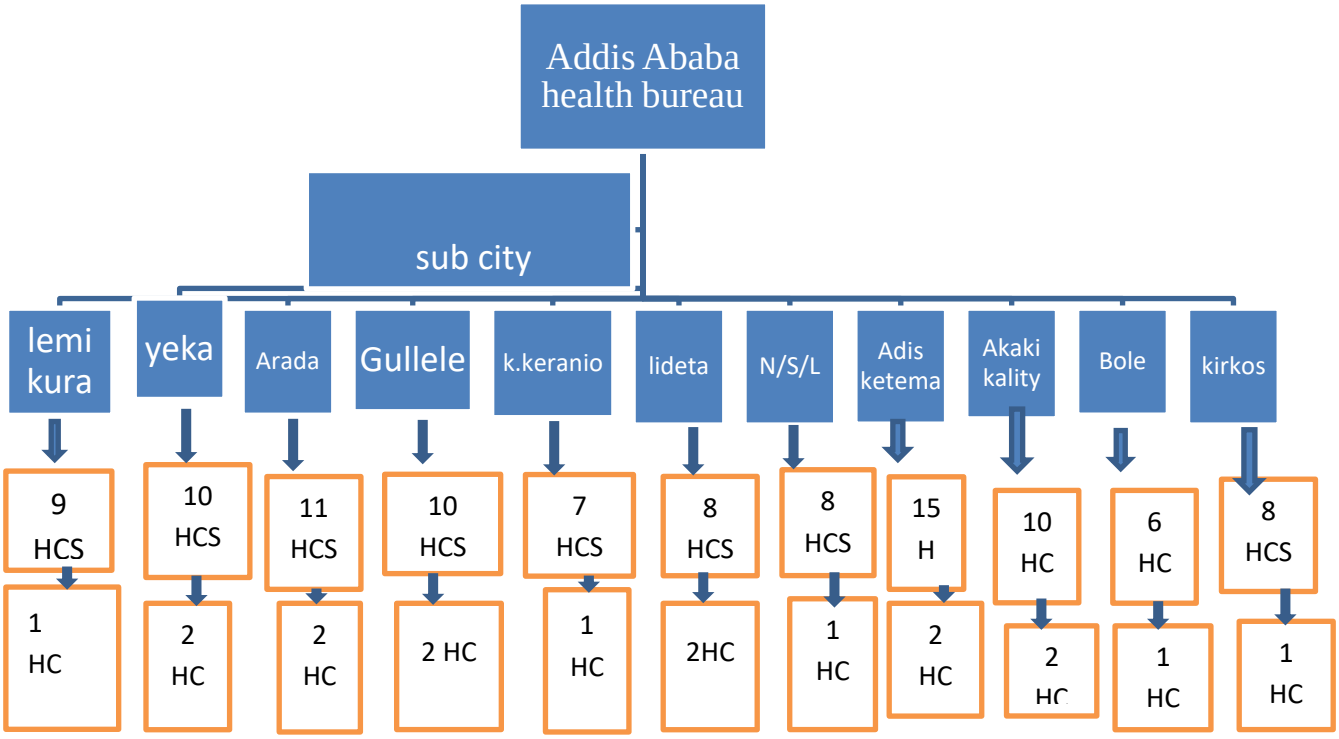

Figure 3 : Stratified sampling for health centers in Addis Ababa.

Key informants were recruited from pharmacy head, drug supply manager, store man, Addis Ababa health bureau logistics officer, sub city logistics officer, and EPSS's side to maximize the range of variation on the subject of the study and data was collected by principal investigator to maintain consistency though the interviews. The participants of the KI were selected based on their potion of information accordingly,4 sore man/store kipper, 6 drug supply manager,7 pharmacy head, 1 sub city logistic officer,1 Addis Ababa health bureau logistics officer, and 2 EPSS logistics officer were included. The key informants identify different types of problems, and the finding was thematically analyzed by categorizing based on the themes data

3.6. Data Source and Type

Primary data source were bin card, for inventory accuracy rate and percent of experience stock and RRF for percent of health centers that report on and lead time, pharmacy heads, drug supply managers, store managers, Addis Ababa health bureau logistics officer, sub city logistics officers, and EPSS logistics officers. The secondary data sources were SOP, manual, books, and different logistics documents from different organizations.

3.7. Data collecting Instruments

The data was gathered using Standardized and semi-structured questionnaire Adopted from national pharmacy service, pharmaceutical supply chain and medical device management monitoring and evaluation framework and together with an interview guiding checklist to be prepared based on literature and the national monitoring and evaluation framework. The process of customizing the tool considered some unique activities related with logistics data recording, reporting and management at each level of the system. Health centers were considered as service delivery points from which pharmaceutical logistics data originate and reported vertically to EPSS hub. Recording and reporting documents were observed using self-prepared check list. The qualitative data was gathered using semi-structured questionnaires for key informants.

3.8. Data Quality Assurance

Before the collection three pharmacists were trained for 2 days on data collection instruments and techniques. Data collectors were recruited from outside the health facilities included in the study to avoid bias. Besides, a pre-test was done on Dilfre health center and Kassanchis health center that were not included in the main study. The principal investigator supervised the data collection process, and any discrepancy was promptly resolved.

3.9. Methods of Data processing and analysis

The quantitative data from the questioner were analyzed by using the Excel spreadsheet and statistical package for social science (SPSS) version 25. The results were then presented using graphs, tables, and texts. Further detail response was requested during in-depth interview data collection time. Thematic content analysis was used to analysis the qualitative data. Themes were identified based on the research questions and analyzed by manually then results were presented in the form of narrative.

3.10. Ethical Consideration

Ethical approval was obtained from School of Pharmacy Ethical Review Committee, Addis Ababa University and ethical committee of Addis Ababa city administration Health Bureau. The study was conducted in each selected health centers after obtaining permission from the relevant bodies the respected health centers. All the study participants were informed verbally about the purpose and benefit of the study along with their right to refuse. Information was collected after obtaining verbal consent from each participant. Data was analyzed in aggregate and individual identifiers was not be used in the data analysis.

3.11 Operational Definition

Pharmaceuticals: are medical supplies, medical equipment, medicines, and laboratory reagents.

Public health facilities: are health owned by government.

Supply chain performance: is the entire chains ability to meet end customer though planning and management of all activities related to material, information, financial flow, and co-ordination and collaboration with supply chain members.

Forecasting accuracy: is the percentage difference between forecast previously made for specified period of time and the actual consumption or issues data for the period greater than or equal to 75% are considered to be high.

Order fill rate: is the percentage of all items ordered by health facility from distribution source (EPSS or other private supplier)over a period that filled correctly in terms of quantity requested those items. Number of line items delivered at least 80%

Average lead time: is the average amount of time between facilities place order to supplier and when the products are delivered to the facility. Suppliers should be resupply products within 20 days

Stock out duration: the number of days in which the tracer drug was not available in a specified period of time. Tracer drugs should be always available

Wastage rate: is the percentage of stock of products, in value, that are unusable because of expiration or damage during a period to the total value of the products received during the same period plus the quantity of the products found during the beginning of the period. The target wastage rate is less than 2 %

Percentage of facilities that maintain acceptable storage condition: is measure the percentage of facilities that meet acceptable storage condition. Storage facilities are expected to meet at least 80% of the requirements according to standard check list.

Inventory accuracy rate: is measure the accuracy of stock balances recorded in stock keeping records (bin card, electronic) versus physical count over a range of items as a percentage of stock balances reviewed for accuracy. Accuracy rate above and equal to 80% indicates good inventory practice.

RRF reporting rate: is the proportion of report and requisition forms (RRFs) submitted to on time until 10^{th} day of the following month.

Essential drugs availability: is the percentage of tracer drugs available throughout the month averaged over all tracer drugs under the review in the month. Essential drugs should be always available

Disposal of unfits –for-use medicines: is the percentage of healthy facilities that have disposed unfit-for-use medicines a least once in the past 12 months.

CHAPTER FOUR

4. Findings

4.1 Characteristics of health facilities and respondents

From A total of 38 staffs the majority of them were male (71.1%) and in the age group of 20-30 years (58.8%) and (41.2%) of them had 5-10years of total work experience. On the other hand from the total of pharmacy head (29.4%), supply manager 52.9%, and store manager (17.7%) on the perspective of position of work. In terms of qualification, majority of the respondents were pharmacist (82.4%).

Table 1: Background characteristics of the respondents, Addis Ababa, June 2025

Variable		Frequency	Percent
Gender	Male	27	71.1%
	Female	9	28.9%
Age	20-25	5	29.4%
	26-30	5	29.4%
	31-35	4	23.5%
	36-40	2	11.8%
	>40	1	5.9%
Position	Pharmacy head	5	29.4%
	Supply manager	9	52.9%
	Store manager	3	17.7%
Work experience	<5yrs	5	29.4%
	5-10yrs	7	41.2%
	>10yrs	5	29.4%
Level of education	Pharmacist	14	82.4%
	Druggist	3	17.6%

4.2 Forecasting Accuracy

The average forecast accuracy of health centers was found to be 62.35% ±7.34 % (min=50 % and max=73%). None of the health centers reached the desired level of forecast accuracy (i.e.75%). The forecast accuracy was found to be higher in Semit health center (73%), and lower in Akaki health center, 50% (Figure 4).

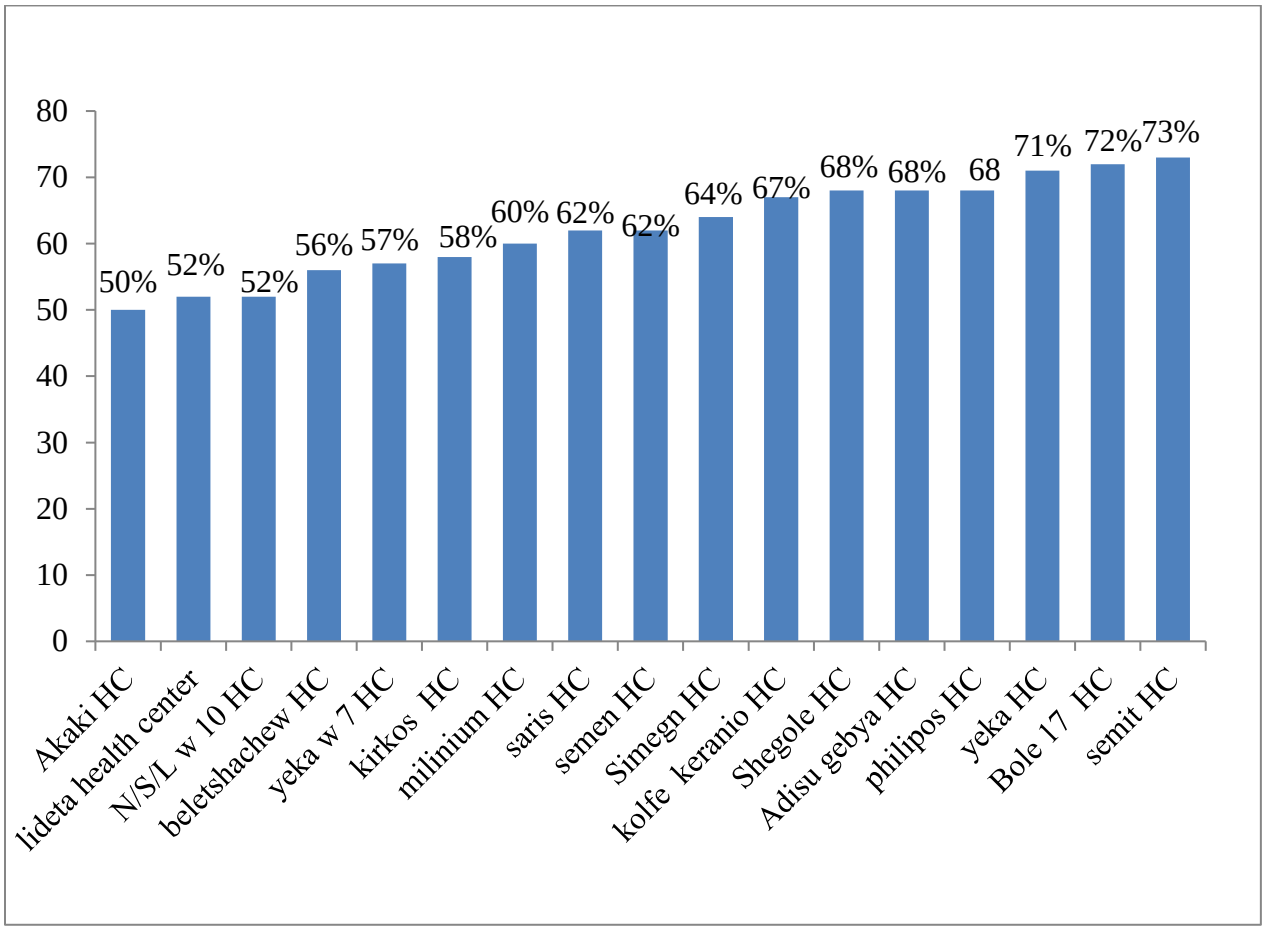

Figure 4: forecast accuracy of public health centers in Addis Ababa Jun 2025.

4.3 Order Fill Rate

The average order fill rate of health centers were 67.5 %. On average 56% ± 15.5% (min=22%, max=73%) and 79% ± 12.8 % (min=48%, max=95%) medicines per health centers were considered to determine order fill rate for RDF and program medicine respectively. The fill rate for program medicine (79%) was higher than the fill rate for RDF medicine 56%). Despite the government plans to ensures fill rate at least 80% of the requested products , all of the health

centers were not achieved this standard .In most of the health centers the fill rate for RDF medicine was lower than program medicine. A Table 2 was sowed order fill rate for both program medicine and RDF medicine.

Table 2: order fill rate for RDF and program medicine of public health centers in Addis Ababa, June 2025.

Name of Health Facilities	Order Fill Rate for Program %	Order Fill Rate for RDF %
Minilium HC	69	61
Philipos HC	57	54
Akaki HC	67	57
Saris HC	81	73
Simegn HC	87	50
Semen HC	85	45
BOLE 17 HC	85	62
Aidsu gebeya HC	95	65
Shegole HC	67	30
Kirkos HC	87	68
Kolfe keranio HC	90	31
Semit HC	89	67
Lideta HC	48	22
Beletshachew HC	81	60
N/S/L W 10 HC	82	67
Yeka HC	85	73
Yeka w 7HC	87	66
Average	79	56

Abbreviation: HC-Health center, RDF-Revolving Drug Fund,

4.4 Inventory Accuracy Rate

Storing medicines in a dispensary is insufficient without regular inventory accuracy checks by public health facilities, which are essential for informed decision-making and the effective utilization of limited resources. This indicator the accuracy of logistics data as the percentage of

discrepancy between physical count electronic and bin card stock records. The calculation is performed for randomly selected 10 tracer products. The average inventory accuracy rate of health centers were 90% ± 8.6% (min =80%, max =100%).

All health centers in this study were achieved 100% inventory accuracy rate the baseline is ≥ 80%.they had an accuracy rate ≥80%.

Table 3: Inventory Accuracy of Health Centers in Addis Ababa city, June 2025

Name of health facilities	Inventory accuracy rate %
Milinium HC	80
Philipos HC	100
Akaki kaliti HC	80
Saris HC	100
Semen HC	80
Simegn HC	90
Bole 17 HC	90
A.gebeya HC	100
Shegole HC	100
Kirkos HC	90
Kolfe keranio HC	80
Semit HC	90
Lidta HC	80
Beletshachew HC	90
N/S/L w 10 HC	100
Yeka HC	80
Yeka w 7 HC	100

4.5 RRF Reporting Rate

Health facilities are linked to suppliers in a public health supply chain through information, financial, and product flows. One of the logistic reports that transfer information from a medical

institution to a supplier for a variety of decisions, such as prompt product refills, is the Report and Requisition Form (RRF). This indicator provides overall measures of whether timely reports and requests are sent to EPSS. All health facilities are expected to send RRF report every two months until 10th day of the following month. Of the 17 health centers included in survey all reported their consumption and future demand to EPSS timely. They had achieved 100% RRF reporting rate which is more than National Pharmacy Service, Pharmaceuticals Supply Chain and Medical Device Management Monitoring and Evaluation Framework standards ≥ 80 %.

4.6 Average lead time

A lead time average exceeding 20 days is considered as delay. As shown in figure 5, average, lead time of health centers were 19 ± 5.2 days (min=12, max=27) days to receive products from EPSS. The average lead time varied across health centers. Beletshachew health center waited for 12 days to receive their order which is the shortest duration while the longest one was in Yeka woreda 7 health center 27 days.

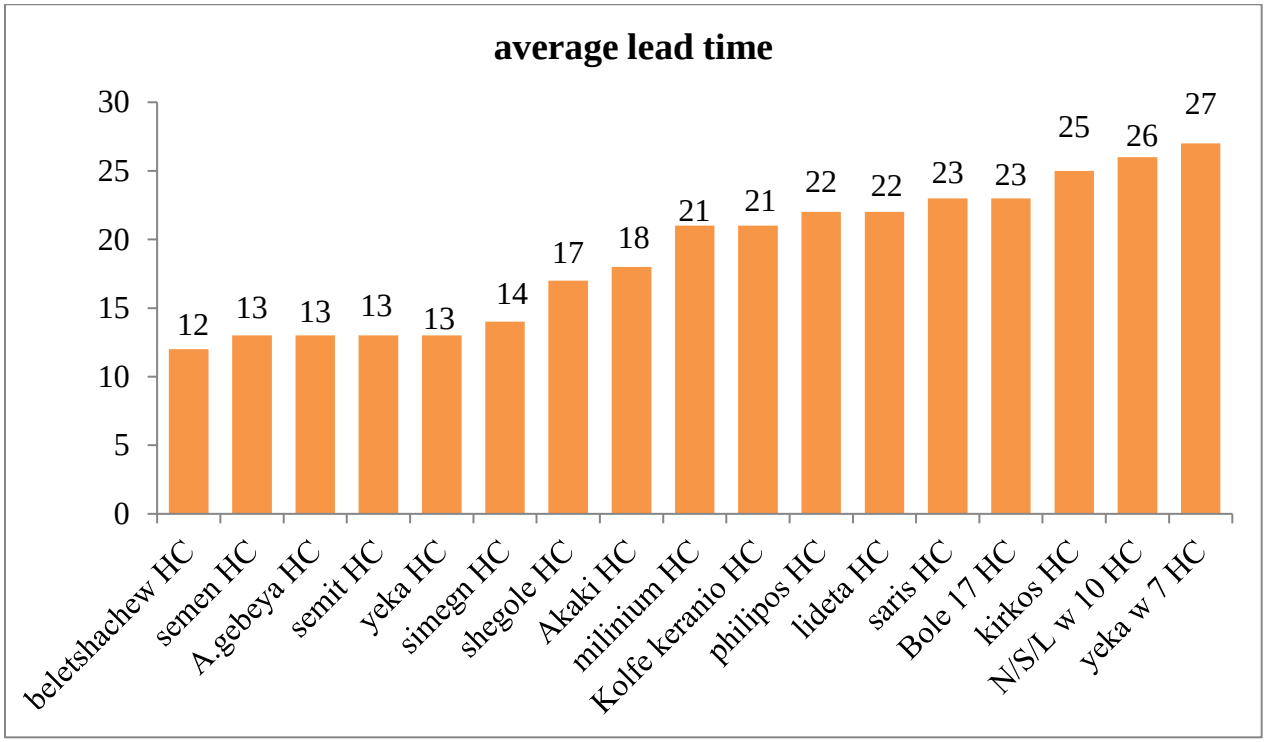

Figure 5: Average lead time in days of health centers in Addis Ababa, Jun 2025

4.7 Average wastage rate

The percentage of the stock of products in value that are unusable because of expiration or damage during a period to the total value of the products received during the same period plus the quantity of the products found during the beginning of the period in monetary value .Average wastage rate of the health centers were 1.24 ± 0.71(min=0.5, max=3.3). Medicine wastage might be unavoidable; it should be kept low. Averagely 1.74% and 0.67% for program and RDF medicines respectively were wasted from the total medicines. Medicine that were provided for patients freely under different program were found to be commonly wasted medicines when compared to RDF medicines and more expiry medicines were registered under program medicine than RDF the difference was showed in Table 4.

Table 4: wastage rate of public health centers in Addis Ababa city

S.N	Name of health facilities	RDF products wastage .rate %	Program products wastage rate%	Average wastage rate %
1	Milinium HC	0.44	1.05	0.6
2	Philipos HC	1	1.46	1.3
3	Kality HC	1.14	1.9	1.6
4	Saris HC	0.19	4	0.6
5	Simegn HC	0.28	0.6	0.7
6	Semen HC	0.41	0.9	1.5
7	Bole 17 HC	0.82	1.6	2.3
8	A.gebeya HC	1.6	2.4	1.3
9	Shegole HC	0.38	2.07	1.1
10	Kirkos HC	0.58	2.6	1.4
11	Kolfe HC	0.64	1.96	1.2
12	Semit HC	1.7	3.4	3.3

13	Lideta HC	0.14	1.28	0.5
14	Beletshachew HC	0.44	1.16	0.8
15	N/S/L W10 HC	0.75	1.7	1.4
16	Yeka HC	0.92	1.09	1
17	Yeka HC	0.42	0.44	0.5

4.8 Tracer drug availability

Availability of 25 tracer medicine was checked in 17 health facilities. Averagely 89.18 ± 3.94(min =80, max=96) tracer drugs were available in the health centers. As figure 6 shows, Adrenaline, TDF/3TC/EV, and RHZE/RH were the three most available (100%) medicines. Contrary to these, Artesunate injection (11%) and dextrose in normal saline (47%) were the least available medicines.

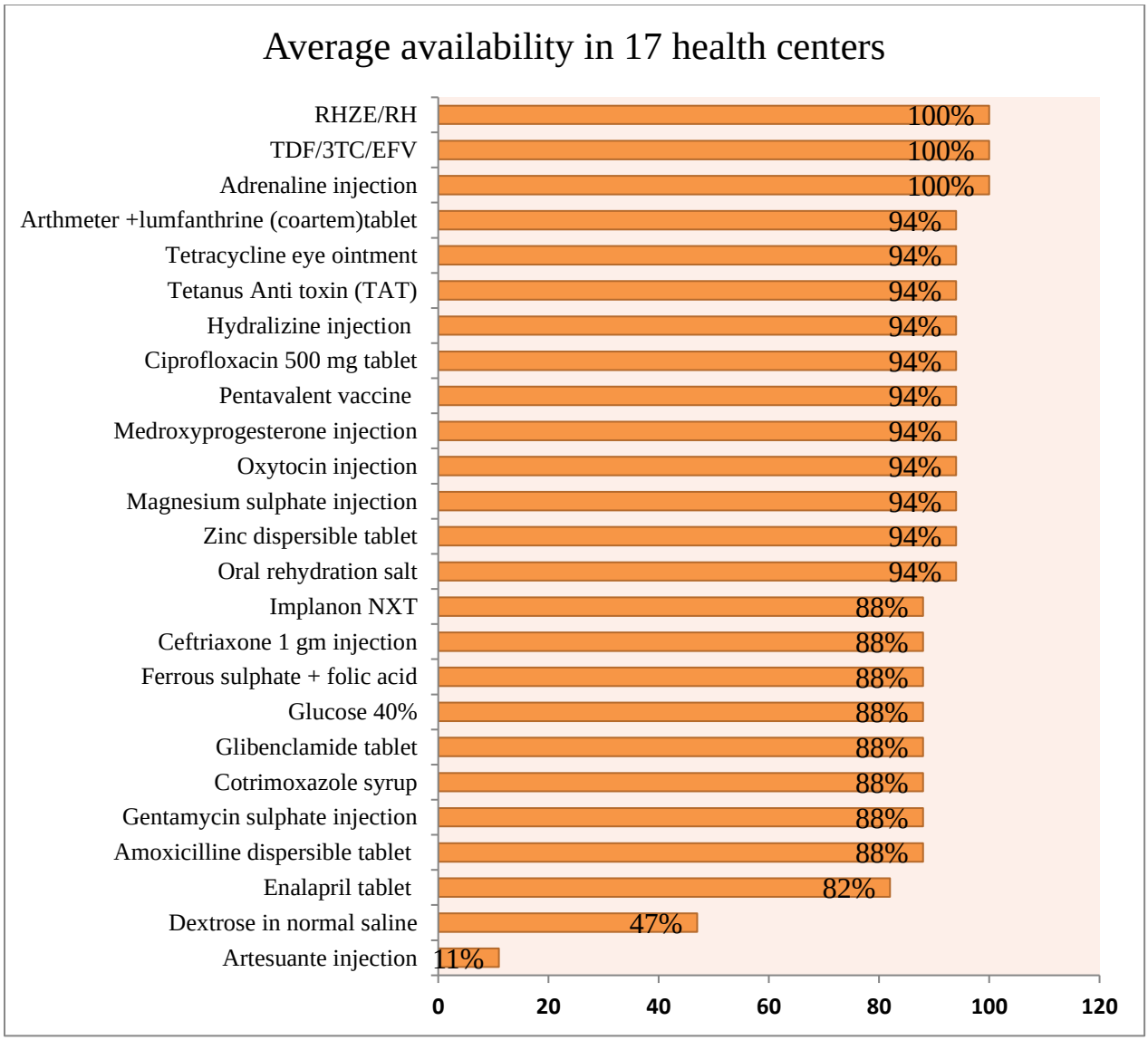

Figure 6: Availability of tracer medicine in public health centers of Addis A baba June 2025.

Table 5 indicates availability of tracer medicines of public health centers in Addis Ababa city from these the most available medicine was registered in Beletshachew health center(96%). while ,the least was in Nifas silk woreda 10 health center.

Table 5: tracer drug availability of public health centers in Addis Ababa, Jun 2025

Name of Health Facilities	**Tracer drug availability %**
Milinium HC	88
Philipos HC	92

Kality HC	88
Saris HC	88
Simegn HC	92
Semen HC	84
Bole 17 HC	88
A.gebeya HC	88
Shegole HC	92
Kirkos HC	84
Kolfe keranioa HC	88
Semit HC	92
lideta HC	92
Beletishachew HC	96
N/S/L HC	80
Yeka HC	92
Yeka w 7 HC	92

4. 9: Good storage practice

Medicine handling and storage in the supply chain involves a number of individuals and actors, making it vulnerable to a number of dangers. Therefore, to reduce these hazards, it is crucial to ensure proper storage practices. Thirteen criteria were set by PMED/FMOH to measure adequacy of medicines storage conditions. A storage condition is considered to be “adequate” if 80% of the criteria are met. Accordingly, out of the 17 health centers where data related to these specific indicators were collected (47%) had acceptable storage condition, while (53%) hadn’t meet at least 80% of the requirements according to standard checklist. Some of the requirements that most health centers failed to meet were: adequacy storage condition, product arrangement, and having dry, well nit and well-ventilated (Figure 7).

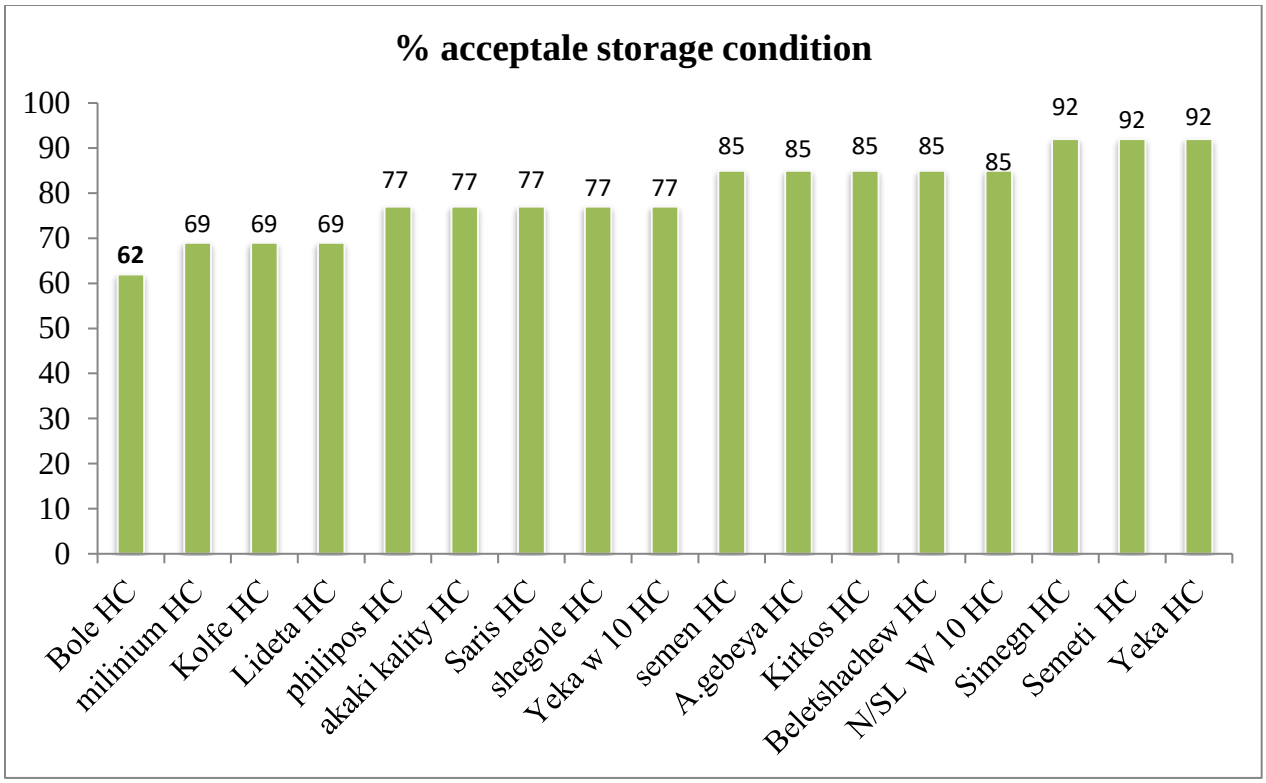

Figure 7: % of acceptable storage of health centers in Addis Ababa city, Jun 2025

4.10 Tracer drugs stock out duration

Availability of tracer medicine was retrospectively assessed using stock card of the health centers as a source of data covering the period of one year. The average stock out duration of the health centers were 25.3 days ± 16.1 days (min=2.4, max =60.8) .The longest stock out duration was recorded in philipos health center (60.8 days), while the shortest was in Bole 17 health center (2.4 days) table 6 shows the average stock out of tracer medicine.

Table 6: Stock out duration of tracer medicine in public health centers Addis Ababa, Jun 2025

Name of Health Centers	Average Sock out Duration of Tracer Drugs
Milinium HC	15.8
Philipos HC	60.8
Akaki Kality HC	18.2
Saris HC	22.6

Simegn HC	15.2
Semen HC	32.6
Bole 17 HC	2.4
Adisu gebeya HC	30
Shegole HC	29.2
Kirkos HC	18.6
Kolfe HC	16.4
Semit HC	15.8
lideta HC	37.6
Beletshachew HC	57.4
N/S/L W 10 HC	35.6
Yeka HC	3.6
Yeka w 7	18.4

Of the 25 tracer medicines Artesuanate injection was not available for 279.1 days followed by dextrose in normal saline for (144.4 days) in contrast, Adrenaline, TDF/3TC/EV, and RHZE/RH were available throughout the year. (Figure 8)

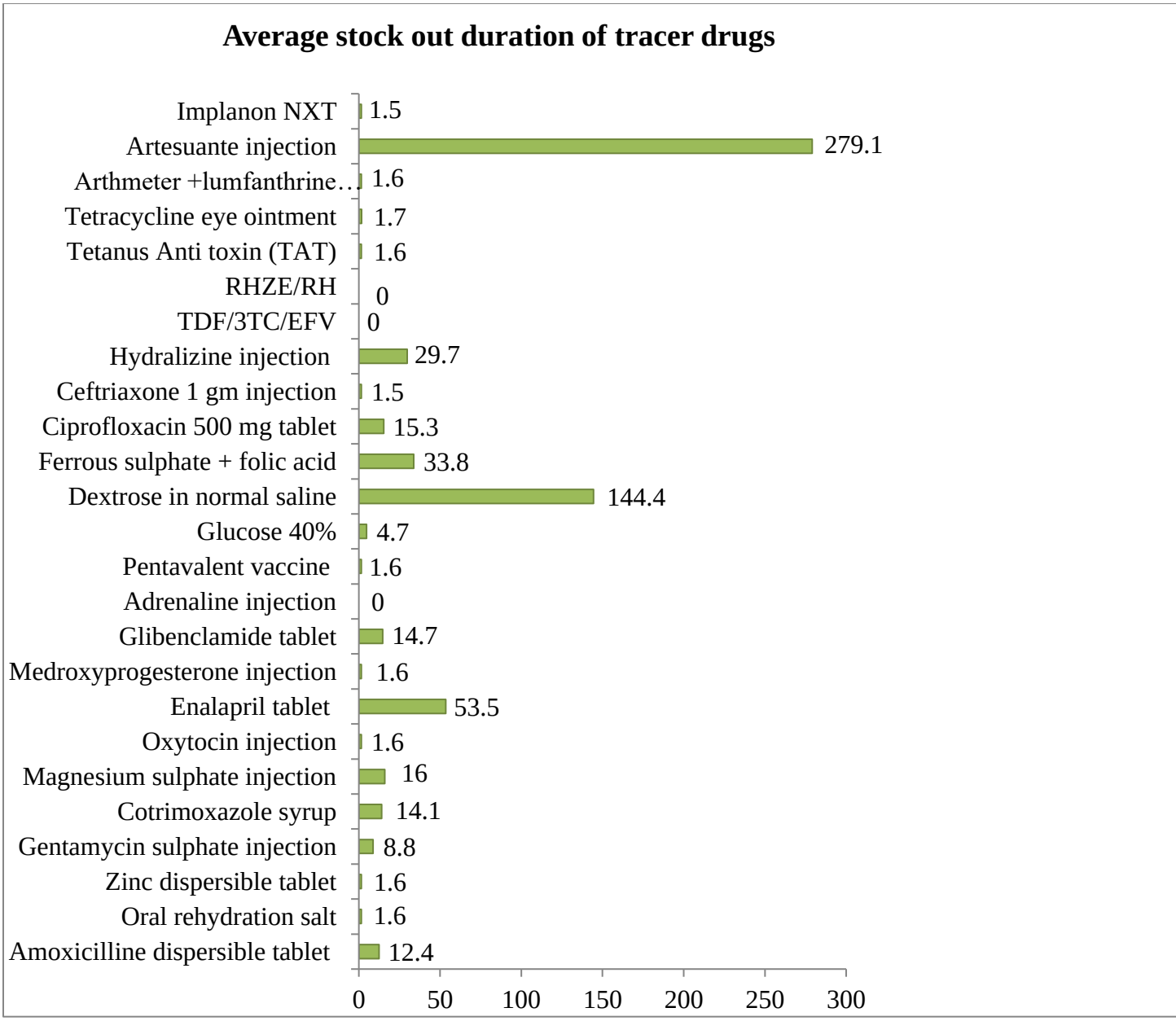

Figure 8: stock out of tracer medicines in (days) in public health center in Addis Ababa , Jun 2025

4.11 Disposal of unfit for use medicines

Disposal of unfit for use medicine is Percentage of health facilities that have disposed unfit-for-use medicines at least once in the past 12 months. It includes expired or damaged pharmaceuticals with quality problems. 71% health centers reported the presence of unfit-for-use medicines and

they were not disposed their unusable products. Only 29% of them were disposed their unfit-for-use medicines at least in the past 12 months.

4.12 Factors contributing to the effectiveness and efficiency of health supply chain in public health centers

Both qualitative and quantitative approach were used to explore factors contribute the effectiveness and efficiency of health supply chain performance in surveyed health centers. In this regards, key informant interviews, and self-administered quaternaries were used to obtain the data.

4.12.1 Supply chain performance determinant

38 respondents were filed out the questioner from that 71.1% were male. To further explore the perceived challenges of health supply chain self-administers questioners were distributed professionals working in the health centers who are directly or indirectly involved in the management of pharmaceutical commodities.

Items determinants	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean	+/- SD
Assign coordinator for supply chain activities attribute to effectiveness of supply chain system	0	0	0	7 (41.2)	10 (58.8)	3.59	0.507
Poor infrastructure (transportation, store premises, recording tools, internet, computer and electric power) attribute for workload and delay in delivery of products.	0	0	0	8 (47.1)	9 (52.9)	3.53	0.514
Irregularity of product movement attribute to sock out of medication.	0	0	0	7 41.2)	10 (58.8)	3.47	0.624

Absence of separate and enough budget allocation for pharmaceuticals attribute to ineffective procurement process	0	0	0	13 (76.5)	4 (23.5)	3.24	0.437
Inadequate tools, training gap and weak decision making attribute to stock out of medicines	0	8 (47.1)	0	7 (41.2)	2 (11.8)	2.18	1.185
Lack of quality data attribute for poor forecasting exercises.	0	0	0	15 (88.2)	2 (11.8)	3.12	0.332
Inadequate refrigerator and monitoring system attribute for poor cold chain system	0	7 (41.2)	0	10 (58.8)	0	2.06	0.889
Insufficient accesses of reliable information and communication technology attribute for poor data collection ,reporting and communication system in health facility	0	0	0	14 (82.4)	3 (17.6)	3.18	0.393
Absence of stock transfer system in the healthcare attribute to shortage of medicines and medical supplies	0	7 (41.2)	0	10 (58.8)	0	2.12	0.993
Enhancing the performance of health supply chain system attribute for improving overall healthcare delivery	0	0	0	0	17 (100)	4	0.0

Table 7: response on public health centers supply chain performance

Note: SD =strongly disagree, D = disagree, N = neutral, A = agree, SA = strongly agree

Decision, weighted average = 2.73

The likert scale data analysis shows that the majority of the respondents appeared to feel that assign coordinator for supply chain activities is increase effectiveness of supply chain system. Also, they felt that poor infrastructure (transportation, store premises, recording tools, computers, and electronic power) had the cause of workload and delay in delivery of products. They perceived

that irregularity of product movement was exposed the health facilities for stock out of medication and medical supply, and they also assumed that absence of separate and enough budget allocation for pharmaceuticals and medical supply were exposed for ineffective procurement process. They were highly perceived lack of quality data was the main factors for forecasting exercise. They also assumed that insufficient access of reliable information and communication technology were the factor of poor data collection, reporting, and communication system in health centers and they highly perceived that enhancing the performance of health supply chain system was improved the overall healthcare delivery. In contrast, they felt inadequate tools, training gap, and weak decision making were low influence for stock out of medication .in addition to this they perceived that refrigerator and monitoring system had little effect for poor cold chain system in their health facilities. They also assumed that absence of stock transfer system in their health facility was not factor for shortage of medicine and medical supplies.

4.12.2 Key informant interviews

The qualitative data was collected by a key informant interview of key informants. These interviews were held with health center 17(80.9%) from those supply chain manager (6,) store man (4), and pharmacy head (7), logistic officers in Addis Ababa health bureau 2(9.5%), and warehouse and distribution manager from EPSS 2(9.5%). Close to sixty nine percent of the key informants were males with a mean age of 32.68 ± 4.7 years and with mean years of professional experience 7.74 ± 3.26.

The findings from key informant interviews are structured into six as perceived challenges for the performance of health supply chain and strategy for improving performance of health supply chain.

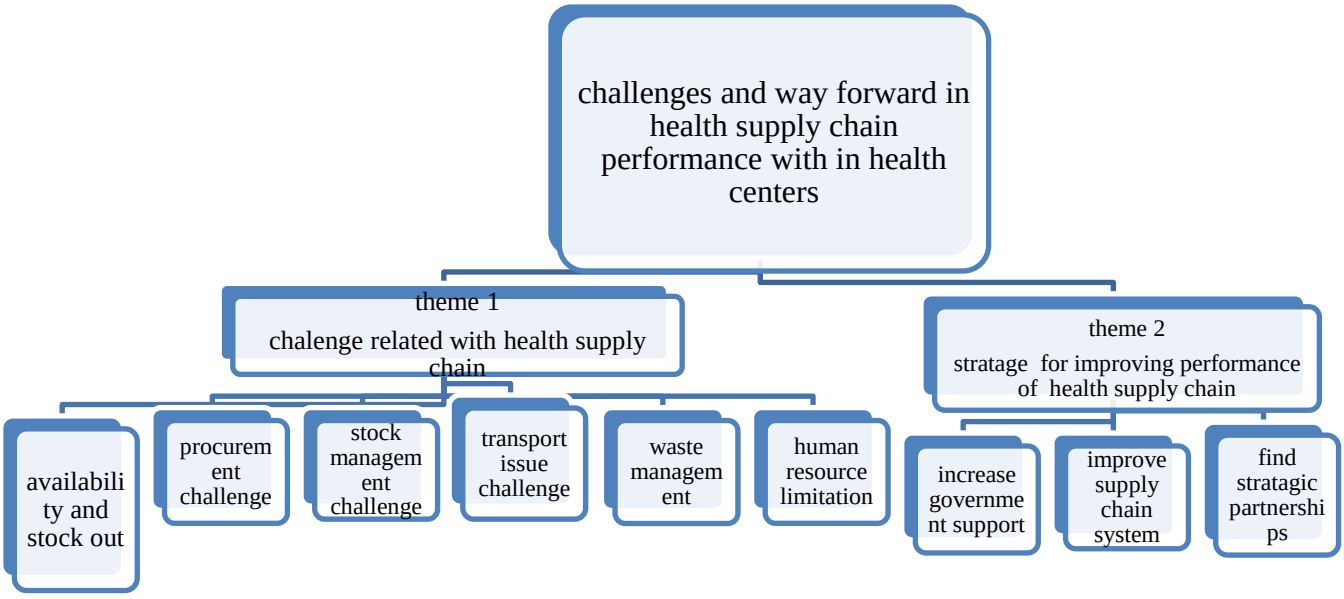

Figure 9: The main themes and sub-themes of the thematic analysis

Theme 1: challenges related with health supply chain

Sub-theme 1: Availability and Stock out

Participants 'emphasized low availability of health commodities .the health facilities consistently reported low fill rate from the Ethiopian Pharmaceutical Supply Service, leading to stock outs of essential medications .this situation forces health centers to procure from private companies, significantly increasing costs and limiting patient access to affordable medications.

The reliance on private suppliers often results in a higher financial burden on patients, exacerbating health inequities .participant in semit health center illustrate this as follow: "*We can't get all requested items from EPSS, so reduce our product availability and order fill rate. For example, if we requested 120 or 130, we get less than 50 items, so the fill rate is very low due to this; there is stock out of products. We fully fill our demand from wholesalers*."

Data quality and reporting issue were another factor. Accurate data is crucial for effective supply chain management. Many facilities highlighted issues with data recording, reporting, and forecasting. Poor quality data contribute to either overstock or stock out, as health facilities struggle to align their inventory with actual demand. This misalignment can lead to wastage of

resources and unavailability of critical medicine when needed. For instance**,** participant in EPSS logistic officer illustrate this as follow:

"As you know, supply chain is a wide concept to find problems end-to-end difficult. Currently, supply chain based on data quality, report timeliness, and completeness is very poor. We use the IPLS system for our supply and logistics system. EPSS uses forecasting and quantification data from health facilities. On the health facility side, there is a problem not filling out report data accurately and not sending it on time".

Sub-theme 2: Procurement challenges

A significant challenge is the lack of reliable product availability from EPSS, compelling facilities to procure from private companies at higher cost. This increases the financial burden on patients and health facilities. Drug supply manager in simegn health center illustrate this as follow:

"When the products are not available in EPSS, we procure them from a private company. Our standard does not permit us to procure products from a private company more than two times per year, and the cost of medication at a private company is very high. It is out of our capacity due to the above problem, and others stock out of pharmaceuticals happen."

Budget constraints were other challenges for health centers. Facilities often face budget limitation that restricts procurement capabilities, particularly in light of rising prices in the private sector.it is a pervasive challenges across health facilities, with many reporting that funding is not equitably allocated based on population needs .health facilities find themselves using the entirety of their budget for one-time procurement, resulting in cash flow issues throughout the year.

Sub-theme 3: Stock management

The push from EPSS creates a dilemma for health facilities this is not only increase the rate of expired medications but also complicates reverse logistics, as there is no mechanism in place return these products. Facilities face environmental challenges due to improper disposal of expired products which can lead to pollution and health hazards. Facilities struggle to manage inventory effectively due to inadequate storage and a lack of properly separation of different types of products. Inadequate storage facilities and insufficient refrigeration capacity complicate the

management of temperature- sensitive products many facilities struggle with adhering to best practices for inventory management of stock level and increase risk of product spoilage.

Sub-theme 4: Transportation barrier

Transportation remains a significant barrier in the supply chain. Many health centers rely on ambulances for transportation, which is not allowed and inadequate for timely deliveries of pharmaceuticals. Delay in product delivery can lead to shortages, particularly for time –sensitive medications. The lack of dedicated vehicles for health facilities compounds this issue, resulting in increased dependency on limited resources. Transportation delays contribute to stock outs especially for essential medications, affecting service delivery. Pharmacy head in shegole health center illustrate this as follow:

"Product delay is happening due to shortage of vehicles for transportation. Even though we use ambulances to transport medicines from EPSS to our health facilities, this leads to the availability of ambulances for referral purposes. Transportation is a serious problem, so the government is trying to avail vehicles for each health facility."

Sub-theme 5: Waste management and disposal

There is a notable lack of waste disposal services, both public and private, leading to environmental concerns. Facilities often quarantine waste without timely disposal options. High costs associated with waste disposal further strain budgets. Limited availability of reliable waste disposal service means that expired or damaged medications may not be disposed of in timely manner, posing environmental and health risks. The lack of effective waste management protocols creates additional challenges for facilities trying to maintain compliance with health regulations.

Facilities express frustration over regularly standards for waste disposal, which hinders efficient management of expired or damaged products. Store manager in bole 17 health centers illustrate this as follow: *"There is a push system from the EPSS side, especially near expiry and less valuable medications; this makes us increase our expiry rate and shortage of storage area. There are a limited number of waste disposal companies, so it is difficult to dispose of our wastes on time. On the other hand, the cost of disposal is very high*."

Sub-themes 6: Human resource limitations

Many facilities report a shortage of qualified pharmacy staff, which affects their ability to manage the supply chain effectively, leading to overwhelming workloads and inefficiencies. There is also recognized gap in training for supply chain management with recommendations for more targeted training programs to enhance staff capabilities which is hinder effective operations. Pharmacy head in yeka health center illustrate this as follow:

"In our health facility, drug supply chain management is managed by the pharmacy head. Due to a shortage of pharmacy manpower, there is no focal person for drug supply management. There is also a shortage of pharmacies that bring medication from EPSS. From this, there is a workload in our health facility."

Theme 2: Strategy for improving performance of health supply chain

Sub-theme 1: Increased government support

There must be governmental support for health facilities, particularly in terms of budget allocation, training, create another option supply other than EPSS, and logistical support.

Sub-them 2: Improved supply chain system

Enhancing the supply chain management system, such as implementing electronic data management system, and better quantification and forecasting methods are essential for overall performance.

Sub-theme 3: Find strategic partnership

Establishing partnerships with private companies for more reliable procurement option may help alleviate some of the financial and transportation burdens faced by health centers. Drug supply chain in Akaki health center illustrate on this as follow:

"We recommend data, records, and information is matched from lower level to higher level. There is also a training gap on the supply chain, so the responsible origination facilitates valuable

training on the supply chain, making us more knowledgeable and increasing our cooperative with other facilities. At the end, MOH gives more attention to the supply chain."

CHAPTER FIVE

5. Discussions

In this study, the performance and challenges of health supply chain were measured using national standard pharmacy service, and pharmaceutical supply and medical equipment management monitoring and evaluation framework, questionnaires, and KPI results would be discussed below.

Forecasting is the practice of predicting future health needs, and a trend using historical data, statistical model and analytical techniques.it is vital for health facility to meet excellent commodity availability with balance inventory level, to effectively use current capital asset, to identify future capital needs, and provide adequate service level (Damtie, 2020). The average forecast accuracy of health centers was found to be 62.35 % ± 7%, which is found to be far lower than the national target of 75%. To decrease this gap, improving the reliability of the data by using advanced technologies, providing training for the forecasters, improving communication with stakeholders, establishing a dedicated team which works on forecasting throughout the year, to ensure accountability and ownership should be explored. Providing formal training for forecasters would eventually help to improve the public health forecast accuracy to the desire target (Subramanian, 2020).

The order fill rate is another health supply chain performance measure indicators. In this study average order fill rate of both RDF and program commodities are 67.5% they received this percent of products from suppliers from their order. In most of the health centers the fill rate for RDF (56%) medicine is lower than program medicine (79%). The government plans to ensure fill rate at least 80% of the requested products, all of the health centers in this study were not achieved this standard. The mean order fill rate in the current study is lower than that of the pervious study (89.7%) conducted in public health centers in awi zone Amhara region (Addisu, 2021). The difference is attributable to population size and demand fluctuation. However order fill rate in this study (67.5%) is higher than previous studies in southern nation and nationality people region (52.4%) (Damtie, Ibrahim and Yikna, 2020) and Addis Ababa (52%)(EPSA, 2020) .The finding implies that there is a need for extensive reform in the order processing system of the agency. They also focus on accuracy of quantification and forecasting data for their procurement. Effortful evaluation is needed to identify potential areas of interventions.

Inventory rate refers to the percentage of inventory items that are correctly counted and recorded in the health facility inventory management system. It measures the accuracy of logistics data as the percentage of discrepancy between bin card, electronic recorded, and physical count. Keeping medicine in a store or dispensary is not enough unless public health centers regularly check their inventory accuracy and make an informed decision to effectively and efficiently utilize the limited resource. Health centers are expected to have high inventory accuracy (± 80%); from this, the current performance of 90% is above the target. This indicates all of the health centers are achieving the target, which means the balance of physical count, electronic record, and bin card most of the time have equal balance. So, they have high inventory practices (FMOH. 2019). The mean average of inventory accuracy rate (90%) is higher than study conducted in west shewa zone, Ethiopia (Bekele, 2020), in south Sudan (Manyuat *et al.*, 2021), Gamo Zone, Southern Nation and Nationality Region of Ethiopia (Alemu, Fenta and Gebregeorgise, 2023) and south west Shewa zone region of Ethiopia (Gutesa, Jebena and Kebede, 2024) (39.23%,37% ,78.5% and 72.5%,) respectively. Therefore, all health centers are continued at this performance level.

Another performance measure is Report and Requisition Form (RRF) is one of the logistics reports that move data from a health facility to a supplier to make various decisions, including timely refilling of products. It measures whether timely reports and requests are sent to EPSS. All health centers are expected to send RRF reports every two months until the 10th day of the following month. The average RRF of health commodities across health centers (100%) is above the standard 80%, which is stipulated by the national monitoring and evaluation framework. So, all health centers are reporting on time to the supplier, EPSS. Study conducted in north-west Ethiopia (Bekele and Anbessa, 2021), 92.7% RRF were timely reported to EPSS, which is nearly identical to this study findings (100%). Studies conducted in (West Welega Zone, Oromia (Tiye and Gudeta, 2018), South-West Shewa Zone, Ethiopia (Gutesa, Jebena and Kebede, 2024) and East Welega Zone Ethiopia (Kebede and Tilahun, 2021), 69%, 88.8%, and 40.52%, respectively, shows far lower than findings in this study. Therefore, RRF has very good performance in all study health facilities.

Average lead time refers to the amount of time between facilities placing orders with suppliers and when the products are delivered to a facility, and is one of the factors that determine a health facility's satisfaction and service quality. In this study, six recent resupply periods were included,

and the average lead time is 19 days, which is nearest to the standards. As per the FMOH Framework, EPSS (the supplier) is expected to resupply within 20 days. The shortest duration of days of delivery is in Beletshachew Health Centre, while the longest one is in Yeka Woreda 7 Health Center. This was due to inadequate supplier vehicles as well as frequent breakdowns of those vehicles. Delivering products to health centers on time enables them to provide better quality service. An average lead time (19 days) is lower than the study conducted in SNNPRS, Ethiopia waiting 59.2 days for receiving medicines (Damtie, Ibrahim and Yikna, 2020). This finding is better than a study conducted in the Uganda Ministry of Health, where an average lead time of 41 days were necessary for delivery of products to the health facility (Lugada *et al.*, 2022). From the key interview, there are many reasons why delay of medicines; some of them are unavailable of medicine in EPSS, transportation problem, misbalance between demand and supply, and shortage of budget.

The other performance measure is waste rate. It refers to the percentage of healthcare resources, such as medication, supplies, or equipment that are being discarded or not used effectively. This indicator is one of the performance indicators to have efficiency gain and one of the health sector transformation plan (HSTP) indicators. The target is to reduce the waste rate of pharmaceuticals to less than 2%. Medicines that were provided for patients freely under different programs were found to be commonly wasted medicines. The average waste rate of this study is 1.24%, which is lower than the national standards (2%) The waste rate of program commodities (1.74%) is higher than RDF medicine (0.6%). This is due to near-expiry commodities being supplied and donated from a refilled organization. The waste rate in this study (1.24%) is lower than a descriptive cross-sectional study conducted in EPSS (EPSA,2020) (2.1%). The current study also has a lower waste rate than studies conducted in the SNNPRS, 2.5% (Damtie, Ibrahim and Yikna, 2020). More over 71% the health centers reported the presence of unfit for use medicine in the past 12 months only 29% them are dispose their unfit for use medicine which is lower than study conducted in Tanzania 40.8% (Mwita and Njegere, 2024). Generally, the waste rate of health centers under this study was lower than national standards and considered to have very good performance based on this performance indicator.

Essential drugs should always be available. Essential drug availability is the proportion of tracer drugs under review that are available throughout the month. Tracer drug is considered available,

but it is not stocked out for a single day in the month of data collection. This finding of this study disclosed that among the selected 25 key essential medicines, the mean availability of tracer drugs on the day of visit was 89.18%, which is lower than standard 100%(MOH,2019). From 25 tracer drugs, RHZE/RH, TDF/3TC/EV, and adrenaline were available throughout the month (100%); contrary to these, artesunate injection and DNS were the least available medicines (11%) and (47%) respectively. The previous study conducted in health centers in Adama town, East Shewa of the Oromia region (Kefale, 2019), and public health facilities in South West Shewa, Oromia Region, Ethiopia,(Gutesa, Jebena and Kebede, 2024) revealed average availability of TMs of 76.3% and 86%, respectively . This finding is also higher than the study on the influence of inventory management practices on the availability of medicine in public health facilities in Kenya, in which the average number of drug availability was 63.35% (Barasa,et al. 2018) . The availability of tracer drugs in the current study was better than the factor affecting inventory management performance of tracer medicines across primary healthcare units, Gamo Zone, SNNPR Region Ethiopia 78% (Alemu, 2022) .While, lower than the study conducted in Awi Zone public health centers in Amhara Region, Ethiopia, 95% (Addisu, 2021). Based on this finding, the health centers try to meet 100% availability of tracer medicines.

Pharmaceuticals must be kept in environment that minimizes deterioration and contamination. All medicine should be stored in compliance with product authorization requirements and manufacturer instructions. Storage and handling of medicines in the supply chain involves various actors, and hence subjected to various risks. So, ensuring good storage practice is essential to minimize these risks. Storage condition to be adequate if 80% of thirteen criteria are met this finding revealed about 47% of public health centers meets the acceptable storage condition which is far from the national standards (FMOH, 2019). The current study (47%) is lower than study conducted in primary healthcare facilities at Pakistan 75%(Punjab, 2024) on the other hand study conducted in EPSS 60% (Lesego *et al.*, 2023). However, the current study is higher than similar study conducted in selected public health facilities at Gondar zone Amhara region, Ethiopia (16.7%) (Tessema, 2023). KIs reported that the store room was not sufficient, shortage of refrigerator, limited equipment like shelf, fire extinguisher, and other materials. Generally storage condition is need to high improvement.

Stock out duration of tracer drug is the number of days in which the tracer drug was not available in a specified period of time. The availability of tracer items is a measure of service availability. Tracer items should be always at the health facility. The length of the stock out duration found in this study was 25.3 days the longest days of stock out is registered in Philipos Health Center (60.8days) while, the shortest was in bole 17 health center (2.4 days).the finding of this study is lower than study conducted in health facilities of east shewa zone oromia region Ethiopia (Gurmu and Ibrahim, 2017), and study conducted in public health facilities in Kenya (Bungoma et al. 2018) (35.31days) and (51.3 days) respectively. Previous study conducted in health center at North West Ethiopia had lower stock out duration (11.2 days) (Bahiru et al. 2022) than the present study (25.3 days). The possible reason could be the difference in duration of time under consideration to review period (12 month versus 6 months).the challenge was also addressed by KIs. Many of the KIs complained stock out of products at EPSS, unavailability of the products on market and inadequate budget.

The present study also identified the major challenges associated with health supply chain management the study facilities by the qualitative method and self-administered questioner. The finding from the survey provides critical insights into the factors influencing the effectiveness of the health supply chain. Notably, several attributes received high perception ratings, indicating strong agreement among respondents regarding their importance. For example, the assignment of a coordinator for supply chain activities garnered a mean of 3.59, highlighting the necessity of centralized management to streamline process and enhance communication among stakeholders .respondents also identified poor infrastructure encompassing transportation, storage and technology as a significant contributor to workload and delays, with a mean score of 3.53. Furthermore, the absence of a dedicated budget for pharmaceutical was seen as a critical barrier to effective procurement reflected in a mean score of 3.12, suggesting a pressing need for robust data collection systems. Additionally, insufficient access to reliable information and communication technology (ICT) was associated with poor data collection and reporting, scoring a mean of 3.18.

Conversely, some attribute received low perception scores, indicating less agreement on their impact. For instance, weak decision –making, resulted in a mean score of 2.18, suggesting this issue may not be viewed as primary concerns relative to other determinants. Similarly, the inadequacy of refrigeration and monitoring systems, for cold chain management scored a low 2.06,

indicating a potential oversight in prioritizing temperature –sensitive medications. The absence of a stock transfer system, linked to shortage of medicines, received a mean score of 2.12,revealing that while acknowledged, it may not be seen as critical compared to other supply chain challenges.

Overall, the findings indicate a need for strategic investments to enhance the effectiveness of the health supply chain Key implications include strengthening coordination through assigned roles, investing infrastructure, ensuring adequate budget allocation for pharmaceuticals, improving data management.

The thematic analysis of supply chain performance across health centers reveals significant systemic challenges that adversely affect medication availability and patient care. Central to these challenges is the inconsistent supply from the Ethiopian Pharmaceutical Supply Service (EPSS), which leads to frequent stock outs and force health centers to rely on costly private suppliers, ultimately impacting patient affordability. For example one of the respondents said that:

"*We don't get all medication from EPSS; as a result, we make procurements from private companies, and the price of medication is increasing because the affordability of medication is very low. This is what I have seen on the supply chain. We try to give service by substituting one material for another. We can't meet the prescribed fill rate."*

Budget constraints further complicate procurement process, especially as rising prices in the private market limit access to essential medications.as a result they were facing stock out of essential medicine. Additionally, the management of inventory is hindered by the prevalence of near-expiry products pushed by EPSS, resulting in increased waste and complicating stock control efforts. Transportation logistics are identified as a major bottleneck, with many health centers relaying on ambulances for deliveries, highlighting the urgent need for improved agreement between EPSS and health centers to ensure timely and safe transportation of medications.one of the respondent said that:

"In our health center, the major constraint is the transportation problem. We don't have vehicles for drug supply; we use our ambulance for transportation. This exposes us to the absence of an ambulance for referral purposes, and it also can't carry all medicines in one time transport, which makes high fuel costs."

Waste management poses another critical challenge, as limited disposal services and regulatory barriers create environmental risks associated with improper disposal of expired products. Compounding these issues is a shortage of qualified pharmacy professionals and a recognized need for comprehensive training programs to enhance staff capabilities in supply chain management. To address these interconnected challenges, stakeholders emphasize the necessity for increased support from the ministry of health enhanced collaboration among health facilities, and improved data collection practices to strengthen forecasting and inventory management efforts.

6. Strengths and limitations of the study

6.1 Strength of the study

The strength of this study is the study involved mixed- methods approach where quantitative and qualitative data collection techniques were used and measure the performance of public health supply chain. This potentiate the findings of the study because quantitative alone providing incomplete picture of the supply chain.

6.2 limitation of the study

This study is limited to one geographical area and single facility level (health centers) Findings from this study only pharmaceutical supply chain indicator were included from national monitoring and evaluation framework due to time, resource materials, and budget constraints. As a result, the performances of all M&E framework were not measured.

7. Conclusion and recommendations

7.1 Conclusion

Based on the results obtained it can be conclude that; the health commodity supply chain performance of those health facilities was found to be poor. Except for RRF reporting rate, inventory accuracy rate, and wastage rate which had relatively better results, the rest of the majority of the indicators were below the national standard which was confirmed by poor forecasting accuracy, order fill rate practices and poor storage condition and unfit for use practice. Availability and stock out of tracer medicines were the main problem for major health facilities most probably because of inadequate supply of medicine and budget constraint as reported by KIs.

The major challenges related to performance of supply chain were identified to be shortage of supply, budget constraint, limited competent human resource, inadequate management support and, a lack of continuous professional training, vehicle and transportation problem, and lack of waste disposal area.

7.2. Recommendation

Based on the gaps identified in the study, the following recommendation can be made.

- Need to create data visibility across lower level to higher level, such as health facilities, EPSS, and MOH to share trustworthy data for accurate decision making
- PMED at Addis Ababa health bureau needs to study and act on the issues reflected in indicators evaluation, challenges and potential for improvement section of this study reports.
- Well- trained or competent pharmaceutical professionals need to assign and coordinate activities to improve drug supply chain management at health facilities.
- Study public health facilities should improve storage condition with respect to storage guidelines and criteria's of key essential medicines in order to maintain safety, efficacy of drugs and minimize damage and expiry of products.
- Addis Ababa heath bureau and health facilities should coordinate together for disposal of unfit- for - use medicines.
- EPSS and other suppliers should work strongly to avail the necessary key essential medicines to the health facilities to avoid stock outs, and should monitor and provide feedback to improve on time request.

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For future researcher

Further studies are needed to identify the status of health supply chain performance in all public and private facilities.

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7. ANNEX

Consent form to study Participants

ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCES,

SCHOOL OF PHARMACY,

DEPARTMENT OF PHARMACEUTICS AND SOCIAL PHARMACY

Dear Participants;

My name is **Robel Gursm** conducting a thesis entitled **health commodity supply chain performance and challenges** for partial fulfillment of my M.Sc. in **Health Supply Chain Management** at school of pharmacy, Addis Ababa University. With sincerity I would like to extend my deep appreciation to you and your institution for the willingness and cooperation in undertaking this valuable research. I request your kind cooperation in answering the questions as truthfully as possible and your response will be highly confidential.

This interview has four parts.

Part I – general information

Part II- health commodity supply chain performance

Part III- in-depth interview

Part IV- document observation

Concerning any problem related with this work, you can contact,

Robel Gursm, principal investigator, 0924558453, e-mail; robelgursm@gmail.com

If you agree to this interview, you can let me know I will proceed. But if you do not agree, you can let me know at this point and I will not proceed with the interview.

ANNEX –II

INTERVIEW GUIDE

Part- 1: General Information

Study site Information	
Health Facility code	Facility Level
	□ Health Center □ hospital □ MOH □ EPSS Health Office
	Facility Type
	□ HCMIS site IPLS paper based □ IPLS Computer based
	SDUs (Health center and hospitals)
	□ Main Store □ distribution center
	Number of key staff in the unit

Participant information				
Date of interview	Interviewee Qualification	Work experience	Start time	End time

Part 2- Health commodity supply chain system performance measures

1, Forecast accuracy

Forecast accuracy for tracer products					
		quantity			
S.N.	**Tracer product**	**Forecast quantity(p1)**	**Consumed(issued) quantity(p2)**	**Forecast error(p3)|(p1 -p2)|/p2**	**Forecast Accuracy (1-P3x100)**
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					

15					
Summary Forecast accuracy					

2. Supply fill rate

EPSS					
S.no	**Pharmaceutical Category**	**Total number of line items requested to EPSS in the quarter (p2)**	**Total number of line items supplied in the quarter**	**Total number of items which are supplied in greater than 80% of the quantity requested (p1)**	**Supplier fill rate (p1/p2)*100**
1	**Program from RRF**				
	RDF pharmaceuticals				
	Total				
EPSS re fill rate for RDF and program drugs = p1*100 / P2					

Private					
S.no	**Pharmaceutical Category**	**Total number of line items requested to EPSS in the quarter (p2**	**Total number of line items supplied in the quarter**	**Total number of items which are supplied in greater than 80% of the**	**Supplier fill rate (p1/p2)*100**

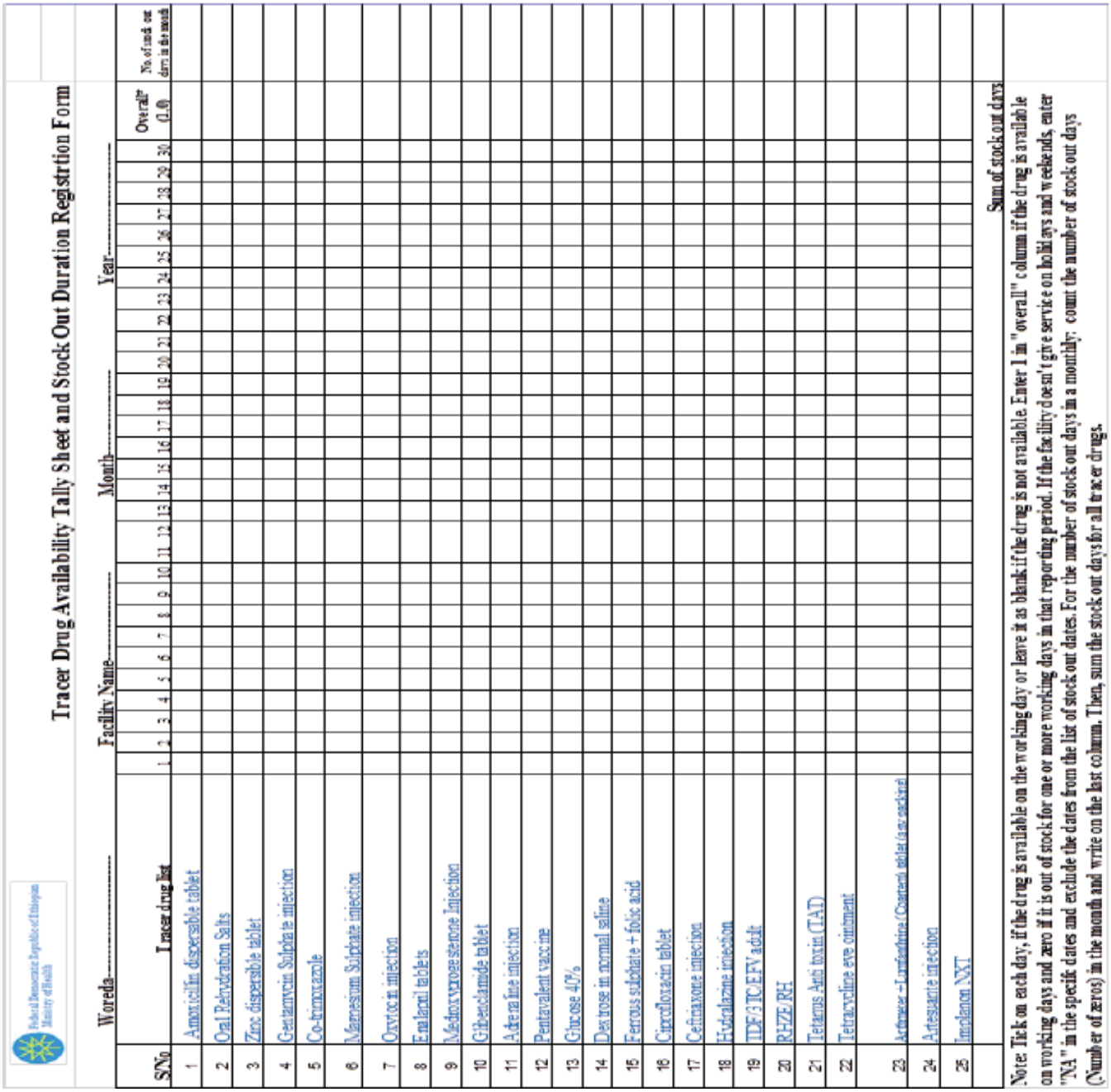
				quantity requested (p1	
1	RDF pharmaceuticals				
2	RDF pharmaceuticals				
3	RDF pharmaceuticals				
Private refill rate for RDF drugs =| p1/p2|*100					

3. Average lead time

S.no	Reporting period	Date the report & request was summited to EPSS	Date the products are delivered by EPSS to HF	Number of days it took by EPSS to deliver products
1	Reported period 1			
2	Reported period 2			
3	Reported period 3			
4	Reported period 4			
5	Reported period 5			
6	Reported period 6			
	Total number of days			

	Number of reporting periods considered for the calculation	
		Average lead time =

4. Tracer drug availability and sock out duration tally sheet and registration format



Tracer Drug Availability Tally Sheet and Stock Out Duration Registrtion Form

Woreda---------- Facility Name---------- Month---------- Year----------

SN	Tracer drug list	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Overall* (1.0)	No. of stock out days in the month
1	Amoxicillin dispersible tablet																																
2	Oral Rehydration Salts																																
3	Zinc dispersible tablet																																
4	Gentamycin Sulphate injection																																
5	Co-trimoxazole																																
6	Magnesium Sulphate injection																																
7	Oxytocin injection																																
8	Enalapril tablets																																
9	Medroxyprogesterone Injection																																
10	Gibenclamide tablet																																
11	Adrenaline injection																																
12	Pentavalent vaccine																																
13	Glucose 40%																																
14	Dextrose in normal saline																																
15	Ferrous sulphate + folic acid																																
16	Ciprofloxacin tablet																																
17	Ceftriaxone injections																																
18	Hydralazine injection																																
19	TDF/3TC/EFV adult																																
20	RHZE/RH																																
21	Tetanus Anti toxin (TAT)																																
22	Tetracycline eye ointment																																
23	Artemether-Lumefantrine (Coartem) tablet (six packs)																																
24	Artesunate injection																																
25	Amlodipine, NXT																																
																																Sum of stock out days	

Note: Tick on each day, if the drug is available on the working day or leave it as blank if the drug is not available. Enter 1 in "overall" column if the drug is available on working days and zero if it is out of stock for one or more working days in that reporting period. If the facility doesn't give service on holidays and weekends, enter "NA" in the specific dates and exclude the dates from the list of stock out dates. For the number of stock out days in a monthly, count the number of stock out days (Number of zeros) in the month and write on the last column. Then, sum the stock out days for all tracer drugs.

5. Wastage rate

s.no	RDF category	Unusable stock of products during a period in monetary value in period(p1)	Value of beginning stock at the beginning of the products(p2)	Value of total items received during the quarter (p3)	
1	RDF pharmaceutical				
2	Program pharmaceutical				
	summation				
				Wastage rate	

6. Percentage of facilities that maintain acceptable storage conditions

Check list to evaluate good storage condition

Assess the storage conditions of main storage area only. Place a check (tick) mark in the appropriate column based on visual inspection of the storage area. To qualify for a "Yes" response, all products must meet the criteria for each item

Good storage condition criteria			
S.N	Criteria	Met	
		Yes(1)	No(0)
1	Products are arranged on s helves with arrows pointing up, and with identification labels, expiry dates, and manufacturing dates clearly visible.		

2	Drugs are stored and organized to FEFO procedures and are accessible for counting and general stock management.		
3	Outer cartons are in good condition (not crushed, perforated, stained, or otherwise visibly damaged).		
4	Damaged and expired products are separated from usable products in the storeroom, and procedures exist for removing them from inventory.		
5	Drugs are stored i n a dry, w ell-lit, w ell-ventilated storeroom. *(Visually inspect roof, walls, and floor of storeroom.)*		
6	Cartons and products are protected from direct sunlight.		
7	There is no evidence of rodents or insects i n the storage area. *(Visually inspect the storage area for evidence of rodents [droppings] or insects that can damage or contaminate the products.)*		
8	Storage area is secured with a lock and key but is accessible during normal working hours; access is limited to authorized personnel.		
9	Products are stored at the appropriate temperature according to product temperature specifications (8°–30°C) and including cold chain storage (2°–8°C), a s required for certain products.		
10	Roof is maintained in good condition to avoid sunlight and water penetration.		

11	Storeroom is clean, with all trash removed, no evidence of food and drinks, products stored on sturdy shelves/bins, and boxes organized neatly.		
12	Current storage s pace i s sufficient for existing products and planned program expansion.		
13	Drugs are stored separately from insecticides, flammable products, and chemicals.		
	Total number of yes		
	Storage condition score (%)=(total yes/13)*100		
	If storage condition score ≥ 80%,say acceptable		

7. Inventory accuracy rate

S.N	List of tracer drugs	Bin card/electronic record balance	Physical count	Bin card balance equals with physical count (if, yes put 1,if,no put 0)
1				
2				
3				
4				
5				
6				
7				

8				
9				
10				
Number of items where bin card(manual or electronic) balance equals physical stock count				
Inventory accuracy rate =|total yes /10|*100				

8. RRF reporting rate

Date entry: (enter 1 if the facility reported using the RRF, 0 if the facility does not use RRF report in the reporting period. Please fill for each period).

RRF reporting rate			
S.N	**Reporting period**	**Date RRF sent to EPSS**	**Send RRF report on time (sent until the 10th day of the month put 1,if not, put 0**
1	**Reporting period 1**		
2	**Reporting period 2**		
3	**Reporting period 3**		
4	**Reporting period 4**		
5	**Reporting period 5**		
6	**Reporting period 6**		
	RRF reporting rate(total number of RRF sent on time/expected number of RRF		

10. Disposal of unfit- for -use medicines

S.N	Activities	Write 1 if yes, write 0 if not
1	**Did the health facility dispose unfit-for-use medicine at least in past 12 month**	

11.likert scale data collection tool

Items determinants	SD	D	N	A	SA
Assign coordinator for supply chain activities attribute to effectiveness of supply chain system					
Poor infrastructure (transportation, store premises, recording tools, internet, computer and electric power) attribute for workload and delay in delivery of products.					
Irregularity of product movement attribute to sock out of medication.					
Absence of separate and enough budget allocation for pharmaceuticals attribute to ineffective procurement process					
Inadequate tools, training gap and weak decision making attribute to stock out of medicines					
Lack of quality data attribute for poor forecasting exercises.					
Inadequate refrigerator and monitoring system attribute for poor cold chain system					

Insufficient accesses of reliable information and communication technology attribute for poor data collection ,reporting and communication system in health facility					
Absence of stock transfer system in the healthcare attribute to shortage of medicines and medical supplies					
Enhancing the performance of health supply chain system attribute for improving overall healthcare delivery					

Part – 3: In-depth Interview

Participants: hospital pharmacy head and store manager, health center store manager, MOH, AND EPSS.

1. How do you assess the current health commodity supply chain performance in your HFs/ offices/Hub?

   Probing with respect to:

   a. Availability of commodities
   b. Quality of data recording data keeping, and organizing
   c. Data reporting and data using for decision
   d. Inventory management

e. Storage management
f. Disposal of wastage

2. How do you assess your role and the role of other health team in your facility/organization in ensuring health supply chain?

   Probing with respect to having:

   a. Supply chain Knowledge
   b. Enough time to do the job
   c. Initiation to do the job

3. How do you assess the capacity of your HF/organization in ensuring pharmaceutical logistics data quality?

   Probing with respect to having:

   a. Enough LMIS tools and guidelines
   b. Regular M and E practices
   c. Regular Supportive supervision
   d. On time feed back

4. How do you assess the attention given for supply chain activities by SDUs as well as by admin part?
5. In relation with HCMIS, what kind of problems encountered and solution under taken?
6. Is anything more would you like to add?

   I will analyze the information you and others gave me and submit a draft report to my advisor at department of pharmaceutics and social pharmacy, school of pharmacy, Addis Ababa University in two months. I will be happy to send you a copy to review at that time, if you are interested. Thank you for your time and cooperation.