SUPPLY CHAIN FACTORS CONTRIBUTING TO MEDICINES WASTAGE: IN CASE OF FIVE FEDERAL HOSPITALS IN ADDIS ABABA

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Supply Chain Factors Contributing to Medicine Wastage: In Case of Five Federal Hospitals of Addis Ababa

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Declaration

I do hereby declare that, this study on “Factors Contributing to supply chain Medicine Wastage in the case of five Federal Hospitals of Addis Ababa.” is my original work and has not been presented for a degree in any other university, and all sources used for the study have been duly acknowledged.

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Acronyms

ALERT: All Africa Leprosy, Education and Rehabilitation Training

APTS: Auditable pharmaceutical transaction and services

DSM: Drug Supply Manager

DTC:Drug and Therapeutic Committee

GPC& HP: Guideline policy change and Hospital practice

EDL: Essential drug list

EFMHACA: Ethiopia food, medicine and health care administration and control authority

EPSA: Ethiopia pharmaceutical supply agency

HCMIS: Health commodity management information system

HCSCM: Health care supply chain management

IPLS: Integrated pharmaceutical logistics service

LMIS: Logistics management information system

NEDL: National essential drug list

PSCM: Pharmaceutical supply chain management

RDF: Revolving drug fund

SC: Supply Chain

SCM: Supply chain management

SOP: Standard Operating Procedure

WHO: World health organization

Abstract

Background: *One of the problem pharmaceutical supply chain faces isMedicine wastage. It is a global problem affecting both developed and developing countries although the nature of the problem differs. Medicine wastage cause logistics operation cost, environmental impact, service interruption, adverse drug reaction and patient death.* ***Objective:*** *The major objective of this study is to identify supply chain factors contributing to medicine wastage in five federal hospitals of Addis Ababa.* ***Methodology:*** *The study conducted at five federal hospitals of Addis Ababa, namely ALERT center, Amanuel mental specialized hospital, Black Lion, St.Paul hospitals and ,St.Peter TB specialized. Data was collected through administering structured questionnaire containing closed ended questions, which are scored on the 5 point-likert scale. The factors were categorized under thematic areas then qualitative analysis done to the collected data using Spss version 20.The study participants were 70 pharmacists, 5 druggist and 5 DTC members working in the sampled hospitals.* ***Result:*** *The relationship proposed in the hypothesis was tested using Pearson correlation and linear regression was used to test the influence of supply chain factors constructs on medicine wastage. The analysis show that Supply chain factors has positive and strong relationship with medicine wastage with pearson coefficient of 0.445 (r=0.445) and significant at p-value of <0.001.This study reveal supply chain factors have weak influence on medicine wastage with adjusted R2 value of 0.237 this is due to that narrow dimensionality of supply chain factors used. Guideline policy change, and hospital practice are statistically significant factor identified for contributing to medicine wastage.* ***Conclusion:*** *To avoid patient service interruption, shortage and unavailability of essential medicines, expensive medicine expiry and high health care cost knowing and following standard practice is crucial. In addition the hospitals should strengthen medicine supply chain management, information management, strengthening the DTC, and developing donation guidelines to minimize the wastage of medicines.*

Key Words: *Drug and Therapeutic Committee (DTC), Essential Medicine, Federal hospitals, Medicine wastage, Supply chain management*

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Medicines are substances intended for use in the prevention, diagnosis, cure, mitigation, or treatment of disease (Mekuanint, 2017).

Medicine wastage defined as all expired, damaged, improperly sealed or labeled or stored, counterfeit, substandard and adulterated, prohibited or unauthorized medicines (Gebremariam, Gebregeorgise and Fenta, 2019).Medicine supply chain management cycle has five core functions these are selection, inventory management, procurement, distribution and use. In addition it has management support operations of organizing, financing and sustainability, information management, human resource and quality assurance management (Iqbal, Geer and Dar, 2017).

Although hospital supply chain is facing problem due to fragmented supplier base, supply chain inefficiencies, administrative hurdle, inappropriate care and waste it can also be optimized through continuous and expanded intervention, robust and flexible supply chain, better management and increased investment of resources(Iqbal, Geer and Dar, 2017; Moons, Waeyenbergh and Pintelon, 2019).

Medicine supply chain success depends on reliable and consistent delivery of quality medicines to health facilities at all levels of the health care system. In order to ensure this success and manage Ethiopian PSC problems Pharmaceutical fund and supply agency was established in 2007 by proclamation No. 553/2007 (now it is called EPSA) based on the pharmaceutical logistics master plan (PLMP).PSCM is responsible for delivering affordable and quality medicines to public health facilities and ensures their rational use. In addition to execute its activities effectively and efficiently it is using integrated pharmaceutical logistics system (IPLS); IPLS is an inventory control system based on a report of hospitals every 2 month to EPSA for all products for emergency product emergency order can be placed (Mekuanint, 2017).

In hospitals supply chain DSM officer/s, store manager, pharmacy head and pharmacists are key personnel for determining the flow of pharmaceuticals and a re-supply schedule for the

dispensing units. The dispensing units receive supplies after filling IFRR which will be signed by head pharmacist or DSM officer then store manager decide the quantity to be supplied until the next request schedule(Mekuanint, 2017).

Medicine wastage is a global problem with multiple causes and has significant impact on patients finance, states economy, cost of health care, public health and environment. It reduces the quantity and quality of medicines delivered to patients therefore affects health service quality (Nakyanzi *et al.*, 2010; West *et al.*, 2015).

Medicines occupy large share of countries capital which reached 20%-50% of total investment in developing countries even though one third of the world of which one half of Asia and African countries doesn't access essential medicines. One of the reason for such inaccessibility is wastage(Gebremariam, Gebregeorgise and Fenta, 2019).

In Ethiopia 80% of pharmaceuticals are imported; due to this medicines supply chain need to be well managed to keep the wastage rate minimum including expiry, misuse and pilferage (Tadeg H. et al, 2014;(Nakyanzi *et al.*, 2010)

Supply chain activities procurement, inventory management/quantification, distribution and use are important elements in the study of medicine wastage.

Procurement practices like selection, forecasting and quantification affect inventory levels that is it may result in overstock or stock out and ultimately affect the service provided to the consumer or patient in the case of hospitals (Mir JavidIqbal et al. 2017,MekuanintNega 2017).

Eliminating wastage is depended upon effective inventory and forecasting management**,**which deals with requirement estimation, analyzing consumption patterns and forecasting demand; Pharmacy inventory management is critical process within the health care delivery system for avoiding wastage. Good inventory management practices lead to availability of medicines, improved financial performance, and reduce risks relating to patient safety (Iqbal, Geer and Dar, 2017).

An efficient drug distribution system strategies (i.e. direct shipment and cross docking) avoids wastage by ensuring the availability of right medicines in sufficient quantities with the available and additional resources and it also serve the function of time and place utility for medicines. They effect coordination of the healthcare resources, effective delivery strategies and enhance measurement of the delivery services for creating high value outcomes including minimizing storage and transportation costs (Mir JavidIqbal et al. 2017).

Hospital supply chain which creates standardized delivery processes will make the hospital service more reliable and offer great opportunities to reduce waste. Besides pull system of delivery optimize supply flow as it provide supplies based on customer demand (K. Moons et al, 2018).

A rational use of medicines is crucial for ensuring appropriate use of medicines it includes dispensing of pharmaceuticals in accordance with country regulations, appropriate inventory maintenance functions, drug monitoring, patient drug assessment functions, appropriate record keeping, drug information, education services and performance improvement functions. SOP and professional competency are also key factors for quality use of medicines (Mir JavidIqbal et al. 2017).

Good storage condition is another important factor for preventing medicine wastage. Adequate environmental controls like proper temperature, light, humidity, conditions of sanitation, ventilation and segregation must be ensured wherever drugs and supplies are stored to avoid wastage of medicines and ensure efficient flow of supplies (Mir JavidIqbal et al. 2017).

This study focuses on supply chain factors contributing to medicine wastage in the case of five federal hospitals of Addis Ababa.

1.2 Statement of the problem

Medicines occupy large share of countries capital which reached 20%-67% of total investment in developing countries even though one third of the world of which one half of Asia and African countries doesn't access essential medicines. One of the reason for such inaccessibility is wastage (Gebremariam, Gebregeorgise and Fenta, 2019; Beyene, Abuye and Tilahun, 2020).

Medicine waste is among the problem today's supply chain faces in addition fragmented supplier base, supply chain inefficiencies, excessive administrative expenses, poor management ,integration problem with suppliers and health facilities, poor procurement practice, incorrect forecasting and information gaps are among the challenges of pharmaceutical supply chain that causes medicine wastage and stock out of medicines (Toba et al., 2008;Mekuanint, 2017).

Medicine wastage affect both developed and developing countries despite the nature of the problem differs. In developed countries unused medicines, change of regimen and patient death are the major source of wastage where as in developing countries poor supply chain management, excess short shelf life medicine donation, lack of accountability, poor monitoring and evaluation,

change of policy are among the mentioned factors for medicine wastage. Generally medicine wastage affect the quantity and quality of medicines delivered to the patients thus result in compromised health service quality (Nakyanzi et al., 2010; West et al., 2015;Ebrahim et al., 2019; Gebremariam et al., 2019; Hakuzimana, 2019; Tumwine et al., 2010).

Excess medicine supply from donors, short shelf life products, poor communication with key stake holders, lack of accountability, poor monitoring and evaluation of stock, poor DTC, stock out due to poor inventory management, inefficient LMIS and Crowded store are among the problems of medicine supply chain management identified in a study conducted in Ethiopia. Pharmaceutical supply chain practice is improved through managing these problems to effect reduced medicine wastage and stock out of medicines (Mekuanint, 2017; Gebremariam, Gebregeorgise and Fenta, 2019).

In Tanzania excess supply, pilferage, patient death and change of regimen were major factors identified for causing medicine wastage where as in Uganda procurement, quantification and irrational use were identified to sources of medicine wastage. In Rwanda abrupt cessation of treatment due to policy change, rare diseases and expensive medicines are mentioned factors to medicine wastage (Nakyanzi *et al.*, 2010; Kagashe, Makenya and Buma, 2014; Hakuzimana, 2019).

One systematic review of the literature on medicine wastage revealed the reason for medicine wastage in developed countries of USA, England and New Zealand. The common reason to medicine wastage are change of medication, patient death, resolution of patient condition and medicine expiry(West *et al.*, 2014).

Extent of medicine wastage has studied in various countries; unused medicine range from 65 to 20,304; of which tablets and capsules are the most commonly wasted dosage forms. The cost of medicine wastage estimated 66 to 770,000 euro; one study found that unused prescription cost the NHS of UK £ 300 million a year(West, 2015).

In a study conducted at South Africa Limpopo province health care facilities in 2015 R 1009998.79 (1R=0.0788 USD at the time of the study) value medicines were expired due to poor supply chain management where as in Tanzania 730 medicines were found wasted. Moreover in a study conducted in Awi Zone during 2010 E.C for 1 month found 56 types of 173 unused medicines (solid medicines and fluids). The study also conducted an assessment on four hospitals in 2009 E.C and found 605 unused medicines; it is found that unused medicines in

AwiZone and Gondar town cost 60654 and 38228 ETB respectively, during 2014 to 2018 in Rwanda 6,046,777,655 FRw (1RF=684.81 USD in 2014) value of medicines are expired due to short shelf life, poor donation management and treatment and policy changes; this study also reveal that HIV commodities has the highest expiration rate which was obtained through donation (Ebrahim et al., 2019; Kagashe et al., 2014; Mashishi, n.d.; Mulugeta et al., 2015, 2015;Hakuzimana, 2019).

There are several direct and indirect consequences of medication wastage; the direct impact are mainly the economic implications for government, individual and society arising from costs of unused medications, expenses required to dispose of unused medication, costs related to wasted time spent on the supply based activities of prescribing and dispensing. Public health compromise and as well as environmental implications during disposal are the indirect consequence of unused medicines. Some of the consequence of medicine wastage found in a study conducted in Ethiopia are economic impact, congested store and stock out of medicines(West, 2015; Gebremariam, Gebregeorgise and Fenta, 2019).

Poor pharmaceutical supply chain management and poor hospital practice is adversely affecting the country scarce resources through causing medicines wastage and as a result causing interruption in health care service. In addition there is no published literature in my knowledge that investigates the problem of medicine wastage in federal hospitals of Addis Ababa. As a result this study aim to identify major supply chain factors that lead to medicine wastage in five federal hospitals of Addis Ababa and it serve for policy makers to make informed decision on the problem.

1.4 Research Questions

This study will answer the following research questions:-

i. What are the supply chain factors that cause medicine wastage in the selected hospitals?
ii. What influence does the supply chain factors have on the wastage of medicines in the selected hospitals?
iii. What is the relationship between supply chain factors and medicine wastage in the selected hospitals?
iv. What are the consequences of medicine wastage on the selected hospitals?

1.3 Objective of the study

1.3.1 General Objective

The major objective of this study is to identify supply chain factors contributing to medicine wastage in the case of five federal hospitals of Addis Ababa.

1.3.2 Specific Objectives

The specific objectives of the study are:

To assess the influence of supply chain factors on the wastage of medicine of the sampled hospitals

To determine the relationship between supply chain factors and medicine wastage of the sampled hospitals

To assess the consequence of medicine wastage on patient service of the sampled hospitals

1.5 Significance of the study

This study assist the management of the hospitals to identify factors that cause medicine wastage then appropriate action plan put in place so as to achieve minimum wastage rate which in turn result improved services delivery. This study also serve as a guidance for policy makers such as MOH and government bodies to make policies and SOPs in the area of pharmaceutical waste management. Finally the study result expected to serve as an input for academicians and scholars who are working in hospital and other organization who are interested to undertake further research in the area of medicine wastage.

1.6 Scope of the study

Due to limitation of capacity this study is confined to federal hospitals which reside in Addis Ababa. The conceptual framework of the study bound on supply chain factors which contribute to medicine wastage.

The study also limited to assessing medicine wastage measures in terms of KPI. The study will be undertaken in Addis Ababa federal hospitals namely Black Lion, St.Peter's TB specialized, Amanuel mental health specialized, ALERT center and St.Paul's hospitals.

The study does not investigate medicines wasted in retail pharmacies, in households, returned medicines to pharmacies and inpatient wards. In addition the study excludes medical supplies and equipment wastage.

1.7 Limitation of the study

Like any study this study has limitations these were:-The sample size contains small number of pharmacists and DTC members of the five federal hospitals in Addis Ababa which was addressed by narrowing the research objective to the study area and generalizing the study result to only the studied hospitals; the sampling technique used for the study was purposeful sampling which was addressed by generalizing the study result and providing recommendations specific to the studied hospitals; some questions were sensitive to participants and it was overcome by collecting data privately with participants. The sample size of the study was small that future research may include using large sample size and with wide constructs of supply chain.

1.8 Operational Definition of Terms

Essential medicines:- Are those that satisfy the priority health care needs of the population. They are selected with due regard to public health relevance, evidence on efficacy and safety, and comparative cost effectiveness. Essential medicines are intended to be available within the context of functioning health systems at all times in adequate amounts, in the appropriate dosage forms, with assured quality and adequate information, and at a price the individual and the community can afford (FMHACA, 2015).

Medication wastage:- In this study refers as all expired, damaged, improperly sealed or labeled or stored, counterfeit, substandard and adulterated, prohibited or unauthorized medicines (EFMACA, 2013).

Medicines wastage rate- It is the percentage calculated by dividing the wasted value in monetary forms to the total value of medicines received during the period (Gebremariam, Gebregeorgise and Fenta, 2019).

Federal Hospitals of Addis Ababa:- These are Black Lion, St. Paul ,ALERT center, Amanuel mental health, St Peter TB specialized , Defense and Police hospitals.

Medicine management cycle:- It involves management of Selection, Quantification, Procurement, Distribution and use of medicines (Iqbal, Geer and Dar, 2017).

Expired medicine: It is the condition when a pharmaceutical product loses its strength, quality and purity after some period of time which is specified on the labeling and packaging following extensive stability study(Farrugia, 2005).

1.9 Organization of the study

This study have five chapters; chapter one is Introduction about the study; Chapter two presents Review of relevant literature; Chapter three about the Methodology used to conduct the study; Data presentation, Results and Discussion of finding appear in chapter four; Finally Summary, Findings, Conclusion and Recommendation will appear in chapter five.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Theoretical Literature Review

Of the 43 papers which are systematically analyzed in 2010 only one study defined medication wastage or related terms using Delphi technique for the definition. The standard definition of medication wastage is "Any medication which expires or remains unused throughout the whole medicines supply chain. It also includes unnecessary or inappropriate consumption of medications by patients, or the unjustified non-adherence to treatment guidelines by healthcare professionals" (West, 2015; West *et al.*, 2015).

Ethiopian food, medicine and health care administration and control authority (EFMHACA) define medicine wastage as all expired, damaged, improperly sealed or labeled or stored, counterfeit, substandard and adulterated, prohibited or unauthorized medicines (Gebremariam, Gebregeorgise and Fenta, 2019).

2.1.1 Global medicine supply chain

Healthcare Supply Chain Management (HCSCM) defined as the information, supplies and finances involved with the acquisition and movement of goods and services from the supplier to the end user in order to enhance clinical outcomes while controlling costs (Jan and robbert, 2011).

The nine Logistics activities in the hospital pharmacy logistics system are planning of medicine supply, request of purchase order, reception of medicines, validation of package delivery, fitting and sorting of medicine packages, storage, preparation for distribution, distribution of medicines to the primary and secondary pharmacies and to automated equipment, and reverse logistics (Romero, 2013).

Medicine management cycle contain five core functions these are selection, quantification, procurement, distribution and use; due to this medicine wastage prevention focused on these core activities(Iqbal, Geer and Dar, 2017).

Medicine supply chain are unique First, supply chain management has an impact on human health needing right supply chain activities to meet the patients' needs; Second, pharmaceuticals are standardized so that they should pass tight standardization stages. Third, complex distribution

network composed of several storerooms and warehouses where different medical supplies are stored following multiple regulations. Fifth, healthcare supply chains are characterized by different stakeholders. Sixth, healthcare supply chains are high regulated and must respect a number of standards and procedures. Finally, healthcare supply chains are vulnerable to terrorism and criminal acts (Romero, 2013).

2.1.2 Ethiopian pharmaceutical supply chain management

Ethiopian hospital service transformation guideline (HSTG) endorsed by ministry of health is a performance standard and guidance aimed at ensuring efficient and quality pharmaceutical service delivery (Mekuanint, 2017).

Ethiopian pharmaceutical supply agency (EPSA) is responsible for procurement and distribution of quality assured medicines and medical equipment to public health facilities for fulfilling the six R's of pharmaceutical delivery that is the right medicine to the right patient with right quantity and condition at the right time and place (Mekuanint, 2017).

2.1.3 Ethiopian Medicine supply chain success: Enablers

2.1.3.1IPLS (Integrated pharmaceutical logistics system)

It is the term used for a single pharmaceutical reporting and distribution system based on the overall mandate and scope of EPSA. It integrates the management of essential medicines such as HIV/AIDS, Malaria, TB and leprosy and it is also a means by which public health facilities get medicines and supplies. At facility level it serves logistics management information system, inventory control system and storage of pharmaceuticals (Mekuanint, 2017).

2.1.3.2 HCMIS (Health Commodity Management Information System)

It is a systematic electronic record-keeping and reporting which enable to manage daily pharmaceutical transactions within facilities. It enables tracking issued commodities, batch and expiry of medicines, knowing consumption data, stock status of store, and loss and adjustments. It enable store manager aggregation of requirement then generate it in to a requisition form called report and requisition (RRF) to request from Ethiopian pharmaceutical supply agency (EPSA) which is the sole supplier of pharmaceuticals and medical supplies to public health facilities. It has two components inventory management and logistics management information system (Mekuanint, 2017).

2.1.3.3 APTS (Auditable pharmaceutical transaction and services)

It is an intervention designed by ministry of health with donor organizations; it is based on data to track information on pharmaceutical transaction that makes transaction transparent, measurable and accountable. It enables efficient budget utilization as a result of accountable transaction and reliable information in addition to this it has a system that enable for customer and professional satisfaction. Effective implementation of APTS results in quality pharmacy service and minimization of resource wastage (Beyene, Abuye and Tilahun, 2020).

2.2 Theoretical framework of the study

Medicine wastage occurs due to poor performance in the functions of medicine logistics cycle. The cycle has five major functions, heart of the cycle and the logistics environment which encompass policy and adaptability. Quality monitoring activities need to be done throughout the medicine supply chain cycle to ensure that objectives are met (Iqbal, Geer and Dar, 2017).

Fig 2.1: The Medicine Logistics Cycle

Source: John Snow, Inc. (2017).

2.1.4 Inventory Management

It is the activities which involved in developing and managing the inventory levels of raw materials, semi-finished (work-in-progress), and finished goods as a result adequate supplies are available and costs are minimized which are the major goals of inventory management.

A good inventory system result in an up to date inventory, good customer service, accurate information, good organization image, and it is one of the practice for reducing medicine wastage. On the other hand poor inventory management result in over- and under-procurement, out-of-stock, medicine shortage and multiple and unnecessary storage condition which is one factor for medicine expiry and obsolescence (Romero, 2013; Gurmu and Ibrahim, 2017).

Adequate inventory management result in the availability of essential medicines when needed as a result early death and communicable diseases can be prevented in addition to its main goal to reduce the costs associated with supplies at the same time maintaining patient care(Gurmu and Ibrahim, 2017; Moons, Waeyenbergh and Pintelon, 2019).

The scope of inventory management is coordinating the activities of purchasing, manufacturing, distribution functions to satisfy marketing and organizational needs; it also involves managing the replenishment lead time, replenishment of goods, returns of defective goods, carrying costs of inventory, asset management, physical inventory, available physical space, demand forecasting, inventory valuation, inventory visibility, future inventory price forecasting and quality management(Iqbal, Geer and Dar, 2017).

2.1.5 Procurement Management

Public procurement defined as the purchase of goods and services by governments and state-owned enterprises that generally accounts for a large share of public expenditure in a domestic economy(Iqbal, Geer and Dar, 2017).

The procurement process of medicines is inherently complex because it involves the coordination of ministry of health (MOH) agencies, funding sources, suppliers, and manufacturers. The lack of capacity to select, forecast, and quantify product requirements, and to manage the procurement process, disrupts the distribution of health commodities to the client thus effective procurement is required to ensure medicine security(Mekuanint, 2017).

The procurement of medicine is unique when compared with procurement of other commodities or capital goods due to the fact that pharmaceuticals are crucial for decreasing morbidity and mortality. Second medicine supply systems are also susceptible to corruption because they are highly regulated. Third long waiting times are not affordable in healthcare systems because patient condition may worsen substantially during the waiting. Fourth inefficient purchasing result additional cost to the overall health care. Finally Procurement practices affect inventory levels and ultimately the service provided to the consumer or patient in the case of hospital (Iqbal, Geer and Dar, 2017).

A sound procurement system has to accomplish two sets of conflicting goals for which policy makers and public procurement officers has to make tradeoff between; these are management goals and policy goals. The procurement management requirements include quality, timeliness, cost, minimizing business, financial and technical risks, maximizing competition and maintaining integrity. The procurement policy requirements normally include economic goals, green procurement, social goals and international trade agreements (Mekuanint, 2017).

2.1.6 Medicine Distribution

The major medicine distribution goal is to maintain a continuous supply of pharmaceuticals and supplies to facilities where and when they are needed, in addition to ensuring that resources are being utilized in the most effective manner. Storage and transportation costs are the major medicine distribution costs of health care supply chain thus effective pharmaceutical distribution system design and good management is required to control these costs; adequate and dedicated transportation facilities laced with cold chain maintenance are an important factor in maintaining timely distribution of quality medicines round the clock at health facilities.

Internal distribution of pharmaceuticals in a hospital is complex, as different types of pharmaceuticals need to be delivered from different storage areas to various point-of-use locations, different actors, uncertain demand and short life cycles of medicines(Moons, Waeyenbergh and Pintelon, 2019).

In addition to the above factors every activity in the distribution of pharmaceutical products should be carried out in accordance with the guidelines on Good Storage Practices and Good Distribution Practices as applicable (Iqbal, Geer and Dar, 2017).

2.1.7 Customer Service

One way of delivering quality health care is to ensure the rational use of medicine. Rational use of medicines defined as delivering medicines to the patient that are appropriate to their conditions, in the right dose, in the right time and the lowest cost possible. It includes providing medicines according to regulation, drug monitoring, information flows, patient education and performance improvement functions(Mahmood et al., 2016;Iqbal et al., 2017).

2.3 Empirical Literature review

Medicines are the second expenditure in a countries health care system, 40-60 % of public health care budget goes for buying medicines although 70 % of resources are wasted due to poor drug management(Iqbal, Geer and Dar, 2017).

Pharmaceutical supply chain management in Ethiopia aimed at increasing the availability of essential medicines at the same time decreasing wastage to less than 2% according to five years plan of ministry of health Ethiopia (Mekuanint, 2017).

Although there are many factors contributing to medicine wastage this study investigates supply chain factors aspects of medicine wastage. This factors are mainly supply chain management major activities, HCMIS and the logistics environment.

2.3.1 Supply chain factors contributing to medicine wastage

A variety of essential and vital drugs are reported wasted in a study conducted in Kampala and Entebbe Uganda due to three major factors in the medicine supply chain these are procurement, inventory management and medicine usage. Details of these include neglect of stock monitoring, lack of knowledge of basic expiry prevention tools, non-participation of clinicians in medicine quantification in hospitals, profit- and incentive-biased quantification, third party procurement by vertical programs and overstocking. Push system of procurement is mentioned in another study at Kilembe hospital in Uganda for contributing medicine expiry and stock out (Nakyanzi *et al.*, 2010; Tumwine *et al.*, 2010).

Supplier related factors are one of the major factors identified contributing to medicine wastage in a study conducted in south west shoa Ethiopia it includes issuing near expiry medicines and not based on health facility needs. The other factors are health institution related for example not using first expire first out principle and management attitude; absence of electronic system to

control stock and lack of trained professionals and their poor practice (Gebremariam, Gebregeorgise and Fenta, 2019).

Poor inventory management was another major factor identified in a study conducted in Ethiopia contributing for medicine wastage and expiry; underlying factors for poor inventory management were shortage of finance, lack of information and human power. Medicine expiration is significantly associated and contributes to 26 % of total and on average 10.43% of key essential medicines wastage in a study conducted at East ShoaOromia regional state. The factors the study identified for medicine wastage were receiving near expiry medicines 55%, inadequate store room 75%, not applying FEFO 25%,poor protection from sunlight 40% (Gebremariam, Gebregeorgise and Fenta, 2019, 2019).

The study in Awi zone identified reasons for medicine expiry, pilferage and obsolescence are PFSA pushing medicines without need, different prescription pattern, quantification problem, poor drug and therapeutic committee, poor data quality, knowledge gap, communication problem, substandard infrastructure for storage of pharmaceuticals. It also revealed of the four hospitals investigated only two have fulfilled the criteria of good storage condition (Ebrahim, Teni and Yimenu, 2019).

2.3.2Extent of medicine wastage

A study conducted in various countries estimated extent of medicine wastage; it ranges from 60 to 20,304 medicines. According to one literature review; medicine waste incur a lot of money it is estimated from 60 euro to over 770,000 euro; in England annual cost of unused prescription reached £300 million (tadeg *et al.*, 2014; West, 2015).

A study in Saudi Arabia and the gulf countries found that the mean percentage of wasted medicines to be 25.8% and 41.3% with mean expired medicines per family 2.2 and 2.7 respectively. The study estimated $15 million medicines are wasted annually.

In a study conducted at Uganda US$550,000 worth of anti-viral and 10 million antimalarial medicines were reported expired in Uganda's National Medical Stores (NMS). Moreover many essential medicines were reported expired at the National Medical Stores, in district and hospital stores (Nakyanzi *et al.*, 2010).

In a study conducted in South Africa Johannesburg form Jan 2011 to June 2014 a total of 32,368 unit packs with a value of R 838,029 of medicine had expired of these more than 80 % were in the essential drug list containing antibiotics and antivirals. Injections were the highest

value of medicine to expire in this study. The study found a 0.6% annual revenue loss of the pharmaceutical budget due to this wastage (Sauls, 2016).

A study in East ShoaOromia and in AWI zone found an estimate of 174,366.98 ETB and 606,545 ETB worth medicine were lost due to medicine wastage respectively. The reason for these loses are poor pharmaceutical supply chain management (Gurmu and Ibrahim, 2017; Ebrahim, Teni and Yimenu, 2019).

2.3.3 Consequences of medicine wastage

Medicine wastage has direct and indirect consequences; the direct impact include economic aspect for government, society, and individuals from unused prescriptions, disposal cost, and wasted time during prescribing and dispensing; the indirect cost is the environmental and public health impact of medicine wastage disposal. Unused medicines at home has a risk of self-poisoning (West, 2015;Abu- Auda 2003)

Waste in the health care supply chain is causing increment of logistics operation costs estimated from 20%-45% of hospital operating budgets, for example handling, moving and processing of materials. As a result of this good logistics practice in a hospital is very crucial (Moons, Waeyenbergh and Pintelon, 2019).

Crowded store, lack of budget and stock out of medicines are the major consequences of medicine wastage revealed in a study conducted at south west Shoa Ethiopia public health facilities(Gebremariam, Gebregeorgise and Fenta, 2019).

2.3.4Literature Gap

Table: 2.1 Summary of literature review

Scholar/Author	Study	Factors of medicine wastage constructs	Major findings	Study limitation
(Nakyanzi et al., 2010)	Expiry of medicines in supply outlets of Uganda	Procurement, Quantification, inventory management and usage	Poor Stock-monitoring, lack of knowledge of basic expiry prevention tools, nonparticipation of clinicians in medicine quantification in hospitals, profit- and incentive-biased quantification, third party procurement by vertical programmes and overstocking.	Limited sample size
(Gebremariam et al., 2019)	Factors contributing to medicines wastage in public health facilities of South West Shoa Zone	Medicine quantification, and inventory management, HCMIS, Trained human resource, key stake holders communication, warehousing condition	Near expiry medicines (< 6 months) are being delivered to the health facilities by the supplier,`` Poor stock management, Lack of electronic stock management tools Shortage of pharmacy professionals in the facilities	Doesn't include unused medicines at wards and perspective of other stake holders

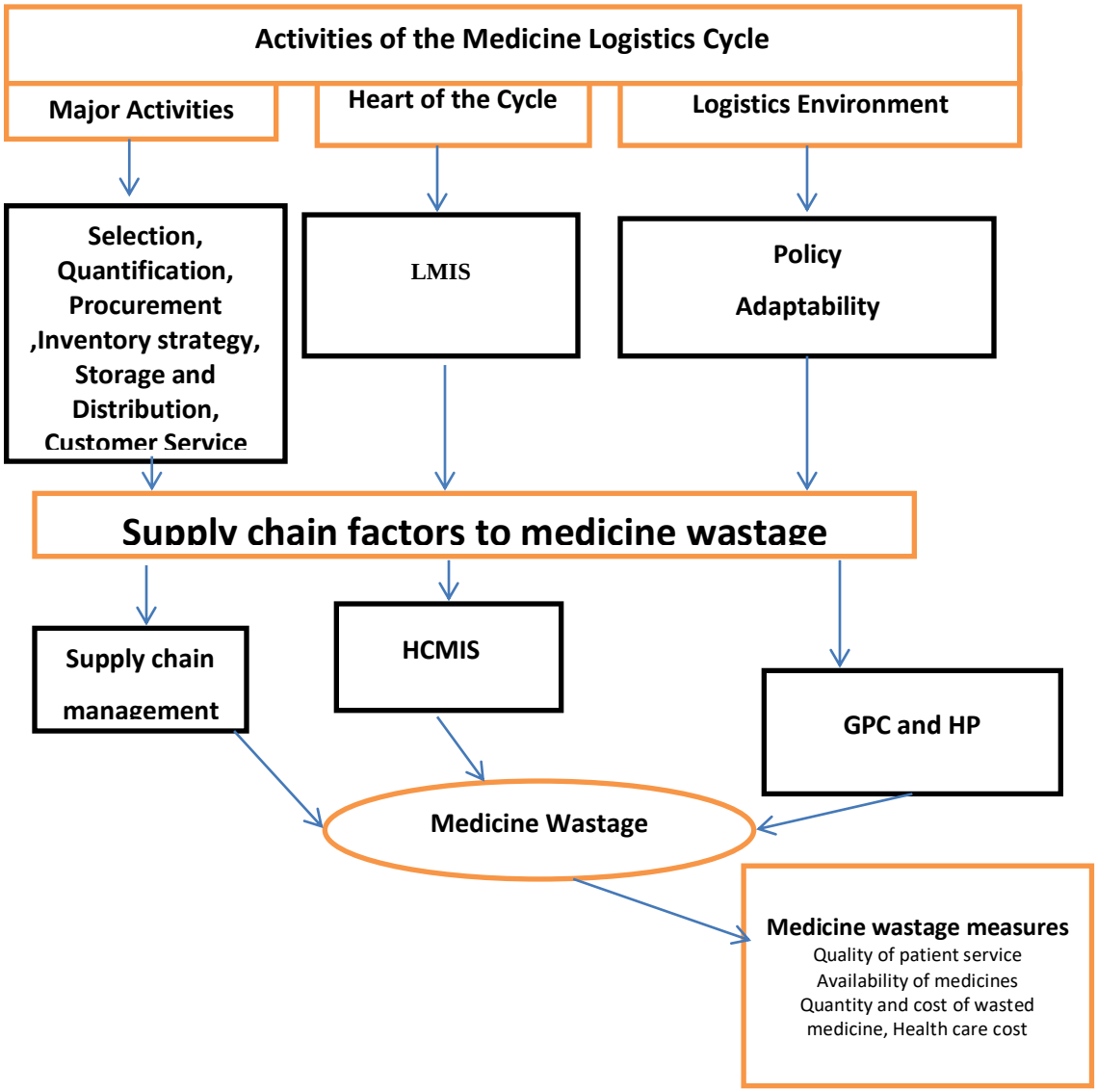
(Kagashe et al., 2014)	Medicine wastage at tertiary hospital in Dar Es Salaam Tanzania	Medicine usage practice at inpatient wards	Excess, pilferage, death and stop of the treatment are major sources of wastage	lack patient opinions for the reason of wastage
(Peltoniemi and Suomi, 2019)	Eliminating medicine waste in a Finnish university hospital — a qualitative study	Information and communication system	Inconsistent information system, lack of integration, poor usability of IT applications, frequent ordering process, inaccurate metrics	The study doesn't include senior management of the hospital and IT vendors
(Hakuzimana, 2019)	Assessment of factors contributing to medicines expiry in Rwanda: The case of central medical store; MPPD	Excess drug supply, poor storage condition, drug supply management	Supply chain management, storage management, excess drug supply and other factors influence drug expiry	The study is limited in only one hospital thus it can't be generalized to other areas, The questions are not well customized
(Mashishi, 2015)	Expiration of drugs in public hospital pharmacies of Sekhukhune district, Limpopo province, South Africa.	Medical Supply demand management, Inventory management, Expiry management	Overstocking, prescribing pattern; short half-life medicine supply; poor stock rotation and minimum and maximum order levels.	Doesn't investigate other factors for medicines expiry

Source: Researcher's Own (2021)

2.2.4 Conceptual Framework of the study

Based on the review of relevant literature the following conceptual framework was developed which guide the study and shows the relationships of variables. The framework shows the logistics cycle with major activities, heart of the logistics cycle, quality monitoring and logistics environment; supply chain factors causing medicine wastage which were put in three major dimensions and indicators of medicine wastage. Supply chain medicine wastage was operationalized mainly in terms of quality of patient care, availability of needed medicines, quantity of expired medicines and health care cost.

Figure 2.1: Conceptual Framework of the Study



CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Description of Study Area

The study supply chain factors contributing to medicine wastage was conducted at five federal hospitals of Addis Ababa. These federal hospitals are ALERT center, Amanuel mental health specialized, Black lion , St. Paul's and St. Peter's TB specialized. Black lion hospital was the first and the only one referral hospital in Ethiopia now it is a center of specialty, sub specialty health services and is now the main teaching hospital for both clinical and preclinical training's of most disciplines. It is administered under higher education and innovation minister. St. Paul hospital is engaging in health care and training to its students through its different biomedical and clinical departments; it is also a teaching hospital. ALERT is the highest level of referral hospital for leprosy complication in and also a WHO recognized international training center. St. Peter's TB specialized is established for initially TB screening and treatment center in addition to that currently it is also providing other health services; Amanuel mental health hospital is specialized in delivering mental health services.

3.2 Research Approach

Qualitative research approach was employed to meet the objectives of the study. Respondents answers were put on a five- point Likert scale (1 = strongly disagree, 2 = disagree, 3 = neutral (neither agree nor disagree),4 = agree, 5 = strongly agree) because it enable response quantifiable, obtaining both opinion and emotion, in addition it is easy and cheap for analysis.

3.3 Research Design

Explanatory research design was used for the survey which is relevant in such studies which try to understand cause effect relationship of a particular problem. As a result conclusion can be drawn on supply chain factors contributing to medicine wastage.

3.3.1 Unit of analysis and Level of analysis

Supply chain factors that are contributing to medicine wastage were the unit of analysis of the study. They were analyzed and observed for which data collected in the form of variables. The level of analysis of the study is on the hospital's medicine store and retail pharmacies perspective.

3.4 Target Population

The study target populations were five federal hospitals of Addis Ababa. These were ALERT Center, Amanuel mental health specialized, Black Lion, St. Paul's and St. Peter's TB specialized hospitals.

3.5 Sample Size

Due to nature of the problem, time and financial limitations Carvalo's sample size determination was used to select 98 participants from 305 population. Pharmacists who are in position of different pharmacy units for example DSM officers, heads of the pharmacy directorate, store managers, retail managers and pharmacists who engage in purchasing and do the invoices of each hospitals and One participant who are in the DTC committee of each hospitals were taken as a sample size.. This is because of they know the problem well as a result they can provide enough and valuable information. There were 12 non-respondent and 6 incomplete questionnaires at all hospitals except Amanuel hospital; after excluding these the sample size obtained were 17, 13, 11, 20 and 19 in Black Lion ,ALERT, Amanuel ,St. Paul's and St. Peter's hospitals respectively. The response rate was 80/98* 100=81.6%

Table 3.1: Carvalho's Sample Size Determination

Population size	**Sample size**		
	Small	**medium**	**Large**
51-90	**5**	**13**	**20**
91-150	**8**	**20**	**32**
151-280	**13**	**32**	**50**
281-500	**20**	**50**	**80**
501-1200	**32**	**80**	**125**
1201-3200	**50**	**125**	**200**
3201-10,000	**80**	**200**	**315**

10,001-35,000	**125**	**315**	**500**
35,001-150,000	**200**	**500**	**800**

Table 3.2: Sample size of the study

Name of the Hospital	**BL Hospital**	**ALERT Center**	**AM Hospital**	**St. Paul's Hospital**	**St.Peter's Hospital**	**Sum**
Total number of pharmacy professionals	**78**	**33**	**42**	**87**	**60**	**300**
DSM Officer	**3**	**1**	**1**	**3**	**3**	**11**
Pharmacist who engage in Purchasing activity	**2**	**2**	**1**	**2**	**4**	**11**
Pharmacy Director	**1**	**1**	**1**	**1**	**1**	**5**
Case team or Retail leaders	**10**	**8**	**5**	**12**	**5**	**40**
Store members	**6**	**4**	**2**	**6**	**8**	**26**
DTC member Nurse/ Physician	**1**	**1**	**1**	**1**	**1**	**5**
Sample taken	**23**	**17**	**11**	**25**	**22**	**98**

Source: Researcher's Own (2021)

3.7 Data Collection Procedure

Data was collected through administering structured questionnaire containing closed ended questions. The questionnaire had five point Likert scale to determine relative strength of contributing factors. The questionnaire had two parts. Part 1 for the respondent's demographic characteristics, Part 2 had questions on research objectives. Questionnaires were administered to hospitals employees personally to shorten the response time and it enabled on the spot clarification of any doubts that the respondents might have regarding any questions. However, for respondents who were having time constraints the questionnaire was administered through

drop and pick later method. The structured questionnaire enabled similarity in the question asked and compatibility in the reply provided.

3.8 Validity and Reliability Test

3.8.1 Validity Test

Validity of the standard questionnaire was tested on 8 pharmacy and 1 nurse professionals who are working other than the selected hospitals in which they understand and respond as intended. This assured validity of the constructed questionnaire. The questionnaire used for the data collection was adapted from Gebremariam et al., 2019 and Hakuzimana, 2019; the questions used in this study were tested by previous researchers which add validity to the study.

3.8.2 Reliability Test

The questionesaires reliability assessed with Cronbach's Alpha taking .Cronbach's Values of greater than 0.7 are considered reliable (Nunnally,1978). Since the Cronbach's Alpha value of the 30 questions used in the study was greater than 0.7 the instrument is reliable.

Table 3.3: Reliability of SC factors and Medicine Wastage

Reliability Statistics		
Cronbach's Alpha	**Cronbach's Alpha Based on Standardized Items**	**N of Items**
0.853	**0.848**	**30**

Source: Research Analysis Data,2021

3.9 Method of Data Analysis

The data collected was analyzed based on the objective and the variable of interest to be discussed. Data collected were coded to easily group to various categories to know the position the participants hold. Qualitative data collected was analyzed through correlation analysis and regression analysis using statistical package for social science (SPSS) version 20. Statistical analysis of mean, median, percentage, frequency and standard deviation had been used to present the findings and the results were presented in tables. The dependent variable was

medicine wastage and the independent variables were supply chain factors which contribute to medicine wastage.

3.10 Ethical Consideration

Ethical approval was obtained from ethics review committee of Addis Ababa University. Prior to data collection willingness of participant to participate was obtained after the overall objective and benefits of the study were explained. In addition participant information was kept anonymous and also they were kept from any physical or psychological harm. Finally findings were analyzed without manipulation of participant ideas.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Response Rate

The study aimed to collect data from 98 participants of these 80 participants response obtained which was valid and used for analysis thus the response rate of the study is 81.6 %.

4.2 Descriptive Statistics

4.2.1 Socio Demographic characteristics of Participant

The total sample size is eighty (80) of these male study participants are half double than female study participant 53 versus 27 respectively. Regarding hospital sex distribution of Amanuel hospital has higher number of female study population of eleven (11) participant seven (7) are female. Due to nature of the problem the major study participants are pharmacy professionals who are working in different position at the studied hospitals. Nurse and physician are included because they are the DTC members who has knowledge of the problem.70 Pharmacist,5 Druggist,3 Nurse,1 Physician and 1 Health officer are the study participants. The minimum work experience is 1.6 years and the maximum work experience is 13 years. Highest 48.8% of respondents are in the 1-5years experience category and 45.0% in the 6-10 years of experience category the rest percentage comprise above 10years experience. St.Paul hospital and St.Peter hospital comprise higher percentage of the study sample population 25% and 23.8% respectively. This is because they have higher number of target employees than other hospitals.

Table 4.1: Socio demographic table

Variable				Category	Frequency	Percent	Cumulative Percent
Sex				Male	53	66.30%	66.30%
				Female	27	33.80%	100
				Total	80	100	
Profession				Pharmacist	70	87.5	87.5
				Druggist	5	6.3	93.8
				Nurse	3	3.8	97.6
				Physician	1	1.3	98.9
				Other	1	1.3	100
				Total	80	100	
Work experience	Minimum	Maximum	Mean	1-5	39	48.8	48.8
	1.6	13	5.89	6-11	36	45	93.8
				12-15	5	6.3	100
				Total	80	100	
Sampled Hospitals				ALERT	13	16.3	16.3
				Amanuel Hospital	11	13.8	30.1
				Black lion Hospital	17	21.3	51.4
				St.Pauls Hospital	20	25	76.4
				St.Peters Hospital	19	23.8	100
				Total	80	100	

Source: Researcher's Own (2021)

4.2.1 Supply chain factors contributing to medicine wastage of the selected Hospitals in Addis Ababa

Table 4.2: Supply Chain Factors and Medicine wastage measures mean and standard deviation.

	Mean	Std. Deviation
SCM	**3.97**	**0.595**
Storage condition	**3.08**	**0.759**
GLP and HP	**3.64**	**0.733**
HCMIS	**2.93**	**1.209**
Quality of Patient Care	**3.75**	**0.879**
Shortage of medicines	**3.25**	**0.893**
Extent of Medicine Wastage	**3.45**	**1.054**
Health Care Cost	**3.72**	**0.927**
Valid N (listwise)	**80**	

Source: Researcher's Own (2021)

4.2.1.1 Supply chain management factors

Supply chain management factors construct has average mean of 3.97 and with standard deviation of 0.595. Supply chain management factors to medicine wastage are assessed with nine questions and the participant frequency distribution are presented in the table below. More than 60% of respondents agree to six questions which assess supply chain management problem.75% (mean=3.69) of the respondents agree with presence of over stocked medicines due to improper forecasting of need in the hospital; Poor communication and coordination with key stake holders agreed by 78.8% (mean=3.66) of respondents ;Near expiry medicines (< 6months) are being delivered to the hospital was agreeable by 77.5% (mean 3.83) of the respondent and there is over supply of some medicines agreed with 82.6%(mean=3.86) of the respondents;61.3% (mean=3.37) of the respondents agree for the presence of discrepancy between physical count and stock cards. Procurement practice is causing medicine wastage was agreeable by 73.8% (mean=3.64).

Table 4.3: Supply chain management factors frequency distribution

Contributing Factors	Strongly Disagree n%	Disagree n%	Neutral n%	Agree n%	Strongly Agree n%	Mean	Std. Deviation
Selection of medicine is based on (Vital, essential, Non essential)	6 (7.5)	5 (8.8)	7(8.8)	46 (57.5)	14(17.5)	3.84	1.07
Presence of over stocked medicines duetoimproper forecasting of need in the hospital	6 (7.5)	7 (8.8)	7(8.8)	46(57.5)	14(17.5)	3.69	1.09
Poor communication and coordination with key stake holders (MOH, suppliers, NGO's)	7(8.8)	6(7.5)	4(5.0)	53(66.3)	10(12.5)	3.66	1.08
Near expiry medicines (< 6months) are being delivered to the hospital	4(5.0)	4(5.0)	10(12.5)	46(57.5)	16(20.0)	3.83	0.98
Medicines to treat rare diseases are procured in the hospital	7(8.8)	14(17.5)	25(31.3)	30(37.5)	3(3.8)	3.1	1.03
There is over supply of some medicines	4(5.0)	6(7.5)	4(5.0)	49(61.3)	17(21.3)	3.86	1.00
Weak physical security in the vehicle during transportation of	6(7.5)	11(13.8)	37(46.3)	20(25.0)	6(7.5)	3.11	0.99

medicines							
There is discrepancy between physical count and stock cards	**9(11.3)**	**11(13.8)**	**11(13.8)**	**39(48.8)**	**10(12.5)**	**3.37**	**1.21**
Procurement practice is causing medicine wastage	**1(1.3)**	**9(11.3)**	**11(13.8)**	**56(70.0)**	**3(3.8)**	**3.64**	**0.78**

Source: Researcher's Own (2021)

4.4.2 Storage Condition

The storage condition construct has average mean of 3.08 and standard deviation of 0.759.The storage conditions of the hospitals reason to medicine wastage are assessed with four qualitative questions and the results are presented in the table below. 50% of the respondent disagreed on the presence of the warehousing problem and agree on adequate shelf life maintenance.

Table 4.4:Storage condition frequency distribution

	Strongly Disagree n%	**Disagree n%**	**Neutral n%**	**Agree n%**	**Strongly Agree n%**	Mean	**Std. Deviation**
Is adequate shelf life of products maintained	**4 (5.0)**	**16(20.0)**	**12(15.0)**	**40(50.0)**	**8(10.0)**	**3.4**	**1.07**
Medicines are stored on floor, and not arranged systematically on shelves in the hospital	**18(22.5)**	**32(40.0)**	**9(11.3)**	**19(23.8)**	**2(2.5)**	**2.44**	**1.17**
There is not enough space for handling and moving products in the store	**14(17.5)**	**29(36.3)**	**8(10.0)**	**23(28.8)**	**6(7.5)**	**2.72**	**1.26**

Medicines that need cold temperature are not stored in a functional refrigerator in the hospital	**27(33.8)**	**30(37.5)**	**7(8.8)**	**11(13.8)**	**5(6.3)**	**2.21**	**1.23**

Source: Researcher's Own (2021)

4.4.3 Guideline Policy Changes and Hospital Practice

GPC & HP construct has average mean of 3.64 and a standard deviation of 0.733.More than half of the respondents agree on four questions of six questions that assess guideline and policy change and that assess the hospital practice factors to medicine wastage these are poor monitoring and evaluation 67.6% (mean=3.46); 70.1 % (mean=3.47) of participants agree on absence of fully functional DTC; treatment and or policy changes was agreeable with 63.8% (mean=3.63). Non-participation of other professionals in medicine selection and quantification was agreeable by 65% (mean=3.33) of the respondents.

Table 4.5: Guideline & policy change and Hospital practice frequency distribution.

Contributing Factors	Strongly Disagree n%	Disagree n%	Neutral n%	Agree n%	Strongly Agree n%	Mean	Std. Deviation
Poor stock management like using neither FIFO nor FEFO in stock management	**19(23.8)**	**29(36.3)**	**10(12.5)**	**17(21.3)**	**5(6.3)**	**2.5**	**1.24**
Weak or no mechanisms for medicine wastage monitoring and evaluation in the hospital	**5(6.3)**	**14(17.5)**	**7(8.8)**	**47(58.8)**	**7(8.8)**	**3.46**	**1.08**

Absence of functional DTC in the hospital	**7(8.8)**	**11(13.8)**	**6(7.5)**	**49(61.3)**	**7(8.8)**	**3.48**	**1.11**
Treatment or policy changes has led to wastage of medicines	**1(1.3)**	**8(10.0)**	**20(25.0)**	**42(52.5)**	**9(11.3)**	**3.62**	**0.86**
Non-participation of other professionals in medicine selection and quantification of the hospital facility	**8(10.0)**	**16(20.0)**	**4(5.0)**	**46(57.5)**	**6(7.5)**	**3.32**	**1.18**
Lack of accountability for stock-outs and wastage of medicines in the hospital	**11(13.8)**	**20(25.0)**	**14(17.5)**	**24(30.0)**	**11(13.8)**	**3.05**	**1.29**

Source: Researcher's Own (2021)

4.4.4 Health Commodity Management Information System

HCMIS construct of the study result shows that it has average mean of 2.93 and a standard deviation of 1.209.Health commodity management information system was assessed with two questions. The result reveal slightly more than 50% of the respondents disagree on the presence of the problem.

Table 4.6: Health Commodity Information System frequency distribution

	Strongly Disagree n%	Disagree n%	Neutral n%	Agree n%	Strongly Agree n%	Mean	Std. Deviation
No accurate data available in the hospital to facilitate quantification of medicines	**15(18.8)**	**25(31.3)**	**3(3.8)**	**33(41.3)**	**4(5.0)**	**2.82**	**1.29**
Lack of electronic stock management tools that automatically capture medicines wastage in the hospital	**13(16.3)**	**32(40.0)**	**7(8.8)**	**18(22.5)**	**10(12.5)**	**2.75**	**1.32**

Source: Researcher's Own (2021)

4.3 Medicine Wastage Operational Measures

Medicine wastage was measured in terms of quality of patient care, shortage of essential medicines, quantity and cost of wasted medicines. Quality of patient care construct has average mean of 3.75 and a standard deviation of 0.879. Quality was assessed with three questions in which participants disagree on patient's service compromised and postponing of procedures. But 90 % (mean =4.02) of respondents agree on unavailability of essential medicines for more than 15days.

Table 4.7: Quality of patient care frequency distribution

Quality of patient care	Strongly Disagree n%	Disagree n%	Neutral n%	Agree n%	Strongly Agree n%	Mean	Std. Deviation
Patients receive substandard (compromised) service due to wastage of medicines	11(13.8)	23(28.8)	15(18.8)	28(35.0)	3(3.8)	2.86	1.16
Some essential medicines are not available for longer period (> 15 days)	5(6.3)	1(1.3)	2(2.5)	46(57.5)	26(32.5)	4.09	0.93
Procedures are postponed due to medicine wastage (expiry, damage)	3(3.8)	20(25.0)	21(26.3)	28(35.0)	8(10.0)	3.22	1.06

Source: Researcher's Own (2021)

Shortage of medicine result shows that it has average mean of 3.25 and a standard deviation of 0.893.Shortage of medicine was assessed with two questions; shortage of essential medicines by type and quantity due to wastage and Patients are treated with less effective medicines due to medicine expiry. Shortage of essential medicines gets 72.5 % positive response with mean of 3.55.

Table 4.8: Shortage of essential medicines frequency distribution

Shortage of essential medicines	Strongly Disagree n%	Disagree n%	Neutral n%	Agree n%	Strongly agree n%	Mean	Std. Deviation

There is shortage of essential medicines by type and quantity due to wastage	**7(8.8)**	**6(7.5)**	**9(11.3)**	**52(65.0)**	**6(7.5)**	**3.55**	**1.04**
Patients are treated with less effective medicines due to medicine expiry	**11(13.8)**	**31(38.8)**	**20(25.0)**	**17(21.3)**	**1(1.3)**	**2.58**	**1.02**

Source: Researcher's Own (2021)

Extent of medicine wastage result show that it has average mean of 3.45 and a standard deviation 1.054.Extent of medicine wasted was assessed with the quantity and cost of medicine wasted. 59% (mean=3.15) agree on high quantity of medicine wasted and 71.3 % (mean =3.46) of participant agree on the high value of medicine wasted.

Table 4.9: Extent of medicine wasted frequency distribution.

Extent of wasted medicines	**Strongly Disagree n%**	**Disagree n%**	**Neutral n%**	**Agree n%**	**Strongly Agree n%**	**Mean**	**Std. Deviation**
Large quantities of medicines are wasted than recommended (> 2%)	**11(13.8)**	**18(22.5)**	**3(3.8)**	**44(55.0)**	**4(5.0)**	**3.15**	**1.23**
High value of medicines are wasted	**9(11.3)**	**9(11.3)**	**5(6.3)**	**50(62.5)**	**7(8.8)**	**3.46**	**1.16**

Source: Researcher's Own (2021)

Health care cost impact of medicine wastage was assessed with two questions which has average mean of 3.72 (Std.dev 0.927) these were high health care cost incurred due to medicine wastage (Logistics operation cost, disposal cost) and patients are forced to buy expensive

medicines due to wastage; 75% (mean=3.82) and 53.8 % (mean=3.28) of participant agreed respectively.

Table 4.10: Health care cost frequency and percentage distribution.

Health care cost	Strongly Disagree n%	Disagree n%	Neutral n%	Agree n%	Strongly Agree n%	Mean	Std.Deviation
High health care cost incurred due to medicine wastage (Logistics operation cost, disposal cost)	**3(3.8)**	**6(7.5)**	**3(3.8)**	**58(72.5)**	**10(12.5)**	**3.82**	**0.88**
Patients are forced to buy expensive medicines due to wastage	**9(11.3)**	**13(16.3)**	**15(18.8)**	**32(40.0)**	**11(13.8)**	**3.28**	**1.22**

Source: Researcher's Own (2021)

4.3 Inferential Statistics of SC factors and Medicine wastage Operational Measures

4.3.1 MultiCollinearity Test

Table 4.11: MultiCollinearity test of SC factors

Model	Tolerance	VIF
SCM	0.86	1.163
Storage Condition	0.782	1.278
GPC & HP	0.695	1.439
HCMIS	0.74	1.336

Source: Research Data,2021

Dependent Variable: Medicine wastage

4.3.2 Correlation analysis

The correlation analysis conducted between SC factors and medicine operational measures. Correlation deals about the relationship between two variables and its value range from -1 to +1 ; values which are +1 indicate strong relationship whereas value -1 indicate no or little relationship. The correlation coefficient in the correlation analysis indicate the strength and the direction of the relationship and the p-value indicate significance of the relationship.

4.3.2.1 Correlation analysis between Supply chain factors and Medicine wastage operational measures

Correlation analysis between SC factors of SCM, Storage condition, Guideline and policy change and hospital practice and HCMIS with medicine wastage operational measure presented in the following table.

Table 4.12: Correlation matrix between SC factors constructs and Medicine wastage

		SCM	Storage condition	Guideline and policy change &HP	HCMIS	MW
SCM	Pearson Correlation	1	.369**	0.182	0.138	0.183
	Sig. (2-tailed)		0.001	0.106	0.222	0.105
	N	80	80	80	80	80
Storage condition	Pearson Correlation	.369**	1	.345**	.227*	.314**
	Sig. (2-tailed)	0.001		0.002	0.043	0.005
	N	80	80	80	80	80
GLP &HPcategory	Pearson Correlation	0.182	.345**	1	.497**	.486**
	Sig. (2-tailed)	0.106	0.002		0	0

	N	80	80	80	80	80
HCMIS	Pearson Correlation	0.138	.227*	.497**	1	.352**
	Sig. (2-tailed)	0.222	0.043	0		0.001
	N	80	80	80	80	80
MW	Pearson Correlation	0.183	.314**	.486**	.352**	1
	Sig. (2-tailed)	0.105	0.005	0	0.001	
	N	80	80	80	80	80

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

Source: Research Data,2021

The table above indicate that SCM has minimum or no relationship with medicine wastage performance with Pearson coefficient of 0.183 (r=0.183).The storage condition correlation with medicine wastage performance indicate that there is strong relationship with correlation coefficient of 0.314(r=0.314) with significant value of 0.005.Guideline and policy change and hospital practice has a strong relationship with medicine wastage performance with Pearson correlation of 0.486 (r=0.486) and significant value of less than 0.001.This indicate that guideline and policy change and hospital practice has strong and positive relationship with medicine wastage performance. HCMIS correlation with medicine wastage performance measure has moderate relationship with Pearson coefficient of 0.352 and has significant value of 0.001.

4.3.2.2 Correlation between SC factors and medicine wastage

Table 4.13: Correlation matrix between SC factors and medicine wastage

		SCF	Medicine wastage
SCF	Pearson Correlation	1	.445**
	Sig. (2-tailed)		0
	N	80	80
Medicine wastage	Pearson Correlation	.445**	1
	Sig. (2-tailed)	0	
	N	80	80

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

Source: Research Data,2021

The Correlation test between SC factors and medicine wastage indicate that there is a moderate positive relationship with Pearson correlation coefficient of 0.445 and significant at p value of 0.

4.3.3 Regression analysis

Linear regression was done between SC factors and medicine wastage; p value of less than 0.05indicate statistical significant effect of SC factors on medicine wastage. The model is presented as follows; Linear regression model:

$Y = \beta0 + \beta1\ X1 + \beta2\ X2 + \beta3\ X3 + \beta4\ X4 + \epsilon$ where Y = Medicine wastage ; β0= the y intercept when x is zero; β1, β2, β3, β4, are regression coefficients of the following variables respectively; x1- SCM; x2- storage condition; x3-GPC& HP; x4- HCMIS; ϵ is the error term

As shown above there is no co-linearity problem of independent variables due to the tolerance value is greater than 0.1 and the VIF is <10.

4.3.3.1 Coefficient of determination

Table 4.14: Coefficient of determination R square

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.525a	0.276	0.237	0.666

Source: Research Data,2021

Predictors: (Constant), SCM, storage conditions, Guideline & policy change and hospital practice and HCMIS

The coefficient of determination, adjusted R2 0.237 meaning that 23.7% of variation in medicine wastage is explained by variation in SCM factors, storage conditions, Guideline & policy change and hospital practice, HCMIS. The reason for the very low adjusted R square could be that there may be other dimension of SCM, storage condition, guideline policy changes and hospital practices and HCMIS that contribute to medicine wastage. In addition the small number of the constructs have resulted small value of the coefficients.

4.3.3.2 ANOVA Test

Table 4.15: ANOVA Test

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	12.68	4	3.17	7.146	.000b
Residual	33.27	75	0.444		
Total	45.95	79			

Source: Research Data,2021

a Dependent Variable: Medicine wastage

b Predictors: (Constant), SCM , storage condition , Guideline &Policy change and hospital practice, HCMIS

The ANOVA test result above shows the regression model has a less than 0.001 probability of giving wrong prediction. As a result the model is the appropriate predictor that determine SC factors impact on medicine wastage.

4.3.3.3 Coefficients Results

Table 4.16: Coefficients Results

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	1.485	0.584		2.545	0.013	0.323	2.648
SCM	0.059	0.136	0.046	0.436	0.664	-0.211	0.33
Storage condition	0.142	0.112	0.141	1.272	0.207	-0.08	0.364
Guideline and policy change and hospital practice	0.377	0.123	0.363	3.076	0.003	0.133	0.621
HCMIS	0.084	0.072	0.133	1.174	0.244	-0.059	0.227

a Dependent Variable: Medicine wastage

Beta values measure the magnitude of influence between variables, the higher the values indicate the strong the influence. The regression analysis formula with Beta coefficients is as follows:

$Y = 1.485 + 0.059X1 + 0.142X2 + 0.377X3 + 0.084X4 + \epsilon$. The model shows that when all variables are held at zero (constant), the value of Medicine wastage would be 1.485. However when holding other factors constant, a unit increase in SCM factors would lead to a

0.059increasein medicine wastage, a unit increase in storage condition lead to a 0.142 increase in medicine wastage, a unit increase in GPC and hospital practice result a 0.377 increase in medicine wastage which means it has great impact on medicine wastage compared to other factors, and a unit increase in HCMIS effect a 0.084 increase in medicine wastage. To put the influence from highest to lowest impact GPC&HP>Storage Condition > HCMIS > SCM.

4.4 Discussion of the Results

More than 60% of participant agree to questions which assess supply chain management problem. Generally SCM factors has little or no relationship and the relationship is not also significant with medicine wastage with Pearson coefficient of 0.183 and p-value of 0.105 which is contradictory to the findings of Gebremariam et al., 2019; Ebrahim et al., 2019; Mashishi, 2015; and Nakyanzi et al., 2010;this may also be due to the small sample size of the study. The presence of over stocked medicine has inventory holding cost which tied up the capital which may otherwise be used for purchasing unavailable medicines, result in deterioration ,damage of the medicines and crowded store. Poor communication with stake holders within and outside the institution can cause excess supply of medicines as a result it can cause wastage of medicines; these findings are consistent with the findings of Gebremariam et al., 2019;Ebrahim et al., 2019. Receiving near expired medicines (< 6months) was another SCM construct which result and has a risk of holding expired medicines. Near expiry medicine may be received due to various reasons for example excess donations, push system of procurement and long lead time; a study by Ebrahim et al., 2019; Mashishi, 2015; and Nakyanzi et al., 2010 also observed near expiry, over supply of medicine and without need as factors to medicine wastage. Poor procurement practice such as poor selection, poor forecasting of need and poor quantification mentioned as a reason for medicine wastage which is in line with the study byNakyanzi et al., 2010 and Tumwine et al., 2010.

The storage condition was assessed disagreed by more than 50% of the respondent and had average mean of 3.08(Std.dev. 0.759). The storage condition has moderate relationship with medicine wastage with Pearson coefficients of 0.314 and significant at p-value of 0.005.This finding is contradictory to the findings of Gebremariam et al., 2019 and Ebrahim et al., 2019. This could be explained by that there is regular monitoring from FMHACA and push from ministry of health. There is also internal push from employee's to the hospital administration. In addition the small sample size and the study population may contribute to the difference.

GPC and HP was the third construct of the study and it is part of the logistics environment the analysis result showed that it had average mean of 3.64(0.733). Of 80 participants 60% of the respondents agree on that GPC and HP strong influence on medicine wastage with Pearson correlation of 0.486 and significant at p-value less than 0.001.This is also observed in a study conducted by Gebremariam et al., 2019;Nakyanzi et al.,2010; Awol J. et al.,2019 and Hakuzimana T.,2019; they found that GPC has resulted in the accumulation of excess medicine inside the warehouses of medical stores. Poor hospital practice was also a problem in those studies weak monitoring and evaluation, not using FIFO and FEFO result in medicine wastage.

Slightly more than 50% of the respondents disagree on the HCMIS problem in the studied hospitals with average mean of 2.93 (Std.dev.1.209). Although a study conducted by Gebremariam et al., 2019 in Ethiopia and Peltoniemi and Suomi, 2019 in Finland was different; they reveal that inappropriate management of product information was contributory to medicine wastage. The relationship of HCMIS with medicine wastage was moderate with Pearson correlation of 0.352 and significant at p-value of 0.001.

This may be due to that all hospitals recently taken training on how to well implement HCMIS in addition to the system has been updated currently due to these they are able to keep and manage product data on the computer. Further investigation with modifying the design of the questions and study approach is needed.

Medicine wastage was measured in terms of quality of patient care, shortage of essential medicines, quantity and cost of wasted medicines. Quality measure result showed that it had average mean of 3.75 (Std.dev. 0.879). Quality was assessed with three questions in which participants disagree on patients service compromised and postponing of procedures this is due to that 18.8%, 26.3 % of participant give neutral answer respectively but 90 % (mean =4.02) of respondents agree on unavailability of essential medicines for more than 15days this finding is consistent with report of Tadeg H. et al., 2014,Gebremariam et al. 2019 and Tumwine Y. et al., 2010. Despite the findings of this study it is logical to say that if medicines are not available it is clear patients service would be compromised and any procedures potentially be postponed as a result further investigation is required. There is a lot of evidence to support this, a systematic review of the literature by Phuong JM et al. 2019, present the various literatures together that medicine unavailability impact on patients. In addition to patient service compromised, stock out of essential medicines and postponing of procedures, according to this literature medicine

wastage generally cause patient complaints, out of pocket cost, increase rate of drug error, adverse event and mortality.

Shortage of medicine result shows that it had average mean of 3.25 (Std.dev.0.893).Shortage of medicines was assessed with two questions they were; shortage of essential medicines by type and quantity due to wastage and patients are treated with less effective medicines due to medicine expiry. Shortage of essential medicines gets 72.5 % positive response with average mean of 3.55. Systematic review of the literature by Phuong JM et al. 2019, shows the shortage of medicines in different settings as well as patients being treated with alternative treatment which is not effective as the first one as a result further research is required through modifying the design. An assessment of hospitals pharmacies in Ethiopia by Tadeg H. et al. 2014, shows there is shortage of essential medicines due to poor supply chain management which is consistent with the findings of this research.

Extent of medicines wasted was assessed with the quantity and cost of medicine wasted. Extent of medicine wastage result showed that it had average mean of 3.4(1.054). 59% (mean=3.15) agree on quantity of medicine wasted and 71.3 % (mean =3.46) of participant agree on the high value of medicine wasted. These result are consistent with the findings of Gebremariam et al.,2019, Awol J. et al.2019, Nakyanzi et al., 2010 and Lorna MW.,2015 that high value of medicine are expired due to poor performance in supply chain factors.

Health care cost impact of medicine wastage result showed that it had average mean agreement of 3.72 (Std.dev. 0.927).High health care cost incurred due to medicine wastage (Logistics operation cost, disposal cost) and patients are forced to buy expensive medicines due to wastage; 75% (mean=3.82) and 53.8 % (mean=3.28) of participant agreed respectively. Medicine wastage has direct and indirect consequences; logistics operation cost, disposal cost, economic burden on government and society, environmental impact are some of the impact of medicine wastage. The direct consequence may include money lost due to expiry, theft and pilferage these effects are seen in a study by Lorna MW. 2015;Gurmu and Ibrahim, 2017; Awol J. et al., 2019;Nakyanzi et al., 2010 ,Gebremariam et al.,2019 and K. Moons et al.,2018.

SC factors generally has positive strong relationship with medicine wastage with Pearson correlation coefficients of 0.445 and significant at p-value of 0 with average mean of 3.78 (Std.dev.0.595) ;this study reveal that improper implementation of SC factors has an impact on wastage of medicines in the health care settings of five federal Hospitals of Addis Ababa. This

study finding is consistent with Gebremariam et al., 2019; Hakuzimana, 2019; Mashishi, 2015; Nakyanzi et al., 2010; Peltoniemi and Suomi, 2019 studies.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary

The major objective of this study was to investigate supply chain factors contributing to medicine wastage. The specific objectives of the study were: to determine the relationship between SC factors and medicine wastage; to determine the influence of SC factors on medicine wastage and to identify the consequences of medicine wastage. The study conducted using primary data collected through administering structured questionnaire of closed ended questions to 80 selected participants who are selected through purposeful sampling technique.

5.2 Summary of the Findings

This study uses both qualitative and quantitative analysis of participant response using Spss version 20. The summary of the finding is based on the result and discussion of the study. The result of the study is discussed on four thematic areas and with operational measures of medicine wastage.

Supply chain management factors to medicine wastage were assessed with nine questions of these six questions were agreeable by more than 60 % of the participants with average mean of 3.97 (std.dev. 0.595). Presence of overstocked medicine due to improper forecast is agreeable with 75% (mean= 3.69). Poor communication and coordination with key stake holders agreed by 78.8% (mean= 3.66) of the respondents. 77.5% (mean= 3.83) and 82.6% (mean=3.86) of the respondents agree with near expiry of medicines delivery and over supply of medicines respectively. Procurement practice causing medicine wastage was agreeable by 73.8% of the respondents with mean of 3.64. Discrepancy between physical inventory and bin cards has lesser agreement 61.3% with mean of 3.37 than the above SC factors. Based on the analysis SCM factors has minimum relation with medicine wastage with Pearson coefficients of 0.183 and not significant with p-value of 0.105.

Storage condition of the hospitals was the second construct to assess contributing to medicine wastage which has average mean of 3.08 (Std.dev.0.759). More than 50% of respondents of this study disagreed on the presence of the problem with average mean of 2.69 this show that there is a weak link between wastage of medicines and storage condition of the studied hospitals. The storage condition has positive relationship with medicine wastage with Pearson coefficient of 0.314 and significant at p-value of 0.005. Adequate shelf life medicines are maintained was

agreeable by 60% with mean of 3.4. Medicines are stored on floor, and not arranged systematically on shelves in the hospital, not enough space for handling and moving products in the store and medicines that need cold temperature are not stored in a functional refrigerator was disagreeable by 62.5 % (mean of 2.44), 53.8 % (mean of 2.72), 71.3 % (mean of 2.41) of the respondents respectively.

GPC and HP was the third construct to assess the medicine wastage of the hospitals. More than 60% with average mean 3.47 of participants agree on the guideline, policy change and poor hospital practice causing medicine wastage. This factor has positive relationship with medicine wastage with Pearson coefficient of 0.486 and significant at p-value of 0.Poor monitoring and evaluation, poor functional DTC, treatment and or policy changes, non-participation of other professionals in medicine selection and quantification was agreeable by 67.6% (mean=3.46),70.1 % (mean=3.47), 63.8%(mean=3.63),65% (mean=3.33) of the participants respectively.

Health commodity management information system practice of the hospitals impact on medicine wastage was assessed with two key questions the result show that the absence of information management system problem agreed by average of 53.3% (av. mean =2.78) of participants. No accurate data available in the hospital to facilitate quantification of medicines, lack of electronic stock management tools that automatically capture medicines wastage in the hospital was disagreed by 50.1% (mean=2.82) and 56.3 %(mean=2.75) of the participants respectively. But there is relationship with medicine wastage and the relationship was also significant with Pearson coefficient of 0.352 and p-value of 0.001.

Hospitals medicine wastage performance assessed with indicators of quality of patient service, shortage of essential medicines, quantity of wasted medicine and health care cost. Some essential medicines are not available for longer period (> 15 days), there is shortage of essential medicines by type and quantity, large quantities of medicines are wasted than recommended (> 2%), high value of medicines are wasted, high health care cost incurred due to medicine wastage were the relevant findings of the result that 90% (mean= 4.09), 73% (mean= 3.55), 60% (mean=3.15) , 71.3% (mean=3.46), 85% (mean=3.82) of participant agreed respectively.

5.3 Conclusion

Pharmaceuticals hold the second share of the health care economy after professional salary. Due to this medicine wastage in the hospitals severely affect the health care economy of the country scarce resources. This problem is worse in a country like Ethiopia in which 80% of

pharmaceuticals are imported. Supply chain management, Guideline and policy changes, hospital practice are the major supply chain factors contributing to medicine wastage identified by this study. The study result shows that medicine wastage has positive relationship on quality of patient care, shortage of essential medicines, extent of medicine wastage and health care cost. Therefore the hospital administrators and decision makers should make strategic relationship with suppliers, manufacturers, donors, MOH etc., maintain good communication with stakeholders, provide training and workshops to employee's, provide recognition to good performers to improve supply chain management functions, procurement activities, guideline and policy implementation of the hospitals thus to avoid and minimize the medicine wastage and its consequences.

5.4 Recommendation, Research Limitation, and Areas of future research

5.4.1 Recommendation

- Medicine wastage is causing increment of logistics operation costs, disposal cost, and environmental impact. This study find shortage and stock out of essential medicines, expensive and high quantity medicine wastage and high health care cost impact of wastage of medicines. Due to this ministry of health (MOH),hospital administrators, department and unit heads should be aware of the various dimensional impact of medicine wastage then they should strengthen medicine supply chain functions and undergo performance measures, maintain standard hospital practice, manage well donations and be cautious about guideline and policy changes.

- Medicine SCM functions (cycle) of selection, procurement, inventory management, distribution and use are the major stages in which medicine wastage occur. This study identified procurement and inventory management activities contributing to medicine wastage in the studied hospitals. As a result hospitals directors, finance department and pharmacy directors should work together to improve and develop good medicine procurement practice and improve inventory management functions specifically on forecasting, demand management, stock management, donation management and information management.

- GPC and HP are the second factors identified by this study for causing medicine wastage. Weak mechanism of monitoring and evaluation of medicines, poor functionality of DTC, treatment and policy change, non-participation of other professionals are the factors identified causing medicine wastage in this construct. Due to this hospital administrators specially the pharmacy directorate should monitor the movement of medicine, strength functionality of DTC and participate other professionals during medicine selection and quantification.

5.4.2 Research Limitation

The study used purposeful sampling technique to select participant which limit the research obtaining the view of procurement officers, hospital CEOs, other health professionals and patients about the problem. The study is conducted at five federal hospitals which reside in Addis Ababa, Ethiopia which make generalization of result only to the studied hospitals on the specific settings.

The HCMIS construct of the study was only aimed at the presence and using the data from HCMIS software and only two questions were asked which is impossible to well know the whole health commodity information management activity of the hospital thus future research fill this gap by adding other aspects such as management of HCMIS, practice of HCMIS, comparative analysis with the traditional system, product information sharing along the SC etc. Finally time and finance are the limitations of the study.

5.4.3 Implication for Future Research

The scope of the research is limited to five federal hospitals in Addis Ababa with a small sample size interested researchers can investigate the problem with other dimension like modifying the sample size, geographic area, using different design and approach.

Due to time and financial constraint the problem was studied from a narrow construct of SCM, storage condition, HCMIS, GPC and HP. Future research may include deep investigation of individual constructs or a combination of constructs which may result different findings from this study.

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Appendix

Questionnaire

Information sheet and Informed consent

My name is HabtamuGeremew, I am a logistics and supply chain management Graduate class student at Addis Ababa University College of Business and Economics school of commerce. Currently I am conducting a research with the title "Factors contributing to supply chain medicine wastage in five federal hospitals of Addis Ababa Ethiopia". The purpose of the paper is to investigate the factors that are contributing for medicine wastage in your institution. The information you are giving will be used for the partial fulfillment for the master's thesis. I will assure you that the information you are given will be kept anonymous and also you are not asked to provide your address. I ask your frank response for the success of the study.

General Instruction:

A. Base your answers on your own actual work experiences
B. Please make tick mark (√) in the appropriate box for answer options that are provided.
C. This questionnaire will take approximately 10 to 15 minutes based on your answers.

Please don't hesitate to contact me for any inquiry, I am available as per your need at mobile: 0912- 458883 or e-mail: habtamugeremew47@gmail.com

Part 1: Assessment of factors contributing to supply chain medicine wastage data collection tools

Instruction: Circle or tick the institution you are working now

Name of Hospital	Code given
1. Black Lion Hospital	1
2. ALERT Center	2
3. Amanuel mental specialized hospital	3
4. St. Paul Hospital	4
5. St. Peter Hospital	5

Part 2: Self-administered questionnaire for data collection on factors contributing to supply chain medicine wastage

Section 1: Socio-demographic Characteristics of Respondents

1. Sex Male ☐ Female ☐

2. Age _____

3. Work Experience (in year)_____

4. Qualification

1. Pharmacist 2. Druggist

3. Nurse 4. Physician Other (Specify) _____

Section 2: Questions on factors contributing to supply chain medicines wastage at the hospitals

In this section, we ask your feelings about factors contributing to supply chain medicine wastage (Expiry, Damage, Obsolete, Theft or others) in your facility. For each statement on the left, please encircle one number which best describes the level of your agreement (1=strongly Disagree (SD); 2=Disagree (D); 3=Neutral-N (Neither agree nor disagree); 4=Agree (A) and 5=strongly Agree (SA))

1. Supply chain management factors

		SD	D	N	A	SA
1	Selection of medicines are based on ABC/VEN analysis (Vital, essential, Necessary)	1	2	3	4	5
2	Presence of over stocked medicines due to improper forecasting of need in the hospital	1	2	3	4	5
3	Poor communication and coordination with key stake holders (MOH, suppliers, NGO's)	1	2	3	4	5
4	Near expiry medicines (< 6months) are being delivered to the hospital	1	2	3	4	5
5	Medicines to treat rare diseases are procured in the hospital	1	2	3	4	5
6	There is over supply of some medicines	1	2	3	4	5
7	Weak physical security in the vehicle during transportation of medicines	1	2	3	4	5
8	There is discrepancy between physical count and stock cards	1	2	3	4	5
9	Procurement practice is causing medicine wastage	1	2	3	4	5

2. Storage Condition

		SD	D	N	A	SA
1	Is adequate shelf life of products maintained	1	2	3	4	5
2	Medicines are stored on floor, and not arranged systematically on shelves in the hospital	1	2	3	4	5
3	There is not enough space for handling and moving products in the store	1	2	3	4	5
4	Medicines that need cold temperature are not stored in a functional refrigerator in the hospital	1	2	3	4	5

3. Guideline & Policy changes and Hospital practice

		SD	D	N	A	SA
1	Poor stock management like using neither FIFO nor FEFO in stock management	1	2	3	4	5
2	Weak or no mechanisms for medicine wastage monitoring and evaluation in the hospital	1	2	3	4	5
3	Absence of functional DTC in the hospital	1	2	3	4	5
4	Treatment or policy changes has led to wastage of medicines	1	2	3	4	5
5	Non-participation of other professionals in medicine selection and quantification of the hospital facility	1	2	3	4	5
6	Lack of accountability for stock-outs and wastage of medicines in the hospital	1	2	3	4	5

4. Health Commodity Management Information System

		SD	D	N	A	SA
1	No accurate data available in the hospital to facilitate quantification of medicines	1	2	3	4	5
2	Lack of electronic stock management tools that automatically capture medicines wastage in the hospital	1	2	3	4	5

Section 3: Medicine Wastage Operational Performance Measures

	Quality of patient care	SD	D	N	A	SA
1	Patients receive substandard (compromised) service due to wastage of medicines	1	2	3	4	5
2	Some essential medicines are not available for longer period (> 15 days)	1	2	3	4	5
3	Procedures are postponed due to medicine wastage (expiry, damage)	1	2	3	4	5

	Shortage of essential medicines	SD	D	N	A	SA
1	There is shortage of essential medicines by type and quantity due to wastage	1	2	3	4	5
2	Patients are treated with less effective medicines due to medicine expiry	1	2	3	4	5

	Quantity of wasted medicines	SD	D	N	A	SA
1	Large quantities of medicines are wasted than recommended (> 2%)	1	2	3	4	5
2	Expensive medicines are wasted	1	2	3	4	5

	Health care cost	SD	D	N	A	SA
1	High health care cost incurred due to medicine wastage (Logistics operation cost, disposal cost)	1	2	3	4	5
2	Patients are forced to buy expensive medicines due to wastage	1	2	3	4	5