



**ST. MARY'S UNIVERSITY
SCHOOL OF GRADUATE STUDIES**

**CAUSES FOR THE EXPIRY OF ESSENTIAL DRUG IN
ADDIS ABABA ADMINISTRATION: A CASE STUDY OF
KOLFEKERANIO SUB CITY HEALTH CENTERS**

BY –SAMRAWIT KIDANE

ID NO. 0116/2009A

**CAUSES FOR THE EXPIRY OF ESSENTIAL DRUG IN
ETHIOPIA: A CASE STUDY OF KOLFEKERANIO SUB
CITY HEALTH CENTERS**

SAMRAWIT KIDANE

**A THESIS SUBMITTED TO ST. MARY'S UNIVERSITY,
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By

SAMRAWIT KIDANE

ID.NO 0116/2009A

APPROVED BY BOARD OF EXAMINERS

Dean, Graduate Studies

Signature & Date

Advisor

Signature & Date

Eternal Examiner

Signature & Date

Internal Examiner

Signature & Date

DECLARATION

I, the undersigned, declare that this thesis entitled: causes for the expiry of essential drug in Addis Ababa administration is my original work, prepared under the guidance of **Dr. Maru Eshete**. All sources of materials used for the thesis have been duly acknowledged. I further confirm that the thesis has not been submitted either in part or in full to any other higher learning institution for the purpose of earning any degree.

Name_____ Signature

St. Mary's University, Addis Ababa

Date_____

ENDORSEMENT

This thesis has been submitted to St. Mary's University, school of graduate studies for examination with my approval as a university advisor.

Research Advisor _____

Signature _____

Date _____

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ABBRIVATION AND ACRONYMS

DACA:	Drug Administration and Control Authority	DTC: Drug Therapeutic Committee
ED:	Essential Drugs	
EDL:	Essential Drugs List	
EFMHACA:	Food, Medicine and Health Care Administration and Control Authority	
FEFO:	First Expiry First Out	
FIFO:	First in First Out	
FIP:	Federation of International Pharmaceutical	
LIDE:	List of Drugs for Ethiopia	
NDL:	National Drugs List	
STG:	Standard Treatment Guideline	
SOP:	Standard Operating Procedure	
SNNPR:	Southern Nations, Nationalities and People Regional state	
WHO:	World Health Organization	

Abstract

This study was conducted to identify the factors associated with the expiry of essential drugs in health facilities of Addis Ababa (kolfe keranio sub city health centers). Kolfe keranio sub-city health center have eleven health centers under it . A descriptive and causal type research design was employed to achieve the objective of the study. In order to get relevant data from the target population and answer the research questions, quantitative method was used .so instrument which was used to collect the data from the sample subjects was a semi structured questionnaire which was analyzed by regression. Due to purposive criteria and small size existence, a total of 77 target population were taken as a sample. Participants were all the pharmacists, store keepers, druggist and the head pharmacists. As a result, it was identifying that irrational essential drug use in the health center of kolfe keranio sub- city was one of the causes for the expiry of essential drugs. This study found standard treatment guideline was not distributed in the health centers and appropriate pharmaceutical treatments were not selected from the standard treatment guideline. In addition donation drug from the country in which they will be used are not properly labeled.

Key words:

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Health is an important indicator of the status of development of a society in a country, and medicines are the cornerstone and integral part of every health care system. The pharmacy is an integral part of any hospital or health facility. A holistic healthcare service can only be provided if the pharmacy is functioning effectively and efficiently. The overall objectives of a public healthcare pharmacy are to promote the rational use of medicines by prescribers, dispensers and patients; and to ensure good dispensing and prescribing practices. Pharmacies should aim to ensure safety, efficacy and quality of medicines; ensure availability and accessibility of medicines to all patients at the facility; and to offer appropriate pharmaceutical services to patients of the hospital (Celeste, 2016).

In Ethiopia, majority of the common leading causes of morbidity and mortality can be substantially reduced if Essential Drugs (EDs) are made available and appropriately used (Mezid, 2014). 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. The implementation of the concept of essential medicines is intended to be flexible and adaptable to many different situations; exactly which medicines are regarded as essential remains a national responsibility (WHO, 2004).

In Ethiopia, despite a high burden of disease, utilization of health services remains very low, with people visiting a health facility less than once every two years(Barbara,2009). Moreover, medications represent a large portion of the costs in the healthcare system. They account for 20–60% of health spending in developing and transitional countries . Unavailability and expire of EDs (essential drugs) in the health centers compels patient

to revert to the private sector where the cost of drugs is high, increasing the chance of incurring catastrophic health expenditures and the associated risks of falling into poverty (Mezid, 2014). The thought of decreasing this health expenditures and associated risks of poverty has created an interest to assess and figure the causes for the expiry of essential drugs which will lead on setting measures to the solution.

Expiry date of drugs is a date specified by the manufacturer of a drug product that a drug should meet applicable standard of identity, purity, strength and quality at the time of use provided it is kept under storage conditions indicated by that manufacture (Kgabo, 2015).A number of reasons have been attributed as the cause of medication wastage. However, the factors responsible for these reasons such as the supply or presence of excessive stock or short expiry dates need to be explored to be able to target medication wastage (Lorna, 2014).Based on the common health problems in the country, Ethiopia has developed national essential medicines list starting from 1985. In 2012 it has also published list of medicines specifically for primary public health facilities of the country to ease making available of the needed medicines at this facility level (Mulugeta, 2017).

In public hospital/health center pharmacies, expiration of drugs before they are dispensed to patients appears to be a common problem which may result from various factors such as ineffective hospital/health center Drug and Therapeutics Committee meetings, lack of the use of first expiry first out (FEFO) and first in first out (FIFO) principles, massive orders of rarely used medical products, which may expire due to patients relocating, lack of supervision by pharmacist when placing pharmaceutical orders, lack of stock rotation among hospital pharmacies, lack of computer system usage, and propensity to prescribe certain drugs by prescribers.. Expiration of drugs is a problem to a system that is already constrained with lack of access to drugs. Drugs expiration often relates to supply chain inefficiencies that result in higher costs or lower patients service levels. Public hospital/health center pharmacies are centers of activities, pharmacists and pharmacist assistants as well as other involved healthcare professionals like nurses must full Understand pharmaceutical inventory management to minimize expiration of drugs (Kgabo, 2015).

The impact of essential medicine shortages and expired medicines is clear in which patients are directly affected. Expired medicines have a high likelihood of being re-circulated into the market. Expired products are not only ineffective but can result in the emergence of resistance to antimicrobial agents and toxicity in humans and other animals. Expired medicines pose risks to food chains and water sources if not properly disposed. In addition, expired medicines constrain storage capacity at the health facilities (FMoH, 2016). So considering the above concepts, the researcher has motivated to see the problems or challenges of expiry drugs circulation in the selected sub city. Related to this the study will attempt to axiomatically identify the causes of the expiry of the drugs in Kolfe Keranio Sub City Health Centers descriptively.

1.2 Statement of the problem

Globally, expired medicines contribute to the poor performance of health systems, driving up costs and reducing access to quality care for patients. Conversely, well managed and controlled medicine supplies that keep wastage to a minimum, may strengthen health system. In Ethiopia, majority of the common leading causes of morbidity and mortality can be substantially reduced if carefully selected, low-cost pharmaceuticals are available and appropriately used. Minimizing the expire of drugs specially the essential drugs is also incorporated in the category of appropriate usage. The expiry of medications leads to a high shortage and poor availability of essential medicines which have a high cost. In the poorest countries of Africa and Asia, as much as

50% of the population lacks such access. While some 10 million lives a year could be saved by improving access to essential medicines and vaccines around 4 million in Africa and South-East Asia alone (Mezid, 2014).

In a study done in Ethiopia, the percentage of expired drugs in the six regions of Ethiopia (Tigray region, Amhara region, Oromia region, SNNPR region, Benishang - Gumz region and Addis Ababa) were calculated in actual process which involve checking the expiry dates of 12 selected key essential drugs available in health facilities, regional drug stores or private retail outlets. Percentages of expired drugs were 8.2% in Public Health

Care Facility, 2% in Regional Drug Stores, and 3% in Private Drug Retail Outlets. When compared by level of health facilities, percentages of expired drugs were 13.1%, 9.7% and 7.5% in hospitals (n=7), health centers (n=19) and health stations (n=85), respectively. The percentage of expired drugs varied in the six regions between 3% (in Tigray) to 38% (in Benishangul-Gumuz) showing very significant variation.

This means that, in relative terms, quality of drugs is best in Tigray but least in Benishangul-Gumuz (FMoH/WHO, 2003). Major tasks are being done in increasing the accessibility of the drugs but not much is being done on the appropriate usage of the accessed drugs which are prone to expiry and damage. Expiry of medicines leads to significant wastage of resources which may result in reduced availability of medicines. This may impact on the quality of healthcare provided to patients and ultimately the loss of confidence in the health system. However, data on the top causes of expire of drugs and the measures used to minimize expire in Ethiopia's health facilities are scarce (Mulugeta, 2017).

In Jordan, an assessment that was done to assess pharmacy and inventory control in ministry of health hospitals showed that quantification of pharmaceutical needs was not done properly and this led to needs being either overestimated, resulting into surpluses and expiration of unconsumed pharmaceuticals, or underestimated, resulting in shortages (Hosiana, 2013).

In 2013 a survey at six public health centers in Gondar Town, indicated lack of proper and consistent inventory management practice was the causes for wastage (expire or loss) of drugs (Mulugeta, 2017). Because of the geographical gap, this study will assess the causes for expire of essential drugs at the health facility level in Addis Ababa.

1.3 Objectives of the study

1.3.1 General objective

To identify the factors associated with the expiry of essential drugs in health facilities of Addis Ababa (Kofe keranio sub city).

1.3.2 Specific objective

To describe if selection has an effect on the expiry of essential drugs in health facilities of Addis Ababa (Kolfekeranio sub city).

To identify if quantification problem has an effect on the expiry of essential drugs in health facilities of Addis Ababa (Kolfekeranio sub city).

To identify if procurement problem has an effect on the expiry of essential drug in health facilities of Addis Ababa (Kolfekeranio sub city).

To assess if irrational drug usage has an effect on expiry of essential drug in health facilities of Addis Ababa (Kolfekeranio sub city).

1.3.3 Research questions

What are the causes for the expiry of essential drugs in kolfekeranio subcity health centers?

Sub questions

Was selection problem a cause for the expiry of essential drugs?

Was quantification problem a cause for the expiry of essential drugs?

Does procurement problem become a cause for the expiry of essential drugs?

Was irrational use of drugs a cause for the expiry of essential drugs?

1.4 Scope and limitation of the study

The study is geographically delimited to the 11 health centers which are found in Kolfe keranio sub city. Sufficient documents concerning the subject under study were lacking. Time constraint has prevented proper and thorough review of empirical and theoretical data that are related to the study.

The analysis of primary data is based on the questionnaires' result and the response may be subjected to personal biases and subjectivity which may affects the reliability of the study.

1.5 Significance of the study

The increased shortages and stock-out of essential medicines have raised the need to understand the causes of medicine expiries and subsequently develop strategies for their prevention and management (MOH, 2016). In addition, reducing waste of essential drugs through expiry helps in cost minimization.

This study has contribution in enhancing decision-making in financial and inventory management there by informing strategies to reduce cost, and may assist policy makers in identifying high waste essential and explore cost saving measures.

1.6 Organization of the Study

This study is organized in to five chapters. The first chapter deals with the introduction part which encompasses the background of the study, the statement of the research problem, objectives of the study, significance of the study, scope of the study and limitations of the study.

The second chapter deals with the review of related literature. Chapter three focused on the research methodology, data collection and procedures, sample and sampling techniques, whereas the fourth chapter handles data presentation, analysis and interpretation of the data. Finally, conclusions and recommendations are presented under fifth chapter.

CHAPTER TWO REVIEW OF LITERATURE

This chapter will cover the medication regulation framework, the pharmaceutical management frame work and the empirical studies and the conclusion of the literature review.

Ethiopia is one of the sub-Saharan African countries where the pharmaceutical sector is being guided by a national medicine policy. “*The Pharmacists and Druggists Proclamation No 43/1942*” was the basis for pharmaceutical regulation where both pharmacists and druggists together with the facilities where they practiced were regulated. Comprehensive regulation of the pharmaceutical sector was started in the early stages by a regulation called “*Pharmacy Regulation No. 288/ 1964*”, which formed the legal basis for official establishment of drug regulation in the history of Ethiopia. The Pharmacy and Laboratory Department under the then Ministry of Health was responsible for medicines regulation until June 1999 when a new regulation called the “*Drug Administration and Control Proclamation No. 176/1999*” was promulgated on 29 June 1999. Following this proclamation, the regulatory component of the Pharmacy Department was transformed to an independent Drug Administration and Control Authority (DACA) of Ethiopia in September 2001. DACA was re-structured as Food, Medicine and Health Care Administration and Control Authority (EFMHACA) of Ethiopia by “*Proclamation No. 661/2009*” in 2010 bearing additional responsibilities like regulation of food, health care personnel and settings (Sultan,2016).

Table 2.1: An overview of the medicine regulatory framework in Ethiopia

NO	Features	Ethiopia
1	Current medicine law of the country	Food, Medicine and Health care Administration and control proclamation No.661/2009
2	Objectives of the current law/proclamation/regulation	Protect public health from unsafe, inefficacious and poor quality medicine
3	Guidelines Official Journal	EFMHACA Negarit Gazette

Source: Sultan, (2016)

2.1 Theoretical review

Inventory management is the core of pharmaceutical supply system. It is all about ordering, receiving, storing, issuing, and again reordering of limited list of products. On a realistic bases inventory management is a difficult task, because in many countries possession of a poor inventory management system in the pharmaceutical supply system has resulted in wastage or blockade of financial resources, shortage and overage of essential drugs, increase in out-of-pocket expenditure and decline in quality of healthcare services (Monica, 2015).

A “sick” inventory arise due to individual decision making on frequency of reordering and quantity to be ordered, ad hoc structuring, inaccurate stock recording, lack of transparency, increase in complexity, and absence of systematic monitoring. These problems mainly arise due to lack of awareness or knowledge about scientific stock keeping and warehouse practices. A poor inventory management in a public pharmaceutical supply can creep in wastage or blockade of financial resources, irrational utilization of drugs, shortage or overage of essential medicines resulting in expiration (Monica, 2015). Avoiding expired medicines as part of inventory management is actually at the heart of a medicines supply system. Every facility needs an effective inventory management system to deal with ordering supplies, receiving, storing stock, issuing, re-ordering and accounting for stock. A constant medicine supply promotes effective healthcare, inspires confidence in the system and contributes to job satisfaction among the staff (Emelda, 2010). All levels are involved in ensuring availability of medicine to patients, however the longer the supply chain, the higher the risk for medicines expiring (Celeste, 2016).

Inventory managements can be exercised by arrangement of drugs. The management of the store should assist the flow of supplies from the source to the end user in the most reliable and economical way without a significant loss of quality, wastage, or larceny. The main

purpose of managing a store is to cater the needs of receiving, holding and dispatch stock. The received drugs are stored in the main store. Shelves are labeled and drugs are arranged and dispatched on (First expiry first out) FEFO/ (first In First Out) FIFO basis (Monica, 2015).

Bincards and stock ledgers are things important in inventory management .Bin cards and stock ledgers book are used to document the stock movement in the health facility. Bin cards are file cards that are physically placed along with the stocks. It documents the status of the stock held in the storeroom. Each card is maintained for different batch numbers of the same drug supplied. Every time the drug is removed for consumption or replenished, entries are made in the bin card. Stock ledgers are maintained to record all the details of every product of varying batch numbers supplied to the health facilities or warehouse. Maintenance of ledger records represents a perpetual inventory system, as it traces and tracks the current quantity of stock in hand (Monica, 2015).Over stocking of drugs may lead to expires and deterioration this affect the economy of the health care system.

Burt et al (2003) maintained that in order to develop ideas of how to reduce waste throughout supply chain cycle, one has to know and understand where that waste has been generate (Kgabo, 2015)looking through the pharmaceutical management frame work is essential.

2.2 Empirical studies

The overestimation of medicine orders to ensure sufficient stock is a major contributor to wastage of medicines. In a Southeast Asian country, losses caused by wastage are estimated to be more than 30% of the annual medicine budget and; in another country in Central Africa, a hospital pharmacist was seen to routinely allow for losses of approximately 90% on certain medicines when placing an order to ensure that sufficient stock was received. But as these cases suggest, there may be multiple reasons, including efforts to avoid stock outs that may weaken accountability which may be complex (Celeste, 2016).

According to Keizer (2007) large buffer stock is amongst the factors that can cause high losses of stock due to expiry.

A few local studies in South Africa conducted at provincial level , district level and hospital level, have pointed to the high levels of wastage due to medicines expiring that may be curtailed with improved management and efficient inventory coordination (Celeste, 2016).

In a study conducted by WHO, in 2002, on the assessment of pharmaceutical sector in Ethiopia indicates that the percentage of public health facilities with essential drug list were less than 1% (Gizah, 2014).

In a study conducted by Coma *et al.*, (2008), the objective was to monitor the amount of unused drugs and the cost to the public health care system. The main reasons cited why drugs were returned to the pharmacy were:

- Expiry dates of the medicines (28.2%),
- The patients' condition had improved and there was no need for further therapy (24.9%),
- Patient had died (20.8%) (Emelda, 2010).

In a study conducted by Bjorkman *et al.* (2007) in Sweden, it was indicated that there is a need for DTC (drug therapeutic committee) in every country with the aim of contribution to reliable safe and cost-effective drug use. Lack of order verification by pharmacists, overstocking, poor methods of stock issues, lack of education about the system used for stock management, inconsistent DTC meetings, preference for certain drugs by prescribers were cited as some of the reasons for drugs expiration (Kgabo, 2015).

In Jordan, an assessment that was done to assess pharmacy and inventory control in ministry of health hospitals showed that quantification of pharmaceutical needs was not done properly and this led to needs being either overestimated, resulting into surpluses and expiration of unconsumed pharmaceuticals, or underestimated, resulting in shortages (Hosiana, 2013).

MOHSW, 2008 reported that a study done in Tanzania showed that from 27 surveyed health facilities only 38% of them had EDL out of which only 52% of facilities procured medicines within the EDL (Mezid, 2014).

Thron et al (2007) reported that issuing and replenishment strategies are crucial and FIFO approach is advisable within a frame work of products having a limited lifetime span. Expiration of drugs is a problem to a system that is already constrained with lack of access to drugs. Drugs expiration often relates to supply chain inefficiencies that result in higher costs or lower patients service levels. Public hospital pharmacies are centers of activities, pharmacists and pharmacist assistants must fully understand pharmaceutical inventory management to minimize expiration of drugs (Kgabo, 2015).

The study had focused on four factors which are assumed to be most important influential factors for the expiry of essential drugs in Ethiopia. These are; selection problem, quantification problem, procurement problem and irrational drug use.

A. Selection problem as a cause for the expire of essential drugs

Selection helps to set priorities for all aspects of the pharmaceutical system. Essential medications are selected with due regard to public health relevance, evidence on efficacy and safety, and comparative cost-effectiveness. Thus, limiting the selection of essential medicine may lead to improved supply, rational medicine use and reduced cost. Overuse or incorrect use of medicines whether essential or non-essential, results in excessive spending on medicines for both patients and the healthcare system which may ultimately waste financial resources (Celeste, 2016).After products are selected, the quantity required of each product must be determined and procured.

B. Quantification problem as a cause for the expire of essential drugs

Quantification is the process used to determine how much a product is required for the purpose of procurement. In addition to estimating the quantities needed of medicines, quantification should estimate the financial requirements to purchase the medicines. Quantification must include contextual factors, such as available funds, storage capacity and capacity to deliver (Mezid, 2014).

Theoretically, quantification of medicines are based on following clauses

- Availability of funds
- Population coverage
- Disease pattern
- Seasonal variation in the disease pattern
- Rate of monthly drug consumption
- Lead time taken for delivery of drugs from the nearest drug warehouse
- Time delay between the placing an indent and receiving the orders
- Stock keeping – the knowledge of quantity of drugs of each form that is consumed regularly (Monica, 2015).

There is a “*List of Drugs for Ethiopia (LIDE)*”, July 2002 G.C edition, and it is further classified by level of health care facility. The list consists of international nonproprietary (generic) names of drugs that can be imported or locally produced and it is also the basis of drug registration A *National Essential Drugs list (EDL)* containing 234 chemical entities was prepared in 1987 G.C. As an extract from the LIDE which was called “*National Drugs List (NDL)*” at the time. But, the EDL has never been revised and published since then (FMoH/WHO, 2003). The next step after quantification is Procurement which seeks to ensure the availability of the right medicines in the right quantities, at reasonable prices, and at recognized standards of quality (Mezid, 2014).

C. Procurement as a cause for the expire of essential drugs:

WHO has developed extensive guidelines for the drug procurement process in developing countries. The guidelines describe four strategic objectives for good pharmaceutical procurement: procure the most cost effective drugs in the right quantity; select reliable suppliers of high quality products; ensure timely delivery; achieve the lowest possible cost (Andrea, 2015).

Effective procurement is an important step in pharmaceutical logistics system. An effective procurement process seeks to ensure the availability of the right pharmaceuticals, in the right quantities, at reasonable prices, and recognized standards of quality. It is

dependent on the routine availability of logistics data (e.g., rate of consumption and stock levels) and the capacity to select products and to forecast and quantify needs (Mezid, 2014).

D. Irrational drug Use as a cause for the expire of essential drugs:

Rational medicine use requires that medicines are prescribed for a particular patient after proper diagnosis of a health problem. The main aspect of rational medicine use includes appropriate diagnosing, prescribing, dispensing, and proper consumption by the patient (Celeste, 2016). The Ministry of Health has prepared Standard Treatment Guidelines (STG) and has distributed them to health care facilities. The STG is a reference intended to assist the health worker in choosing the appropriate pharmaceutical treatment after the correct diagnosis has been made. The availability and the use of STGs by health workers encourage uniformity in disease management, thus promoting and maintaining the rational use of drugs in the health care delivery system (Sameh, 2012).

A national formulary based is under preparation by DACA. The concept of essential drugs is part of the basic curricula of pharmacists and pharmacy technicians. Public education on rational use of drugs is being given by DACA through the mass media. There is no mandated continuing education program for health professionals, except that Pharmacy and medical associations occasionally organize continuing education programs for their members (FMoH/WHO, 2003).

Regarding donation drugs, both WHO and FIP (international pharmaceutical federation) also make recommendations for how donors should provide donations of medications as well as how recipients should handle these donations. These guidelines reflect that donated drugs may be short dated or expired, not meet the needs of the recipient, be improperly labeled for the country in which they will be used or be donated in inappropriate amounts (Andrea, 2015).

Many developing countries have a shortage of personnel trained to evaluate drug storage and stability. “Guidelines for the Storage of Essential Medicines” is a WHO document that provides guidance for both pharmacists and untrained personnel to store medication safely and securely. Topics discussed include receiving and arranging medications,

special storage conditions, maintaining the quality of medicines, designing and building a medical store and other relevant topics (Andrea, 2015).

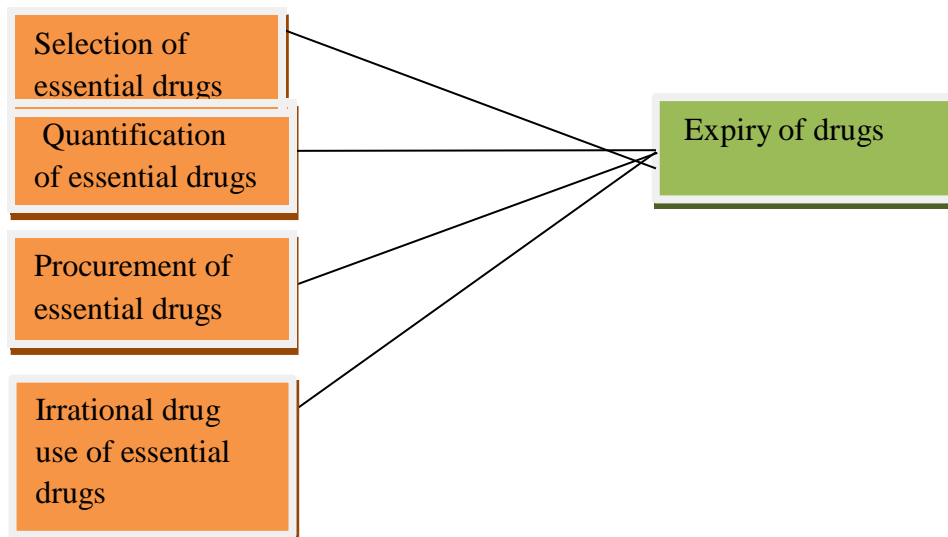
Each major function builds on the previous function and leads logically to the next. At the core of the pharmaceutical management cycle are management support systems, which include the planning and organization of services, financing and financial management, information management, and human resource management. These management support systems should strengthen the pharmaceutical management cycle. As part of management support, managers at all levels of an organization should be concerned with effectively using resources, as financial sustainability is only achieved when expenditures and financial resources balance and are sufficient to support a given level of demand (Celeste, 2016).

2.3. Conceptual Framework

From the literatures discussed above, this research will see the main variables for expiry of drugs. The independent variables being selection, quantification, procurement and rational drug use. The dependent variable in this study will be expiry of drug.

Independent Variable

Dependent variable



Source:(Hosiana,2013)

Fig. 2.1 Conceptual frame work

2.4 Research hypothesis

- H 1 : Selection problem has an effect on the expiry of essential drugs
- H 2 : Quantification problem has an effect on the expiry of essential drugs
- H 3 : Procurement problem has an effect on the expiry of essential drugs
- H 4 : Irrational drug usage has an effect on expiry of essential drugs

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1 Description of the Study setting

The study was mainly focused on the health centers available under Kolfe keranio sub- city involving all the eleven health centers under the sub-city. Under every health centers there are head pharmacists, pharmacists, druggists and store keepers which have direct connection with essential drugs (medications) and are pertinent to the research.

3.2 Research design and approach

Research design can be viewed as the blue print of the research and as a general plan of how to go about answering the research question(s). This study was focused mainly on the health centers which are located in Kolfe keranio sub city of Addis Ababa, Ethiopia. The researcher has implemented quantitative research approach. The research has adopted a descriptive and casual type of research design. The descriptive has helped to describe the existing variables or phenomenon in detail and the causal design provided to identify the causal effect of one variable to the other or it indicated the relationship between the variables.

3.3 Population, Sample size and sampling procedure

3.3.1 Target Population

The target population of the study included the entire pharmacist, head pharmacist and the store keepers which were working in the eleven health centers under Kolfe keranio sub city, because they played a vital role in position to identify quality and care of drugs and pharmaceuticals. The total number of pharmacist, head pharmacist and store keepers working in the health centers were 77.

3.3.2 Sampling Technique and Sample size Determination

Due to purposive criteria and small size existence the study had taken the whole population of the head pharmacists/ pharmacists /druggists/store keepers as a sample. A total

population size of 77 had been taken as a sample because 77 data points are very Easily manageable and don't need to take a sample to study only a part of the population

While the whole population can be easily studied.

3.4 Ethical Considerations in Research

When human beings are the focus of investigation, it is necessary to look at the ethical implications of what we are proposing to do. Most ethical issues fall in to one of four categories: protection from harm, informed consent, right to privacy, and honesty with professional colleagues.

Therefore, taking the nature of this study under consideration, participants have been told the nature of the study to be conducted and given the choice of either participating or not participating because any participation should be strictly voluntary. More specifically, for ethical clearance the study had been confirmed containing the following information:

- A brief description of the nature of the study
- A description of what participation involved, in terms of activities and duration
- The guarantee that all response remains confidential and anonymous
- An offer to provide detailed information about the study (e.g., summary of findings upon its completion)
- The researcher reports the findings in a complete and honest fashion and gives appropriate credit where credit is due and acknowledges any indebtedness to others.

3.5 Data sources and data collection method

A. Primary Data Sources

Primary sources had been detected through the tool of questionnaires (semi-structured) to the targeted samples. Questionnaire had been preferred for data collection because it anonymously allows for richer feedbacks that may provide insight in the explanation for what is happening.

B. Secondary Data Sources

The secondary data had been taken from previous worked literatures, books which were related to essential drugs and the guides for managing the pharmaceutical frame work.

3.6 Data Analysis

Data's which were collected through questionnaires tools have be analyzed through regression. Lists of responses of questionnaires have been tabulated and presented using accumulative frequency method. This would help to indicate the responses of the samples clearly and make it simple to make further analysis and to give interpretation .In order to analysis the relationship and causality of the variables; the study had applied a multivariate analysis, that is, regression analysis using SPSS system.

3.7 Validity of the Study

Validity refers to the degree to which a study accurately reflects the specific concept that the researcher is attempting to measure or describe. The validity of research is conceived as the precision or correctness of the research finding. A number of measures were taken to enhance the validity of the research. First the researcher identified the study target carefully, second structured questionnaire survey was used and the questionnaires of the study was reviewed and commented by randomly selected pharmacists and finally Likert like scale was used in the survey instruments.

3.8 Reliability of the study

A pilot study was carried out to determine reliability of the questionnaires. The pilot study involved the sample respondents. Reliability analysis was subsequently done using Cronbach's Alpha which measured the internal consistency by establishing if certain item within a scale measures the same construct. The findings were as shown below

Reliability test result

Variables	Cronbach's Alpha	N of Items	Level of reliability
Selection of the essential drugs	.720	5	good reliability
Quantification of the essential	.786	8	good reliability
Procurement of essential drugs	.776	4	good reliability
Irrational drug use	.705	3	good reliability
Degree of expiry of essential	.750	1	good reliability

Source: own survey result (2018)

CHAPTER FOUR

4. DATA ANALYSIS AND INTERPRETATION

4.1 Introduction

This chapter of the study deals with presentation, analysis, interpretations and discussions of the data gathered through primary data (questionnaire).

To conduct data analysis, the study employed a descriptive analysis (mean and frequency distribution approach) to observe the feature of variables, following this, the regression analysis conducted to measure the impacts of independent variables on dependent variable. A total of 77 questionnaires were sent to the whole population of which 68 questionnaires were properly filled and returned which is 88.3% response rate. The discussion is made on the basis of the valid responses.

4.2 Respondents' profile

The analysis about sex, age, educational qualification and work experience of respondents in the organization is presented in table 4.1.

Table 4.1 profile of respondents

Characteristics of respondents		frequency	percent
Sex	male	28	41.2
	female	40	58.8
	total	68	100.0
Age	20-30 years	60	88.2
	31-40 years	5	7.4
	41-50 years	3	4.4
	total	68	100.0
Educational qualification	First degree	50	73.5
	diploma	18	26.5
	Total	68	100.0
Work experience	0-5 years	54	79.4
	6-10 years	14	20.6
	total	68	100.0

Source: own survey result (2018)

In this study, majority of the respondents were female participants 40(58.8%) and the remaining were male participants 28(41.2%) which indicated there is a good distribution of gender proportion. In relation of the age category more of the respondents were in the range of 20-30 years 60(88,2%) which includes the youth age group which are more active and fast decision makers age wise. In terms of work experience the majority of the respondents have from 6- 10 years of experience which indicates they have more likely developed a good work experience so that they are not new and have good work place experience.

4.3 Descriptive Statistics of Dependent and Independent Variables

To include all the data values, the most frequently used measure of central tendency is the mean or average, which includes all data values in its calculation. Because the mean is the building block for many of the statistical tests used to explore relationships.

4.3.1. Selection of essential drugs

Selection involves choosing a few pharmaceutical products deemed essential to meeting health care needs of individuals in a particular country or area. The limited number of items contributes to better supply, more rational use, and lower costs. Selection of essential drugs has been consistently identified as a crucial contributor for the expiry of drugs. **Table**

4.2 Descriptive statistics on selection of essential drugs

Item	N	Mean	Std. Deviation
Essential drugs were being selected due to public health relevance	68	4.06	0.570
Essential drugs were being selected due to evidence on efficacy and safety	68	4.03	0.828

Essential drugs were being selected due to comparative cost effectiveness	68	3.72	0.826
essential drugs were being selected from the essential drug list of the health center	68	3.99	0.970
Donation drugs don't meet the needs of the recipient	68	4.07	0.971
Over all		3.97	

*Source:*own survey result (2018)

According to the findings, the respondents agreed with a mean of 4.06, 4.03, 3.72, 3.99 and 4.07 and a standard deviation of 0.570, 0.828, 0.826, 0.970 and 0.971 that essential drugs were being selected due to public health relevance, evidence on efficacy and safety, comparative cost effectiveness and from the essential drug list of the health centers and donation drugs don't meet the needs of the recipient.

The overall mean for Selection of essential drugs is 3.97 which imply that there was effective selection of essential drugs due to public health relevance, evidence on efficacy and safety, comparative cost effectiveness and from the essential drug list of the health centers and donation drugs do not meet the needs of the recipient.

4.3.2 Quantification of essential drugs

Quantification is also one of the critical processes in the cause of expiry of drugs because it is estimating quantities and costs of medicines and health products required for a specific period and determining when shipments of the products should be delivered to ensure an optimal and uninterrupted supply.

The respondents were asked to indicate their level of agreement with the statements on quantification of essential drugs being a cause for the expiry of the essential drugs. The results are shown in table below.

Table 4.3 :Descriptive statistics on quantification of essential drugs

Item	N	Mean	Std. Deviation
without proper quantification, essential drugs are bought in huge quantities	68	2.93	0.982
population coverage is not considered while quantification of essential drugs	68	1.99	0.855
Seasonal variation in disease pattern is not considered while quantification of essential drugs	68	2.91	1.089
Rate of monthly drug consumption is not considered while quantification of essential drugs	68	2.06	0.731
Lead time taken for delivery of drugs from the nearest Drug warehouse is not considered while quantification of essential drugs.	68	3.21	1.030
Time delay between the placing an indent and receiving the orders was considered while quantification of essential drugs	68	3.44	1.297
appropriate inventory of essential drugs is done before procurement	68	4.01	1.044
donation drugs are not supplied in appropriate amounts	68	3.50	1.113
Over all		3.01	

Source: own survey result (2018)

According to the findings, the respondents agreed with a mean of 3.21, 3.44, 4.01 and 3.50 a standard deviation of 1.030,1.297,1.044 and 1.113 implying that Lead time taken for delivery of drugs from the nearest drug warehouse was not considered, Time delay between the placing an indent and receiving the orders were not considered, appropriate inventory of essential drugs is done before procurement and donation drugs are not supplied in appropriate amounts while quantification of essential drugs.

4.3.3 Procurement of essential drugs

Table 4.4: descriptive statistics on procurement of essential drugs

Item	N	Mean	Std. Deviation
The most cost effective essential drugs were not procured with in the right quantity	68	2.93	1.529
reliable suppliers of high quality products were not selected and procured	68	2.79	1.299
timely delivery is not ensured after procurement	68	3.34	1.074
Over all		3.02	

Source: own survey result (2018)

According to the findings, the respondents agreed with a mean of 3.34 and a standard deviation of 1.074 that timely delivery is not ensured after procurement of essential drugs.

4.3.4 Irrational drug use

Table 4.5 descriptive statistics on irrational drug use of essential drugs

Item	N	Mean	Std. Deviation
Standard treatment guideline is not distributed in the health center	68	2.65	1.494
The appropriate pharmaceutical treatment are not selected from the STG.	68	2.76	1.351
Donation drugs for the country in which they will be used, are not properly labeled	68	3.54	0.871
Over all		2.99	

Source: own survey result (2018)

According to the findings, the respondents agreed with a mean of 3.54 and a standard deviation of 0.871 that donation drugs for the country in which they will be used, are not properly labeled.

4.3.5 Expiry of essential drugs

Table 4.6 Expiry of essential drugs

Item	N	Mean	Std. Deviation
Rate the degree of expiry of essential drugs	68	2.75	1.084
Over all		2.75	

Source: own survey result (2018)

According to the findings most of the respondents agreed that there is low degree of expiry of essential drugs with a mean of 2.75 mean and a standard deviation of 1.084.

4.4 Factors Affecting Expiry of Essential Drugs: Estimation Results of the Regression model

The regression analysis was conducted to establish whether the independent variables (selection, quantification, procurement, irrational drug use of essential drugs) and dependent variable had impact on the dependent variable (expiry of essential drugs). In order to achieve the regression analysis and the research model, the researcher believed it is better to employ prominent assumption tests. Thus, the study employed prominent assumption tests for the regression analysis in order to minimize any error to inferences the results based on the samples for the whole population and the assumption test is attached under annex 3.

4.4.1 Multiple Regression Analysis

Multiple regression analysis was done using SPSS 24 to establish whether there is any relationship between the dependent and independent variables. The outcome was predicted by the model:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$$

Where Y= causes for expiry of drugs

α = constant (Intercept)

β = slope (gradient) showing rate dependent variable is changing for each unit change of the independent variable.

X1= selection of essential drugs

X2= quantification of essential drugs

X3= procurement of essential drugs

X4= irrational drug use

ε = Error Term

Expiry of essential drugs = $\alpha + \beta_1$ selection of essential drugs + β_2 quantification of essential drug + β_3 procurement of essential drugs + β_4 irrational drug use + ε

In the multiple regression analysis model of the relationship between the independent variable and dependent variable the coefficient of determination (R²) and correlation coefficient (R) shows the degree of association between the two. The results of the analysis posited that R²=0.367 and R = 0.606 which indicates that there is a positive relationship between independent variables (selection, quantification, procurement, irrational drug use of essential drugs) and dependent variable (expiry of essential drugs).

In addition to this, the result divulged that whenever the independent variable changed by 1%, it had predicted the dependent variable by 36.7%.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.606 ^a	0.367	0.327	0.412	2.381

a. Predictors: (Constant), Irrational drug use, quantification of the essential drugs, Procurement of essential drugs , selection of the essential drugs

b. Dependent Variable: Degree of expiry of essential Drugs

According to Field, 2009, in his study mentioned that Durbin-Watson result between 1.5 and 3.00 posited free from auto correlation. So the study also obeyed this assumption test rule.

Table 4.7 Estimation Result of the Regression Analysis

Variables	Unstandardized Coefficients		Standardized coefficients	T	Sig.
	B	Std.error	Beta		
Constant	2.034	1.151		4.704	0.000
selection of the essential drugs	0.120	0.108	0.149	1.114	0.270
quantification of the essential drugs	0.076	0.079	0.109	0.959	0.341
Procurement of essential drugs	0.051	0.097	0.061	0.529	0.599
Irrational drug use	0.358	0.120	0.409	2.975	0.004

Source: own survey result (2018)

Table 4.7 indicated the regression coefficient, constant and the P-Value or significance test of the analysis. On the basis of this analysis, the multiple regression equation has the following features.

The significance level, $p < 0.05$ is used to establish the relationship between Independent variables (IVs) (selection, quantification, procurement, irrational drug use of essential drugs) with the Dependent variables (DV)(expiry of essential drugs).

The values of the unstandardized Beta Coefficients (β) indicate the effects of each independent variable on dependent variable. Furthermore, the values of the unstandardized Beta Coefficients in the Beta column of the Table 4.7 above indicate

which independent variable makes the strongest contribution to explain the dependent variable, when the variance explained by all other independent variables in the model is controlled. The t value and the sig (p) value indicate whether the independent variable is significantly contributing to the prediction of the dependent variable. The study's hypothesis testing was made based on β , t , and P values. Hence using those coefficient results, the proposed hypotheses for this study were tested as follows.

Hypothesis 1: Selection problem has an effect on the expiry of essential drugs.

In South Africa, the National Essential Medicines Committee (NEMLC) consisting of multi-disciplinary technical experts are responsible for the selection of medicines for the EML and development of STGs for use by prescribers in the public sector. STGs exist to assist prescribers on specific treatments for specific clinical problems. In addition to listing essential medicines, the EML indicates at which level of care specified medicines should be used. Therefore, there is need to manage and monitor the process to avoid medicine wastage (National Department of Health, 2012). In this study the results of multiple regressions, as presented in Table 4.7 above, revealed that selection problem had no significant effect on the expiry of essential drugs of Kolfe keranio health centers ($\beta=0.120$, $t=1.114$ and $p=0.270$). Holding all the other independent variables constant, a unit increase in selection problem would lead to a 0.120 increase in expiry of essential drugs. Thus, the proposed hypothesis was rejected.

Hypothesis 2: Quantification problem has an effect on the expiry of essential drugs

Studies indicated that sometimes drugs expiration is influenced by requests to order drugs (kgabo, 2016). In this study fund availability for quantification, population coverage, Seasonal variation in disease pattern, Rate of monthly drug consumption, Lead time taken for delivery of drugs from the nearest drug warehouse were not being the causes for the expiry of essential drugs in Kolfe keranio health centers. The results of multiple regressions, as presented in Table 4.7 above, revealed that quantification problem had no significant effect on the expiry of essential drugs Of Kolfe keranio health centers ($\beta=0.076$,

$t = 0.959$ and $p = 0.341$). Holding all the other independent variables constant, a unit increase in quantification problem would lead to a 0.076 increase in expiry of essential drugs. Thus, the proposed hypothesis was rejected.

Hypothesis 3: Procurement problem has an effect on the expiry of essential drugs

The results of multiple regressions, as presented in Table 4.7 above, revealed that procurement problem had no significant effect on the expiry of essential drugs of Kolfe keranio health centers ($\beta=0.051$, $t = 0.529$ and $p = 0.599$). Holding all the other independent variables constant, a unit increase in procurement problem would lead to a 0.051 increase in expiry of essential drugs. Thus, the proposed hypothesis was rejected.

Kogabo (2016) discussed that several drugs are short-dated, meaning that they need to be purchased and used within a short period of time. It is therefore important for the department of health to purchase only drugs that are necessary or that are commonly used per health centers, in order to reduce drugs expiration. In this study procurement problems like procuring high cost drugs from non-reliable suppliers and non-timely delivery were not being the causes for the expiry of essential drugs in Kolfe keranio health centers.

Hypothesis 4: Irrational drug use has an effect on the expiry of essential drugs

Holden and Wilson (1996) emphasized that prescribers need to think rationally about therapeutics and consider carefully drugs they will include in their formularies as well as being mindful that formularies require continuing attention if they have to be effective. The results of multiple regressions, as presented in Table 4.7 above, revealed that irrational drug use problem had an effect on the expiry of essential drugs of Kolfe keranio health centers ($\beta=0.358$, $t = 0.120$ and $p = 0.004$). Holding all the other independent variables constant, a unit increase in irrational drug use problem would lead to a 0.358 increase in expiry of essential drugs. Thus, the proposed hypothesis was accepted.

CHAPTER FIVE

5. SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

In this section, the research is dealt about the summary of findings, conclusions and recommendations. The researcher strived to take the summarized results of the study from the discussion of analysis part; following this, the conclusions were derived on the basis of the research objectives and hypothesis. In the last part of this section, the recommendation part drew from the literature and theoretical concepts context.

5.1 Summary of finding

The key finding of this study is that the causes for the expiry of essential drugs may be curtailed by enhanced pharmaceutical management strategies. Most of these strategies can be adopted and improved at the organizational level, where the biggest impact may be made.

The main purpose of this study was to investigate the causes for the expiry of essential drug. The findings of the study encompassed The Data collected using questionnaires and analyzed through descriptive statistics, frequency distribution, and multiple linear Regression analysis

The discussion attempted to accomplish the objectives of the study, answer the research questions and test the hypotheses; accordingly, the following findings were identified

Related to the demographic characteristics, majority of the respondent, 40(58.8%), were female. The majority of the respondent 60(88.2%) were 20-30years of age. Regarding educational level, above half of the respondent were degree holders. In terms of work experience, 54(79.4%) of the total respondents have less than 5 years of experience and 14(20.6%) have between 6 and 10 years of experiences.

The results of multiple regressions revealed that selection of essential drugs ($p > 0.05$), quantification of essential drugs ($P > 0.05$) and procurement of essential drugs ($P > 0.05$) has insignificant effect in causing the expiry of essential drugs. However, irrational drug use of essential drugs had a positive and significant effect on causing the expiry of essential drugs ($P < 0.05$).

5.2 Conclusion

The aim of this study was to describe the cause for the expiry of drugs. When exploring the possible cause for essential drugs expire, the mainly attribute is ineffective inventory management. Ineffective inventory management can be curtailed by identifying internal and external contributing factors that can be used to strengthen intervention. There are aspects within pharmacist control to minimize medicines expiry and these are in the process of selection, quantification, procurement and rational use of drugs. This study applied hypotheses test, which emphasized

H1: selection problem has an effect on the expiry of essential drugs

H2: Quantification problem has an effect on the expiry of essential drugs

H3: procurement problem has an effect on the expiry of essential drugs,

H4: Irrational drug usage has an effect on expiry of essential drugs

The first three hypotheses were rejected since they had insignificant effect on causing expiry of essential drugs in Kolfe keranio health centers. However, the last hypothesis had accepted since it had significant effect on causing expiry of essential drugs in Kolfe keranio health centers.

Even if Ministry of Health has prepared Standard Treatment Guidelines (STG) and has distributed them to health care facilities, there are health centers without the Standard Treatment Guidelines (STG) which interrupts appropriate diagnosing, prescribing, dispensing, and proper consumption of drugs by the patient. Due to short expiry date and inappropriate amount, donation drugs have not met the needs of the recipients.

This study shows that the majority of medicines that expire at the Kolfe keranio sub-city health center are due to irrational use of drug. Medicine use is only possible if there is access, therefore minimizing waste may contribute to access and availability. Rigorous vigilance in medicine management and maintenance of demand planning at health center level may improve stock management. Additionally, the health centers should emphasize the use of STGs. Rational drug use is not restricted to the role of the pharmacist and, though the tools that exist support individual performance, the application of these tools require personal skills. Accountability can only be effective if it is assigned and practiced. Sound coordination and communication is needed between the pharmacy and other departments in the health centers to enhance the rational drug use in the health centers

5.3 recommendations

The study makes the following recommendations that will enhance the decrease of expiry of essential drugs.

Every health center needs an integrated inventory system and written procedure to deal with selecting quantification, procurement and rational drug use. Selection of essential drugs is very crucial because it helps to set priorities for all aspects of the pharmaceutical system. Essential drugs should be selected with due regard to public health relevance, evidence on efficacy and safety, and comparative cost- effectiveness.

Drug use is only possible if there is access, therefore minimizing waste may contribute to access and availability. Sound coordination and communication is needed between the pharmacy and other departments in the health centers on availability of STG and Identify innovative ways to ensure the use of STG.

Additionally, improve communication from pharmacy to other units Conduct departmental specific expiry reports to provide more strategic guideline to reduce waste and health stuffs should work in collaboration with the provincial pharmacy team to ensure that the conditions and facilities required to deliver high quality and safe medications were in place.

Written policies or guidelines for drug selection, forecasting and procurement should be prepared by the health centers or by respective Health Offices. The fact that policies and guidelines provide guidance on appropriate and standard course of actions, it might have helped the pharmacy professionals in the health centers to get best out of the logistics system

5.4 Suggestions for Further Research

The study sought to investigate but little studies has been undertaken to study causes for the expiry of essential drugs. This is the reason why the researcher calls for further studies to be undertaken in Ethiopia.

Furthermore, the study gave attention to only few critical factors that cause for the expiry of essential drugs and it could not exhaust the entire critical factors that cause for the expiry of essential drugs Therefore, there is need for more research which will be inclusive of all the critical factors that cause for the expiry of essential drugs

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Appendix 1
Saint Mary University
Department of MBA
Questionnaire

Dear sir/Madam;

I am undertaking a research on the topic entitled “Causes for the expiry of essential Drug in Ethiopia; in the case of kolfekeberanio health centers “in the department of MBA at Saint Mary University.

Essential medicines are those that satisfy the priority health care needs of the population. They are selected with due regards to public health relevance, evidence on safety, efficacy, quality and comparative cost-effectiveness. The Food, Medicine and Healthcare Administration and Control Authority (FMHACA) of Ethiopia in collaboration with World Health Organization (WHO) prepares the essential drug list of Ethiopia which will be updated from time to time following changes in disease patterns and recent developments in the health sector.

For the simplicity purpose the researcher has selected the essential drugs mostly used to treat the common health problems in health centers this are Gentamycin, Zinc, Pentavalent DPT-Hep-Hib Vaccine, Ferrous Salt Plus Folic Acid, Ergometrine Maleate Tablets, Medroxyprogesterone (depo) Injection, Refampicine /Isoniazide/ Pyrazinamide/Ethambutol, Paracetamol, Tetracycline Eye Ointment, Mebendazole Tablets, Artemisin/ Lumphantrine, Oral Rehydration Salts and Amoxicillin.

The main purpose of this questionnaire is to collect information regarding Causes for the expiry of essential Drug in Ethiopia; in the case of kolfekeberanio health centers. As a pharmacist/druggist of a health center you are invited to participate in this study.

I would like to confirm you that your response will be kept strictly confidential and it will be used exclusively for the purpose of this research. Besides, your swift response is enormously important in order to finalize the research timely and I would appreciate if you complete and return it within a short period of time of your receipt of same. Your cooperation is highly appreciated in advance, and looking forward to receiving your response.

Yours faithfully,
Samrawit kidane
Tel: 0963164648
E-mail: ktewolde@yahoo.com
Thank you very much!

PART I: Background Information of Respondents

Please fill the answer by putting “√” mark

No.	Items	Option/dimension	Put (√)
1	Gender:	Male	
		Female	
2	Age:	20-30 Years	
		31-40 Years	
		41-50 Years	
		51 Years & Above	
3	Educational Qualification:	PhD	
		Masters(2nd Degree)	
		First Degree	
		Diploma	
4	Work Experience (Overall):	0-5 Years	
		6-10 Years	
		11-15 Years	
		Above 15 Years	

PART II

Please Indicate Your Response by using tick mark (√) According to Your Choice

Code	Descriptions	Scales				
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	Selection of essential drugs					
1.1	Essential drugs were being selected due to public health relevance					
1.2	Essential drugs were being selected due to evidence on efficacy and safety					
1.3	Essential drugs were being selected due to comparative cost effectiveness					
1.4	Essential drugs were selected from the essential drug list of the health center					
1.5	Donation drugs don't meet the needs of the recipient					
2	Quantification of essential drugs					
2.1	Without proper quantification, essential drugs are bought in huge quantities					
2.2	Population coverage is not considered while quantification of essential drugs					
2.3	Seasonal variation in disease pattern is not considered while quantification of essential drugs					
2.4	Rate of monthly drug consumption is not considered while quantification of essential drugs					
2.5	Lead time taken for delivery of drugs from the nearest drug warehouse is not considered while quantification of essential drugs.					

2.6	Time delay between the placing an indent and receiving the orders was considered while quantification of essential drugs					
2.7	Appropriate inventory of essential drugs is done before procurement					
2.8	Donation drugs are not supplied in appropriate amounts					
3	Procurement of essential drugs					
3.1	The most cost-effective essential drugs were not procured within the right quantity					
3.2	Reliable suppliers of high-quality products were not selected and procured					
3.3	Timely delivery is not ensured after procurement					
3.4	Reliable suppliers of high-quality products were not selected for procurement					
4	Irrational drug use					
4.1	Standard Treatment Guidelines (STG) is not distributed in the health center					
4.2	The appropriate pharmaceutical treatment is not selected from the STG					
4.3	Donation drugs for the country in which they will be used are not properly labelled					
6	Degree of expiry of essential drugs	Very Low	Low	Medium	High	Very High
6.1	Please rate the degree of expiry of essential drugs					

Appendix 2 Assumption Test

In order to achieve the regression test, there should be assumption test of linearity, normality, homoscedasticity, autocorrelation and multicollinearity. Pursuant to this, the study employed independent variables tests.

Multicollinearity statistics test

Multicollinearity refers to the assumption that the independent variables are uncorrelated. The researcher is able to interpret regression coefficients as the effects of the independent variables on the dependent variables when Multicollinearity is low. This means that we can make inferences about the causes and effects of variables reliably.

Multicollinearity can be tested by looking at the **Coefficients** table. This allows to more formally check that the predictors (or IVs) are not too highly correlated. VIF and Tolerance statistics can be used to assess this assumption. For the assumption to be met VIF scores should be well below 10, and tolerance scores should be above 0.2.

As depicted in the table below there were no problem of multicollinearity since VIF values <10, and all tolerance >0.2.

Model	Coefficients	
	Collinearity Statistics	
	Tolerance	VIF
1 (Constant)		
selection of the essential drugs	0.560	1.785
quantification of the essential drugs	0.773	1.293
Procurement of essential drugs	0.756	1.323
Irrational drug use	0.533	1.878

a. Dependent Variable: Degree of expiry of essential Drugs

Own source 2018

Autocorrelation test

The Durbin Watson statistic is a number that tests for autocorrelation in the residuals from a statistics regression analysis. The Durbin-Watson statistics is always between 0 and 4. A rule of thumb is that test statistic values in the range of 1.5 to 2.5 are relative normal. Any value outside this range could be a cause for concern. The result of the Durbin-Watson figure stated $d=2.381$ which is between $1.5 < d < 2.5$, this means, there were no autocorrelation problem.

Homoscedascity test

Homoscedasticity refers about the homogeneity of variances. The researcher applied a Levene Statistic which means if the result of a SPSS output has insignificance results, it means the diagnosis has achieved homogeneity of variance (Field, 2013).

Test of Homogeneity of Variances

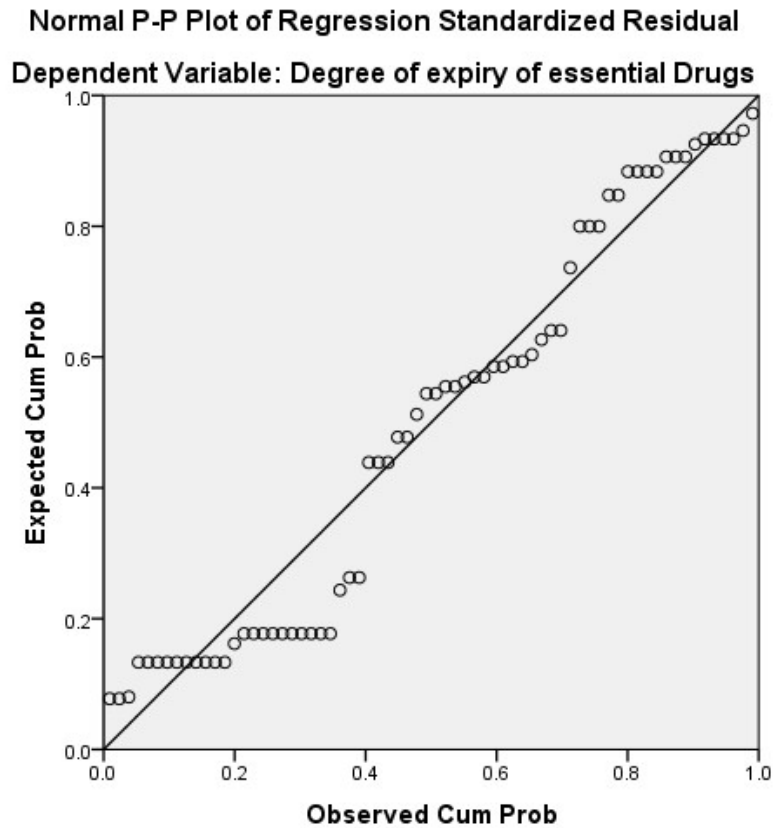
	Levene Statistic	df1	df2	Sig.
selection of the essential drugs	1.994	1	66	.163
quantification of the essential drugs	.006	1	66	.940
Procurement of essential drugs	7.251	1	66	.059
Irrational drug use	3.725	1	66	.058

As described in the above table homoscedasticity test referred the homogeneity of variance. The researcher deployed Levene Statistic according to the result the median disclosed a P-Value $>.05$ with df1 and df2 of 1 and 47 respectively. On the basis of Levene Statistic insignificance referred existing of homogeneity of variance.

Linearity Test

Linearity defines the dependent variable as a linear function of the predictor (independent) variables Multiple regression can accurately estimate the relationship between dependent and independent variables when the relationship is linear in nature.

The figure below shows normal P-plot with normal distribution from the SPSS software.



Normality Test

Multiple regression assumes that variables have normal distributions. This means that errors are normally distributed, and that a plot of the values of the residuals will approximate a normal curve. The assumption is based on the shape of normal distribution and gives the researcher knowledge about what values to expect. Once the sampling distribution of the mean is known, it is possible to make predictions for a new sample.

The figure below shows histogram with normal distribution from the SPSS software.

