LOGISTICS MANAGEMENT PERFORMANCE FOR KEY ESSENTIAL MEDICINE IN PUBLIC HEALTH FACILITIES OF AWI ZONE, AMHARA REGIONAL STATE, NORTH WEST ETHIOPIA

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Abstract

Background: *"logistics management is the part of supply chain management (SCM) that plans, implements, and controls the efficient and effective forward and reverses flow and storage of goods, services, finance and related information between the point of origin and the point of consumption in order to meet customers' requirement."*

Objective: *To assess the logistic management performance for key essential medicine and associated challenges in public health facilities of Awi zone, Amhara region.*

Methods: *A facility based cross sectional mixed method strategy was conducted from March 15, 2019 – May 15, 2019 in 22 selected public health facilities in Awi zone and logistics management performance was measured by core logistics indicators; availability and utilization of facility specific drug list, forecast accuracy error, inventory accuracy and wastage rate, availability and stock-out rate and good storage condition. Quantitative data was collected by using semi-structured questionnaire and check list adopted from LIAT. The collected data were cleaned and analyzed by using SPSS version 23. Descriptive findings were presented by tables, graph and charts. Fisher's exact test was conducted to determine the association between dependent and independent variables. For qualitative data Physical observation and in-depth interview of key informants was carried out by using tools adopted from LSAT. Then the data were analyzed by using thematic content analysis approach.*

Result: *This study revealed that out 22 HFs surveyed majority of them 19(86%) developed their own specific drug list and used it as a reference tool for procurement; the mean absolute percentage forecast error was 41.42%. And 446(92%) tracer drugs had bin card, inventory accuracy rate was 85.43% and also average percentage availability of RDF key Ems on the day of visit was 85.6%; twelve(55%) HFs didn't fulfill the criterion for good pharmaceutical storage condition.*

Conclusion*: As measured by core logistics indicators this study concluded that the overall logistics management performance of the studied facilities was good.*

Key words: logistics management, performance, key essential medicines, public health facilities, Awi zone.

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List of abbreviations and acronyms

AIDS	Acquired immune deficiency syndrome
APE	Absolute percentage error
CSCMP	Council of supply chain management professionals
CSA	central statistics agency
DFID	united kingdom department for international development
DTC	drug and therapeutic committee
EMs	essential medicines
EML	essential medicine list
EPSA	Ethiopian pharmaceutical supply agency
FDRE	federal democratic republic of Ethiopia
FEFO	first expiry first out
Fefol	ferrous sulphate with folic acid
Fig	figure
FMOH	federal ministry of health
Freq.	Frequency
FSDL	facility specific drug list
HCs	health centers
HFs	health facilities
HPs	hospitals
HIV	human immune virus

IBs	innovator brands
IPLS	integrated pharmaceutical logistics system
IRB	institutional review board
IRP	international reference price
IT	information technology
KIs	key informants
LIAT	logistics indicator assessment tool
LMIC	low and middle income countries
LM	logistics management
LMIS	logistics management information system
LSAT	logistics system assessment tool
MAPE	mean absolute percentage error
MPR	median price ratio
MS	medical stores
MSH	management science for health
NEML	national essential medicine list
PFSA	pharmaceutical fund and supply agency
PHC	primary health care
PHCU	primary health care unit
PI	principal investigator
PLMP	pharmaceutical logistics master plan

PRF	purchase request form
PSA	pharmaceutical supply agency
RDF	revolving drug fund
RMs	regional medical store
SCM	supply chain management
SDPs	service delivery points
SOP	standard operating procedure
SPSS	statistical package for social science
STG	standard treatment guideline
TOR	Term of reference
UK	United Kingdom
US	United States
USAID	United states agency of international development
WHO	World health organization
WoHOs	Woreda health office

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1. Introduction

1.1. Background

Health services provision heavily depends on the availability of essential medicines. Essential medicines are the corner stones for every health care system (1). These essential medicines (EMs) are meant to be always available in a functioning health care system in adequate amounts, appropriate dosage forms with assured quality and adequate information. Essential medicines not only save lives, prevent epidemics and diseases but also promote trust and community participation in the health care system too. During the Alma-Ata conference in September 1978, the availability and accessibility of essential medicines were reaffirmed as basic components of primary health care as well as fundamental human right (2).

Despite this fact, hundreds of millions of people do not have regular access to essential medicines. Mortality figures across developing regions reflect a huge burden of illness that can be substantially reduced if carefully selected low cost pharmaceuticals are available and appropriately used (3, 4).

As defined by council of supply chain professionals (CSCMP) "Supply chain management (SCM) encompasses the planning and management of all activities involved in sourcing, procurement and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers, and customers. Logistics management is defined as "the part of SCM that plans, implements, and controls the efficient, effective forward and reverses flow and storage of goods, services, finance and related information between the point of origin and the point of consumption in order to meet customers' requirement"(5).

Logistics management includes selection, quantification, procurement, storage, inventory management, distribution, use and data collection and reporting. A successful logistics system provides excellent customer service by fulfilling the six rights: procuring the right medicine, in the right quantity, in the right condition, delivered to the right place, at the right time, for the right cost (6).

In any logistics system, the first step is selecting the appropriate product which flows throughout the system. In the health sector, no health care system can afford to supply all drugs that are available on the market. Selection of medicines ensures that available financial resources are used wisely provide a limited list of drugs and dosage forms that are appropriate to the health problems of a country or community. Selection of medicines involves reviewing the prevalent health problems of the area, identifying treatments of choice, choosing individual medicines and dosage forms, and deciding which medicines will be available at each level of a health care system (3).

In Ethiopia, the drug policy ensures that medicines which are required for prevention, diagnosis, treatment, mitigation and rehabilitation of diseases affecting the majority of Ethiopian people have to be identified and classified to respective levels of health service delivery and drug and therapeutic committee (DTC) is responsible for the development and maintaining of facility specific drug (pharmaceuticals) list (7,8).

After appropriate products are selected, the quantity required of each product must be determined for procurement. Quantification is the process of estimating the quantities and costs of the products required for a specific health program or service and determining when the products should be delivered to ensure uninterrupted supply for the program. Quantification must consider contextual factors, such as available funds, storage capacity, capacity to deliver services, and human resources. It may be carried out at central level and facility level. Ethiopia follows both centralized and decentralized quantification process. Program drugs are quantified at central level while revolving drug fund (RDF) products quantification are done in decentralized way at the health facility level. Health facilities are expected to quantify their annual requirement and submit to the nearby pharmaceutical supply agency (PSA) hub, the hub aggregates and report to the central PSA based on the common list of pharmaceuticals approved from the central level. If it is managed properly, decentralized quantification increases responsibility and creates ownership of the results of quantification. In this study the terms quantification and forecasting are used interchangeably (9, 10).

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. In Ethiopia public health facilities procure medicines primarily from

Ethiopian pharmaceutical supply agency (EPSA); the only governmental medical supplier. In the case of stock out of products from EPSA, the agency issues stock out certificate to the requesting facilities and the facilities find their way to private suppliers to fulfill their demand (3, 10).

After pharmaceuticals are selected, quantified and procured, it must be stored until dispensed to the patient. Maintaining proper storage conditions for health commodities is vital to ensuring their quality. Product expiration dates are based on ideal storage conditions and protecting product quality until their expiration date is important for serving customers and conserving resources. Finally Pharmaceutical logistics management should include an effective inventory management and information system that satisfies patient needs at the minimum expense (11).

Measuring pharmaceutical logistics management system performance in public health facilities helps to understand how it is currently performing and to identify key bottlenecks and ways to strategically improve the system. The health facilities logistics management performance was measured by using core logistics indicators; availability and utilization of facility specific drug list, forecast accuracy error, inventory accuracy and wastage rate, availability and stock-out rate and good pharmaceutical storage condition (12). This study tried to fill the dearth of information on the performance and challenges of the pharmaceutical logistics management particularly that of RDF drugs in public health facilities of Awi zone, Amhara region.

1.2. Statement of the problem

Pharmaceutical expenditures in developing countries account between 10 - 40% of public health budgets. Particularly, in Africa it ranges from 24% in South Africa to 66% in Mali as compared to an average of 12% in developed countries (13). Despite such huge investment on pharmaceuticals, shortages of essential medicines, and spending on unnecessary or low-quality medicines results in wastage of scarce resources, burden of preventable illness and death. Lack of careful selection, incorrect quantification, high prices, poor quality, improper storage, expiration of medicines, irrational prescribing, corruption, and incorrect medicine use by patients cause total losses of 70 percent of the above original expenditure (3). This shows that a significant portion of pharmaceutical expenditures is wasted due to inefficiencies associated with logistics management system including poor drug selection practice, inaccurate forecasting of future demand, inefficient procurement, poor inventory management and poor storage conditions.

Poor performance of pharmaceutical logistics management not only wastes a resource, but also hampers availability and access to essential medicines in poorest countries of Africa and Asia, where more than 50% of their populations lack access to essential medicine for their primary health care needs (14). Poor availability of essential medicine especially in public sector where majority of poor people's relies on, results in increased burden of preventable disease, loss of productivity, socio economic and political consequence as well as loss of confidence and community participation in the health care system. Many of these sources of wastage could be reduced if some basic principles of medicine management and use are followed. An efficient and robust medicines management in public health facilities ensures rational selection, quantification, procurement, storage, distribution, use and thereby availability of the right drugs in the right quantities, at reasonable prices, and at recognized standards of quality throughout the year without any stock-out periods in between can be ensured (15).

In the health sector, no health care system can afford to supply all drugs that are available on the market. Selection of medicines ensures that available financial resources are used wisely provide a limited list of drugs and dosage forms that are appropriate to the health problems of a country or community (3). But studies conducted in different countries showed that there were malpractices regarding product selection and procurement. The study conducted in Nepal

showed that majority of the visited facilities had no facility specific drug list and medicine procurement was done based on doctors' prescriptions (prescriber's preference) which is heavily influenced by pharmaceutical companies' marketing strategies. This study further revealed that majority of visited facilities were used an expensive direct procurement model for purchasing medicines (20). Again a study conducted in Tanzania also revealed that only 38 % of surveyed public health facilities have their own essential medicine list. Among these only 52% of facilities procured medicines within EDL (16). Another study conducted in South Africa showed that standard operating procedures, standard treatment guidelines and essential drug list were not available at all facilities(17).

Forecast is really perfect studies revealed that forecast accuracy error results in bullwhip effect and increases in organizations cost up to 30% which leads to substantial damage to the system performance. The impact of forecast accuracy errors happened at each lower level facilities in decentralized quantification system is not only restricted to the individual facilities but also affects the countries over all pharmaceutical demand and supply (18). The study conducted in public health facilities of Uganda showed that medicine forecasting based on neither morbidity nor consumption methods of quantification, requisitions are based on credit available (19).

Inventory management is continuing "process of planning, organizing and controlling inventory" that aims at "minimizing the investment in inventory while balancing supply and demand." Specifically, the process aims at reducing procurement and carrying costs, while maintaining an effective stock of products to satisfy customer and prescriber demands. An efficient inventory management reduces shortage and wastage of essential medicines in health care settings (49). A study conducted in Uganda public health facilities showed that only 36% of the records that coincide with the physical counts of the drugs and only 20% of the staffs were formally trained in the drug logistic management (21). This study further revealed that only 10% of the warehouses have fulfilled adequate storage condition for pharmaceuticals (21). Again a study conducted in public health facilities of Eastern coastline of Tanzania (Zanzibar island) showed that inventory accuracy rate was 70% and 48% of storage facilities did not maintain acceptable storage condition (22). Another cross sectional study conducted in public health facilities of east shewa zone of Ethiopia showed that inventory accuracy rate was 28% and only 25% facilities

were fulfilled criteria for acceptable pharmaceutical storage conditions. This study further revealed that on average around 10.43% of medicines were wasted (27).

The ultimate goal of health logistics system is availing the right product, at the right quantity, at the right quality, in the right cost to the right place at the right time. Despite this fact studies showed that public health facilities were experienced frequent stock out of essential medicines everywhere (2). A study conducted in Uganda public health facilities revealed that availability of key drugs on the day of visit was only 65.5% (20). Another study conducted in Uganda public health facilities also revealed that average stock out duration for key essential medicines was 5 months (21). Again a study conducted in public health facilities of Eastern coastline of Tanzania (Zanzibar island) showed that average percentage of days of stock out of essential medicines were 31% (22). Also a study conducted in Addis Ababa public health centers showed that 75% health centers experienced stock out of one or more key essential medicines in day of visit (24). A national survey conducted in our country in 2015 revealed that average availability of baskets of tracer drugs was 78% still less than world health organization recommendation of 100% availability of essential medicines (26). Again another cross sectional study conducted in public health facilities of east shewa zone of Ethiopia showed that average stock out duration of key essential medicines was 35.31 day (27).

Studies revealed that African countries in particular sub-Saharan countries faced several challenges regarding pharmaceutical logistics management like poor information communication technology, poor data quality, inadequate storage facilities and capacity, lack of management commitment, lack of transparent procurement procedures, lack of guidelines for good storage procedures, a lack of appropriate planning, monitoring and evaluation and budget constrain and inadequate budget allocation, lack of human resource capacity and expertise on pharmaceutical logistics management and lack of dedicated transport and transportation infrastructure are the most common challenges that face most of sub Saharan countries (67).

Keeping this fact in mind, this study assessed and measured the logistics management performance for RDF key essential medicines and associated challenges in public health facilities in Awi zone and identified at which point it is under performing and provided additional information on forecasting performance of HFs for RDF key Ems that was not addressed by previous studies conducted at the public health facility level in our country.

1.3. Significance of the study

The importance of having medicines and medical supplies at the health facilities is not over stated and their availability often depends on how well or how poorly the logistics management system is performing. Hence to improve logistics system performance, it is necessary to know how it is currently performing. For instance this study was conducted to provide an empirical snapshot of the current pharmaceutical logistics management situation for RDF key essential medicines in public health facilities of Awi zone, and provided baseline information to track changes and improvements in pharmaceutical logistics performance over time. This study would have significant importance to the individual's / organizations.

i. To health facilities

This study explored the logistics management performance of HFs for RDF key EMs and challenges affecting logistics management system. Such findings may be used by the management of each public health facility in making decision on ways of improving their performance.

ii. To policy makers

Ministry of Health, pharmaceutical supply agency of Ethiopia (EPSA) and other stack holders like non-governmental organizations may find results of this study of importance to reassess the system again and to develop policies that ensure the efficiency of logistics management systems for RDF key essential medicines in health facilities; and ultimately to ensure availability of those products at minimum costs.

iii. Health care practitioners

This study documented logistics management performance for RDF tracer drugs in public health facilities by using core logistics indicators and assessed the challenges that faced the practice. Such results may be used by professionals in charge of drug supply management as a bench mark to monitor and evaluate their day to day activities.

iv. To scholars

The finding documented in this study may be used as the reference literature by students and other people who have interested to conduct the related study in this field.

2. Literature review

2.1. Essential medicine concept and pharmaceutical management

The International Conference on Primary Health Care (PHC), Alma-Ata, on September 6–12, 1978, strongly reaffirms that health, which is a state of complete physical, mental, and social well-being, and not merely the absence of disease or infirmity, is a fundamental human right and that the attainment of the highest possible level of health is the most important worldwide social goal whose realization requires the action of many other social and economic sectors in addition to the health sector (28). Essential medicines (EMs), as demarcated by the World Health Organization (WHO), are the medicines that "satisfy the priority health-care needs of the population, should consequently be accessible always in sufficient quantities and in the appropriate dosage forms and at a cost that a patient personally or society or country can afford. Currently, availability of medicines is considered as the most essential component of any effective health-care system (28). Essential medicines lists (EMLs) are efficient means to ensure access to safe and effective medications. The WHO has led this initiative, generating a biannual (every two years) EML since 1977. Nearly all countries have implemented national EMLs based on the WHO EML (29). Ethiopia developed the first edition of national essential medicine list (NEML) in 1985 and consequently updating it in 1987, 1996, 2002 to the current fifth edition in 2007 E.C based on knowledge advancement in the field of medicine and pharmacotherapy. All health facilities at all level expected to adopt their own specific drug list from the NEML.

2.2. Pharmaceutical logistics management

As defined by CSCMP logistics management is "The part of supply chain management that plans, implements, and controls the efficient, effective forward and reverses flow and storage of goods, services, finance and related information between the point of origin and the point of consumption in order to meet customers' requirement. It is an operational component of supply chain management. The goal of a health logistics management system is much larger than simply making sure a product gets where it needs to go. Ultimately, the goal of every public health logistics system is to help ensure that every customer has commodity security. Commodity security exists when every person is able to obtain and use quality essential health supplies whenever he or she needs them. Well-functioning supply chains benefit public health programs in important ways by; increasing program impact, enhancing quality of care improving cost

effectiveness and efficiency. Within the healthcare industry, the supply chain associated with pharmaceutical products is critical in ensuring a high standard of care for patients and providing adequate supplies of medication for those who needs it (5). In terms of cost, it is estimated that supply chain accounts for 25-30 percent of operational costs for hospitals. Therefore, it should be managed effectively to meet both service and cost objectives (30). It has been shown that the appropriate management of pharmaceuticals is directly related to the ability of a country to address public health concerns and it is one of the most important managerial issues in healthcare industries (31). A study conducted in Singapore hospitals showed that more than 30 percent of total hospital expenses are invested in logistics activities and half of this cost could be eliminated through efficient logistics management (32).

2.3. The logistics cycle

Logistics management includes a number of activities that support the six rights. Over the years, logisticians have developed a model to illustrate the relationship between the activities in the logistics system; this is termed as the logistics cycle. An effective logistics system meets the six rights; the right product, in the right quantity, at the right quality, by the right cost, to the right place at the right time (5).

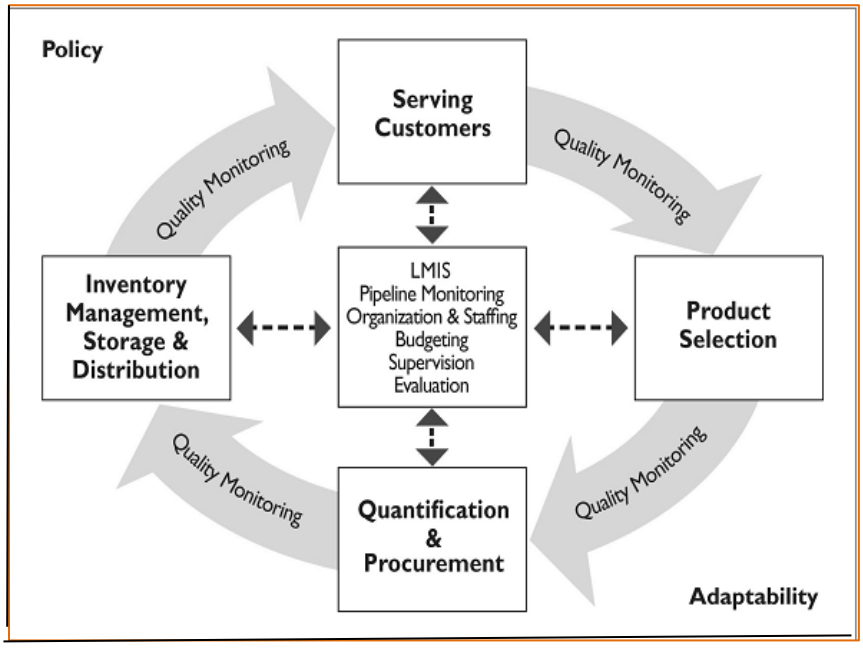

Fig. 1: The logistics cycle (Source: logistics hand book)

2.4. Selection, quantification and procurement

2.4.1. Selection

There are vast numbers of medicine in the market; availing all this medicine in a certain country will never be a wise chose as well the cost of those medicine is unaffordable. Therefore for insuring the availability of the safe, effective and good quality medicines limiting the number of medicine used in a country as well as in the facility is necessary (33). Establishing and using a limited list of carefully selected essential medicines is perhaps the single most cost-effective action that any health care system or health care provider can take to promote regular supply and rational use of medicines(3). In any health logistics system, health programs must select products based on local diseases prevalence, safety efficacy, quality and cost. In pharmaceutical logistics system of public health facilities of Ethiopia, drug and therapeutic committee (DTC) are responsible for product selection (34). Facility-level medicine selection ensures the maximal involvement, acceptance, and compliance of the prescribers concerned. Products selected for use will impact the logistics system, so the logistics requirements must be considered during the product selection (35). Lack of facility specific drug list and non-adherence to essential medicine list results in potential wastage of the limited health care budget through purchasing unnecessary , ineffective and even toxic and dangers medicines in public health facilities (3). A study conducted in Tanzania revealed that only 38 % surveyed public health facilities have their own essential medicine list. Among these only 52% of facilities procured medicines within EDL (16). Another study conducted in South Africa showed that standard operating procedures, standard treatment guidelines and essential drug list were not available at all facilities. The study further revealed that in adequacies and weakens in procurement, quantification, stock control, storage and record keeping (17). A cross sectional study conducted in public health centers of Addis Ababa showed that 95% health facilities have their own facility specific drug list but the study did not reveal how much of drugs were procured from facility specific drug list(24). Again cross-sectional study conducted in four public hospitals of Southern Ethiopia in 2014, reported that all of the assessed facilities did not have their own drug list, NEML, national formulary and even STG (36).

2.4.2. Quantification

Quantification is the process of estimating the quantity and cost of the products required for a specific health program (or service), and to ensure an uninterrupted supply for the program, determining when the products should be procured and distributed. Quantification performance of a given health program is measured by a standard indicator i.e. forecast accuracy error (9). Forecast is rarely perfect, a scale to judge the accuracy of forecast based on the mean absolute percentage error (MAPE) measure was develop by Lewis and is shown in the (Table 1) below (37).

Table 1: A scale of judgment of forecast accuracy.

Mean absolute percentage error (MAPE)	Judgment of Forecast Accuracy
Less than 10%	Highly accurate
11% to 20%	Good forecast
21% to 50%	Reasonable forecast
51% or more	Inaccurate forecast

Studies suggests that forecast accuracy error results in bullwhip effect and an increases in organizations cost up to 30% which leads to substantial damage to the system performance(18). The study conducted in public health facilities of Uganda showed that medicine forecasting based on neither morbidity nor consumption methods of quantification, Requisitions are based on credit available (19).

2.4.3. Procurement

Procurement is means of obtaining goods, works, consultancy or other services through purchasing, hiring or obtaining by any other contractual means. Health systems or programs can procure from international, regional, or local sources of supply; or they can use a procurement agent for this logistics activity. In any case, procurement should follow a set of specific procedures that ensure an open and transparent process that supports the six rights (3).

Pharmaceutical procurement system is a major determinant of pharmaceutical availability and total pharmaceutical costs. In most developing countries, pharmaceutical purchases represent the single largest health expenditure after personnel costs. Pharmaceuticals also consume the major share of health-related foreign currency exchange. The procurement of health commodities is different from the procurement of non-health products; as the demand for medicines and health supplies reflect changes in population health and environmental conditions, there exists a great need for flexibility and responsiveness in procurement and contracting (38).

Procurement performance in the Public Health facilities worldwide involves several key indicators in public procurement processes. Some scholars argued that, procurement efficiency and effectiveness contribute to increased performance of public health facilities since drugs and commodities are always readily available for consumption. In most African countries, public procurement for pharmaceuticals is handled by personnel with limited knowledge and experience in designing optimal procurement systems to fit the ever changing demands in health facilities (39). To strengthen the public procurement process for public health commodities procurement performance should be measured by using standard indicators like product price variance(ratio of purchase prices to world market prices (international price reference)), supplier lead times, and percentage of purchases made through competitive tendering, and planned versus actual purchases (3,40). According to WHO and HAI, governments in lower and middle income countries (LMICs) should be able to achieve median price ratio (MPR) of ≤1 when buying medicines (41). Given the impact of procurement activities on the operation and effectiveness of health facilities, it is essential that these activities must be performed by qualified staff with high professional and ethical standards and using sound procedure anchored in policies and regulations (42).

Study conducted in Indian tertiary care hospitals revealed that there was no specific technical committee in place for ensuring quality of medicines procured. Available pool of human resource was inadequate and there were no standard procedures in place to monitor the performance of procurement and supply system on regular basis (43). Another study conducted in Nepal public health facilities showed that majority of facilities had procurement guide line but used an expensive direct procurement model for purchasing medicines. Most facilities had no facility specific formulary and procured medicines solely based on doctors' prescriptions, which were heavily influenced by pharmaceutical companies' marketing strategies (44).

2.5. Inventory management and storage condition of pharmaceuticals

2.5.1. Inventory management

Inventory is the stock of any item or resource used in an organization. It can be described in financial terms as the sum total value of raw materials; semi processed and finished goods at any given time. Inventory control is the basis of coordinating the flow of medicines and medical supplies in the supply chain. An inventory control system informs the manager what to order, when to order and, how much to order so that clients can be served at all time. An efficient inventory control system minimizes spoilage and expiry at all level (45, 46). Inventory requirement differs with the type of organization. In the health facilities, this includes the drugs and all other raw materials or finished products involved in diagnostic and therapeutic services for the patients. About one-third of the annual expenditure of health facilities is spent in buying those supplies including drugs (47, 48).

Inventory management is defined as the continuing "process of planning, organizing and controlling inventory" that aims at "minimizing the investment in inventory while balancing supply and demand." Specifically, the process aims at reducing procurement and carrying costs while maintaining an effective stock of products to satisfy customer and prescriber demands. Information technology makes methods of inventory management and methods of evaluating inventory management more efficient, more precise, and more accurate. Thus, relevant software should be employed in medical stores and pharmacists should be trained on utilizing such systems for managing inventory (49).

In Ethiopian IPLS all health facilities at each level established their maximum and minimum stock level and are practicing periodic forced ordering inventory control system. The medical store manager at each facility reviews all stock levels and order enough stock to bring the level to maximum (10). A survey conducted in public sector health facilities in Pakistan showed that only 5% of surveyed facilities have standard operating procedure (manual) for inventory management (50). Another study conducted in public health facilities of Bojanala Health District of south Africa revealed that availability of stock recording tools was 71%, on average, only 50% of the stock cards assessed had accurate information and only 20% of facilities determined their maximum and minimum stock level. Availability of tracer drug was 80% for hospitals and 79% for health centers (51). A similar study conducted in public health facilities of Uganda showed that discrepancies between stock/bin card balances and physical balances in health center was 40% while in regional referral hospital was 31%. Eighteen percent (18%) of the indicator items did not have stock cards at all. And only Fifty seven percent of the Bin cards were up-dated by the time of the visit to the health facilities (52). Another study conducted in public health facilities of east shewa zone of Ethiopia to assess inventory management performance of key essential medicines showed that out of 400 bin cards (40.50%) of them were not updated and only 28.50% of bin-cards were accurately filled. The mean stock out rate of key essential medicines was around 27.25% with average stock out duration of 35.31 days. This study also revealed that on average around 10.43% of medicines were wasted. The authors further identified that budget constraints, human resource inadequacy, & over supply of near expiry date medicines were the main challenges of inventory management in the surveyed facilities (27).

2.5.2. Over view of pharmaceuticals and information flow in Ethiopia

Program pharmaceuticals are ordered every two months by hospitals and health centers and delivered by EPSA to these facilities directly or indirectly. Direct delivery sites are facilities that receive program pharmaceuticals directly from EPSA hubs whereas non-direct delivery sites are health centers that receive products from EPSA hubs through Woreda Health Offices (WoHOs). Health posts report to health centers monthly and collect pharmaceuticals from those health centers; the health centers use the data in the Health Post report to calculate consumption and resupply quantities (53). For revolving drug fund (RDF) pharmaceuticals, health centers and hospitals complete PRF as per the facilities review period which can be every two month, every quarter or every six months and collect products from affiliated EPSA branch(10).

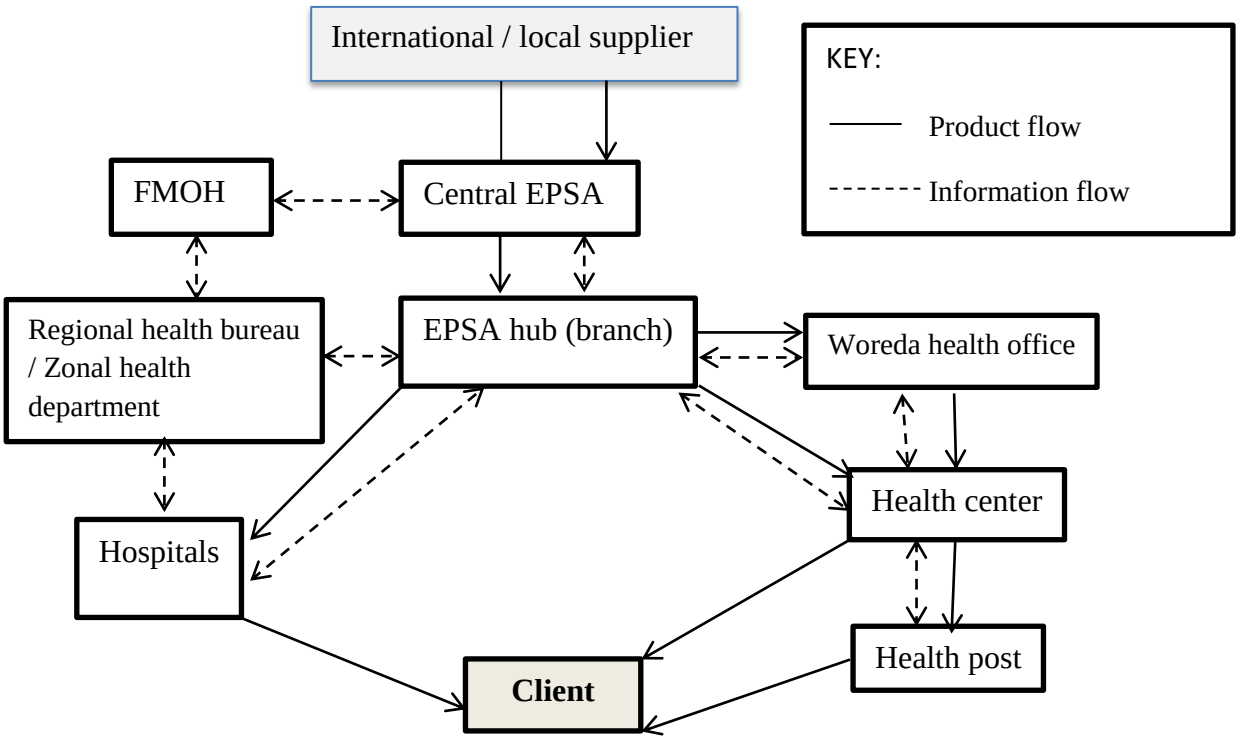

Fig 2: Flow of Pharmaceuticals and Information in Ethiopian IPLS. (Source: IPLS (SOP) manual second edition, November, 2015)

2.5.3. Storage condition

Gains made by careful selection of medicines and rational procurements can all are reduced if followed by poor storage practice. In such situations medicines are likely to be wasted due to altered quality and spoilage. Medicines have "enemies" like heat, light, moisture and pest. It is also recognized that medicines have to be protected from theft, expiration, and physical damage and fire (45). The quality and storage of EMs settings were considered as an imperative question and time-to-time assessment has been advocated (53). A survey of public sector health facilities in Pakistan found that only 60% of public health facilities had functional refrigerators and temperature control was present in 24 percent of health facilities (50). Again Supply chain management performance assessment conducted in public health facilities in two province of Democratic republic of Congo showed that more than 50% of the cold chain equipment available at health facilities was not working, partly due to simply old and out-of-date equipment and partly due to lack of repair or maintenance(54). Another study conducted in public health facilities of east shewa zone of Ethiopia to assess inventory management performance of key essential medicines showed that only 25% of the health facility have full filled good pharmaceutical storage condition criteria(27). Again a cross sectional study conducted in Woreda health office medical stores of eastern part of Ethiopia to assess pharmaceutical storage condition showed that all of the surveyed stores were lacked refrigerator, fire extinguisher and wall thermometer (55).

2.6. Availability of essential medicines

Essential medicines are meant to be always available in a functioning health care system in adequate amounts, appropriate dosage forms with assured quality and adequate information. The ultimate goal of health logistics system is availing the right product, at the right quantity, at the right quality, in the right cost to the right place at the right time. Despite this fact public health facilities experience frequent stock out of essential medicines (2). A study conducted in Belgium and France revealed that one of the main causes of medicine shortage was distribution and supply problem (56). Another study conducted in Malaysia showed that the regular availability of vital medicines in the public health clinics of Malaysia was 95.4%. The usual stock-out period of vital medicines was 6.5 days (57). While cross sectional study conducted in Indian Uttar Pradesh state public health facilities showed that the mean percentage availability of children's medicines was only 17% (58). Another study conducted in Delhi, India showed that the overall

mean availability of surveyed medicines in public health facilities under state government was 41.3% and the overall mean availability of medicines in three tertiary care facilities operated by the federal government was 49.3%. The researcher argued that low availability of medicines in the public sector could results from factors such as under-budgeting, purchasing medicines not included in the EML, inability to forecast needs accurately, and inefficient purchasing/distribution in the supply chain (59). A similar study conducted in 80 public health facilities across 12 districts in Haryana and Punjab states of India revealed that overall availability of medicines was 45.2 % and 51.1 % in Punjab and Haryana respectively. And most of the facilities followed a scientific method of inventory management first expiry first out (FEFO). However, the average number of days needed to receive the medicines varied from 4 to 14 weeks in a public sector facility which might explain frequent stock-outs and thus pointing to the inefficiencies in the procurement/distribution system. The investigators argued that strengthening the public sector availability of medicines is a long-term, sustainable way to reduce private expenditure on healthcare. Increased allocation of funds on medicines is of paramount importance. Robust information technology (IT) systems should be used for scientific warehousing and inventory management, real-time stock monitoring and transparent centralized procurement and decentralized distribution mechanism are key factors to avail medicines in public sector (60). Another Cross-sectional survey conducted in 28 public health facilities, 7 district warehouses, and 14 private pharmacies in 7 districts of Nepal showed that the availability of medicine was 92.44%. The percentage of expired medicines in district warehouse was 8.40. The average stock-out duration in district warehouse was 0.324 days (61). The study conducted in public health facilities of Uganda in (2007) showed that the average stock out duration of the basket of the key drugs was approximately 5 months. Only 20% of the staff was formally trained in the drug logistic management. The study further revealed that only 10% of the warehouses have adequate storage condition for the drugs (21). Similar study conducted in Uganda in 2010 to assess availability of essential medicine in public health facilities showed that the average availability of key medicines in the public health facilities was 76.11% (79.53% for essential medicines and 72.68 for medical supplies). Artemether/lumefantrine (20/120 mg) had the highest percentage stock-out followed by Cotrimoxazole 480mg tablets (51.6% and 32.4 %, respectively) (19). A study conducted in Bojanala Health District of south Africa revealed that Availability of tracer drug was 80% for hospitals and 79% for health centers (51). A similar

cross sectional study conducted in one administrative area (Manzini region) of Swaziland revealed that Mean availability of essential medicine in public health facilities was 68% (62). A study conducted in Tanzania to assess national pharmaceutical supply chain performance of public health facilities in (2013) showed that annual average stock out rate of antimalarial drugs were 35% and more than 40% of facilities were experienced stock out of paracetamol. Most frequently stocked out essential medicines were amoxicillin syrup and cotrimoxazole syrup. A study conducted in south western part of Ethiopia revealed that the availability of essential medicines in public health facilities were only 55.65 % (64). On the other hand to the study conducted in primary public health care facilities in northern part of Ethiopia (Gondar town) reveals that average availability of Ems on the day of visit was 90% and the mean duration of days of stock out 30.5 days. The discrepancy between physical count and stock record count of tracer drugs among surveyed facilities were ranged from 0% to 60% (65).

2.7. Challenges in pharmaceutical logistics management

Pharmaceutical logistic management in low and middle income countries face several challenges which ranges from lack of systematic, coordinated approaches to key functions surrounding pharmaceutical supply management, poor or absent communication between stakeholders, limited availability of quality data regarding utilization of commodities prevents adequate forecasting of demand and appropriate quantification of supplies essential to meet requirements at a regional, district and community level. Commodity distribution is frequently inadequate and inefficient to meet requirements and lack of responsive and data-driven supportive supervision (66). In addition to the above challenges African countries in particular sub Saharan countries face the following challenges regarding pharmaceutical logistics management; poor information, communication and consumption data, inadequate storage facilities and capacity, lack of management commitment, lack of transparent procurement procedures, lack of guidelines for good storage procedures, a lack of appropriate planning, monitoring and evaluation and budget constrain and inadequate allocation, lack of human resource capacity and expertise and poor governance, lack of dedicated transport and transportation infrastructure are the most common challenges that face most of sub Saharan countries (67).

2.8. Conceptual frame work

Conceptual frame work is a scheme of concepts which shows interrelationship between dependent and independent variables to operationalize a given study.

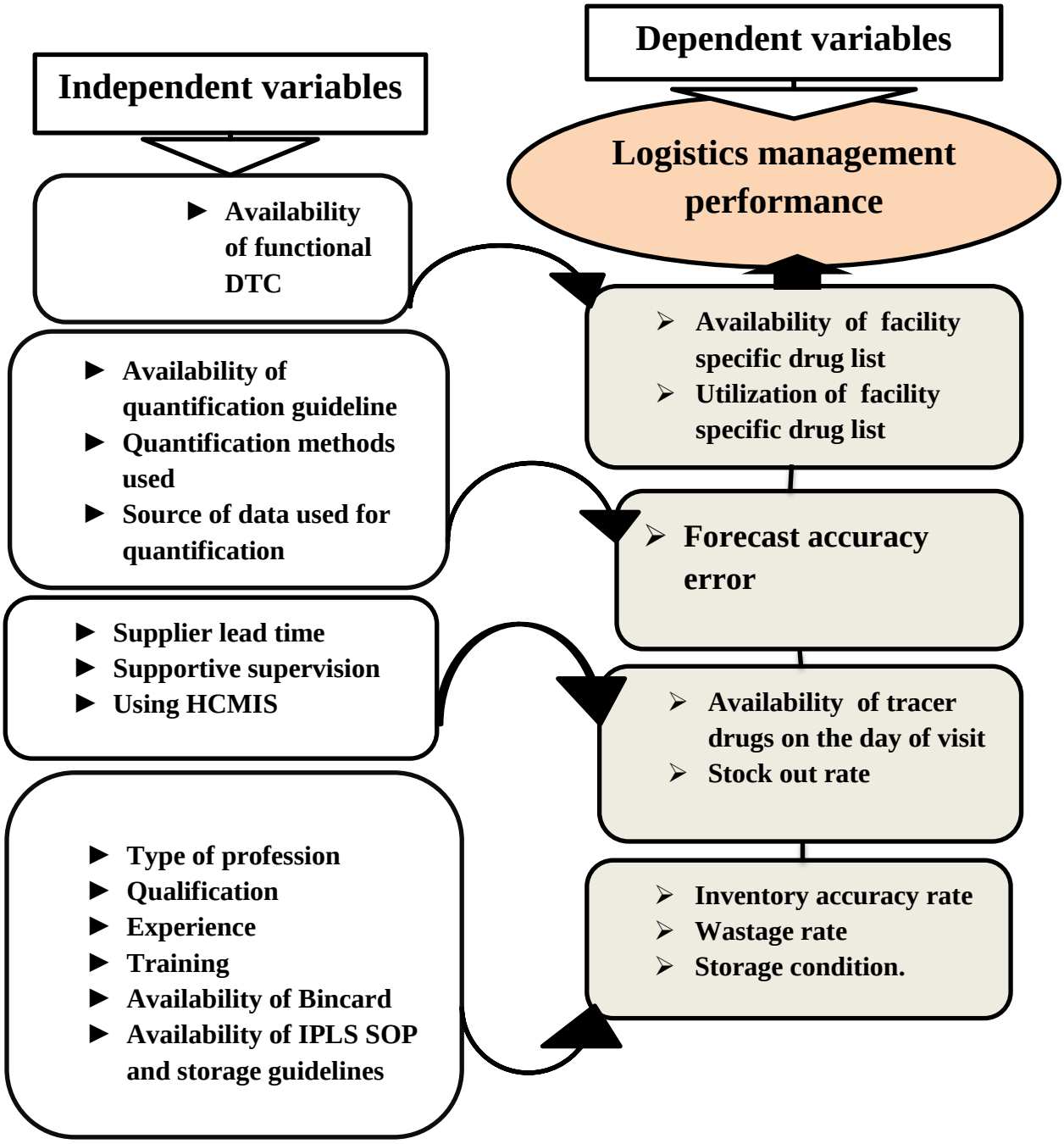

Fig. 3 : Conceptual frame work (Source: own work)

3. Objectives

3.1. General objective

To assess logistics management performance for RDF key essential medicines in public health facilities of Awi zone, Amhara Region.

3.2. Specific objective

i. To assess selection and procurement performance of public health facilities for RDF key essential medicine in Awi zone
ii. To assess forecasting performance of public health facilities for RDF key essential medicines in Awi zone
iii. To assess inventory management performance of public health facilities for RDF key essential medicine in Awi zone
iv. To assess availability of RDF key essential medicines in the public health facilities of Awi zone
v. To determine the challenges that face logistics management practice of RDF key essential medicines

4. Methods

4.1. Study area and study period

The study was conducted in selected public health facilities of Awi zone, Amhara regional state. Awi zone is one of 12 zones found in Amhara regional state, which is located 452 km away from Addis Ababa, the capital city of Ethiopia. Covers a land mass of 9,148.43 square km/ 857,886 hectar; it accounts 5.91% of Amhara regional state land mass coverage. According to zonal health department report the zone has total population of 1, 285,242 inhabitants. Of these 1,075,747 people are rural residents and 209,494 people are urban dwellers. Administratively it is divided in to nine Woredas/ districts and three city administrations. The health service is provided by total of 254 public health facilities; including five hospitals, one general hospital and four district hospitals, 46 health centers and 203 health posts, and total of 190 private health facilities including 114 clinics, 71 drug stores, 4 rural drug vendors and one medium diagnostic laboratory center. There are 2,043 health professionals and 533 health extension workers working in urban and rural public health facilities (68). This study was conducted from March 15, 2019 to May 15, 2019.

4.2. Study Design

This study used a facility based cross-sectional mixed method strategy to explore logistic management system performance for key essential medicines in public health facilities of Awi zone.

4.3. Source of population

Public health facilities found in Awi zone, health care providers working in public health facilities and medicines managed in public health facilities of in Awi zone.

4.4. Study population

Public hospitals and health centers established before 2017/2009E.C, health care professionals in charge of pharmaceutical logistics activities with experience of 6 months and above and key essential medicines from budget category managed in the selected public health facilities.

4.5. Inclusion and exclusion criteria

4.5.1. Inclusion criteria

Public hospitals and health centers established before 2017 were included, because this study evaluated facilities forecasting performance and wastage rate of RDF key EMs for EFY 2010. Health care professionals who have knowledge on pharmaceutical logistics management activity with service year of 6 months and above on pharmaceutical logistics management and tracer drugs from budget category were included.

4.5.2. Exclusion criteria

All health posts were excluded because the major logistics functions and activities of health posts are carried out in affiliated health centers. Tracer drugs from program source were also excluded.

4.6. Study variables

4.6.1. Dependent variable

- Availability of facility specific drug list
- Utilization of facility specific drug list
- Forecast accuracy error
- Inventory accuracy
- wastage rate
- Availability of tracer drugs and stock out rate
- Storage condition

4.6.2. In dependent variable

Managerial related

- Availability of functional DTC
- Supportive Supervision

Professional related

- Type of profession
- Level of qualification
- Experience and Training

Practice related

- Availability guideline and SOP manuals; like storage guideline, pharmaceutical quantification guidelines and IPLS SOP manuals.
- Availability of logistics data recording tools
- Availability of automated stock tracking system (HCMIS)
- Quantification method used
- Source of data used for quantification
- Supplier lead time

4.7. Sampling and sample size determination

4.7.1. Sample size determination

The sample size was determined based on the recommendations given by USAID / DELIVER PROJECT, Task Order 1 and Management Science for Health (MSH). LIAT recommendation suggests that to assess logistics system performance of health facilities a minimum of 15% of facilities can be used to evaluate the logistics management performance of the facilities in a given area in case of resource constraints (69). On the other hand rapid pharmaceutical management assessment (RPMA) the guideline developed by Management Science for Health (MSH) (1995), for conducting an indicator based pharmaceutical logistics assessment recommends that at least 20 health facilities to be included for such studies (70). Based on the above two recommendations 39 % of total facilities were taken to get a sample of 20 facilities. The sample size was calculated as follows:

$$n = N*0.39$$

Where: n = the required sample size

N = Total # of public health facilities under study in Awi zone [5 hospitals + 46 health centers =total of 51 health facilities], so that:-

n =51*0.39 = 19.89 ~ 20 facilities.

Then 10 percent of the calculated sample size for non- respondents were added to get the final sample of 22 health facilities. Regarding to the products studied, all 22 budget key essential drugs were taken from zonal tracer drug list for hospital and health centers developed by zonal health department to treat top ten diseases. All store manager and pharmacy heads total of 44 participants from selected health facilities were included for the quantitative survey made by using interviewer administered questionnaires. And eight key informants (four pharmacy unit heads, two logistics officers, one hospital medical director and one health center head) were participated for in-depth interview. The number of participants for in-depth interview was determined based on the information saturation.

4.7.2. Sampling techniques

A total of 22 public health facilities were included in this study. First health facilities were clustered into Woredas / districts. Then according to the recommendation provided by logistics indicator assessment tool (LIAT) (69), the higher level facilities that provide large service to the population should be selected first. Therefore the five hospitals which were located in different districts were included first. Then a proportionate sample was determined from each Woreda/ district to get total of 17 HCs. Finally individual HCs were drawn by using lottery method from each district. All 22 RDF key Ems and their bin cards were included. Purposive sampling technique was employed to select 44 study participants for interviewer administered questionnaire and 8 key informants for in-depth interview that have knowledge on pharmaceutical logistics management and in charge of pharmaceutical logistics activity in their facility including facility heads, pharmacy unit heads, and store managers and logistics officers.

4.8. Data collection method

4.8.1. Data collection instrument

A semi structured questionnaire and observational check lists adopted from logistics indicator assessment tool (LIAT) was used to collect quantitative data. LIAT is a tool developed by the USAID-funded DELIVER PROJECT , Task order 1, which is used to conduct a facility-based survey to assess health commodity logistics system performance and commodity availability at health facilities(69). Interview guide adopted from logistics system assessment tool (LSAT) (71), was used for the in-depth interview of key informants (KIs) in order to gather qualitative data about challenges that faced logistics management of RDF essential medicines.

4.8.2. Data collection procedure

The quantitative data was collected by trained data collector administered questioners from total of 44 participants i.e. twenty two facility pharmacy unit head and twenty two medical store manager and the recorded documents of twenty two RDF tracer drugs such as 22 annual quantification documents, 22 annual physical inventory records, 22 expired drug registry book, 22 receiving and issuing vouchers and 446 bin cards were reviewed carefully. And physical observation of twenty two medical stores and physical inventory of 446 RDF tracer drugs were conducted. In depth interview of (one hospital medical director, one health center head, four pharmacy unit head and two logistics officers total of 8 key informants was conducted by

principal investigator (PI). In-depth interview was conducted until the end point; the point when additional interview did not result identification of new concept, the so called data saturation.

4.8.3. Data quality control

The data was collected by two trained pharmacy technicians who were trained for the session of half days on data collection process by principal investigator (PI). And pretest of the prepared questionnaires, data abstraction forms and checklist was performed on 5% (1 facility) of the sample facilities; which was not included in the study to ensure the validity of the survey tools. The data collection process was supervised and the completed questionnaires were reviewed by principal investigator (PI) to clarify any data inconsistencies.

4.8.4. Data analysis

The quantitative data were cleaned and checked for completeness then annual consumption of each tracer drug, mean absolute percentage error, average stock out duration, inventory accuracy rate, percentage of storage facilities which fulfill the acceptable condition, the amount and value of tracer drugs wasted due to expiration were computed by using Microsoft Excel 2010 spread sheet and scientific calculator. Then the data was coded and entered in to SPSS version 23 for further analysis. Fisher's exact test was used to determine the association between dependent and independent variables with confidence interval of 95% and at (α =0.05) and (p- value of below 0.05) was considered as statistically significant association between variables. Finally the findings were presented by tables, charts and graphs. The qualitative data were analyzed by using a thematic content analysis approach which means that the recorded audio data were listened repeatedly for several times, then transcribed and categorized to main themes and finally the findings were presented by narration.

4.9. Ethical clearance

Before commencing data collection Ethical clearance & approval letter (Reff. No, IHRPGJ/195/2019. Issue date.27/02/2019) was obtained from Institutional Review Board (IRB) of Jimma University and was submitted to Amhara Regional State Health Bureau, public health institute. Then the institute accepted the request and permission letter (Reff No, የጤ/ም/ቴ/ሽ/ዳ/ 03/291/2011. Issue date, 10/07/2011) was received. Then I have summited letter of permission written by Amhara public health institute to each hospitals and zonal health department. Again

letter of permission was written by Awi zone ZHD to Woreda health office. Finally the last collaboration letter was issued by Woreda health officer to each selected health center. For qualitative study a verbal consent was obtained from key informants and confidentiality of the information was re-assured to them.

4.10. Definitions of terms

Acceptable storage condition: - The storage condition which fulfills at least 80% and above of the criterion listed in the good pharmaceutical storage condition guide line (5).

Accurate inventory record: - When the amount found by physical inventory equals with the amount recorded on the bin card ether manual or electronic (12).

Availability of facility specific drug list: - The presence of specific drug list in the facility on the day of visit.

Availability key essential medicine: - The presence of at least a single unit of usable/ unexpired stock on hand in the facility store or dispensary at the day of visit.

Bin card: - A format used to track received and issued items in store, contains beginning balance, quantity received, issued, loss/ adjustment ,stock on hand, batch number and expire date of the products.

Dispensed to patient registry book:- A document containing the type and quantity of drugs issued to the patient at the service delivery point.

Drug and therapeutic committee:-Interdisciplinary team led by clinical/ medical director which is responsible for preparing and updating facility specific drug list in a given facility.

Facility specific drug list: - A document which contains a list of drugs, supplies and laboratory reagents approved for use in a given facilities.

Functional DTC: - The DTC which full fill at least 75% of criteria's stipulated to evaluate its functionality (75).

Good forecast: - Forecasts with forecast accuracy error (MAPE) ≤25% (37).

Good availability of EMs: - Average availability of EMS in on the day of visit ≥80%

Good procurement practice: - Procurement practice that fulfill criterion mentioned in good procurement practice guide line (3).

Inaccurate inventory record: - Means when percentage discrepancy between physical inventory and amount recorded on bin card >10% (69).

Inventory accuracy rate: - The proportion of bin cards with accurate record to the total number of bin card selected/ observed.

Invoice: - A document issued by the supplier which contains description about the drug, quantity, expiry date and price

Key informants: - participants who are believed to have sufficient knowledge about the challenges in the logistics system of RDF drugs.

Logistics management performance: - Ability of health facilities to implement and perform the components of logistic management against the standard.

Medical store: - A place where medicines are kept in the facility.

Model 19 (receiving voucher):- A document used to register in coming drugs from suppliers or other facilities which contains description about the drug, quantity, expiry date and price components.

Model22 (issuing voucher):- A document used to record issued drugs to pharmacy units , service delivery points and other facilities which contains description about the drug, quantity and price component.

National essential drug list:-A document containing list of drugs approved for use in Ethiopia.

Near accurate record: - Means when discrepancy between physical inventory and amount recorded on bin card= +/-10%

Physical inventory: - A manual counting of usable drugs available in store.

Physical inventory record document: - A document containing list of usable / unexpired pharmaceuticals and their quantity, batch number and expire date that is recorded/ counted at the end of each fiscal year.

Poor availability of EMs: - Average availability of EMS on the day of visit < 80%

Principal investigator: - A person who conducted this research.

Public health facilities: - Government institutions which provide health care service

RDF drugs: - Drugs purchased by the facilities own budget

Stock out on the day of the visit: - Defined as not having any usable stock in the facility store and dispensary on the day of visit.

Top ten diseases: - Prevalent cases in a given facility which causes majority of morbidity and death.

Tracer drugs: - Drugs that are selected by the facility to treat top ten diseases

Utilization of facility specific drug list:- means using FSDL as a reference tool during procurement of medicines.

4.11. Measurement of variables

This study used standard logistics system performance indicators adopted from LIAT (69), Management Sciences for Health; Rapid Pharmaceutical Management Assessment Measuring manual (70), Supply Chain Performance: Guide to Key Performance Indicators for Public Health Managers to measure logistics management system performance of public health facilities system (12).

4.11.1. Selection performance indicators

Availability of facility specific drug list (FSDL)

Indicator 1: Percentage of facilities that have their own specific drug list

Definition: This indicator measures the presence of up dated facility specific drug list in the facility. It will be calculated by using the formula: % of facilities with specific drug list =

$$\frac{\text{number of facilities with specifc drug list}}{\text{total number of facilities visited}} \times 100$$

Ideally all facilities are expected to develop their own facility specific drug list

Data source: respondents, observation of copy of the document.

Indicator 2: **Utilization of FSDL**

% of facilities that used the FSDL as a reference tool to select drugs for procurement

=

$$\frac{\text{number of facilities that used FSDL to select drugs for procurement}}{\text{total number of facilities visited}} \times 100$$

Data source: interview

4.11.2. Forecasting performance

Indicator: **Forecast accuracy error (absolute percentage error)**

Definition: This indicator measures the percentage of difference between forecasts previously made for a year and the actual consumption or issue data which is termed as absolute percentage error (APE). Accurate forecasting helps the health facilities to improve financial management and procure adequate quantities of each product, thereby reducing the likelihood of wastage or shortage. Formula: APE $==\frac{|\text{forecasted demand} - \text{actual demand}|}{\text{actual demand}} \times 100$

First the forecast accuracy error of each tracer drugs was calculated then the same of forecast error of each drug divided by the total number of tracer drugs to get average forecast accuracy error of the facilities. Forecasts are rarely 100% accurate, but a forecast error of 25% or less is usually the accepted standard margin (37). This study used the last one year 2010 E.C forecasted and consumption data.

Data source: annual Forecast document, Consumption/issue records like model 22, dispensed to patient registry books and bin cards.

4.11.3. Availability

The availability of indicator drugs is perhaps the single most important indicator of this entire set logistics system. This indicator measures a procurement and distribution system's ultimate effectiveness in fulfilling its basic mission, which is, providing drugs at health facilities.

Indicator1: **Average percentage of a set of unexpired indicator drugs available in health facilities on the day of visit.**

Definition: A drug is defined as available if even one unit of unexpired product is in stock on the day of visit. Formula:

$$\textbf{\% of tracer drugs availability for each facility} = \frac{\text{number of tracer drugs in stock}}{\text{total number of tracer drugs seleted}} \times 100$$

For the total sample facilities average % availability was calculated as follows:

Average % tracer drug availability = $\frac{\text{sum of average \% for eache facility}}{\text{total number of facilities in sample}}$, Target =100% (23)

Data source: physical inventory, observation of stock on the shelf.

Indicator2: **Average percentage of days out of stock**

Definition: Time out of stock, or stock out time, is defined as the number of days that a product was not present in health facility over a recent twelve month.

Formula: Average % of days that Tracer Drugs were out of Stock for the last 12 months in each facility = $\frac{\text{total number of stock out days for all tracer drugs}}{\text{365x total number of tracer drugs selected}} \times 100$

Then after calculating average % of stock out days of tracer drugs for each facility, an average % for all facilities in study was calculated as follows:

Average % of days that tracer drugs were out of stock in all surveyed facilities =

$$\frac{\text{sum of average \% for each facilities}}{\text{total number of sample facilities}}$$

Target: 0% (72), Data source: bin card (manual or electronic) and interview

4.11.4. Inventory management performance indicators

Indicator 1: **Inventory Accuracy Rate**

Definition: This indicator measures the accuracy of logistics data as the percentage of discrepancy between physical stock count and stock record count. Percentage of stock keeping records corresponding with physical counts was calculated as follows;

Formula: % of stock records corresponding with the physical count =

$$\frac{\text{number of stock records with no discrepancies}}{\text{total number of stock records examined}} \times 100$$

Ideally all stock records are expected to be accurate.

Data source: bin card (manual or electronic) and physical inventory.

Indicator 2: percentage of tracer drugs wasted due to expiration or damage over the last 12 months (July 2009 EC to July 2010 EC)

Definition: this indicator is defined as the percentage of the tracer drug that is unusable because of expiration or damage during a period of one year to the total quantity of that tracer drug received plus the quantity that items found the beginning period of that year.

Formula: **wastage rate by amount =**

$$\frac{\text{unusable stock of a tracer drug during a period of one year}}{\text{Begining balance plus quantity received of that drug druging a period of one year}} \times 100$$

Data source: Annual inventory record, Model 19, expired or damaged drug registry book, disposal certificate, and bin card.

Target: below 2% (72)

Indicator 3: value of expired stock as a percentage of total value of items purchased over a period of one year (July 2009 EC to July 2010 EC)

Definition: this indicator is defined as the percentage of the value for an item that is unusable due to expiration or damage during a period of one year to the total value of that item received during a year plus the value of that item found during the beginning period of the year. Formula:

Wastage rate by value= $\frac{\text{value of an item expired or damaged in he last 12 months}}{\text{Beginning value + value of the item purcased in the last 12 months}} \times 100$

Data source: supplier invoice, model 19, disposal certificate, annual inventory record

4.11.5. Storage performance

Indicator: Percentage of facilities that maintain acceptable storage condition

Definition: This indicator measures the percentage of storage facilities that meet acceptable storage conditions. Performance target ≥80% of criteria's listed by storage guide line. It was calculated by using the Formula: **% of facilities that maintain acceptable storage condition** = $\frac{\textbf{\#of storage facilities meeting acceptable storage condition}}{\textbf{total number of facilities visited}} \times \mathbf{100}$ **, Data source:** observation of medical store and interview of store manager

5. Result

5.1. Demographic data

This study included a total of 22 HFs (health facilities) (i.e. 5 hospitals and 17 health centers). Total of 22 health facility pharmaceutical stores were observed, physical inventory of 446 tracer drugs was conducted and total of 44 participants (22 pharmacy unit heads, 22 store managers were interviewed by data collector administered questionnaire to gather quantitative data) and total of 8 participants (four pharmacy unit head, two logistics officers, one hospital medical director and one health center head) were participated for in-depth interview to collect qualitative data). From those participants all pharmacy unit heads and store managers were pharmacy by profession. Further information is provided in the (table 2) below and Annex VII.

Table 2: Socio-demographic characteristics of pharmacy unit heads and store managers in selected public health facilities of Awi zone, Amhara region, May 2019.

SN	Variables		Store manager	Pharmacy head	Total
			Freq. (%)	Freq. (%)	
1	Educational qualification				
		Diploma	22 (100%	19(86%)	41(93%)
		Degree	0	3(14%)	3 (7%)
		Total	22(100%)	22(100%)	44 (100)
2	Service year (Experience)				
		6 month- 1 year	4(18%	0	4(9%)
		1 year- 5 year	18(82%)	6(27%)	24(55%)
		Above 5 years	0	16(73%)	16(36%)
		Total	22(100%)	22(100%)	44(100%)
3	Types of Traing taken				
	IPLS	Trained	19(86%)	22(100%)	41(93%)
		Not trained	3(14%)	0	3(7%)
		Total	22(100%)	22(100%)	44(100%)
	DTC	Trained	0	6(27%)	6(14%)

	Not trained	22 (100%)	16(73%)	38(86%)
	Total	22(100%)	22(100%)	44(100%)
Quantification	Trained	0	2(9%)	2(5%)
	Not trained	22(100%)	20(91%)	42(95%)
	Total	22(100%)	22(100%)	44(100%)

Out of 22 facilities surveyed 19 (86%) of them were established drug and therapeutic committee (DTC). Among those facilities that established DTC only 8(42%) facilities (three hospitals and five health centers) had functional DTC. And 18 (82%) of HFs had received regular supportive supervision from regional health bureau, EPSA and JSI delivery project (non-governmental organization) regarding pharmaceutical logistics management. The availability of manual bin cared was 100%. The detail information is provided below in the table -3.

Table 3: Availability of logistics data recording tools and guidelines in selected public health facilities of Awi zone (May, 2019), (n=22)

Recording tools and guides lines		Frequency (%)	Total
Bin card		Yes =22(100%)	22
Stock card		Yes =2 (9%)	
		No = 20(91%)	22
HCMIS[automated stock tracking system]		Yes =14(64%)	
		No = 8(36%)	22
Guidelines		Yes =16 (73%)	
	Storage guide line	No = 6 (27%)	22
	IPLS SOP	Yes = 18(82%)	
		No = 4(18%)	22
	Quantification guide line	Yes =14(64%)	
		No = 8(36%)	22
	Procurement guide line	Yes =16 (73%)	
		No = 6 (27%)	22

5.2. Selection and procurement performance of Health facilities for RDF key essential medicines

Selection of the products used at each facility level is the primary job for logistic management. So that this study has measured the selection practice of surveyed public HFs by using indicators i.e. proportion of HFs that developed facility specific drug list and proportion of facilities that used this document as reference tool for selecting drugs for procurement. As shown in the (Fig.4) below 19 (86%) of facilities developed their own specific drug list and used it as a reference list for procurement of medicines, whereas 3 (14%) of facilities have not developed their own specific drug list, in these facilities procurement was made by prescribers preference.

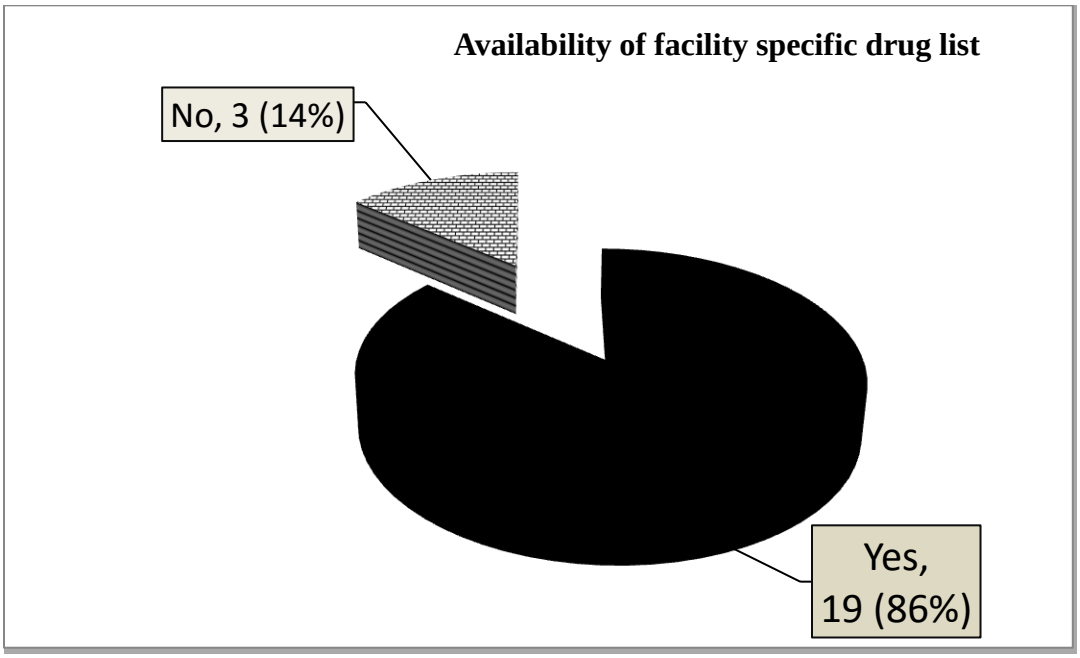

Figure 4: Availability of facilities specific drug list in selected public health facilities of Awi zone. May, 2019. (n=22)

Similarly in 19(86%) of facilities the drug selection process was carried out by drug and therapeutic committee(DTC), while in the rest of 3 (14%) facilities selection of drugs made by store managers and prescribers preference. All 22(100%) of the surveyed HFs reported that they have purchased medicines from private suppliers in the last year in case when the requested medicines are not available in government supplier (Ethiopian pharmaceutical supply agency

(EPSA). As shown in the (Table- 4) below procurement of medicines was made by generic name in all 22 (100%) HFs. And 16 (73%) of HFs developed written procedure to guide the procurement process and had procurement plan. Again 12(55%) of HFs established quantification and procurement committee and these committee determine the quantity to be procured and follow the procurement process of products purchased from private suppliers. And 4(18%) HFs purchased medicines through direct procurement method from private suppliers. And average lead time from EPSA was 3 days and from private suppliers was 21days.

Table 4: Pharmaceutical procurement practice in selected public health facilities in Awi zone. May, 2019. (n =22).

Variables	**Frequency (%)**	**Total**
Medicine procurement made by generic name?	Yes = 22(100%)	22
Does the facility have procurement committee?	Yes =12(55%) No =10(45%)	22
Does the facility have procurement plan?	Yes = 16(73%) No = 6 (27%)	22
Who is responsible to determine the quantity of medicines to be procured?	Quantification committee=12(55%) Pharmacy head=4 (18%) Store manager= 6 (27%)	22
How to determine the quantity to be procured?	By using standard formula (100%)	22
Who is responsible to purchase medicines in your facility?	Pharmacy head= 8(36%) Assigned pharmacy Purchaser =14 (64%)	22
Type of procurement methods used in your facility?	Proforma method = 18 (82%) Direct procurement =4 (18%)	22
Average lead time from EPSA?	3 days	22
Average lead time from private suppliers?	21 Days	22

5.3. Forecasting performance of HFs

Quantification performance of a given health program is measured by a standard indicator i.e. forecast accuracy error. Majority of surveyed facilities 20 (91%) practice consumption method to quantify their pharmaceutical demand and only 2(9%) of facilities used (morbidity +consumption) methods to determine their annual need. And also 17 (77%) of HFs used bin card as a source of data for quantifying their demand. While 5(23%) facilities used (Model 22) as source of data for demand forecasting and none of the facilities were used dispensed to patient data. As shown in the (Table-5), below the forecast error of each product line by line was measured and means absolute percentage error (MAPE) was 41.42% which is beyond the acceptable margin of error, the absolute percentage error ranges from 3.8% for ciprofloxacin to 85.5% for Ampicillin injection. The detail description is provided in the table below.

Table 5: Forecast accuracy error for RDF key essential medicines in selected public HFs of Awi zone. May, 2019.

SN.	Name of tracer drug	Unit	Forecasted demand (n=22)	Consumption adjusted for stock-out days (n=22)	Algebraic deviation	Absolute deviation	Absolute Percentage Error(APE)
1	Amoxicillin syrup	Bottle	11,607	26,781	-15,174	15,174	56.7%
2	Amoxicillin capsule	Box	2,904	4,345	-1,441	1,441	33.16%
3	Ceftriaxone injection	Vial	58,309	151,065	-92,756	92,756	61.4%
4	Metronidazole injection	Vial	25,120	55,894	-30,774	30,774	55%
5	Ciprofloxacin tablet	Pk.	9,962	10,363	-401	401	3.8%
6	Doxycycline capsule	Pk.	3,963	9,256	-5,293	5,293	57.1%
7	Metronidazole capsule	Box	1,074	1,249	-175	175	14%
8	Metronidazole syrup	Bottle	3,071	3,800	-729	729	19.18%
9	Cotrimoxazole syrup	Bottle	10,041	16,885	-6,844	6,844	40.5%
10	Antacid suspension	Bottle	5,095	10,965	-5,870	5,870	53.5%
11	Tetracycline 1%	Tube	14,516	25,252	-10,736	10,736	42.5%
12	Paracetamol tablet	Box	924	1,324	-400	400	30.2%
13	Paracetamol syrup	Bottle	21,745	12,566	9,179	9,179	73%

14	TAT injection	Amp	16,518	24,789	-8,271	8,271	33.36%
15	Mebendazole tablet	Pk.	295	472	-177	177	37.5%
16	Oral rehydration salt	Sachet	69,502	64,047	5,455	5,455	8.5%
17	Ampicillin injection	Vial	11,598	80,264	-68,666	68,666	85.5%
18	Gentamycin injection	Amp	21,226	16,630	4,596	4,596	27.63%
19	Chloroquine tablet	Box	317	242	75	75	30.9%
20	Benzoic acid 6% + salicylic acid 3% skin ointment	Tube	11,713	18,923	-7,210	7,210	38.1%
21	Hydralazine injection	Amp	15,620	25,640	-10,020	10,020	39%
22	Fefol tablet	Box	9,812	33,586	-23,774	23,774	70.78%

Mean absolute percentage error (MAPE) = $\frac{sum\ of\ APE}{number\ of\ items}$ = 41.42 %.

*Algebraic deviation =forecasted quantity – consumption adjusted for stock out

*Absolute deviation =| algebraic deviation|

*Absolute percentage error = $\frac{\text{absolute deviation}}{\text{consumption adjusted for stock out}} \times 100$

* Consumption adjusted for stock out = Recorded consumption X $\frac{\text{period in calculation}}{\text{period in stock}}$

Where

- Period in calculation =365 days because this study has taken the last one year consumption
- Period in stock = number of days in which the product was available

This study further examined the forecasting performance of each health facility by adding absolute percentage error of each tracer drug and dividing it by total number of tracer drugs surveyed. And result was summarized in the (Fig. 5) below. Accordingly 18 (82%) of facilities had forecast errors (MAPE) above 25% which is out of the acceptable margin of error.

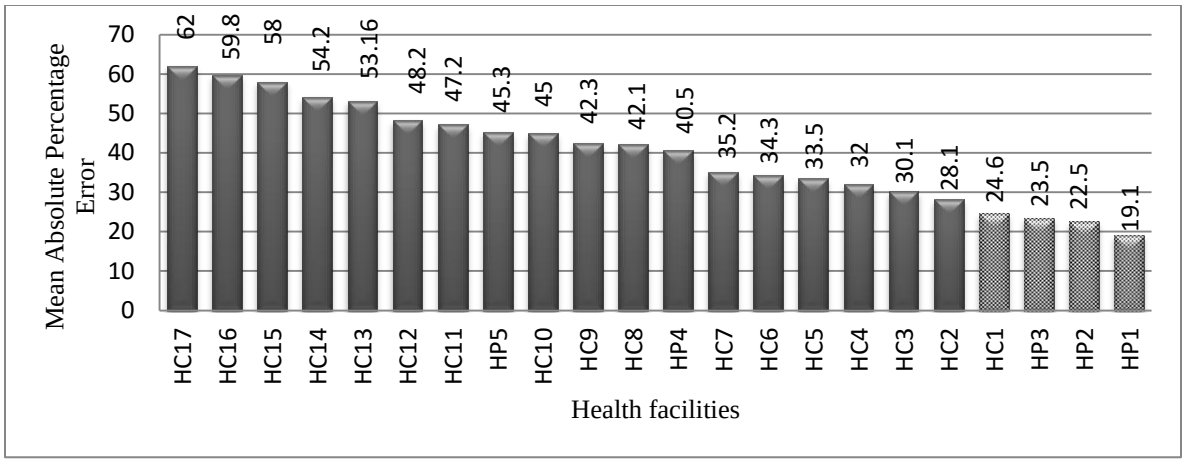

Fig. 5: HFs forecasting performance for key essential medicine in selected public health facilities in Awi zone, Amhara region. May 2019.

5.4. Inventory management performance of HFs

Inventory management performances of each facility were measured by inventory accuracy rate (stock recording accuracy) and wastage rate due to expiry/ damage/loss. Total of 484 RDF tracer drugs (22 tracer drug from 22 facilities) were reviewed for the presence or absence of bin card in the day of visit, whether the bin cards are updated or not and the accuracy of stock records.

5.4.1. Bin card availability and updating practice of HFs

Availability and utilization of Bin card and stock record card is an important input to keep the logistics records of any stock, besides this keeping it up to date helps logisticians to generate accurate information for decision making. This study examined that proportion of tracer drug with bin card and the proportion of bin cards updated with in the last 30 days. The availability and updating practice of the bin card was checked by physical observation of the bin card for each tracer drug at each facility and the time when it was up dated (i.e. bin cards updated within last 30 days and bin cards with zero physical balance with the product not received yet considered as updated). Thus the proportion of key essential medicine with bin card was 446 (92%). Among those bin cards 431 (96.6%) of them were updated. The detailed information is provided below in the (Table - 6) below.

Table 6: Bin card utilization and updating practice in selected public HFs of Awi zone. May 2019 (n=22).

SN.	List of tracer drugs	Manual Bin card/ automated					
		Available			Bin card updated		
		Yes	No	Tot.	Yes	No	Tot.
		Freq. (%)	Freq. (%)		Freq. (%)	Freq. (%)	
1	Amoxicillin syrup	22 (100%)	0 (0%)	22	22 (100%)	0 (0%)	22
2	Amoxicillin 500 mg capsule	22 (100%)	0 (0%)	22	21(95%)	1 (5%)	22
3	Ceftriaxone 1 gram injection	21 (95%)	1 (5%)	22	20 (95%)	1 (5%)	21
4	Metronidazole injection	16 (73%)	6 (27%)	22	16 (100%)	0 (0%)	16
5	Ciprofloxacin 500 mg tablet	22 (100%)	0 (0%)	22	21 (95%)	1 (5%)	22
6	Doxycycline 100 mg capsule	22 (100%)	0 (%)	22	22 (100%)	0 (0%)	22
7	Metronidazole 250 mg capsule	21 (95%)	1 (5%)	22	21 (100%)	0 (0%)	21
8	Metronidazole syrup	22 (100%)	0 (0%)	22	21 (95%)	1 (5%)	22
9	Cotrimoxazole syrup	21 (95%)	1 (5%)	22	21 (100%)	0 (0%)	21
10	Antacid suspension	21 (95%)	1 (5%)	22	21 (100%)	0 (0%)	21
11	Tetracycline 1% eye ointment	21 (95%)	1 (5%)	22	20 (95%)	1 (5%)	21
12	Paracetamol 500 mg tablet	22 (100%)	0 (0%)	22	21 (95%)	1 (5%)	22
13	Paracetamol 120 mg/5ml syrup	21 (95%)	1 (5%)	22	19 (90%)	2(10%)	21
14	Tetanus antitoxin injection	14 (64%)	8 (36%)	22	11 (79%)	3(21%)	14
15	Mebendazole 100 mg tablet	21 (95%)	1(5%)	22	20 (95%)	1 (5%)	21
16	Oral rehydration salt(ORS)	22 (100%)	0 (0%)	22	21 (95%)	1(5%)	22
17	Ampicillin powder for injection	22 (100%)	0 (0%)	22	22 (100%)	0 (0%)	22
18	Gentamycin injection	22 (100%)	0 (0%)	22	21 (95%)	1 (5%)	22
19	Chloroquine tablet	20 (91%)	2 (9%)	22	20 (100%)	0 (0%)	20
20	White filed skin ointment	16 (73%)	6 (27%)	22	16 (100%)	0 (0%)	16
21	Hydralazine injection	17 (77%)	5 (23%)	22	16 (94%)	1 (6%)	17
22	Ferrous with folic acid tablet	18 (82%)	4 (18%)	22	18 (100%)	0 (0%)	18
Total (%)		446(92%)	38 (8%)	484	431(96.6%)	15(3.4%)	446

5.4.2. Inventory accuracy rate of HFs

Keeping accurate records of pharmaceuticals plays a pivotal role to prevent wastage and shortage of medicines by providing accurate and timely information about medicines on hand and helps the logistics officers to decide when and how much to order. In this study the bin card accuracy was determined by conducting physical inventory of each product and cross checking it with the amount recorded on the bin card. While inventory accuracy rate is the proportion of bin cards with accurate record to the total number of bin cards observed which was computed by dividing the number bin cards with accurate record to the total number of bin cards assessed. As shown in the (Table-7) below 381(85.43**%)** bin records were accurate; the amount provided on the bin card (manual or electronic, HCMIS) were matched with the physical inventory. While 51(11.14%) of bin cords were inaccurate (where % discrepancy between bin card balance and physical inventory greater than 10% and the rest 14(3.43%) of bin cards were near accurate (where % discrepancy was +/- 10%).

Table 7: Bin card accuracy rate for key EMS by item type in selected public health facilities of Awi zone May, 2019.

SN.	List of tracer drugs	Bin card accuracy rate			
		Accurate Freq. (%)	Near accurate Freq. (%)	Inaccurate Freq. (%)	Total
1	Amoxicillin 250 mg/ 5 ml syrup	17(77%)	1(5%)	4(18%)	22
2	Amoxicillin 500 mg capsule	19(86%)	1(5%)	2(9%)	22
3	Ceftriaxone 1 gram injection	19(90%)	1(5%)	1(5%)	21
4	Metronidazole iv infusion	14(88%)	0%	2(12%)	16
5	Ciprofloxacin 500 mg tablet	19(86%)	1(5%)	2(9%)	22
6	Doxycycline 100 mg capsule	20(90%)	1(5%)	1(5%)	22
7	Metronidazole 250 mg capsule	17(80%)	2(10%)	2 (10%)	21
8	Metronidazole 125mg/ 5 ml syrup	18(82%)	1(5%)	3(13%)	22
9	Cotrimoxazole 240 mg / 5 ml syrup	21(100%)	0%	0%	21
10	Antacid suspension	17(81%)	1(5%)	3(14%)	21
11	Tetracycline 1% eye ointment	15(71%)	2(10%)	4 (19%)	21

12	Paracetamol 500 mg tablet	17(77%)	1(5%)	4(18%)	22
13	Paracetamol 120 mg/5ml syrup	17(81%)	0(0%)	4(19%)	21
14	Tetanus antitoxin (TAT) injection	11(77%)	0%	3(23%)	14
15	Mebendazole 100 mg tablet	17(82%)	0%	4(14%)	21
16	Oral rehydration salt(ORS)	18(82%)	1(5%)	3(13%)	22
17	Ampicillin injection	21(95%)	0(0%)	1(5%)	22
18	Gentamycin 80 mg/ 20 ml injection	21(95%)	0(0%)	1(5%)	22
19	Chloroquine phosphate250mg tab	19(95%)	0(0%)	1(5%)	20
20	(white filed) skin ointment	14 (88%)	0 (0%)	2 (12%)	16
21	Hydralazine injection	15 (88%)	0 (0%)	2 (12%)	17
22	Ferrous sulphate +folic acid tablet	15 (83%)	1 (5%)	2 (12%)	18
	Total (%)	381(85.43%)	14(3.14%)	51(11.43%)	446(100%)

This study also further assessed inventory accuracy rate by facility level and summarized the result in the (Fig. 6) below. As shown on the (Fig. 9), 17 (77%) HFs were failed to maintain 100% inventory accuracy rate which means that discrepancy was observed between bin card balance and the physical inventory at least in one bin card at 17 health facility. Inventory accuracy rate ranges from 64% to 100%.

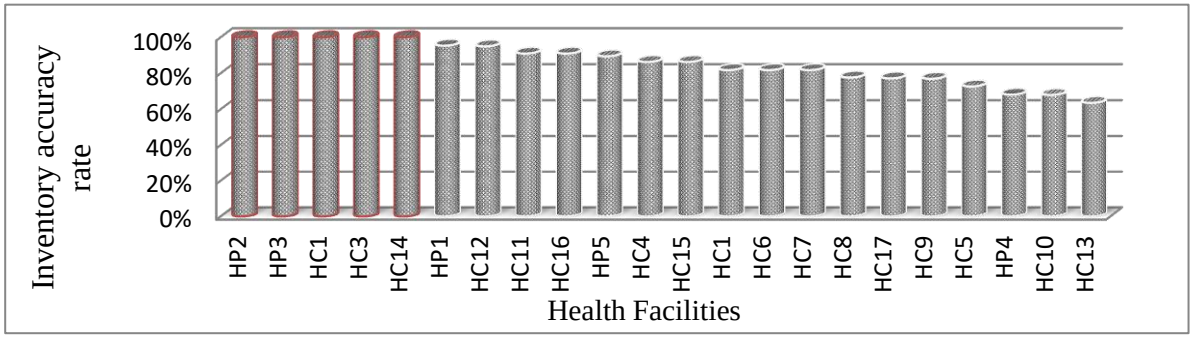

Fig. 6: Inventory accuracy rate of surveyed public HFs in Awi zone, Amhara region. May, 2019.

5.4.3. Wastage rate of RDF key essential medicines

Wastage rate is one of the indicators used to measure inventory management performance of health facilities. It is computed by dividing the amount or value of products wasted due to expiry / damage/loss to the total amount or value of the same product (beginning amount / value plus

purchased amount / value) throughout the year. It is measured in annual basis. So that this study examined the annual wastage rate of selected key essential medicines in selected public health facilities of Awi zone for the year 2010 E.C. Accordingly this study examined wastage rate of selected tracer drugs due to expiry because of lack of documented record or verbal information about wastage due to damage/ loss of tracer drugs. So RDF key essential drugs expired in EFY 2010 E.C was traced in amount as well as in value and the percentage by value of each tracer drug is provided in the (Table-8) below: As shown in the (Table-8) below; total value 49,092.14 (ETB) was wasted by EFY 2010 due to expiry of RDF key essential medicines. Among the expired tracer drugs Gentamycin injection covers the largest proportion i.e. (39.65%) followed by chloroquine phosphate tablet (19.43%). While doxycycline 100 mg capsule was kept in the bottom line (1%).

Table 8: Amount and value of RDF key essential medicines wasted due to expire in EFY 2010 in selected public health facilities of Awi zone (n=22)

Name of the drug	Unit	Quantity expired	Unit price (ETB)	Total price (ETB)	Percentage (%)
Gentamycin 80mg/20ml injection	Ampoule	4866	4.00	19,464.00	39.65%
Chloroquine phosphate 250 mg tablet	Tablet	15,900	0.30	9,540.00	19.43%
Tetanus anti toxin (TAT) 1500 IU. Inj.	Ampoule	120	51.74	6,208.80	12.64%
Paracetamol 120 mg/ 5 ml syrup	Bottle	400	7.00	2,800	5.7%
Ciprofloxacin 500 mg tablet	Tablet	3400	0.82	2,788	5.68%
Tetracycline 1% eye ointment	Tube	400	6.00	2,400	4.88%
Oral rehydration salt (ORS)	Sachet	500	3.5	1,750	3.56%
Cotrimoxazole 240 mg/ 5 ml syrup	Bottle	152	10.92	1,659.84	3.38%
Mebendazole 100 mg tablet	Tablet	7200	0.15	1,080	2.19%
White filed skin ointment	Tube	85	10.7	909.5	1.85%
Doxycycline 100 mg capsule	Capsule	1200	0.41	492	1%
Total value of tracer drugs expired in EFY 2010				49,092.14	100%

The wastage rate was calculated by dividing the sum of the value of tracer drugs expired in EFY 2010 E.C to the total value of the tracer drugs under study in the same year. The total value of studied Ems were computed by adding the value of each product at the beginning of the year captured from annual inventory record (inventory of June, 2009 E.C) and the total value of each EM received throughout the year captured from receiving voucher (model 19). Thus as shown in the (Table-9) below the total value of studied Ems in the year 2010 was **13,249,073 ETB** and the total value of Ems wasted for the same year was **49,092.14 ETB** in 22 surveyed facilities.

Table 9: Wastage rate of RDF key essential medicines in EFY 2010 in selected public HFs of Awi zone. May, 2019 (n=22)

List of key essential medicines/ tracer drugs	Unit	Total quantity (Beg. Balance + quantity Received in EFY 2010)	Total Value (ETB.)	Quantity Expired in EFY 2010	Value of drugs Expired (ETB.)
Amoxicillin syrup	Bottle	23,773	391,065.85	0	0.00
Amoxicillin 500 mg capsule	Box	4,321	1,728,400	0	0.00
Ceftriaxone 1 gram injection	Vial	144,236	3,459,264	0	0.00
Metronidazole injection	Vial	49,025	686,350	0	0.00
Ciprofloxacin 500 mg tablet	Pack.	10,155	812,400	34	2,788
Doxycycline 100 mg capsule	Pack.	9,209	755,138	06	492
Metronidazole capsule	Box	1,232	184,800	0	0.00
Metronidazole syrup	Bottle	3,621	39,831	0	0.00
Cotrimoxazole syrup	Bottle	16,408	171,463.60	152	1,659.84
Antacid suspension	Bottle	9,975	139,650	0	0.00
Tetracycline1% eye ointment	Tube	24,438	78,201.60	400	2,400
Paracetamol 500 mg tablet	Box	1,307	130,700	0	0.00
Paracetamol syrup	Bottle	11,493	80,451	400	2,800
(TAT) Injection	Ampoule	22,915	1,185,622	120	6,208.80
Mebendazole 100 mg tablet	Pk.	466	16,776	30	1,080
Oral rehydration salt(ORS)	Sachet	63,329	221,651.50	500	1,750

Ampicillin injection	Vial	78,813	173,388.60	0	0.00
Gentamycin injection	Ampoule	16,425	65,700	4,866	19,464
Chloroquine tablet	Box	242	72,600	16	9,540
Benzoic acid +salicylic acid	Tube	17,200	184,040	85	909.50
Hydralazine injection	Ampoule	23,140	671,060	0	0.00
Fefol tablet	Box	33,348	2,000,520	0	0.00
Total amount and value		565,071	13,249,073	6,609	49,092.14

Wastage rate by value $= \frac{\textbf{Total value of expird tracer drugs in EFY 2010}}{\textbf{Total value of tracer drugs in EFY 2010 (begining+recived)}} \times 100 = 0.37\%$

Wastage rate by amount $= \frac{\textbf{Total amount of tracer drugs wasted in EFY 2010}}{\textbf{Total amount of tracer drugs in EFY 2010}} \times \mathbf{100} = 1.17\%$

This study further investigated the causes of expiry for RDF key essential medicines in selected public health facilities of Awi zone and summarized the result in the (Fig. 7) below. Thus 14 (64%) of the facilities reported that poor communication within the facility (i.e. pharmacy unit and prescribers and store keepers and dispensers/ dispensing out lets and service delivery units) as well as between other facilities to share near expire and non-moving products to the facilities where they are demanded, as the main causes expiry of medicines, 6 (27%) of facilities reported that purchasing near expiry products as a cause of expiry while 2 (9%) facilities reported that demand uncertainty or seasonal demand variation for some products like antimalarial drug chloroquine results in dumping of inventory and leads to wastage due to expiry.

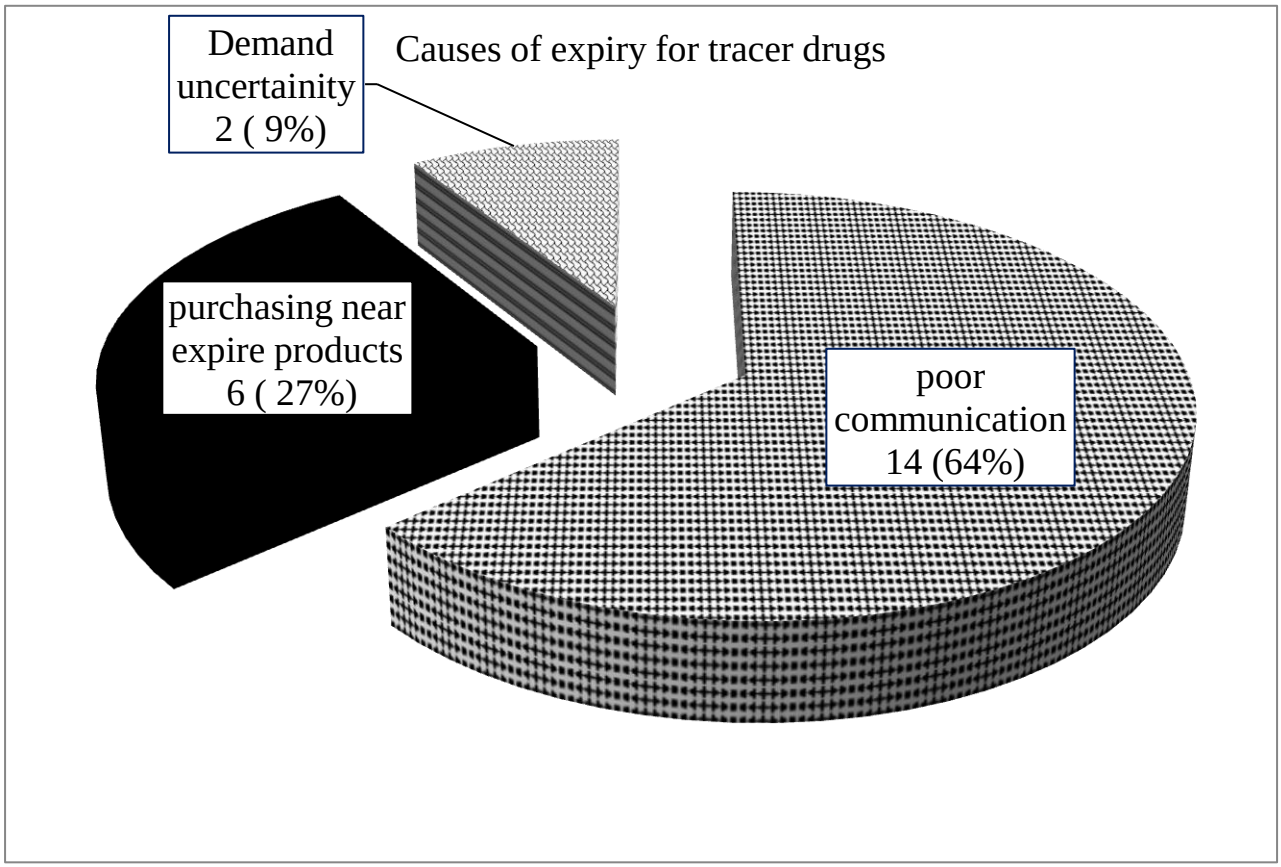

Figure 7: Causes of expiry for RDF key essential medicines in selected public health facilities of Awi zone Amhara region. May, 2019, (n=22).

5.5. Availability and stock out rate of RDF key essential medicines

The availability and stock out of Ems was assessed by observing the presence of the each product in the shelf on the day of visit and the stock out duration of the last 12 months was determined by assessing the bin card transaction report i.e. counting the number of days between zero quantities on hand and until it is received, and by interviewing the store manager for those products without bin card.

Thus as shown in the (Table-10) below average percentage availability of RDF key essential drugs per item on the day of visit was 85.6%. Almost all 21(95%) of tracer drugs were experienced stock out on the last 12 months. The mean stock duration ranges from 0 days for chloroquine to 44.86 days for metronidazole injection and average days of stock out duration of key essential medicines were 15.56 days and stock out rate was 4.28%.

Table10: Availability and stock out duration of key essential medicines in selected public HFs of Awi zone May, 2019. (n=22)

SN.	List of tracer drugs	Available in the day of visit		Duration of stock out in the last 12 months	
		Yes Freq. (%)	No Freq. (%)	Total days of stock out (n=22)	Mean stock out duration (n =22)
1	Amoxicillin 250 mg/ 5 ml syrup	14 (64%)	8 (36%)	903	41.04545
2	Amoxicillin 500 mg capsule	22 (100%)	0 (0%)	38	1.727273
3	Ceftriaxone 1 gram injection	16 (73%)	6 (27%)	363	16.5
4	Metronidazole injection	7 (32%)	15 (68%)	987	44.86
5	Ciprofloxacin 500 mg tablet	22 (100%)	0 (0%)	161	7.318182
6	Doxycycline 100 mg capsule	21 (95%)	1 (5%)	41	1.863636
7	Metronidazole 250 mg capsule	21 (95%)	1 (5%)	90	4.090909
8	Metronidazole syrup	21 (95%)	1 (5%)	378	17.18182
9	Cotrimoxazole syrup	20 (91%)	2 (9%)	227	10.31818

10	Antacid suspension	15 (68%)	7 (32%)	725	32.95455
11	Tetracycline 1% eye ointment	20(91%)	2 (9%)	259	11.77273
12	Paracetamol 500 mg tablet	22 (100%)	0(0%)	105	4.772727
13	Paracetamol syrup	19 (86%)	3 (14%)	686	31.18182
14	Tetanus antitoxin (TAT) inj.	16 (73%)	6 (27%)	607	27.59091
15	Mebendazole 100 mg tablet	22 (100%)	0 (0%)	100	4.545455
16	Oral rehydration salt(ORS)	21 (95%	1 (5%)	90	4.090909
17	Ampicillin powder for injection	21 (95%)	1 (5%)	146	6.636364
18	Gentamycin injection	20 (91%)	2 (9%)	99	4.5
19	Chloroquine tablet	22 (100%)	0 (0%)	0	0
20	white filed skin ointment	17(77%)	5(23%)	731	33.22727
21	Hydralazine injection	14 (67%)	8(33%)	783	35.59091
22	Ferrous sulphate +folic acid tablet	21 (95%)	1 (5%)	57	2.590909
Average percentage availability on the day of visit		414 (85.6%)	70 (14.4%)		

Total days of stock out for all tracer drugs in the last 12 months 7,576

Stock out rate $= \frac{\textbf{Total number of stock out days for all tracer drugs}}{\textbf{Total number of tracer drugs (22 x22) x 365}} \times \mathbf{100} =$ 4.28%

This study also measured percentage availability of key Ems on the day of visit by facility level. Thus as shown in the (Fig. 8) below; only a single (5%) HF. maintained 100% availability of key essential medicines on the day of visit and overall 13(59%) of HFs (4 hospitals and 9 health centers) maintained availability of Ems above 80% and availability on the day of visit ranges from 68% to 100%.

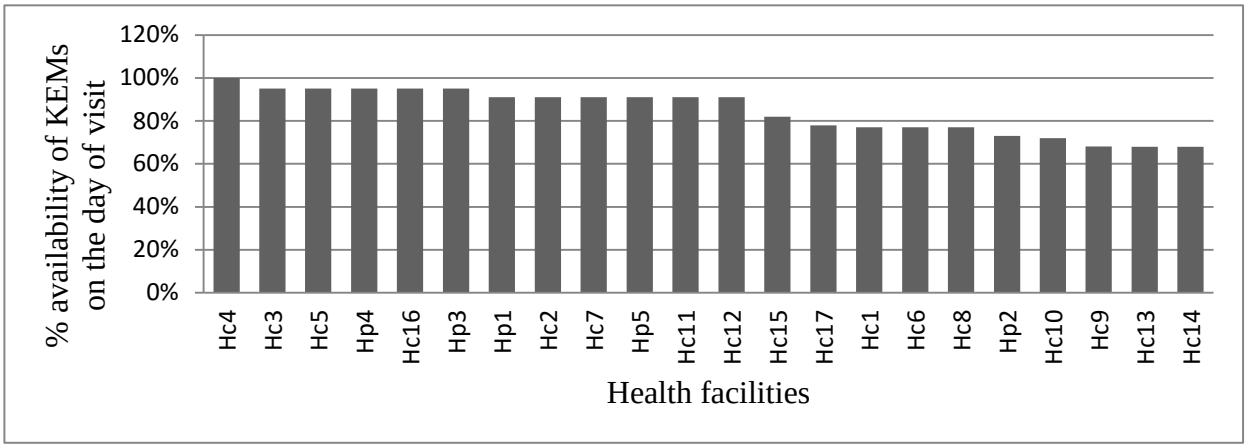

Figure 8: Availability of RDF key essential medicines on the day of visit by facility level in selected public HFs of Awi zone Amhara region. May, 2019.

As shown in the (Table -11) below supportive supervision with fisher's exact test of significance at Df=1, (**p-value=0.017)** and using an electronic stock tracking system (HCMIS) with fisher's exact test of significance at Df=1, (**p-value 0.026)** which are below the cut- off point set to test the association between variables (**p-value = 0.05**) had shown evidence of association with the availability of essential medicines in public health facilities on the day of visit.

Table 11:- Association between availability of key essential medicines and regular supportive supervision and using HCMIS in selected public health facilities in Awi zone. May, 2019 (n=22).

Predictor/independent variables		Response/ outcome variable		Total	**Exact Sig.(2-sided)**	
		% availability of tracer drug on the day of visit			Df	P - value
		Good (>80%)	Poor (<80%)			
Regular Supportive supervision	Received	13 (72.2%)	5 (28.2%)	18	1	0.017
	Not received	0 (0%)	4 (100%)	4		
	Total	13	9	22		
Using HCMIS	Yes	11 (78.6%)	3 (21.4%)	14	1	0.026
	No	2 (25%)	6 (75%)	8		
	Total	13	9	22		

As shown in the (Fig. 9) below, 10 (45%) of facilities reported that supplier stock level as the main cause of stock out for key essential medicines. The detailed information is provided in the figure below.

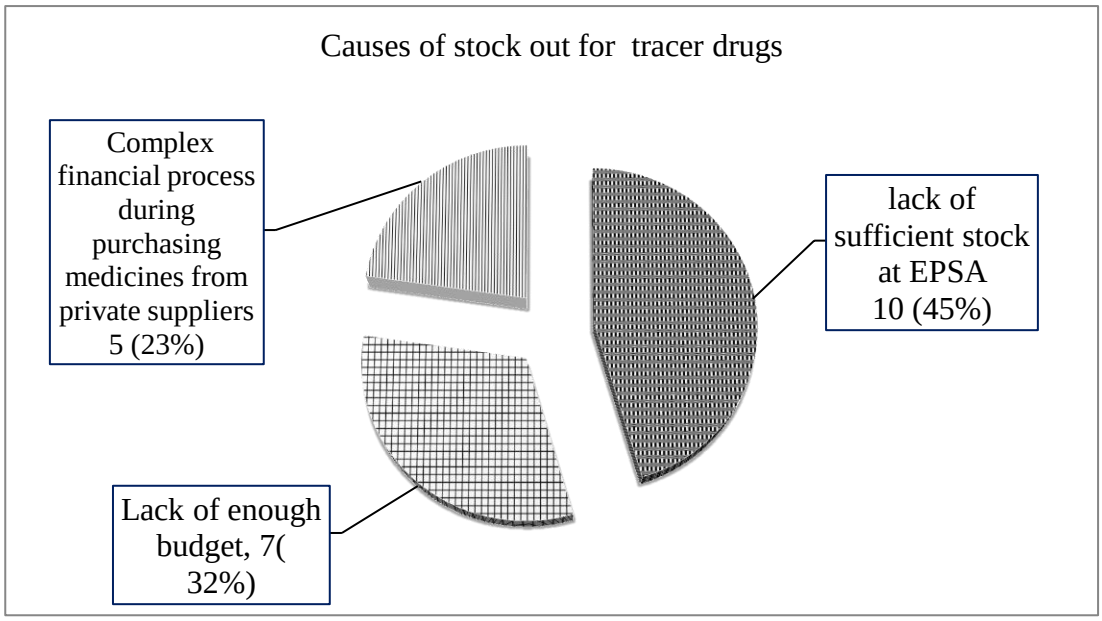

Figure 9: Causes of stock out for key Ems in public HFs of Awi zone Amhara region May 2019. (n=22)

5.6. Storage conditions of key essential medicines

As provided on the table below all facilities full filled the following five criteria; Products are arranged so that identification labels and expiry dates and/or manufacturing dates are visible, Products are stored and organized in a manner accessible for first-to-expire, first-out (FEFO) counting and general management, Products are stacked at least 10 cm off the floor, Storage area is secured with a lock and key and Products are stacked no more than 2.5 meters. While 82% of facilities did not full fill the following two criteria; Products are stacked at least 30 cm away from the walls and other stacks and the current space and organization is sufficient for existing products and reasonable expansion. The detail information is provided in the table below.

Table 12: Health facilities adherence to principles of good storage condition for pharmaceuticals in selected public health facilities of Awi zone, Amhara region, May, 2019 (n =22).

SN.	Description	Criteria fulfilled		
		Yes	No	Tot.
		Freq. (%)	Freq. (%)	
1	Products are arranged so that identification labels and expiry dates and/or manufacturing dates are visible.	22 (100%)	0 (0%)	22
2	Products are stored and organized in a manner accessible for first-to-expire, first-out (FEFO) counting and general management.	22 (100%)	0(0%)	22
3	Cartons and products are in good condition, not crushed due to mishandling.	20 (91%)	2 (9%)	22
4	The facility makes it a practice to separate Damaged and/or expired products from usable products and removes them from inventory.	20 (91%)	2 (9%)	22
5	Products are protected from direct sunlight.	21 (95%)	1 (5%)	22
6	products are protected from water and Humidity.	20 (91%)	2 (9%)	22
7	Storage area is visually free from harmful insects and rodents.	20 (91%)	2 (9%)	22
8	Storage area is secured with a lock and key, but is accessible during normal working hours; access is limited to authorized personnel.	22 (100%)	0	22
9	Products are stored at the appropriate temperature according to product temperature specifications.	18 (82%)	4 (18%)	22
10	Roof is maintained in good condition to avoid sunlight and water penetration.	20 (91%)	2 (9%)	22
11	Storeroom is maintained in good condition (clean,	17(77.3%)	5 (22.7%)	22

	all trash removed, sturdy shelves, organized boxes).			
12	The current space and organization is sufficient for existing products and reasonable expansion.	4 (18%)	18 (82%)	22
13	Fire safety equipment is available and accessible (any item identified as being used to promote fire safety should be considered).	12 (55%)	10 (45%)	22
14	Products are stored separately from insecticides and chemicals.	8 (36%)	14 (64%)	22
15	Products are stacked at least 10 cm off the floor.	22 (100%)	0	22
16	Products are stacked at least 30 cm away from the walls and other stacks.	4 (18%)	18 (82%)	22
17	Products are stacked no more than 2.5 meters high.	22 (100%)	0	22

As shown in the (Fg.10) below only ten (45%) health facilities were fulfilled ≥ 80% of the criterion listed in the storage guideline and the performance ranges from 58% to 100%.

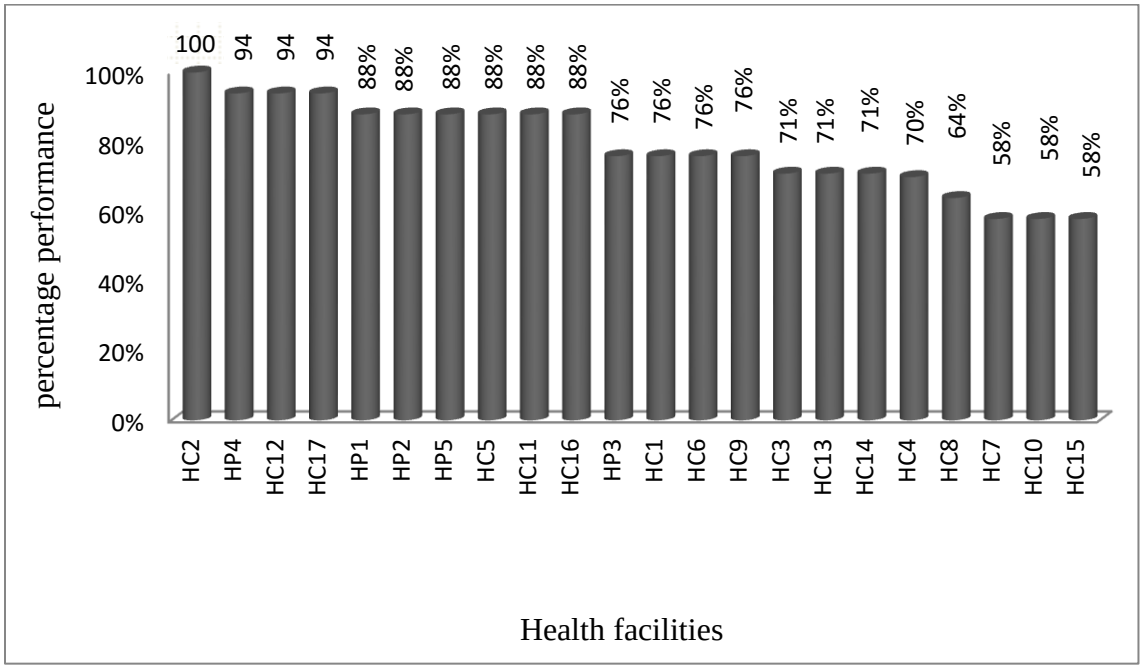

Figure 10: Performance of study facilities in terms of adhering to good pharmaceutical storage condition in Awi zone, Amhara regional state. May, 2019. (n =22).

5.7. Challenges that face logistics management practice of RDF key essential medicines

The Qualitative data were collected by in-depth interview of eight purposively selected KIs and the data were analyzed after categorized into four themes i.e. Selection quantification and procurement related challenges, availability related challenges, and inventory management related challenges and storage condition related challenges.

5.7.1. Selection quantification procurement related challenges

Inappropriate use of medicines may waste resources and seriously undermines the quality of patient care (74). So that selecting the right medicine with respect to the level of care is a wise decision. Skill gap / lack of training on DTC and resource constraint were mentioned by KI as a challenge for their selection practice. In health care delivery settings, a drug and therapeutics committee (DTC) provides a forum to bring together all the relevant people to work jointly to improve the overall health-care service. As such DTC may be regarded as a tool for promoting more efficient and rational use of medicines. But some of the facilities included in this study did not establish DTC and in some of HFs DTC fail to carry out its responsibility. KI mentioned the situation as follows ..... *"In our facility DTC is not functional and facility specific drug list is not prepared. The procurement of medicines is based on the prescribers' preference and it has its own risk, we may not get those drugs from Ethiopian pharmaceutical supply agency (EPSA) and leads us to purchase from private suppliers which ends with loss of our limited budget generated from medicine sale (revolving drug fund)."*

Perhaps the most important function of a DTC is the evaluation and selection of medicines for the essential medicines list or formulary list. And it is a valuable resource that can provide advice to medical staff and to the management in the HFs (74, 75). In order to practice such functions the members of DTC require resource and technical expertise or course of training on DTC. KIs mentions the situation that *".....The role and responsibility of DTC is not merely evaluation and selection of medicines but also monitor rational drug use and adverse drug reaction and a likes. In order to carry out such activities i think training is mandatory. I am the member of DTC in this facility but I have not taken any training regarding to DTC."*

The other KI added that; "…. *drug selection, preparing facility specific drug list and revision of the list as well as promotion of ration drug use and monitoring adverse drug reaction needs scientific evidence and up-to-date knowledge of the situation but here there is limited internet access and standard reference books to do so."*

In decentralized system quantification of pharmaceuticals is made by the lower level facility itself. The facilities announce their future demand to the nearby supplying agency. In Ethiopia RDF pharmaceuticals are quantified in decentralized way while program drugs are estimated at the central level. The main challenge mentioned by KI was poor data quality and lack of training on pharmaceutical quantification. KI mentioned the situation : " *in our facility consumption method is used to estimate our demand but the data (from Bin card and model 22) what we are using cannot be real data because of poor record keeping , frequent stock out of medicines such challenges results poor forecasting accuracy finally ends with under stock or over stock (shortage and wastage)" The other KI "….added that in our facility no one was trained on pharmaceutical quantification we forecast our annual demand using the information from the quantification template given from EPSA and by reading the job aids provided with it."*

Related to procurement key informants underline the following challenges i.e. financial (budget constrain), market inflation and process related challenges. Key informant mentioned that "*….the budget allocated to the facilities is too little (i.e. 7.42 birr / individual) based on the catchment population size. Health service utilization by the community is increased time to time so it is difficult to accommodate such demand with this little fund."* The price of the drug charged by the private suppliers also unaffordable to the facilities and become an obstacle for the facilities to avail products which are not supplied by EPSA. Another KI said that *".....market inflation for medicines is very high. The private suppliers charge very high price as compared to EPSA price for the same generic drug, it is difficult for us to accommodate such inflated price to purchase from private suppliers by limited internal budget generated from medicine sale, the government should regulate pharmaceutical market and medicine price."* Another procurement relate challenge mentioned by KIs was prolonged financial process, KI mentioned that *"….medicines are different from other products, they are life saving their procurement should be treated differently. But in our facility when we procure medicines from private suppliers we*

always face bureaucratic hurdles and the process takes couple of weeks and months in such occasions we experience stock out of tracer drugs which ends with patient dissatisfaction."

5.7.2. Challenges related with availability of key essential medicine

As noted by the key informant's; supplier stock level and purchasing near expiry products are main challenges that have faced health facilities to avail key essential drugs at all time. KIs mentioned that *"…. The EPSA capacity to full fill facilities demand for RDF medicines is decreased time to time. The line fill rate for the last fiscal year/ 2010 E.C) was 35% but in this year it is decreased to 28%. It is very frustrating. The agency is the only choice to us to satisfy our patients need, the government should empower and restructure the system as soon as possible."* Another KI added that *"…. Sometimes EPSA push near expiry products to the facilities, if you refuse to take, the Agency never issue stock out certificate to that product, in this time there is no option other than accepting their offer such like events increase facilities expiry rate and stock out of tracer drugs."* Another KI added that "*….. All pharmaceutical procurement bottle necks can be the bottle necks for availability of key essential drugs as well."*

5.7.3. Inventory management related challenges

Key informants underline that lack of sufficient human resource as the main challenge in their facility to manage inventory. As attested by KI that *"… scarcity of pharmacy professionals in the market and high attrition rate of professionals increase the work load on the existing workers, a single store keeper is obliged to manage all the paper work and the labor work, so it compromises the timing and accuracy of record keeping because inventory management is a tough work by itself and it needs full time and attention"*

5.7.4. Storage condition related challenges

Key informants noted that lack of sufficient space and storage equipment is the main challenge for maintaining good pharmaceutical storage condition. KI mentioned that *"… you see we have stored medicines in the house constructed for other services other than pharmaceutical storage. Besides this it is very narrow, not ventilated, even there is no room to segregate expired/ damaged products we put in the ground in the bottom of the shelf. Due to lack of refrigerator we put those drug which require cold chain like insulin, Tetanus antitoxin etc. in laboratory unit where refrigerator is available."* Another key informant added "*…our store room is not sufficient and equipment like refrigerator, shelves and fire safety equipment are not fulfilled."*

6. Discussion

Pharmaceutical logistics management is a key functional area for success of any health care program. Its ultimate goal is to fulfill the six rights (the right medicine, in the right quantity, in the right quality, at the right price, at the right time and to the right place/ person) to satisfy the final customer/end user/patients. To make it real the system need to be assessed regularly by using standard logistics management indicators to identify the strength and limitations of the system (12). The finding of this study was focused on the selection, quantification and procurement, inventory management performance, availability, storage condition and associated challenges of RDF key essential medicines logistics management in public health facilities.

The study revealed that 19(86%) surveyed facilities develop their own specific drug list and used it as a reference tool to select medicines for procurement. Which is higher than a study conducted in Tanzania where only 38 % surveyed facilities had their own medicine list (16) and South Africa where essential drug list were not available in the served facilities (17). Again this finding is better than the study conducted in public health facilities in southern part of Ethiopia where none of the visited facilities were developed their own specific drug list (36), the difference may be due to the presence of drug and therapeutic committee that is responsible for preparing FSDL in this study. While the result of this study is slightly lower than a study conducted in in public health centers of Addis Ababa where 95% facilities developed their own essential medicine list (24) and a study conducted in Adama town where all surveyed facilities were developed FSDL(76). The difference may be due to limited access to internet and reference materials to develop and revise the document in the current study as mentioned by one key informant ….." *drug selection and revision of the list needs scientific evidence and up-to-date knowledge of the situation but here there is limited internet access and reference books in this facility.*

Quantification performance of a given health program is measured by a standard indicator i.e. forecast accuracy error. Forecast is rarely perfect, and the error results in bullwhip effect and increases the organizations cost up to 30% which leads to substantial damage to the system performance (37). This study revealed that majority of HFs 20(91%) used consumption method of quantification while the rest 2(9%) of HFs used both morbidity and consumption method of quantification in combination. This finding is better than the study conducted in public health

facilities of Uganda where HFs were used neither morbidity nor consumption methods of quantification to estimate their demand, requisitions were based on credit available(19). The difference may be due to the availability of DTC and quantification committee in the current study. This study further documented that forecast accuracy error of facilities as measured by mean absolute percentage error (MAPE) was 41.42% which is far apart from a standard margin of error for good pharmaceutical forecast which is ≤ 25% (37). This gap may be due to poor data quality and training gap on pharmaceutical quantification as vowed by KI. "In *our facility consumption method is used to estimate our demand but the consumption data what we are using cannot be real data because of poor record keeping, frequent stock out of medicines. The other KI "….added that in our facility no one was formally trained on pharmaceutical quantification we forecast our annual demand by using the information from the quantification template given from EPSA and by reading the job aids provided with it."*

In this study it was found that all surveyed facilities 22 (100%) procured medicines by their generic name which is in line with good pharmaceutical procurement practice (3). And 16 (73%) of facilities were developed procurement guide line which is in line with the study conducted in Nepal where majority of facilities developed procurement guide line (44). The study also showed that 10 (45%) facilities were failed to separate key functional areas; selection ,quantification and procurement unit which contradicts the standards stated by good pharmaceutical procurement practice (GPP), which dictates that each public health facilities should separate key functional areas to reduce corruption (3). In addition 4(18%) of health facilities procured medicines from private supplier by direct procurement method. This is lower than the study conducted in Nepal where majority of facilities practice direct procurement method (44). The difference may be due difference in public procurement policy recommendation that allows the districts to practice a single contract award to only one pharmaceutical company for the provision of all essential drugs in Nepal . While the finding of this study is still unacceptable according to Ethiopian public procurement manual (EPPM) recommendation which dictates that public sectors should follow competitive procurement methods for all but very small and emergency purchases (73). The deviation may be due to poor follow up and supervision by management bodies. This study further revealed that the average lead time when pharmaceuticals purchased from EPSA was 3 days and the average lead time from private suppliers was 21days.

The result of this study almost in line with the standard set by federal democratic republic of Ethiopia ministry of health (FMOH) (75) where the average amount of time between placing an order and receiving the product should not exceed 20 day.

This study documented that out of 484 key essential medicines assessed 446 (92%) of tracer drugs had bin card. This finding is higher than the finding reported from a study conducted in public health facilities of Uganda where only 82% of the indicator items had bin card (52).The difference may be due to difference in availability of logistics data recording tools, in this study availability of bin card was 100%. This study further revealed that out of 446 bin cards 431 (96.6%) of bin cards were updated on the day of visit. This finding is higher as compared to the finding reported from the study conducted in public health facilities of Uganda where only 57% of bin cards were updated by the time of visit (52), the difference may due to poorly trained staff in logistics management as reported by the former study. And the updating practice was also encouraging as compared to a study conducted in public health facilities of East shewa where only 59.5 % of bin cards were updated on the day of visit (27). The difference may be due to difference in the type of professionals' assigned for managing inventory and IPLS training. Regarding to inventory accuracy rate this study revealed that out of 446 bin cards 381 (85.43%) bin cards were accurate, which means that bin card balance match with the physical inventory, this finding is higher than findings reported from a study conducted in Uganda public health facilities (21) and a study conducted in public health facilities of Bojanala Health District of south Africa (51), where their inventory accuracy rate was 36% and 50% respectively. This study finding is also slightly higher than a finding from a study conducted in public health facilities of Tanzania (Zanzibar province) (22), which revealed that 70% of bin cards were accurate. The difference may be due to presence of supportive supervision and trained staff on IPLS in the current study. The result of this study is encouraging as compared to the local finding reported from the study conducted in East shewa zone, Ethiopia. Which revealed that only 28.5% bin cards were accurately filled (27). The difference may be due to difference in the type of professionals assigned for inventory management (in this study all store keepers who are responsible for inventory management are pharmacy by profession) and better availability of HCMIS (automated stock tracking system) in the facilities in this study.

This study calculated the wastage rate of essential medicines due to expiry based up on key essential medicines selected for this study and revealed the wastage of essential medicines only due to expiry because wastage due to loss/damage hasn't been well documented. Therefore the result showed that the wastage rate by value was 0.37%. Which is lower than the study conducted in Nepal (61) and East shewa zone of Ethiopia (27) where the proportion of products wasted was 8.4% and 10.43%. The difference may be due to difference in practicing FEFO principle. Where all facilities included in this study have used FEFO principle to issue products but only 25% facilities were followed FEFO principle to issue products in the former study. While the result of this study is in line with national target set by FMOH (federal ministry of health) reducing expiry rate below 2%, which is stated in HSTP IV (health sector Transformation plan four) (23). This study further revealed that the causes of expiry of tracer drugs and thus majority of facilities 14(64%) mentioned that poor communication within and between facilities, 6 (27%) of HFs reported that purchasing near expiry products and 2 (9%) HFs reported that demand uncertainty (seasonal variation of demand for certain products like chloroquine) as main cause of expiry. Some of the above causes of expiry also mentioned as a main cause of expiry in the study conducted in East shewa zone of Ethiopia (27).

Availability of key essential medicines in the health care setting is an indicator of well-functioning logistics system. In order to improve the logistics management system performance the system should be evaluated regularly by using standard indicators (12). This study revealed that average availability of key essential medicines on the day of visit was 85.6% which is slightly lower than the study conducted in Malaysia (57) and Nepal (61) where average availability of medicines were 95.4%, 92.44% respectively. The difference may be due to difference in the number of facilities and products studied. On the other hand this finding is higher than the study conducted in India (59), Swaziland (62), Uganda (19), and South Africa (51) where mean availability of medicines were 41.3%, 68%, 79.53%, 80% respectively. When compared to study findings in Ethiopia this study finding is almost similar with a study conducted in Gondar town (65), where availability of medicine in the day of visit was 90% and higher than a study conducted in South West Ethiopia (64) where availability of Ems was 55.56%. The mean days of stock out duration ranges from 0 days for chloroquine tablet to 44.86 days for metronidazole injection and the average days of stock out duration in the last 12 months were 15.65 days. This result is higher than the finding from a study conducted in Nepal (61),

Malaysia (57) where average days of stock out duration was 0.324 days, and 6.5 days respectively. The difference may be due to difference in supplier's stock status and budget allocation for health facilities. And the result of this study is lower than findings reported from a study conducted in Uganda (21) and Tanzania (22), where average days of stock out duration was 150 days and 113 days respectively. Similarly this study finding is also lower than other local study findings reported from a study conducted in Gondar town (65) and Adama town (76) where average days of stock out duration was 30.5 days and 40.6 days respectively. The difference could be due to good inventory management practice in the facilities included in this study as compared to the former studies. This study further documented that the main causes of stock out in the studied facilities were insufficient stock from the supplier (EPSA) as mentioned by key informants *"…. The EPSA capacity to full fill facilities demand for RDF medicines is decreased time to time. The line fill rate for the last fiscal year was 35% but in this year it is decreased to 28%. It is very frustrating. The agency is the only choice to us to satisfy our patients need, the government should empower and restructure the system as soon as possible."* insufficient budget allocation as ascertained by KIs "…*the budget allocated to the facilities is too little (i.e. 7.42 birr / individual) based on the catchment population size. It is insufficient because health service utilization of the community is increased time to time so it is difficult to accommodate such demand with this little fund."* And bureaucratic financial process, as attested by KIs …*"medicines are different from other consumer products, they are life saving their procurement should be treated differently. But in our facility when we procure medicines from private suppliers we always face bureaucratic hurdles and the process takes couple of weeks and months in such occasions we experience stock out of tracer drugs which ends with patient dissatisfaction."* Such factors were also mentioned in other studies conducted in public health facilities of Uganda (21), East shewa zone of Ethiopia (27) and Adama town – Ethiopia (76).

Medicines have "enemies": heat, light, moisture and pest. It is also recognized that medicines have to be protected from theft, expiration, and physical damage and fire (45). The quality and storage of EMs settings were considered as an imperative question and time-to-time assessment has been advocated (53). This study have assessed the storage condition of key essential medicines and showed that 45% of facility stores were fulfilled the minimum standard set by storage guide line. This finding is lower than the result reported from a research conducted in Tanzania where 52% facility warehouses fulfilled the minimum standard (22). The difference

may be due to lack of management commitment to full fill storage equipment as mentioned by KIs *"…our store room is not sufficient and equipment like refrigerator, shelves and fire safety equipment are not fulfilled. I have reported this several times to the facility management but no response. I think the management did not understand the characteristics of pharmaceuticals to such extent."* And higher than the result of the study conducted in Uganda public health facilities (21) and East shewa zone of Ethiopia (27) where only 10% and 25% of facilities were fulfill the good pharmaceutical storage condition criterion respectively. The difference may be due to availability of storage guide line and pharmacy professionals managing the warehouse in the current study.

Pharmaceutical logistic management in low and middle income countries face several challenges which ranges from lack of systematic, coordinated approaches to key functions surrounding pharmaceutical supply management, poor or absent communication between stakeholders, limited availability of quality data regarding utilization of commodities prevents adequate forecasting of demand and appropriate quantification of supplies essential to meet requirements at a regional, district and community level (66). This study identified that lack of training on DTC , budget constrain, inadequate human resource, insufficient supplier stock level and poor infrastructure/ resource were identified as the main challenges of the logistic management of essential medicines. The finding of this study is in line with the studies conducted in sub-Sahara countries where poor infrastructure, poorly trained staff on logistics management and insufficient budget allocation were mentioned as a main challenge for logistics management (67). Similarly the challenges identified in this study also mention as a main challenge for logistics management of essential medicines in the study conducted in public health facilities of Adama town in Ethiopia (76).

7. Limitation of this study

This study did not address some components of the logistics cycle such as serving the customers or patient use because it needs another approach other than used in this study. Due to insufficient local study in area of pharmaceutical quantification performance and procurement practice at the health facility level; this study limited to compare some findings with international studies and against the target set by standard books and guidelines.

8. Conclusion and recommendation

8.1. Conclusion

This study concluded that the selection performance in terms of preparing facility specific drug list and its utilization was good. While forecasting performance of facilities in terms determining their annual demand was very poor. The procurement practice was good in terms of purchasing medicines by their generic name but separation of key functional areas (selection, quantification and procurement unit) of the system and preparing procurement guide lines for those purchases made from private suppliers needs an improvement. Regarding to inventory management performance majority of tracer drugs had bin card and updating practice and inventory accuracy was good. And average percentage availability of bench of EMs on the day of visit was good. But as a principle tracer drugs must be available 7 days / week and 365 days/year in every health care setting to ensure this further improvement is needed to avail Ems all the day. Regarding to the storage condition health facilities performance was poor. Majority of facilities left with inadequate space, lack of refrigerators, fire safety equipment and unsafe storage area due to rodent infestation and leaking roof. Overall logistics management performance of surveyed facilities as measured by core logistics indicators was good.

8.2. Recommendations

- The facility management should support the logistics activities undergoing in their facility by establishing and strengthen DTC, preparing facility specific drug list, procurement guide lines and minimize complex financial process /bureaucratic hurdles for timely purchasing of tracer drugs medicines.

- Woreda health office and zonal health department should provide regular supportive supervision and follow up especially for rural facilities, provide maintenance for those store room in which the roof is leaking and buy refrigerator for those facilities in need.

- Amhara regional state health bureau should organize traing on DTC and pharmaceutical quantification, allocate sufficient budget based on the need of the health facilities and deploy man power in pharmacy units.

9. Reference

1. Rational Pharmaceutical Management plus Program. Pharmaceutical System Performance. Within the Context of Health Sector Reform. Arlington, VA: Management Sciences for Health. 2005.

2. WHO. Declaration of Alma Ata, International Conference on Primary Health Care, Alma ta, 1978.http://www.unicef.org/about/history/files/Alma_Ata_conference_1978_report.pdf (accessed on December 19, 2018.)

3. Management Sciences for Health. MDS-3: Managing Access to Medicines and Health Technologies. Arlington, VA: Management Sciences for Health. 2012.

4. WHO. Essential drugs monitor, DOUBLE ISSUE – No 25 & 26 (1998), World Health Organization CH-1211 Geneva 27, Switzerland.1998.

5. USAID | DELIVER PROJECT. The Logistics Handbook: A Practical Guide for the Supply Chain Management of Health Commodities. Arlington, Va.: USAID | DELIVER PROJECT, Task Order 1.2011

6. Council of Supply Chain Management Professionals (CSMP). Supply Chain Management Definitions. 2011. http://cscmp.org/aboutcscmp/definitions.asp (accessed on 19 December,2018)

7. FMOH. Health Policy of the Transitional Government of Ethiopia. Ministry of Health, Addis Ababa, Ethiopia. 1993.

8. FMOH. Ethiopian hospital service transformation guide line (EHSTG), Ministry of Health Addis Ababa, Ethiopia. August, 2017.

9. USAID | DELIVER PROJECT, Task Order 4. 2014. Quantification of Health Commodities: A Guide to Forecasting and Supply Planning for Procurement. Arlington, Va.: USAID | DELIVER PROJECT, Task Order 4.

10. Pharmaceuticals Fund and Supply Agency (PFSA). Standard operating procedure manual for the integrated pharmaceutical logistics system in health facilities of Ethiopia, 2nd Edition. Addis Ababa.2015.

11. John Snow, Inc. /DELIVER in collaboration with the World Health Organization. Guidelines for the Storage of Essential Medicines and Other Health Commodities. Arlington, Va.: 2013.

12. Aronovich, Dana, Marie Tien, Ethan Collins, Adriano Sommerlatte, and Linda Allain. Supply Chain Performance: Guide to Key Performance Indicators for Public Health Managers. Arlington, Va.: USAID | DELIVER PROJECT, Task Order 1.2010.
13. Govindaraj R., Reich MR., Cohen J C. World Bank Pharmaceutical, Human Development Network (HNP) Discussion Paper, the World Bank: Washington D.C. 2000.

14. Elamin EI, Izham M, Ibrahim M, Abd M, Yousif E. Availability of essential medicines in Sudan. Sudan J public Heal. 2010; 5(1):32–7.

15. Mir et.al. Medicines Management in Hospitals. Systematic Reviews in Pharmacy. 2017; 8(1):80-85.

16. MOHSW. In-depth Assessment of the Medicines Supply System in Tanzania. Ministry of Health and Social Welfare, Dare salaam, Tanzania. 2008.
17. Tayob S. Challenges in the management of drug supply in public health care centers in the Sedibeng district, Gaunten province, South Africa. Master's thesis University of Limpopo. 2012.
18. Trapero, J.R., Kourentzes, N. & Fildes, R. Importance of information exchange on supplier forecasting performance. Omega. 2012: vol. 40 issue6, 738-747.
19. Bruno O, Nyanchoka OA, Ondieki MC, Nyabayo MJ (2015). Availability of Essential Medicines and Supplies during the Dual Pull-Push System of Drugs Acquisition in Kaliro District, Uganda. J Pharma Care Health Sys S2-006. doi:10.4172/jpchs.S2-006.
20. Shrestha M, Moles R, Ranjit E, Chaar B. Medicine procurement in hospital pharmacies of Nepal: PLoS ONE. 2018: 13(2):e0191778. https://doi.org/10.1371/journal.pone.0191778
21. Nahamya D. Assessment of essential drug management in public health facilities of Uganda. Master thesis, university of Cape Town. 2007.

22. Eliakimu H. Pharmaceutical logistics system performance of Public health facilities in Pemba, Zanzibar. Master's thesis, Muhimbili University of Health and Allied Sciences. 2013.
23. Federal democratic republic of Ethiopia ministry of health. Health sector transformation plan (HSTP, 2015/16-2019/20).Addis Ababa. October, 2015.

24. Mudzteba M. Assessment of pharmaceutical logistics system in public health centers of Addis Ababa. Master's thesis, Addis Ababa University 2014.
25. Ewen et al. Prices and availability of locally produced and imported medicines in Ethiopia and Tanzania. Journal of Pharmaceutical Policy and Practice (2017) 10:7 DOI 10.1186/s40545-016-0095-1.
26. Shewarega, Abiye, Paul Dowling, Welelaw Necho, Sami Tewfik, and Yared Yiegezu. National Survey of the Integrated Pharmaceutical Logistics System. Arlington, Va.: USAID | DELIVER PROJECT, Task Order 4, and Pharmaceuticals Fund and Supply Agency (PFSA).2015.
27. Gurmu TG. , Ibrahim AJ. Inventory management performance of key essential medicines in health facilities of East Shewa Zone, Oromia Regional State, Ethiopia. Cukurova Med J 2017; 42(2):277-291. DOI: 10.17826/cutf.322908.
28. Haque M. Essential medicine utilization and situation in selected ten developing countries: A compendious audit. Journal of International Society of Preventive and Community Dentistry. 2017; 7:147-60.
29. M.C. Broccoli et al. Essential medicines for emergency care in Africa. African Journal of Emergency Medicine 8 (2018) 110–117.
30. Roark, D.C. Managing the healthcare supply chain. Nursing Management.2005: 36-40.
31. Carlos F., Edgar A. A Structured Review of Quantitative Models of the Pharmaceutical Supply Chain. Hindawi Complexity Volume 2017, Article ID 5297406, 13 pages https://doi.org/10.1155/2017/5297406
32. Poulin E. "Benchmarking the hospital logistics process: a potential cure for the ailing healthcare sector", CMA Management.2003: Vol. 77 No. 1, pp. 20-4
33. EFMHACA. National essential medicine list of Ethiopia. Fifth edition. Addis Ababa: ministry of health; January, 2015.
34. FMOH. National Assessment on Functional Status and Perceived Effectiveness of Drug and Therapeutics Committees at Public Hospitals in Ethiopia. Addis Ababa: ministry of health; January 2014.
35. Kumurya A. Supply Chain Management of Health Commodities and Logistics: Fundamental Components of Booming Medical Laboratory Services. European Journal of Logistics, Purchasing and Supply Chain Management. November 2015: Vol.3, No.4, pp.62-72.

Published by European Centre for Research Training and Development UK (www.eajournals.org).

36. Gidebo KD, Summoro TS, Kanche ZZ, Woticha EW. Assessment of drug use patterns in terms of the WHO patient-care and facility indicators at four hospitals in Southern Ethiopia. BMC Health Service Res: 2016;16:643.
37. Lewis, C. D. Industrial and business forecasting methods: A Radical guide to exponential smoothing and curve fitting. London; Boston: Butterworth Scientific.1982.
38. Arney L. & Yadav P. Improving Procurement Practices in Developing Country Health Programs.2014.
39. David W., Dr. Fred M. Effects of Pharmaceutical Procurement Processes on Performance of Public Health Facilities in Mombasa County, Kenya. International Journal of Sciences: Basic and Applied Research, (IJSBAR). (2015): Volume 24, No 1, pp. 245-272.
40. USAID | DELIVER PROJECT, Task Order 4. Procurement Performance Indicators Guide—Using Procurement Performance Indicators to Strengthen the Procurement Process for Public Health Commodities. Arlington, Va.: USAID | DELIVER PROJECT, Task Order 4. 2012
41. World Health Organization. World Medicines Strategy 2008-2013. Geneva: World Health Organization; 2008.
42. Muhia J, Waithera L, Songole R. Factors affecting the procurement of pharmaceutical drugs in Kenya. Med Clin Rev.2017: Vol. 3 No. 4: 20.
43. Iqbal MJ, Geer MI, Dar PA. Indicator Based Assessment of Medicines Procurement Practices in Various Public Sector Hospitals of District Srinagar. Int Arch BioMed Clin Res. 2016 April;2(2):18-24. 10.21276/iabcr.2016.2.2.4.
44. Shrestha M, Moles R, Ranjit E, Chaar B. Medicine procurement in hospital pharmacies of Nepal. PLoS ONE. 2018: 13(2):e0191778.
    Available at; https://doi.org/10.1371/journal.pone.0191778. Accessed April/2019.
45. Ghana Ministry of Health, DFID, World Health Organization. Ghana: Assessment of Medicines Procurement and Supply Management Systems in the Public Health Sector. 2009.
46. Chase, Richard B. Operations Management for Competitive Advantage; 10th ed.; McGraw-Hill/Irwin; New York, 2004.

47. Doshi RP, Patel N, Jani N, Basu M. Mathew, Simy. ABC and VED analyses of drug management in a government tertiary care hospital in Kerala. Explorations in Health Economics Paper. Presented in iHEA 6th World Congress, 2007.
48. Kant S, Pandaw CS, Nath LM. A Management Technique for Effective Management of Medical Store in Hospitals. Journal of Academic Hospital Administration, 1997; 8:41-7.
49. Ayad K. Ali. Inventory Management in Pharmacy Practice: A Review of Literature. Archives of Pharmacy Practice. 2011; 2(4) pp. 151-156.
50. Zaidi S., Bigdeli M., Aleem N., Rashidian A. Access to Essential Medicines in Pakistan: Policy and Health Systems Research Concerns. PLoS ONE. 2013: 8(5):e63515. doi:10.1371/journal.pone.0063515.
51. Strengthening Pharmaceutical Systems and Systems for Improved Access to Pharmaceuticals and Services Program. Assessment of Availability and Delivery of Pharmaceutical and Surgical Supplies in Bojanala District. Submitted to the US Agency for International Development by the Strengthening Pharmaceutical Systems and Systems for Improved Access to Pharmaceuticals and Services (SIAPS) Programs. Arlington, VA: Management Sciences for Health; 2013.
52. REEV Consult International. Essential medicines and health supplies tracking in Uganda. October, 2009. Available at. WWW.reevconsult.co.ug.
53. Nogueira FH, Moreira-Campos LM, Santos RL, Pianetti GA. Quality of essential drugs in tropical countries: Evaluation of antimalarial drugs in the Brazilian health system. Rev Soc. Bras Med Trop. 2011;44:582-6.
54. An Assessment of Vaccines and other Health Commodities Supply Chains in the Equateur and Tshuapa Provinces, Democratic Republic of Congo.2015.
Available at; WWW.VILLAGEREACH.ORG .
55. Gizat M. & Samson M. Assessment of pharmaceutical store management in Woreda health office of west Hararghe zone, Ethiopia. Int. Res. J. pharm. 2014; 5(8) 642-642. Available at; http://dx.doi.org/10.7897/2230-8407.0508131 .
56. Bogaert P., et al. A Qualitative Approach to a Better Understanding of the Problems Underlying Drug Shortages, as Viewed from Belgian, French and the European Union's Perspectives. PLoS ONE. 2015: 10(5):e0125691. doi:10.1371/journal.pone.0125691.

57. Salah K. & Ibrahim MI. Are essential medicines in Malaysia accessible, affordable and available? Pharm World Science. 2005;27:442-6.
58. Pujari NM, Sachan A. & Kumar Y. Cross-sectional study on availability and affordability of some essential child-specific medicines in Uttar Pradesh. Int. J Med Sci. Public Health 2016; 5:2047-2051.
59. Kotwani. Where we are now: assessing the price, availability and affordability of essential medicines in Delhi as India plans free medicine for all. BMC Health Services Research. 2013:13:285.
60. Prinja, et al. Availability of medicines in public sector health facilities of two North Indian States. Bio Med Central Pharmacology and Toxicology. 2015: 16:43. DOI 10.1186/s40360-015-0043-8.
61. Shiva Raj A., et al. Universal Access to Essential Medicines: An Evaluation of Nepal's Free Health Care Scheme. Journal of Nepal health research council. 2018: Jan-Mar; 16(38):36-42.
62. Mhlanga BS, Suleman F. Price, availability and affordability of medicines. African Journal of Primary Health Care Family Medicine. 2014; 6(1), Art. #604, 6 pages.
Available at: http://dx.doi.org/10.4102/phcfm.v6i1.604.
63. Printz, N. et al. Tanzania: Strategic Review of the National Supply Chain for Health Commodities. 2013.
64. Abiye et al. Barriers to access: availability and affordability of essential drugs in a retail outlet of a public health center in south western Ethiopia. Journal of Applied Pharmaceutical Science. October 2013: Vol. 3 (10), pp. 101-105.
Available online at http://www.japsonline.com DOI: 10.7324/JAPS.2013.31017.
65. Mulugeta Fentie, et al. Availability of essential and inventory management practice in primary public health care facilities of Gondar town, North West Ethiopia. Int. J. of Res. In pharmacology & pharmaceutics.2014: Vol-3(3): [173-178].
66. WHO & MMV. Challenges to Antimalarial Access and Malaria Case Management. Addis Ababa, Ethiopia, 7-8 December 2016 | Meeting Report.
67. Supply and Awareness Technical Reference Team, UN Commission on Life-Saving Commodities for Women and Children. Challenges and Barriers along the In-Country Supply Chain. Systems for Improved Access to Pharmaceuticals and Services (SIAPS) Program. Arlington, VA: Management Sciences for Health.2013.

68. Awi zone, zonal health department annual report. October, 2018.
69. USAID | DELIVER PROJECT, Task Order 1. Logistics Indicators Assessment Tool (LIAT). Arlington, Va.: USAID | DELIVER PROJECT, Task Order 1.2008.
70. Management Sciences for Health; Rapid Pharmaceutical Management Assessment: An Indicator Based Approach. Boston, 1995.

    http://erc.msh.org/mainpage.cfm?language=English&file=8.60.htm&module=toolkit

71. USAID | DELIVER PROJECT, Task Order 1. Logistics System Assessment Tool (LSAT). Arlington, Va.: USAID | DELIVER PROJECT, Task Order.2009.
72. Federal democratic republic of Ethiopia ministry of health. Health sector development program IV (HSDP IV 2010/11 -2014/15). Addis Ababa, Ethiopia. October 2010.
73. FDRE MOFED. Public procurement manual. Addis Ababa, Ethiopia. December 2011
74. WHO/MSH. Drug and therapeutic committee: practical guide .2003. available at: http://www.who.int/medicines/areas/rational_use/en/ accessed on June 7 /2019.
75. Federal Democratic Republic of Ethiopia Ministry Of Health. National pharmacy service, pharmaceuticals supply chain and medical equipment management monitoring and evaluation frame work. Addis Ababa, Ethiopia. May, 2019.
76. Kefale A., Shebo H. Availability of essential medicines and pharmaceutical inventory management practice at health centers of Adama town, Ethiopia. BMC health service research. 2019:19:254.
    Available at: https://doi.org/10.1186/s12913-019-4087-0.

Annex I: Consent form

Consent to participate in a study in titled: "key essential medicine logistics management performance in public health facilities of Awi zone, Amhara region."

Hello I am Abera Tibebu, a Masters student from Jimma University Institute of Health pursuing Master of Science (MSc) degree in pharmaceutical supply chain management.

Purpose of the study

This study aims to assess key essential medicine logistics management performance in public health facilities of Awi zone.

Participation

If you agree to join the study, you will be kindly requested to answer all the questions that will be asked by the data collector.

Confidentiality

Information obtained from you will be treated confidentially and will NEVER be used for any purpose other than this study.

Risk

No harm is expected to happen to anyone participating in this study.

Benefit

Your participation in this study will helps us to understand how key essential medicine logistics management is currently performing in Awi zone public health facilities and suggest ways to improve it.

If you agree to participate in this study choose YES.

□ YES □ NO

Annex II: Questionnaires

Jimma university institute of health

School of pharmacy

Department of pharmaceutical supply chain management/*PSM*/

Questionnaires to assess key essential medicines logistics management performance in public health facilities of Awi zone.2011 E.C

Part I: FOR PHARMACY HEAD

Facility Name: _____ Woreda/ district: _____code: _____

Facility type: General hospital / District hospital / Health center.

1. What is your profession?
   A. Pharmacy
   B. Other _____
2. Number of years you have worked
   A. 6 months -1 year
   B. 1_5 years
   C. >5 years
3. Your educational qualification
   A. Diploma
   B. Degree
   C. Masters
4. What type of training you have taken?
   A. Integrated pharmaceutical logistics system (IPLS)
   B. Quantification of pharmaceuticals
   C. DTC
   D. Never trained
5. Does the facility have drug and therapeutic committee (DTC)? Yes □ No □

   5.1. If yes for Q#5. Does the members of DTC assigned by official letter? Yes □ No □

5.2. Dose the DTC has approved TOR (term of reference)? Yes □ No □

5.3. Does DTC members conduct regular meeting at least every month with documented minute? Yes □ No □

5.4. Dose the DTC developed action plan? Yes □ No □

5.5. Dose the DTC developed medicine use policy? Yes □ No □

6. Does your facility has the following guidelines
   A. Storage guide line Yes □ No □
   B. IPLS SOP Yes □ No □
   C. Quantification guide line Yes □ No □
7. Have you ever received supervision visit regarding the pharmaceutical logistics management activities in your facility by higher level managers? Yes □ No □
8. If yes #8. when_____ how often____ by whom_____
9. Who is responsible to select drugs in your facility?
   A. DTC (drug and therapeutic committee)
   B. Pharmacy head
   C. Store manager
   D. Purchaser
10. Does the facility have updated facility specific drug list? Yes □ No □ , if yes show me
11. If yes #11. Do you use facility specific drug list as a reference tool to select drugs during purchasing? Yes □ No □
12. If no Q#11. What document do you use to select drugs for procurement? _____
13. Does your facility procure medicines from private whole sales (suppliers)?

    Yes □ No□, if your answer is yes, what was the reason to procure from private suppliers other than EPSA? _____

    i. If yes for Q # 13. Is the medicine procurement made by generic name in your facility? Yes □ No □
    ii. If yes for Q # 13. Does your facility have procurement committee? Yes □ No □
    iii. If yes for Q # 13. Does your facility have procurement plan? Yes □ No □

iv. If yes for Q # 13. Does your facility have a written procedure to guide the procurement process? Yes □ No□

14. Who is responsible to determine the quantity to be procured in your facility?
    A. quantification committee
    B. Store manager
    C. Pharmacy head.
15. How do you determine the quantities to be procured?
    A. by using a formula
    B. by guess
    C. by other means specify_____
16. Who is responsible for purchasing medicines in your facility?
    A. Pharmacy head
    B. assigned pharmacy Purchaser
    C. others specify_____
17. What type of procurement method do you follow?
    A. National competitive bidding
    B. Request for quotation (pro forma method).
    C. Direct procurement
18. On average how long it takes from placing an order and receiving the product?
    A, from EPSA_____B, from private supplier_____
19. What type of quantification method do you use
    A. Consumption method
    B. Morbidity method
    C. Both
    D. Others _____
20. What is your data source during quantification of tracer drugs?
    A. Bin card/ HCMIS
    B. Model 22
    C. Dispensed to patient registry

Thank you for your time and cooperation!!!

Jimma university institute of health

School of pharmacy

Department of pharmaceutical supply chain management

Questionnaire to assess key essential medicines logistics management performance in public health facilities of Awi zone.

Part II: FOR STORE MANAGER

Facility Name: _____ Woreda/ district: _____code: _____

Facility type: General hospital / District hospital / Health center.

1. What is your profession?

A. Pharmacy

B. others _____

2. Number of years you have worked

A. 6 months - 1 year

B. 1_5 years

C. >5 years

3. Your educational qualification

A. Diploma

B. Degree

C. Masters

4. What type of training you have taken?

A. Integrated pharmaceutical logistics system (IPLS)

B. Quantification of pharmaceuticals.

C. DTC

D. Never trained

5. Does the facility use HCMIS (electronic/automated) stock tracking system? Yes □ No □

6. Does your facility have the following logistics forms?

Bin card Yes □ No □ stock card Yes □ No □

7. What is the cause of stock out for RDF tracer drugs in your facility? _____

Thank you for your time and cooperation!!!

Annex III: Interview guide

1. How do you assess the current selection, quantification and procurement practice of RDF key essential medicines in your facility?

   Probing (1): With respect to:

a) Development and adherence to facility specific drug list.
b) Forecasting the future demand.
c) Procurement procedures & procurement from private suppliers

   Probing (2): What challenges do you face in the selection, forecasting and procurement of RDF key essential medicines?

   Probing (3): What do you recommend to improve the selection, quantification and procurement practice of RDF key essential medicines further?

2. How do you assess the availability of RDF key essential medicines in your facility?

   Probing (1): What are the challenges facing you to avail RDF key essential medicines in your facility?

   Probing (2): What is your recommendation for improving the availability of RDF tracer drugs further?

3. How do you assess the inventory management performance of RDF key essential medicines in your facilities?

   Probing (1): With respect to:

   a. Maintaining accurate stock keeping records (inventory accuracy).
   b. Reducing wastage rate

   Probing (2): What challenges do you face regarding inventory management of RDF tracer drugs in your facility?

   Probing (3): What do you recommend to improve the inventory management of RDF tracer drugs in your facility further?

4. How do you assess the storage condition of RDF key essential medicines in your facilities?

Probing (1): what challenges do you face to maintain good storage condition of medicines in your facility?

Probing (3): what do you recommend to improve the storage condition of medicines in your facility?

5. Is there anything more you would like to add?

Thank you for your time and cooperation!!!

Annex IV: Check lists and data abstraction forms

Facility Name_____ Facility code: _____ DATE: ____data collector: _____

Table 1: Format to collect forecasted demand and actually consumption data of RDF tracer drugs for EFY 2010 in Awi zone.

SN.	Tracer Drug name strength	Unit	Forecasted demand (EFY 2010)	consumption adjusted for stock out (EFY 2010)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

Facility Name_____ Facility code_____

Data collector_____ Date_____

Table 3: format for measuring inventory management performance of selected RDF tracer drugs in public health facilities of Awi zone (**2011 E.C).**

SN.	Drug name and strength and dosage form	Unit	Bin card available (Yes/No)	Bin card updated (Yes/No)	Stock balance on bin card adjusted for recent issues and receives	Physical inventory	Discrepancy
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							

Facility Name_____ Facility code_____

Data collector_____ Date_____

Table 4: Check list for availability and stock out duration selected RDF tracer drugs in public health facilities of Awi zone (2011 E.C).

SN.	Drug name and strength	Unit	Available on the day of visit (Yes /No)	Stock out for the last 12 months (Yes / No)	Total number of days stocked out	Reason for stock out
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

Facility Name: _____Facility code: _____

Data collector: _____ DATE: _____

Table 5: Check list to assess storage condition of pharmaceuticals in selected public health facilities of Awi zone (2011 EC)

SN.	Description	Yes (1)	No (0)	Comment
1	Products are arranged so that identification labels and expiry dates and/or manufacturing dates are visible.			
2	Products are stored and organized in a manner accessible for first-to-expire, first-out (FEFO) counting and general management.			
3	Cartons and products are in good condition, not crushed due to mishandling.			
4	The facility makes it a practice to separate Damaged and/or expired products from usable products and removes them from inventory.			
5	Products are protected from direct sunlight.			
6	products are protected from water and Humidity.			
7	Storage area is visually free from harmful insects and rodents.			
8	Storage area is secured with a lock and key, but is accessible during normal working hours; access is limited to authorized personnel.			
9	Products are stored at the appropriate temperature according to product temperature specifications.			

10	Roof is maintained in good condition to avoid sunlight and water penetration.			
11	Storeroom is maintained in good condition (clean, all trash removed, sturdy shelves, organized boxes).			
12	The current space and organization is sufficient for existing products and reasonable expansion.			
13	Fire safety equipment is available and accessible (any item identified as being used to promote fire safety should be considered).			
14	Products are stored separately from insecticides and chemicals.			
15	Products are stacked at least 10 cm off the floor.			
16	Products are stacked at least 30 cm away from the walls and other stacks.			
17	Products are stacked no more than 2.5 meters High.			

Facility Name: _____Facility code: _____

Data collector: _____ DATE: _____

Table 6: format to track quantity and value of products expired in the last 12 month

SN.	Drug name, strength and dosage form	Unit	Beginning balance + received	Quantity expired	Unit price (ETB)	Total price (ETB)	Causes of expiry
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							

Annex V: List of facilities visited and medicines studied

SN.	Name of the facilities
1	Dangila primary hospital
2	Jawi primary hospital
3	Injibara general hospital
4	Chagini primary hospital
5	Agew/Gemijabet primary hospital
6	Dangila health center
7	Jawi health center
8	Injibara health center
9	Addis kidam health center
10	Lideta health center
11	Kessa health center
12	Dinkara health center
13	Kilaje health center
14	Gimjabet health center
15	Buya health center
16	Tulita health center
17	Azena health center
18	Ayehu health center
19	Degera health center
20	Telele health center
21	Messela health center
22	Wundege health center

List of RDF tracer drugs included in this study in Awi zone, Amhara region, May, 2019.

SN.	Description of the drug
1	Amoxicillin syrup
2	Amoxicillin 500 mg capsule
3	Ceftriaxone 1 gram injection
4	Metronidazole injection
5	Ciprofloxacin 500 mg tablet
6	Doxycycline 100 mg capsule
7	Metronidazole 250 mg capsule
8	Metronidazole syrup
9	Cotrimoxazole syrup
10	Antacid suspension
11	Tetracycline 1% eye ointment
12	Paracetamol 500 mg tablet
13	Paracetamol 120 mg/5ml syrup
14	Tetanus antitoxin injection
15	Mebendazole 100 mg tablet
16	Oral rehydration salt(ORS)
17	Ampicillin powder for injection
18	Gentamycin injection
19	Chloroquine tablet
20	Benzoic acid +salicylic acid (white filed) skin ointment
21	Hydralazine injection
22	Ferrous sulphate + folic acid tablet

Annex VI: Top ten diseases in Awi zone public health facilities according to zonal health department report. 2010 E.C

SN.	Disease type
1	Acute febrile illness (Typhoid fever and typhus)
2	Acute upper respiratory tract infection
3	Pneumonia
4	Diarrheal disease
5	Dyspepsia
6	Malaria
7	Skin infection
8	Trauma
9	Urinary tract infection
10	Intestinal Helminthic Infestations

Annex VII: Socio demographic characteristics of key informants

Variable		Yes (frequency)	Total
Profession	Pharmacy	6	8
	Medical doctor	1	
	Health officer (Ho)	1	
Qualification	Diploma	3	8
	Degree	5	
Service year (Experience)	1-5 years	2	8
	Above 5 years	6	
Position	Health facility head	2	8
	Pharmacy unit head	4	
	Logistics officer	2	

Assurance of principal investigator

The undersign certify that he has read and hereby recommend for acceptance by school of pharmacy, institute of health, Jimma University a research Thesis entitled ;

"**Logistics management performance for Key essential medicines in selected public health facilities in Awi zone."** In partial fulfillments of requirements for the **Degree of Master of Science (MSc) in pharmaceutical supply chain management.**

Name of the student: **Abera Tibebu Yihun (Bpharm.)** **ID: RM 0054/2010**

Signature. _____. Date _____

Advisor: **Gizachew Tilahun (Assistant professor of pharmacoepidemiology and social pharmacy)**.

Signature _____. Date _____

Internal examiner: Tadesse Gudeta (Bpharm. MSc PSCM)

Signature. _____. Date_____

External examiner: Dr. Mesfin Haile (PhD.)

Signature _____. Date_____