VACCINE LOGISTICS SYSTEM PRACTICES IN PUBLIC HEALTH FACILITIES OF ARSI ZONE, SOUTH EAST ETHIOPIA

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Vaccine Logistics System Practices in Public Health Facilities of Arsi Zone, South East Ethiopia

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DECLARATION

I hereby declared that this study entitled “Vaccine logistics system practices in health facilities of the Arsi zone, south-east Ethiopia” is my original work prepared under the guidance of my advisors Shiferaw Mitiku (Ph.D.), Zelalem Tilahun (Ph.D. candidate) and Julia. kleineidam (MSc). This paper is submitted to the department of pharmaceutics and social pharmacy, school of pharmacy in partial fulfillment of the requirements for the award of Master of Science degree in health supply chain management and it has not been previously submitted to any diploma or degree in any college or university. I would like also to confirm that all the sources of materials used in this study are duly acknowledged.

By: Yetnayet Yeshitela

Signature _____

Date _____

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SCHOOL OF GRADUATE STUDIES

This is to certify that the thesis prepared by Yetnayet Yeshitela carried out her study on the topic entitled *"Vaccine logistics system practices in public health facilities of the Arsi zone, south-east Ethiopia"* and submitted in partial fulfillment of the requirements for the Degree of Master of Science in Health Supply Chain Management complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

Approved by the Examining Committee:

External Examiner: _____Signature_____ Date_____

Internal Examiner: _____Signature_____ Date_____

Advisor: _____ Signature _____ Date _____

_____

Head of Department

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List of abbreviations and acronyms

EFY	Ethiopian Fiscal Year
EPI	Expanded Program for Immunization
FMOH	Federal Ministry of Health
IPLS	Integrated Pharmaceutical Logistics System
LMIS	Logistic Management Information System
MSH	Management Sciences for Health
NGOs	Non-Government Organizations
PFSA	Pharmaceutical Fund and Supply Agency
PHC	Primary Health Care
EPSA	Ethiopia Pharmaceutical supply Agency
RDF	Revolving Drug Fund
RHB	Regional Health Bureau
RRF	Report and Requisition Form
SCM	Supply Chain Management
SCMS	Supply Chain Management System
SKR	Stock Keeping Records
SKU	Stock Keeping Unit
SOPs	Standard Operating Procedures
VLMIS	Vaccine Logistic Management Information System
VRRF	Vaccine Report and Requisition Form
WHO	World Health Organization
WoHO	Woreda Health Office
ZHD	Zonal Health Department

Abstract

This study examines the Vaccine logistics system practices in public health facilities of the Arsi zone.

Vaccines are very sensitive biological products; they lose their potency if they are exposed to a temperature beyond the recommended ranges. Supply chains play a significant role in improving health, saving lives, and reducing child mortality. A well-functioning supply chains need the network of staff, equipment, vehicles, and data to get vaccines safely from manufacturer to end user. The main objective of the study was to examine current vaccine logistics system practices at health facility. The study was conducted among 24 health facilities of Arsi zone, focus on vaccine logistics handling and storage, inventory management and logistics management information system. Descriptive statistics was used. The quantitative data was collected by data abstraction formats and self-administered questionnaires and analyzed using SPSS version 25.0. and the qualitative data was collected through in-depth interview with the heads of the health facility and mother and child health coordinators and analyzed using thematic analysis. Results of the study revealed that the inventory control system used by all facilities in this study were pull system, though there are conditional pushes from their suppliers, the supplier of the facilities were woredas health office. Only (8.3%) facilities reported conditional push system, storage units and equipment were available in all 24 health facilities and 100% stored vaccines. Half of health facilities 12 (50.0%) did not have access to a generator/solar out of this only 10(41.7%) had functional back up and only 3(12.5%) had a voltage stabilizer connected to the refrigerator, 23(95.8%) have thermometer out of 23 only 14(58.3%) thermometer was placed inside refrigerator, all health facilities suppliers are Woreda health office out of this 17(70.8%) of the health facilities used vaccine reporting and requesting form,5(20.8%) health facilities prepared their own forms to order vaccines from suppliers and 2(8.3%) health facilities that used government requesting voucher(model 20). and the study identified that the most challenges affecting logistics system were lack of training in logistics system, lack of training in vaccines logistics system, difficulty of obtaining continuous supplies, The shortage of human resources in the facility and power interruption. These findings indicate that appropriate actions are needed to ensure vaccines logistics system in all public health facilities.

Key words: Inventory, Logistics, Storage, thermometer, Vaccine.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Vaccines are certainly one of the most successful and cost-effective disease prevention strategies to reduce child and mother morbidity and mortality. Annual use of recommended vaccines for children has been estimated to avert up to 3 million deaths per year globally, with even greater numbers of prevented cases of illness and substantial disability (Ehreth.J, 2003).

Vaccines are bulky and more expensive both to purchase and store. Thus, it is essential that an improved and efficient logistics system is put in place to reduce waste, stock outs, overstocking, and expired stock, and to improve on decision and information flow between the national cold storage, the regional health facilities, and every level of the vaccine supply chain. Vaccines are very sensitive biological products; they lose their potency if they are exposed to a temperature beyond the recommended ranges. Proper forecasting, procurement, handling, storage and distribution of the vaccine are vital in order to provide effective vaccines to protect children from vaccine preventable diseases (CDC, 2018).

The immunization program in Ethiopia is adopting new initiatives and strategies aimed at increasing coverage and reducing 'drop-out' rate. A key prerequisite for the success of these initiatives and strategies is the communities' access to adequate supply of good quality vaccines that can only be assured through the establishment of an effective vaccine and cold chain management systems There are no significant problems at national level but weak vaccine stock and inventory management has been noted at regional and service delivery levels (FMOH, 2015).

Despite the availability of effective vaccines in Ethiopia against common childhood infections, a significant number of children under five years of age continue to die from communicable diseases. The causes of these deaths include: viral, bacterial, parasitic, and vector-borne diseases. According to JSI report, 95% of health centers and 48% of health posts stored vaccines overnight. However, 67% of health centers and 40% of health posts

experienced stock shortages of vaccines in the previous six months. BCG, Rota, OPV and TT vaccines were stocked-out in most health facilities. Additionally, the median stock-out time for BCG, Rota and TT antigens was more than a week (JSI /RTI, 2015).

Accessible EPI service, suitable delivery strategy and government commitment to vaccinate all eligible children vaccination coverage is still low and mortality rate of children under the age of five years remains highest in Ethiopia (88 per 1,000 births) and from five children aged 12–23 months (39%) had gotten totally fundamental immunizations at some time, also 22% have gained vaccine by the suitable period time. There was increment of fully vaccinated children aged 12–23 months percentage from 24% to 39% (EDHS, 2016).

To support the routine immunization and supplementary immunization activities, the EPI logistics team ensures people, information, equipment, finances are in the right place, at the right time, in the right quantity, at the right quality, in the right condition, at the right cost in order to meet immunization needs at all levels in a country. Immunization supply chains play a critical role in improving health, saving lives, and reducing child mortality. Under-resourced and poorly functioning supply chains the network of staff, equipment, vehicles, and data needed to get vaccines safely from manufacturer to end user (CDC, 2018).

Thus, logistics support is critical to immunization services to ensure the availability of appropriate equipment and an adequate supply of high-quality vaccines and immunization-related materials to all levels of the program. It is important to ensure correct implementation of relevant strategies. The key areas of logistics support include vaccine management and monitoring, cold chain management and immunization safety. If the logistics program is well-managed, it can help save on program costs in ensuring program implementation efficiently without sacrificing the quality-of-service delivery. Poorly managed logistics systems can lead to high and/or unnecessary vaccine wastage rates, stock outs, or improper management of waste, resulting in significant operational program costs, as well as a negative impact on public health (WHO, 2018).

Historically, vaccine commodities like any other health commodities were managed under the Federal Ministry of Health (FMOH). In 2007 the Ethiopian Pharmaceutical supply Agency (PSA), a semiautonomous government agency was established with the mandate of

administering and managing all aspects of health supply chain management and accompanying supportive activities to ensuring facilities are correctly managing their medical supplies. Since its establishment, PSA has been working to take hold of its mandate to transit all Health Commodity Supplies from FMOH, but in step wise approach, to its Integrated Pharmaceutical Logistics System (PFSA, 2014). In 2015 Vaccine supply chain management transit to PFSA and integrated to Integrated Pharmaceutical Logistics System (IPLS). The transition considered the unique characteristics of the commodity and required careful planning including effective capacity building at both the central and PFSA branches. It also considered the need to strengthen the IPLS to be responsive and alert enough to accommodate vaccine product and service model specifications. It has to balance the need to improve availability of vaccine commodities with proper utilization and operational efficiency (FMOH, 2015).

PFSA also designed and implemented a distribution mechanism whereby health facilities receive their drugs on a monthly cycle based on their need. To facilitate informed decision making, a paper-based pharmaceutical Logistics Management Information System has been designed and implemented throughout the public sector health facilities as part of the IPLS. Likewise, logistics management information system (LMIS) is a management information system that collects, records, and reports logistics data. A well-functioning LMIS provides decision makers throughout a supply chain with accurate, timely, and appropriate data. The system serves a variety of functions such as managing data on the quantity of medicines or supplies needed at specific service delivery point, reporting on current stock levels of supplies at service delivery points and storing, tracking data regarding usage of medical commodities over time at all levels of the health (USAID/DELIVER,2012).

1.2 Statement of the Problem

Immunization is one of the scientific methods that have been proven effective in preventing the transmission of infectious diseases and hence reduction of infant and child mortality rate in the world. It has been the most effective preventive strategy to control infectious diseases and it can dramatically reduce morbidity and mortality from many serious diseases (Angela, 2014.

However, program on immunization supply chain was inadequate and under-performing over time. Poor supply chain performance has been linked with poor or inequitable vaccine coverage rates, delayed new vaccine introductions, excessive waste of expensive vaccines and reduced availability of all vaccines at the point of immunization (Prosser,*et.al,*2016).

Gaps in vaccine logistics systems are one of the common factors limiting full and equitable access to the benefits of immunization. This is because such gaps undermine the availability of vaccines at the point of administration (Sinha*, et.al,* 2017). Unfortunately, cases of outbreak of vaccine preventable diseases especially measles have been reported in some area in the country. Not maintaining proper cold chain up to the end user may be one of the factors contributing to poor immunization practices.

In Ethiopia there are no significant problems at national level but weak vaccine stock and inventory management has been noted at regional and service delivery facilities (Hajara*, et.al*, 2011)

In Arsi zonal health department technical working group was established to strengthen EPI. Supportive supervision has been done in this organization about the immunization performance. The supervisors found out that related to logistics system, there is a Poor Storage Conditions of vaccines on transit and in the health facilities, non-adherence to Good Storage Practices, inadequate health workers personnel at facility level., infrastructure Problems especially Road Networks, unavailability of vehicles for distribution of vaccines/lack of reliable transport, unreliable electricity, poor vaccine logistic management information system and less involvement of pharmaceutical personnel in EPI (Zonal review meeting report 2018).

However, to the knowledge of the researcher, there is no objective evidence and previously, there is no study carried out in the study area with respect to vaccine supply chain management. Hence this study was intended to fill this gap. Therefore, the aim of this study was to assess the vaccines logistics systems found in south-East Arsi zone, Oromia Regional State. This study provided a picture of the current vaccines logistics situation in public health facilities and provide baseline information to track changes.

1.3 Research Questions

This study was conducted to answer the following basic questions:

- How vaccines inventory management is being controlled among health facilities in Arsi zone?
- How vaccines store management is being practiced among health facilities in Arsi zone?
- How vaccines logistics management information system is being practiced among health facilities in Arsi zone?
- What are the barriers in vaccines logistics management system among health facilities in Arsi zone?

1.4 Research Objective

The general and specific objectives of the study are presented as follows:

1.4.1. General Objective

- To assess the vaccine logistics system practices among public health facilities of Arsi Zone, Northwest Ethiopia.

1.4.2. Specific Objectives

- To assess the vaccines inventory management practices in public health facilities
- To assess the vaccines storage management practices of vaccines in public health facilities

- To assess the Vaccine logistics management information systems practices in public health facilities
- To identify barriers of the vaccines logistics management system in public health facilities

1.5. Significance of the Study

The study will contribute valuable information to the available literature on vaccine logistics system and its storage practices. The study will also contribute valuable information for local health policy makers, EPI, healthcare providers, donors and all stakeholders involved in cold chain medicines to effectively plan, manage and supervise the logistics system and storage practices of vaccines. Accordingly, the final report would share with the Pharmaceuticals Supply Service and the visited health facilities so that they can use the information as an input to take appropriate actions. It was the investigator's belief that, despite the small number of sites that were visited, the assessment identifies specific strengths to further build upon, and challenges that suggest improvements and/or initiate a wider assessment.

1.6. Scope of the Study

This assessment was focused only on the public sector vaccine supply chain logistics system in Arsi zones health facilities and thus did not address the private and NGO sector. The assessment was also limited to vaccination service providing health facilities, and focusing only on vaccines commodities managed by these facilities, which makes its generalization to the overall public health facilities vaccine logistics difficult.

1.7. Operational Definition

The following are the working definitions of the key words that were used in this thesis.

- ✓ **LMIS-**A logistics management information system is collects, organizes, and reports data that enables people to make logistics system decisions **(**USAID | DELIVER PROJECT, 2011).
- ✓ **Stock registration book-** It is a stock keeping record that contains the same information as the inventory control tool.

- ✓ The terms vaccination and immunization are used interchangeably by many organizations and individuals.
- ✓ **Proper refrigerator storage -** A refrigerator with adequate air circulation between the vaccine boxes, vaccine kept only on the refrigerator shelves and not in the door or bottom drawer, and no food or drink stored in the refrigerator (CDC, 2019).
- ✓ **Recommended temperature range -** Recommended internal temperature of refrigerators is between 2^{O}C to +8°C (CDC, 2019).

1.8. Organization of the Study

This study was organized in to five chapters.

Chapter one dealt with the background, statement of the problem, research questions, and objectives, operational definition, significance and scope of the study. Chapter two discussed the review of related literature consists theoretical review which is Ethiopian public health system, pharmacy sector, integrated pharmaceutical logistic system, Selection, forecasting and procurement, inventory management of vaccines, storage management of vaccines and logistics management information system; and Empirical Review of the study. Chapter three described the study area, study design, study approach, study population, sample size determination and sampling techniques, method of data collection, method of data analysis, ethical consideration, dissemination and communication plan and reliability and validity test. Chapter four covered the study findings, analysis, interpretation and discussion of the results. Chapters five summarized the major findings and conclusion. It also presented the recommendations, its limitations and area of future research from the study.

CHAPTER TWO

RELATED LITERATURE REVIEW

2.1. Theoretical Literature Review

2.1.1 Ethiopian Public Health system

There is extensive decentralization of service delivery, with the regional and city administrations largely responsible for implementation. For administration of public health care, there is a Regional Health Bureau (RHB) at the Regional level, and a Zonal Health Department (ZHD) at the Zonal level and woreda health office at woreda level. At each kebele level (averaging 5,000 total populations), there is health post staffed with two female health extension workers. Some regions do not have zonal health administrative level (FMOH, 2015).

The immunization program has made significant achievements to prevent and control Vaccine Preventable Diseases (VPDs) in Ethiopia. Immunization is a high priority and must be sustained and strengthened to continue to reduce the incidence of VPDs such as measles, and tetanus, as control of these and other diseases contributes to attaining the Millennium Development goals.(FMOH,2013)

2.1.2 The pharmaceutical sector

The cold chain and supplies logistics management is the backbone of the health service. As it is a critical element, the strengthening of the system is necessary to provide better immunization and other health services in Ethiopia. Cold chain and logistics management ensures regular and smooth flow of vaccines and other cold storage requiring health commodities to all health facilities (CDC, 2018).

Currently the country operates 25 vaccine cold rooms and 1 freezer room at national level and 8 regions (Oromia- Dukem, Nekemete, Jimma and Chiro; SNNPR – Hawassa and Bonga; Dire Dawa; Somali- Jijjiga and Gode; Afar- Semera; Amhara- Dessie and Bahir Dar; Tigray-

Mekele; and B/Gumuz - Assossa) with a total cold storage gross capacity of 1021 m^3 and 45 m^3 gross freezing storage capacity for EPI and 580 m^3 gross storage capacity for Non-EPI (very old non-EPI cold rooms are not considered). Cold rooms located at National (central) are being managed by PFSA whereas the regional and zonal level cold rooms are managed by respective regional health bureaus and zonal health offices (FMOH, 2013)

2.1.3 Integrated Pharmaceutical Logistic System(IPLS)

PFSA is responsible for the procurement and distribution of pharmaceuticals for the public sector. To successfully achieve its main objective, which is to ensure that patients get pharmaceuticals that they need, PFSA designed and implemented IPLS. IPLS is the term applied to the single pharmaceuticals reporting and distribution system based on the overall mandate and scope of PFSA. The IPLS is the primary mechanism through which all public health facilities obtain products that are included on the National Pharmaceuticals Procurement List (PFSA, 2014).

The IPLS defines the reporting and re-supply schedules. Health facilities are expected to complete the RRF every two months for program pharmaceuticals, the data of which will be used to determine re-supply quantity. To help maintain adequate stock levels, the maximum months of stock, minimum months of stock and an emergency order point have been established for each health facility in the system. For RDF pharmaceuticals, health centers and hospitals will complete the RRF as per the facilities review period which can be every two month, every quarter or every six months and collect products from affiliated PFSA branches (PFSA, 2014).

The standard operating procedures manual for the Integrated Pharmaceuticals Logistics System in Health Facilities of Ethiopia' defines the roles and responsibilities of the relevant stakeholders that are involved in the supply chain. The system also lists out the basic logistics data that are required to make logistics decisions with the accompanying definitions and data sources. All the relevant recording and reporting forms are also included with detailed instructions for use (PFSA, 2014).

Vaccine commodities like any other health commodities were managed under the FMOH. In 2007 the Ethiopian PSA, an autonomous government agency was established with the

mandate of administering and managing all aspects of health supply chain management and accompanying supportive activities to ensuring facilities are correctly managing their medical supplies. Since its establishment, EPSA has been working to take hold of its mandate to transit all Health Commodity Supplies from FMOH, but in step wise approach, to its Integrated Pharmaceutical Logistics System (PFSA, 2014).

In 2015 vaccine supply chain management transferred to EPSA and integrated to IPLS. The transition considered the unique characteristics of the commodity and required careful planning including effective capacity building at both the central and PFSA branches. It also considered the need to strengthen the IPLS to be responsive and alert enough to accommodate vaccine product and service model specifications. It has to balance the need to improve availability of vaccine commodities with proper utilization and operational efficiency and also designed and implemented a distribution mechanism whereby health facilities receive their drugs on a monthly cycle based on their need. A paper-based pharmaceutical Logistics Management Information System has been designed and implemented throughout the public sector health facilities as part of the IPLS (FMOH, 2015).

2.1.4 Selection, Forecasting, and Procurement of Vaccines

Vaccine selection, forecasting and procurement are done by the FMOH and EPSA with the support of partners; procurement of the vaccines is through UNICEF. The National Food and Drug Authority, which was named as Food Medicine and Health care Administration and Control Authority (FMHACA), is responsible for controlling the vaccine quality and usually gives clearance for new vaccines when introduced to the country for the first time (FMOH, 2013)

2.1.5 Inventory Management of Vaccines

An inventory control system informs the storekeeper when to order or issue, how much to order or issue, and how to maintain an appropriate stock level of all products to avoid shortages and oversupply (USAID /DELIVER, 2011).

Proper vaccine inventory management is essential for appropriate vaccine ordering and stock rotation, and ensures your facility has the vaccines your patients need. Vaccines are expensive, so making sure they are unpacked, stored, prepared, administered, and transported correctly is critical (CDC, 2019).

2.1.6 Storage Condition of Vaccines

Vaccine management, including proper storage and handling procedures, is the basis on which good immunization practices are built. Vaccines are sensitive, it must be maintained at the temperatures recommended by vaccine manufacturers and protected from light at every link in the cold chain. Most live virus vaccines tolerate freezing temperatures, but deteriorate rapidly after they are removed from storage. Inactivated vaccines can be damaged by exposure to temperature fluctuations. Potency can be adversely affected if vaccines are left out too long or exposed to multiple temperature excursions that can have a cumulative negative effect. It is a good idea to post a sign on the front of the storage unit(s) indicating which vaccines should be stored in the freezer and which should be stored in the refrigerator (CDC, 2011).

The success of efforts against vaccine-preventable diseases is attributable in part to proper storage and handling of vaccines. Vaccines exposed to temperatures outside the recommended ranges can have reduced potency and protection. Storage and handling errors can cost thousands of dollars in wasted vaccine and re-vaccination. Errors can also result in the loss of patient confidence when repeat doses are required. It is better to not vaccinate than to administer a dose of vaccine that has been mishandled (MOHGP, [n.d];(CDC, 2019)).

Storage and handling errors result in re-vaccination of many patients and significant financial loss due to wasted vaccines in each year. Failure to store and handle vaccines properly can reduce vaccine potency, resulting in inadequate immune responses in patients and poor protection against disease. Patients can lose confidence in vaccines and providers if they require re-vaccination because the vaccines they received may have been compromised. Proper vaccine storage and handling are important factors in preventing and eradicating many common vaccine-preventable diseases (CDC, 2019).

2.1.7 Logistics Management Information System (LMIS)

Logistics Management Information System (LMIS) is a system that generates information, which is needed to make logistics decisions. The logistics decisions include selection, forecasting, procurement, training, re-supply disposal, supervision, monitoring, and management (USAID /DELIVER, 2011).

LMIS is the system of records and reports that you use to collect, organize, and present logistics data gathered across all levels of the system. Most important, an LMIS enables logisticians to collect the data needed to make informed decisions that will ultimately improve customer service (USAID /DELIVER, 2011).

Uninterrupted supply of vaccines is a re-requisite and a challenge for national immunization programs. Designing an efficient and sustainable supply chain system for vaccine and other medicines is important and can be complex. A correct run supply chain system should keep vaccines in good condition, rationalize vaccine storage points, use transport an efficiently as possible, reduce wastage and provide information for forecasting needs. This requires good management of the system along with simple but well-designed information system in place (MOHGP, [n.d]).

2.2. Empirical Literature Review

2.2.1 Inventory control

The Audit team reviewed the stock records of the Central Depot in Nairobi and the Regional Depot in 2016, observed significant shortcomings in record keeping. When reviewed by the audit team, stock records in the vaccine stock ledgers and the web-based stock management tool were incomplete and inaccurate. There were significant delays in transcribing vaccine movements from the vouchers. The “real time” manual records at the Central Depot had not been updated for three months since June 2015. As a consequence, there was no systematic sequential recording of the movements. In addition, the subsequent retrospective updating of these ledgers in September 2015 resulted in inaccurate stock balances and some negative stock balances occurred due to errors. There was no process to reconcile the Vaccine Stock

Ledger with the web-based Stock Management Tool (which was updated based on the respective ledger entries). There were large variances between both records of 15-20% of some vaccine balances, and it was concluded that neither set of records was accurate. The vaccine physical stock counts were not documented. The quantities counted were recorded in the Stock Ledgers replacing the running balance without supporting documentation. Several occasions inventories identified significant discrepancies (WHO, 2016).

In cross sectional survey that was conducted by Birhane and his friends in Addis Ababa city, and in Kenbata -Alaba- Timbaro and Hadiya Zones of southern Ethiopia Region in 1995 indicates that, complete record of the vaccines stock and up-to date refrigerator temperature records taken twice a day were observed 59.4% and 57.8% of the 64 functional immunization centers, respectively (Birhane Y. *et.al,* 2000).

2.2.2 Storage conditions of vaccines

According to a study carried out in Philippines a cold chain survey by Maglasang and his friends in 2017 indicated that storage units and equipment were available in all 22 PHCs, even though only 22.7% stored vaccines. The majority of PHCs (90.9%) did not have access to a generator and only 9% had a voltage stabilizer connected to the refrigerator. Refrigerators that were equipped with thermometer were only found in 68.2% PHCs (Maglasang, PL.*et.al,* 2018).

A study conducted in Russia and Namayingo Districts by Namuhaya in 2013 on cold chain and logistics management for EPI indicate that none of the EPI service units practice either stock taking or issued their stock according to FEFO and FIFO. Result also show 5% had been staffed with non EPI items. Majority of functional refrigerator 83 % had optimal temperature range of 2 - 8^0C and had evidence of use of temperature monitoring charts (Namuhaywa, M.M., 2013).

Another study which was conducted in Cameroon by Ebile.Ak and his friends in 2013 on the expanded program on immunization service delivery of health facilities. It indicates that 16.7 % health facilities did not have a functional refrigerator, 2.4 % did not have a vaccine carrier, 54.8 % did not have a means of transport (vehicle or motorcycle) and 28.6 % did not have an EPI guideline. The knowledge of health personnel on vaccine and cold chain management and on diseases of the EPI under epidemiological surveillance was found to be limited (Ebile, Ak.*et.al,* 2016).

Study conducted in Tanzania about Vaccine distribution by Mohamed M. in 2012 at facility level indicated that availability of 6 tracer vaccines during the time of survey was high at regional vaccine store 100%, followed by district vaccine stores 93.3% and low at healthcare facilities 82%. Stocks out duration were more at health care facilities level 72 days than district vaccine stores 33 days. Most of the parameters of storage conditions were not met by the facilities. Knowledge level of health care givers was inadequate. The study reveals that all personnel involved in handling and storage of vaccines were non pharmaceutical personnel (Mohamed M, 2012).

In cross sectional survey that was conducted in Addis Ababa city, and in Kenbata -Alaba-Timbaro and Hadiya Zones of southern Ethiopia Region by Birhane and his friends in 1995 indicates that, thermometer was not available in 6.3% and thermometer reading was found to be outside the optimal range in 10.9%. Vaccine storage in the refrigerator was not proper in 73.4% (Birhane Y. *et.al,* 2000).

A baseline Survey of the Routine Immunization Improvement Initiative carried out in 2015 in Ethiopia indicates that refrigerators were not functional in 32% health centers and 71% of health posts at the time of the survey. Moreover, at least two-thirds of facilities encountered breakdown of their vaccine refrigerators in the previous three months. Of those facilities which had functional refrigerator, the temperature reading was outside of the recommended range of 2-8ºC in 46% health posts and 23% health centers on the day of the visit (JSI/RTI, 2015).

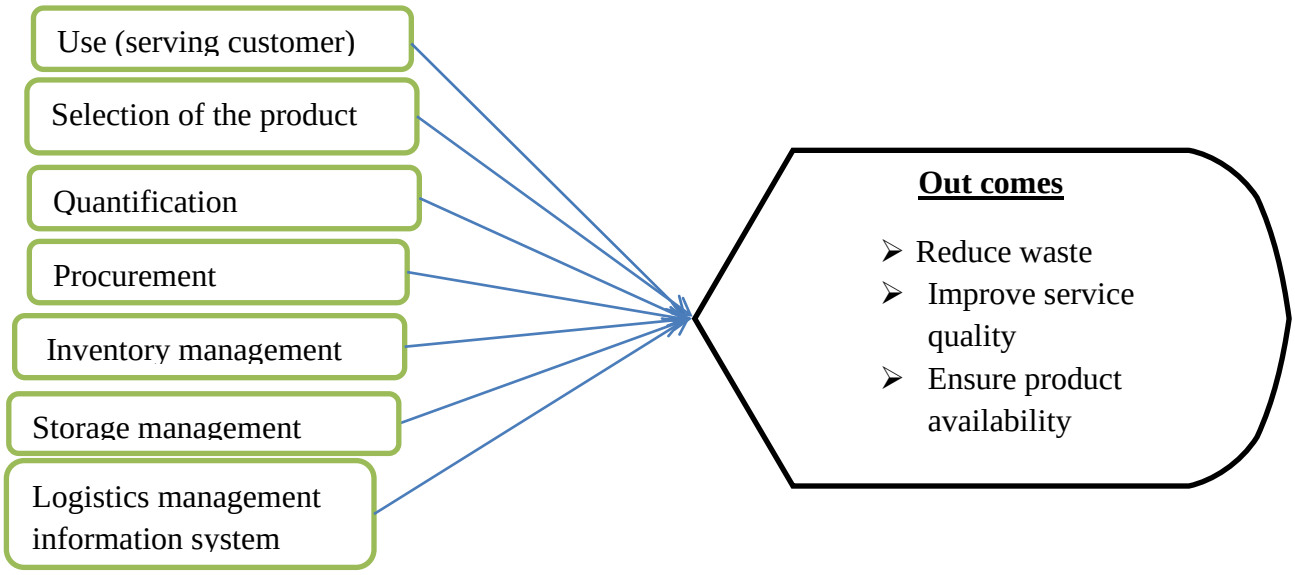
2.2.3 . Logistics Management Information System

A study conducted in Rusia and Namayingo Districts by Namuhayma in 2013 indicate that almost all 92% the EPI service units used requisitions and issuing vouchers, only 68% of the EPI service units had their requisition and issue vouchers filled up to date and only less than a half 41% of the vaccine and injection materials control book had been up to date for vaccine (Namuhaywa, M.M., 2013).

Another survey done in Ethiopia by EPSA in 2015 indicated that the availability of blank recording and reporting formats (bin cards, IFRR, and RRF) have high at hospitals above 90 percent, but declines farther down the supply chain close to 80 percent at health centers and 40 percent at health posts. Across all levels, utilization of bin cards for the products included in the study was reasonable, although some discrepancies were observed at the level of facility and product types (Shewarega.*et.al, 2015*).

2.3. Conceptual Framework of the Study

2.3.1 Conceptual Model for vaccines logistics system.



Own source adopted from pharmaceutical handbook (USAID | DELIVER PROJECT, 2011).

Fig 1: Conceptual framework of vaccines logistics system

The study was focused on storage management practices, inventory management practices, and logistics management information system. Because in vaccine logistics system, product selection, quantification, procurement and distribution are the responsibility of FMOH.

CHAPTER THREE

METHODS OF THE STUDY

Introduction

3.1.Description of Study Area

Arsi zone is one of 20 zones in Oromiya regional state, central Ethiopia and locate near Chilalo Mountain, and found at a distance of 165km south east of Addis Ababa. The zone covers an area of 540 km^2 with a total population of 3.5 Million. It is administratively sub-divided into 26 Woreda health offices (ORHB, 2017). There are 6 public hospitals, 2 private and NGO HCs, and 105 public HCs, while 1 hospital and 2 more HCs are under construction. One hundred five pharmacies and drug stores are also in the zone. One hundred forty nine pharmacists and pharmacy technicians work in public sectors in Arsi zone (ORHB, 2017). This study was conducted from April 14 to May 8, 2019 in Health facilities of Arsi zone. The images were downloaded from United States Geological Survey (USGS, https://earthexplorer.usgs.gov/) earth explorer and delineated the map using Arc GiS 10.5

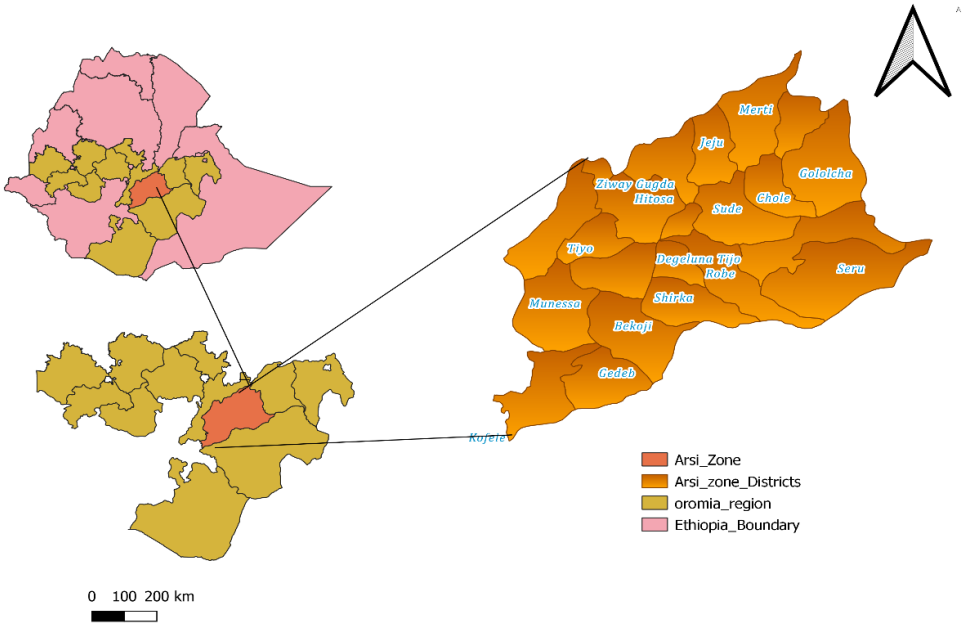


Fig 2: Location Map of the Study area (GPS)

3.2.Study Design

A descriptive facility based cross sectional study design was employed. Staff responsible for vaccine logistics management were interviewed about practices of vaccine logistics handling and storage inventory management and logistics management information system. Refrigerators were inspected and temperature document from thermometer and observation of vaccine storage conditions.

3.3.Study Approach

Both quantitative and qualitative research approach were used to undertake study. Because the quantitative data and results provide a general picture of vaccines logistics practice, whereas the qualitative data and its analysis were improved these statistical results by exploring the participants' views in more depth. The benefit of using mixed methods is that it enables to triangulate and support the data and result collected by questionnaire (Tashakkori & Teddlie, 2010; Creswell, 2014).

3.4.Study Population

The source population for the study was being all public health facilities in Arsi Zone which provide EPI service with functional cold chain system.

Inclusion criteria

All functioning refrigerators, item in the store and refrigerator, health personnel employed as in-charges of the vaccines and cold chain store were included.

Exclusion criteria

Health facilities personnel who were unwilling to participate and those who were on leave during the study and nonfunctional refrigerator.

3.5.Sample Size Determination and Sampling Techniques

The sample of health facilities were calculated by using Logistics Indicators Assessment Tool (LIAT) (USAID/DELIVER PROJECT, 2008). The document recommends a minimum of 15% of the targeted health facilities to be included in the study. The World health organization guide also recommends a minimum of 20 health facilities from target facilities

(WHO, 2007). Accordingly, 20 health facilities were selected out of 111 health facilities which have more than 6 months in operation. Of these, health facilities were selected by using multi stage sampling techniques. If a multi stage sampling is used, LIAT and LISAT guidelines recommends that the sample size should be multiplied by 1.2 (the design effect (DEFF)) so the sample size is 24 health facilities. First, health centers and hospitals were clustered into four based on their zonal geographical clustering system. Then, proportionate numbers of health centers and hospitals from each level were chosen by using simple random sampling techniques (See annex C).

Logistic officers responsible for managing vaccines in the health facilities were selected to participate in the quantitative survey made using self-administered-structured questionnaire. Maternal and Child Health (MCH) coordinator and health facilities head were selected also for the in-depth interviews. The MCH coordinator and health facilities head were selected purposefully for the in-depth interview because they are expected to be responsible of the overall activities of logistics and hence able to provide the needed information.

3.6.Method of Data Collection

Data were collected by the principal investigator and four data collector who are pharmacists after they were oriented on the data collection tool and data collection process on how to fill questionnaires and the necessary information from public facilities of Arsi zone after getting informed consent.

This study was employing to collect primary and secondary data (temperature monitoring chart, vaccine balance registration book, VRF, HPMRR) through a structured checklist and in depth-interview. A structured questionnaire which was originally developed by USAID/DELIVER (DELIVER, 2008; DELIVER, 2009) and locally adapted was used to collect quantitative information from the cold chain room in public health facilities. The information was collected through interview used the structured questionnaire, observation, physical counts of Vaccines and vaccine commodities in order to assess data quality by comparing the actual counts with the available records. The vaccines and vaccine commodities were covered in the assessment are all vaccines which are applicable in public health sector with diluents, Ad syringes, mixing syringes and safety box were assessed. The instrument was being used to provide information on the indicators like percentage of

facilities with personnel trained in logistics, percentage of facilities with stock /bin cards available and accuracy of stock keeping records and observation of the selected facilities were used facility indicator forms for storage and handling condition and vaccines inventory management (WHO-modified model) at the health facilities.

3.7.Method of Data Analysis

After completion of data collection from each sample health facilities, each questionnaire was checked and screened for completeness and consistency. Omissions, errors, whether responses are complete, and all necessary information included were checked by supervisor and senior investigator. Data was cleaned, edited, and coded before entry. Inaccurate and irrelevant records removed and data pre categorized. Data entry were used Statistical package for social science (SPSS) version 25 for analysis. Descriptive analysis such as frequencies, percentages, means, standard deviations and cross tabulation used to summarize and present the data. In addition to this, Pearson correlation coefficient were used to show the interdependence between the independent and dependent variables. And for the qualitative aspect of the study, a thematic analysis approach was used.

3.8.Ethical Consideration

Ethical clearance was obtained from ethical review committee of School of Pharmacy, College of health Science, Addis Ababa University and formal letter of cooperation was written to Arsi zonal health office. Written and verbal consent obtained from each study subjects after explaining the information about study. Respondent were informed their full right to fill the questions or to withdraw from the study at any time without any unfavorable consequences, and they are not harmed as a result of their participation or non-participation. All the responses of participants and the results obtained from each health facilities were kept anonymous and confidential by using coding system whereby no one have access except the principal investigator.

3.9.Dissemination and Communication Plan

The findings of this study were contributing a substantial share in maximizing vaccine logistics system for decision making at health facility level. In order to promote and increase

the logistic system and to work on major contributing factors the result of the study was being presented to stake holders, health managers and logistic officer involved in cold chain system. The result also disseminates to concern and government offices; Addis Ababa University, Arsi zonal and woreda health office, Oromiya regional health bureau and Pharmaceutical supply Survice Adama hub Ethiopia.

3.10. Reliability and Validity Test

3.11.1 Validity Test

To increase the validly of the study, the interview tools were designed in the form of modified structured questions. First, this tool was tested and examined by the advisor and subjects' experts those who are not linked to the study to determine its content validity.

3.11.2 Reliability Test

To increase the reliability of the survey, Cronbach's alpha was used by using SPSS and the result presented in table 4.1. The alpha values for all constructs in the study are greater than the guideline of 0.70, so it can be concluded that the measurements can be applied for analyses with acceptable reliability.

Table 3.1. *Measurement Reliability*

Variable	Number of Items	Cronbach's alpha
Inventory management practices of vaccines	24	0.88
Storage management practices of vaccines	18	0.85
Vaccines logistics management information systems	17	0.92
Challenge of vaccines Logistics System Management	12	0.73
Reliability of total scale	71	0.84

Source*: Survey Data (2019)*

CHAPTER FOUR

4. RESULT, DISCUSSION AND INTERPRETATION

Introduction

Generally, this chapter is organized in the following manner: It consists of reliability test for the measures used, the demographic profile of the respondents was presented and analyzed. To facilitate ease in conducting the empirical analysis, the results of descriptive analyses were presented first, followed by the results of Pearson's correlation coefficient.

4.1 Results

A total of 24 health facilities (21 health center and 3 hospitals) were included in this study. A total of 24 valid questionnaires were administered for a response rate of 100%.

4.1.1. Demographic profile of respondents

The samples of this study have been classified according to three demographic characteristics, Respondent were informed their full right to fill the questions or to withdraw from the study at any time without any unfavorable consequences, and they are not harmed as a result of their participation or non-participation. Demographic information was collected during the questionnaire survey. The purpose of the demographic analysis in this research is to describe the characteristics of the sample such as the number of respondents' proportion of males and females in the sample, range of age, and academic qualification of respondents. The demographic composition of the respondents is summarized in Table 4.1.

It is evident from the table that the majority of respondents were females 18(75%), while 6(25%) of the respondents were males. The majority of the respondent were between the age 25-29(45.8%). In terms of field of study, 3 (12.5%) of respondents were BSc nurse, 4 (16.7%) of respondents were midwifes, 16 (66.7%) of respondents were diploma nurse and 1(4.2%) were level 4 health extension. Most of the respondents, 16 (66.7%) were having 6- 10 years of work experience and 16(66.7%) were having experience on EPI from 6-10 years (Table 4.1).

Table 4.1: Socio demographic characteristics of health professionals working in the selected public health facilities in Arsi Zone, Ethiopia, May 2019 (n=24)

Items	Description	Frequency	Percentage
Gender	Male	6	25
	Female	18	75
Age	25-29	11	45.8
	30-34	4	16.7
	35-39	5	20.8
	40+	4	16.7
Profession	Nurse BSC	3	12.5
	Midwifes	4	16.7
	Nurse Diploma	16	66.7
	Health Extension	1	4.2
Total Work Experience	less than 5 years	4	16.7
	6-10 years	16	66.7
	11-15 years	2	8.3
	15+	2	8.3
Work Experience in EPI	less than 5 years	6	25
	6-10 years	16	66.7
	11-15 years	1	4.2
	15+	1	4.2

***Source**: Survey Data (2019)*

4.1.2. Vaccines Inventory Management

In this study an assessment was conducted on vaccines inventory management practice of public health facilities of Arsi Zone.

The majority of the respondents (92.0%) claimed that the main reason for keeping inventory was to maintain the vaccine supply maintenance as a reason to keep inventory followed by safety stock (8.3%).

The target coverage was the major factor claimed by all respondents (100%) in determining the level of inventory (how much to stock) followed by expiration date (29.2%), and storage requirement (16.7%).

Table 4.2: Health professionals' response towards vaccine inventory management in public health facilities of Arsi Zone, Ethiopia, May 2019 (n=24)

Description (N=24)	**Yes**		**No**	
	Frequency	**percent**	**Frequency**	**percent**
Inventory management in place	24	100%	0	0
LMIS tools available				
Vaccines Stock record book	19%	79%	5	21
Expired/defect format	0%	0%	24	100
Reasons to keep inventory				
Supply maintenance	22	92%	2	8
Safety stock	2	8.3%	22	91.7
Determining level of inventory (how much to stock)				
Target coverage	24	100%	0	0
Expiration date	7	29.2%	17	70,8
Storage requirement	4	16.7%	20	83.3

***Source**: Survey Data (2019)*

All of the facilities also reported that they are performing physical inventory. However, most of the facilities 17(70.8%) reported for performing cyclic inventory.

In this study, most of the facilities 22(91.7%) reported that vaccines are transported by the health facilities themselves. which affect the delivery lead time (Table 4.3).

Table 2.3. Health professionals' response towards vaccine inventory management in public health facilities of Arsi Zone, Ethiopia, May 2019 (n=24)

Description (N=24)		Frequency	Percent (%)
How frequent the physical inventory was done?	Cyclic	17	70.8
	not done	7	29.2
What type of inventory replenishment system is usually used by the health facility?	Pull	24	100.0
	Push	0	0
Who is responsible for transporting vaccines to this facility?	EPSA	1	4.2
	Health Facilities	22	91.7
	Woreda Health office	1	4.2

***Source**: Survey Data (2019)*

4.1.3. Vaccine storage management

The storage conditions of 24 health facilities were assessed.

In this study observed that storage units and equipment were available in all 24 health facilities. Half of health facilities 12 (50.0%) did not have access to a generator/solar power. Out of this, only 10(41.7%) had functional power back up and only 3(12.5%) had a voltage stabilizer connected to the refrigerator.

From the 24 facilities assessed in this study, 23(95.8%) of them had working thermometer during the study; out these, in 14(58.3%) facilities the thermometer was placed inside. This study found out that in 19(79.2) health facilities refrigerators were suitable for FEFO implementation and on the same facilities vaccine are stored in the right place in the right way (in basket not on floor).

Another criterion in the assessment of storage condition was related to the practice of separating damaged, quality defected and/or expired medicines from usable medicines. In this regard, it was identified that all health facilities separated from damaged/expired products but only 4(16.7%) were separated damaged and/or expired products from usable products and

removed them from inventory registered. None of the health facilities have fire extinguisher or fire safety equipment or was not accessible as observed at the time of the visit.

Table 4.4. Store management of vaccines in the selected public health facilities in Arsi Zone, Ethiopia, May 2019 (n=24)

No	Descriptions	Yes	No
	Storage practices	N (%)	N (%)
1	Do you have a functioning refrigerator(s) to store vaccines?	24(100)	0(100)
2	Are refrigerators located away from any surrounding objects (approximately ½ meter)?	24(100)	0(100)
3	Functional voltage stabilizer is available with refrigerator	3(12.5)	21(87.5)
4	Thermometer is working?	23(95.8)	01(4.2)
5	Working thermometer is placed inside	14(58.3)	10(41.7)
6	Daily vaccine temperature monitoring chart maintained (monthly chart available)	10(41.7)	14(58.3)
7	Vaccine are stored in the right place in the right way (in basket not on floor)	19(79.2)	5(20,8)
8	Vaccines are stored and organized in a manner accessible for first-to-expire first-out (FEFO) or First-in first-out(FIFO) counting and general management	19(79.2)	5(20.8)
9	Vaccines are in good condition, not crushed due to mishandling	24(100)	0(100)
10	Only vaccines and diluent are kept inside the refrigerator?	24(100)	0(100)
11	Electricity back-up available? (Generator/UPS/solar etc.)	12(50.0)	12(50.0)
12	Electricity back-up functional	10(41.7)	14(58.3)
13	The facility makes it a practice to separate damaged and/or expired products from usable products and removes them from inventory.	4(16.7)	20(83.3)
14	Fire safety equipment(fire extinguisher, sand) is available and accessible (any item identified as being used to promote fire safety should be considered	0(100)	24(100)
15	Is there updated fire extinguisher	0(100)	24(100)

***Source**: Survey Data (2019)*

4.1.4. Vaccine logistics management information system

Regarding the LMIS, only 4(16.7%) out of 24 health facilities had documented policy or guideline for managing and using the LMIS. 20(83.3%) of the health facilities reported to use vaccines stock record book and 17(70.8%) of the health facilities used Report and Requisition

Form (RRF), while only 5(20.8%) of the health facilities used Health post monthly reporting and Resupply Form (HPMRR) to manage vaccines.

Table 4.5. Availability and recording update status of vaccines stock record tools in the selected public health facilities in Arsi Zone, Ethiopia, May 2019 (n=24)

Description [n=24]	Available[n=24]		Used		Updated	
	Yes	No	Yes	No	Yes	No
	F (%)	F (%)	F (%)	F (%)	F (%)	F (%)
Vaccines stock record books	20 (83.3)	4(17.6)	19(79.2)	5(20.8)	10(41.0)	14(51.0)

***Source**: Survey Data (2019)*

Description [n=24]	Available		Used	
	Yes	No	Yes	No
	F (%)	F (%)	F (%)	F (%)
VRF	17(70.8)	7(29.2)	17(70.8)	7(29.2)
Expired/defect registration form	0 (0)	24(0)	0 (0)	24(0)
HPMRR [n=21]	5(20.8)	16(79.2)	3(14.3)	18(85.7)

***Source**: Survey Data (2019)*

Regarding reporting of the stock status of vaccines. All health facilities suppliers are Woreda health office out of this 17(70.8%) of the health facilities used vRRF,5(20.8%) health facilities prepared their own forms to order vaccines from suppliers and 2(8.3%) health facilities that used government Requesting voucher (model 20).

All health facilities were supplied by Woreda health office; out of this 17(70.8%) of the health facilities used VRF, 5(20.8%) health facilities prepared their own forms to order vaccines from suppliers and 2(8.3%) health facilities used government requesting voucher (model 20).

Health posts request vaccines from Health centers EPI rooms. Only 3(14.3%) were used HPMRR,11(52.4%) health post prepared their own forms to request vaccines from health

center and 1(4.7%) health facility used government requesting voucher (model 20) and the other 6(28.6%) were not used any forms to request vaccines from health centers.

More than half 13(54.2%) of the health facilities were did not used any form to received vaccines and the rest 11(45.8%) were used government receiving voucher/model 19 for receiving vaccines.

Only 2(9.5%) of health centers were used government issuing voucher/model 22 for issuing of vaccines the rest 17(81%) were did not used any forms for issuing vaccines to health posts and 2(9.5%) were used facility own forms.

Table 4.6. Availability and recording update status of vaccines stock record tools in the selected public health facilities in Arsi Zone, Ethiopia, May 2019 (n=24)

Description [n=24]		Frequency	Percent
What types of form do you use for requesting/ordering vaccines from suppliers?	Gov't requesting voucher (Model 20)	2	8.3
	VRRF	17	70.8
	Facility's own form	5	20.8
What form do health post use to request vaccines from EPI room?	Gov't requesting voucher (Model 20)	1	4.7
	HPMRRF	3	14.3
	Facility's own form	11	52.4
	Not used any form	6	28.6
What form do you use for receiving vaccines from suppliers?	do not used	13	54.2
	Gov't receiving voucher (Model 19)	11	45.8
	Total	24	100.0
What forms do you use for issuing of vaccines to health post in the facility	do not used	17	81.0
	Gov't distribution voucher (Model 22)	2	9.5
	Facility's own form	2	9.5

***Source**: Survey Data (2019)*

Almost all the respondent knew how to complete logistics forms/records in one or the other way. EPI training was the major source for majority 13(54.2%) of the respondents to fill the formats. Five (20.8%) and 4(16.7%) of the respondents learned from on job training and self-learning, respectively. The rest 2(8.3%) of the respondent never learned how to complete logistics forms.

Table 4.7. ***Knowledge and skill sources for filling the EPI tools in the selected public health facilities in Arsi Zone, Ethiopia, May 2019 (n=24)***

Description		**Frequency**	**Valid Percent**
How did you learn to complete logistics forms/records used at this facility?	Never learned	2	8.3
	On the job training	5	20.8
	On the job(Self-learning)	4	16.7
	On EPI training	13	54.2

Source*: Survey Data (2019)*

Concerning supervision, the Health facilities reported to have had supervision on the vaccines logistics in quarterly, bimonthly, every 4 months, semi-annually, annually and monthly as claimed by 7(29.2%), 5(20.8%), 4(16.7%), 3(12.5%), 4(16.7%) and 1(4.2), respectively.

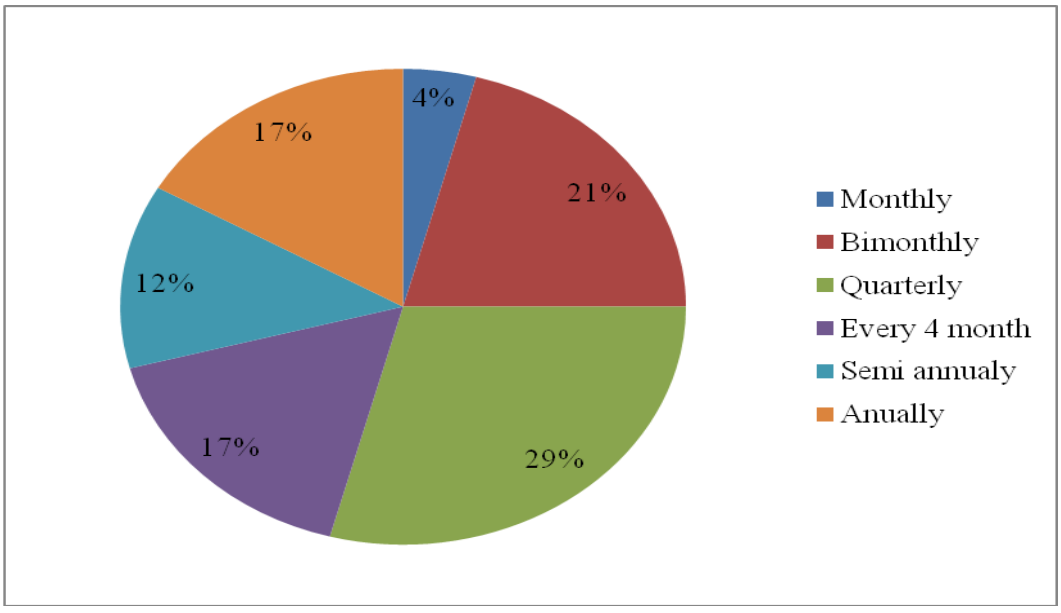


Fig.2 -supervision of vaccine logistics system schedule in the selected public health facilities in Arsi Zone, Ethiopia, May 2019 (n=24)***, Source****: Survey Data (2019)*

4.1.5. Barriers of the vaccines logistics management system

Table 4.8. ***The perceived factors contributing to poor vaccines logistics systems by health professionals***

**Responses ranged from strongly agree (5) to strongly disagree (1).*

S.N	Challenges	SD	DA	NE	AG	SA	Mean
1	Difficulty obtaining continuous supplies	0	4	0	15	5	3.88
2	Unknown demand	4	17	2	0	1	2.04
3	Invoice and real product information inconsistency	1	0	23	0	0	2.96
4	Lack of training in logistics system	1	4	0	14	5	3.75
5	Lack of training in vaccines logistics system	1	4	0	11	8	3.88
6	Lack of accountability for stock-outs and wastage of vaccines in the facility	5	10	1	6	2	2.58
7	power interruption	3	4	0	4	13	3.83
8	The shortage of human resources in the facility	1	7	0	10	6	3.54
9	There are staff turnover	2	16	0	3	3	2.54
10	Poor communication and coordination with key stakeholders (health bureau/office, suppliers, NGO‟s)	5	8	0	9	2	2.79
11	There are Shortage of Recording forms	6	9	0	6	3	2.63
12	There are Wastage of vaccine opened/unopened	17	6	0	1	0	1.38

Where, ***SD= strongly Disagree; DA =Disagree; NE =Neutral (Neither agree nor disagree); AG =Agree and SA = strongly Agree.***

Source*: Survey Data (2019)*

The study identified that difficulty obtaining continuous supplies, lack of training in logistics system, lack of training in vaccines logistics system, power interruption and shortage of human resources was the barriers of the vaccines logistics management system in the health

facilities. This finding is similar what was found in assessment report undertaken in Uganda where lack of training contributing to logistics system (Namuhaywa, M.M. (2013) and in Tanzania where electricity failure in urban and lack of gas in rural areascoupled with absence of contingency plan as major challenges inTanzania health facilities (Ringo, S., et.al.2017).

Table 3 The correlations Analysis

Correlations				
		Training on storage, distribution and handling procedures of vaccines and cold chain medicines.	Stock register maintained till date according to procedure.	Daily vaccine temperature monitoring chart maintained (monthly chart available)
Training on storage, distribution and handling procedures of vaccines and cold chain medicines	Pearson Correlation	1		
	Sig. (2-tailed)			
	N	24		
Stock register maintained till date according to procedure.	Pearson Correlation	.255	1	
	Sig. (2-tailed)	.229		
	N	24	24	
Daily vaccine temperature monitoring chart maintained (monthly chart available)	Pearson Correlation	-.051	.314	1
	Sig. (2-tailed)	.813	.135	
	N	24	24	24

**Correlation is significant at the 0.5 level (2-tailed)*

***Source**: Survey Data (2019)*

There is a positive correlation between Training on storage, distribution and handling procedures of vaccines and cold chain medicines and Stock register maintained till date according to procedure. This positive correlation coefficient (.255) indicates that there is a statistically significant ($p < .5$) linear relationship between these two variables such that the more train a person has, maintained the register properly. Also observe that there is a statistically significant ($p < .5$) negative correlation coefficient (-.051) for the association between training and daily vaccine temperature monitoring, indicating that the linear relationship between these two variables is one in which the values of one variable decrease as the other increases. The third correlation coefficient (.314) also indicates a positive association between Stock register maintained till date according to procedure and Daily vaccine temperature monitoring chart maintained, although this correlation is fairly weak.

4.1. 6. Facilitators and Barriers of the vaccines Logistics System in the HCs

In-depth interviews were held with all MCH coordinators and health centers managers of the HCs involved in this study.

The MCH coordinators and health centers managers identified various facilitators and barriers on the vaccines logistics system. They also forwarded important recommendations to improve the problems in the system.

Facilitators and barriers for inventory management

When asked about the facilitators and barriers of inventory management systems, most KIs identified facilitators and barriers of inventory management systems in relation to the systems. Majority of the KIs mentioned that

All KIs related the facilitators and barriers for availability of formats for inventory management. Some of them agreed that the availability of formats showed improvement. Majority of the KIs mentioned that unrecorded the stock of vaccines on stock ledger not only became a barrier for unavailability of the format, but also for workload of manpower.

Moreover, majority of the KIs identified barriers related to proper requisition. Some of the participants identified that lack of knowledge how to register the balance in reporting and requesting form was a barrier for EPI personnel. One EPI focal persons said that:

"We do not have stock registration form and we do not used model 22. Therefore, on the day of reporting to woredas health office, count stock on hand and registered on VRF. Even we could not know how much stock used on the past month".

The followings are among the recommendations forwarded by the KIs regarding to inventory management systems: Continues training should be given on the vaccine inventory management practice, continues supportive supervision should be given up to internalize the system and EPSS should be avail formats which help to facilitate inventory management.

Facilitators and barriers for vaccine storage management

When asked about the facilitators and barriers of storage conditions, all KIs claimed that there was frequent power interruption as a determinant on storage condition. While some respondents indicated that adequate store spaces facilitated proper storage practices, several respondents mentioned that inadequate digital thermometer became an obstacle for proper storage of vaccine. From the worst cases, MCH coordinators narrated the problem as:

"We do not have internal thermometer (fridge tag) in the refrigerator and there is continuous power interruption. In the first place, there is no electric back up for refrigerators. Therefore, vaccine handling is very difficult. Even we could not know the vaccines potency, it is difficult to register the thermometer reading. Even we do not know above and below level of the recommended temperature."

In addition to store spaces, other factors that became facilitators or barriers were mentioned by several respondents. Some facilities heads mentioned that, training on storage of vaccines, availability of adequate store equipment, and supervision from the management, higher level had facilitated the storage practice.

Moreover, inadequate generators were also mentioned by several participants as a barrier for proper storage practice.

To improve storage practices some respondents recommended that refrigerators should be avail with functional stabilizers and generators/solar refrigerator according to standards. They also recommended that install internal thermometer other than external thermometer.

The followings are among the recommendations forwarded by the KIs regarding to storage condition: Continues training should be given on the vaccine storage practices backup battery power sources, generators, fire extinguisher should be availed, tested quarterly and serviced annually.

Facilitators and barriers for vaccine logistics management information system

KIs identified facilitators and barriers of LMIS, majority of the KIs mentioned that the availability of necessary materials was a facilitator of the LMIS. In contrast, resistance and negligence of using the LMIS by EPI units had been an obstacle for the LMIS as described by some respondents. In connection to this, one facility head said that:

"They do not consider the activity of LMIS as their responsibility."

Another barrier mentioned by some of the respondents was that there was a rotation among staff where the trained and experienced were replaced by another staff who was new to EPI program.

Another barrier mentioned by most of the respondent was there were workloads.

The followings are among the recommendations forwarded by the KIs regarding LMIS: Continues training should be given on the LMIS, EPSA should be networked with all health facilities by information and communication technologies, adequate awareness should be created on staff that work in EPI units other than the focal persons, until they internalize the system and the LMIS should be computerized

4.2. Discussion

The ultimate goal of the vaccines logistics management system is to ensure potent vaccines accessibility to the end users. To achieve this, the system should be monitored frequently, so that limitations, barriers, strengths and facilitators of the system are identified. The findings of this study focused on inventory management, storage managements and LMIS of vaccines.

Proper vaccine inventory management is essential for appropriate vaccine ordering and stock rotation, and ensures facility has the vaccines your patients need (CDC, 2019).
The inventory replenishment system used by all facilities in this study were pull system, though there are conditional pushes from their suppliers, the supplier of the facilities was Woreda health office. Only (8.3%) facilities reported conditional push by their suppliers.

In this study, it was found that all of the HCs did not use expired or defect formats for managing vaccines and also not registered in expired registered column which is prepared for expired product at vaccines Stock record book. The CDC recommendation which states that there should be always checking of expiration dates while counting stock and remove any expired doses immediately (CDC, 2019).

In this study, it was found that most of the HCs did not use VRRF for managing vaccines. Instead they prepared their own form to request vaccines from Woreda health office. It might be easier for the HCs' logistics officers to prepare their own simple format instead of filling the relatively numerous columns of the VRF.

This study also revealed that most of the HCs in the EPI room had stock register book. Among HCs which had stock register books half of them were not updated. Here it is important to note that stock register books in HCs might not be updated if the HCs had been using. Stock registration books are important tools in the management of vaccines as they provide information on stock status, expiry date, and availability of products in addition to maintaining accountability. The vaccine physical stock counts were not documented. The quantities counted were recorded in the Stock Ledgers replacing the running balance without supporting documentation. Several occasions inventories identified significant discrepancies (WHO, 2016).

Once in a month and before placing any vaccine order, they count all vaccine and diluent doses to make sure the number of doses in the storage unit matches the number of doses documented in the stock record (CDC, 2019).

Liquid vaccines containing an adjuvant can permanently lose potency when exposed to freezing temperatures, single exposure to freezing temperatures (0° C [32° F] or colder) can actually destroy potency. (CDC, 2019).

In this study observed that storage units and equipment half of health facilities did not have access to a generator/solar power. Out of this, only 41.7% had functional power back up and only 12.5% had a voltage stabilizer connected to the refrigerator. This is almost the same result with the study carried out in PHCs of Philippines, in a cold chain survey by Maglasang and his friends, all PHC had refrigerators and 9.0% had voltage stabilizer connected to refrigerators. On the other hand, 90.9% did not had generator (Maglasang, PL.*et.al,* 2018)

In this study most of them had working thermometer during the study; half of them of the facilities the thermometer was placed inside. This finding is in agreement with the study finding in Addis Ababa and Kenbata -Alaba- Timbaro and Hadiya Zones of southern Ethiopia Region in which 93.7% of health facilities had functional thermometer (Birhane Y. *et.al,* 2000). Thermometer protects patients from inadvertently receiving compromised vaccine and your facility against costs of re-vaccinating patients, replacing expensive vaccines, and losing patient confidence in your practice. Investing in a reliable device is less expensive than replacing vaccines wasted due to the loss of potency that comes from storage at out-of-range temperatures (CDC, 2019).

Vaccine temperature monitoring is critical for protecting vaccines. Refrigerators should maintain temperatures between 2° C and 8° C . Monitoring vaccine storage equipment and temperatures are daily responsibilities to ensure the capability of vaccines. Implementing routine monitoring activities can help you identify temperature excursions quickly and take immediate action to correct them, preventing loss of vaccines and the potential need for re-vaccination of patients(CDC,2019).

This study found out that in 79.2% health facilities refrigerators were suitable for FEFO implementation and on the same facilities vaccine are stored in the right place in the right way (in basket not on floor) which is much better than the finding 26.6 % of health facilities of Addis Ababa city, and in Kenbata -Alaba- Timbaro and Hadiya Zonesof southern Ethiopia Region (Birhane Y. *et.al*,2000) and in Russia and Namayingo Districts by Namuhaya in 2013 on cold chain and logistics management for EPI indicate that none of the EPI service units practice either stock taking or issued their stock according to FEFO and FIFO.

CHAPTER FIVE

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The study has identified about main challenges that lack of on job training with special emphasis on storage, handling, Inventory management and logistics management information systems of vaccines. Lack of or improper inventory system at healthcare facility level appear to be some of the factor which causes stock out. Poor or lack of proper storage conditions in the health facility also prevent effective logistics system. Another challenge identified is unreliable electricity and lack of backup these appear to be a problem in maintaining the recommended temperature range needed. Non-adherence to good storage practices refrigerator has no temperature monitoring & recording chart in most of the facilities visited. Thermometers found only in some refrigerators and absent in the rest of all refrigerators in health facilities refrigerators visited. No involvement of pharmaceutical personnel to manage vaccine stores or immunization site provided is known to be custodian in the field of medicines. All these may contribute to facilities not being able to maintain the required storage condition which may lead to deterioration of the vaccine. Although stock registration books were available at the EPI rooms, most of them were incomplete or incorrectly filled in and also were not up-to date. These findings indicated that appropriate actions are needed to ensure vaccines logistics system in all health facilities in the study areas.

5.2 Recommendations.

The following are recommendation in response to the above challenges observed by study:

MOH- Need to involve pharmaceutical personnel up to health facilities in the supply chain of vaccines because the study reveals no involvement of pharmaceutical personnel in this programme.

Zonal and Wereda health office - Need to strengthen supportive supervision at lower health facilities delivery site so as to improve their performance in chart monitoring and recording for recommended temperature range because these systems are not working in most healthcare facilities.

EPSA- Need to supply freezer tags to all healthcare facilities which can help in monitoring and recording temperature even when the stores in charge and immunization focal personnel are absent.

Facilities -Need to strengthen the storage practices of vaccines by providing on job training, so as to store in-charge and immunization focal personnel they can know how to use refrigerator and good practice of storing vaccines.

EPSA and Facilities - Need to that train personnel who will monitor and access the vaccine stock on a regular basis. Thus, there has to be a proper inventory system in place in order to facilitate the usage of vaccinations.

Limitations and directions for future researches- Although the research questions proposed in the first chapter were addressed, there remain important uncertainties related to them that need to be addressed in the future study. Further research would be carried out to cover the whole country to assess the magnitude of the problem because this study just focused on public health facilities located in Arsi. More meaningful results would have been produced if the scope of the study was extended to more than one zone to get a better understanding of the potential challenges of vaccines logistics system at public health facilities across the country.

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APPENDIX

APPENDIX A: Assessment tool

Questionnaire

Addis Ababa University

College of Health Sciences

School of Pharmacy

Department of Health supply Chain Management

Informed Consent Form

My name is Yetnayet Yeshitela, a post graduate student from the Addis Ababa University, College of Health science, School of Pharmacy department of Health Supply Chain Management. First of all I would like to thank you for giving me your time. I am very interested to hear your valuable opinion on vaccine supply chain management practices. The purpose of this study is to investigate the vaccines logistic management practices in public health facilities of Arsi Zone, focusing on availability of vaccines and vaccine supplies, store management, logistics management information system; and knowledge and practices of vaccine logistics handling and storage. The study is purely for academic purpose and will remain confidential and not to be used to assess your performance; thus not affects you in any case. Your participation is voluntary and you have the right not to answer any question and stop the interview at any time if you have any doubt. Moreover, your name will not be written and your responses are identified only by codes. However, your genuine, honest and timely response is vital for successfulness of the study. Therefore, I kindly request you to respond to each items of the question very carefully.

If you have/will have any comments/questions/problem please contact

1. **Yetnayet Yeshitela (**Principal investigator for the study): yetnayet990@gmail.com
2. **Dr. Shiferaw Mitiku** The research project adviser): shiferaw@edu.et.com

Would you be willing to participate?

1. Yes. Thank you! Let’s begin.

2. No. Thank you!

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INTERVIEW QUESTIONNAIRES AND OBSERVATION CHECKLIST TO ASSESS LOGISTICS SYSTEM IN PUBLIC HEALTH FACILITIES OF ARSI ZONE, ETHIOPIA

1.Background information for Health Facility

1.1. Name of Cluster: _____

1.2. Name of the Woreda: _____

1.3. Name of the Health Facility: _____

1.4. Type of Health Facility □Hospital □Health Center

1.5. When the health facility was established (E.C)? _____

1.6. Type of services provided by health centers □ART □PMTCT □ non PMTCT

1.7. Level of health facility (if health center) □ Type A □ Type B

Socio-demographic Characteristics of Respondents

1.8. Respondent's Sex □ Male □ Female

1.9. Marital Status □ Single □ Married □ Divorced □Widowed

1.10. Respondent's age …… ……years

1.11. Total work experience …… ……years

1.12. Work experience in EPI …… ……years

1.13. Profession of in charge/coordinator of facility in cold chain of vaccine store?

□Pharmacist (BSc) □ Diploma in Pharmacy

□Nurse BSc □ Nurse Diploma

□Health officer □ Environmental health

□Midwifes □ Others (Specify)……

1.14. Have you ever attended training on storage, distribution and handling procedures of vaccines and cold chain medicines?

□Yes □No

1.15. Where did you get the training?

□ University/college □ In service training

□ In-service orientation □ online training

1.16. How many times have you attended such a course within last three years?

A. Once B. Twice C. Thrice D. Not attended

2. Inventory Management Practices of Vaccines

2.1.Are the following LMIS tools available in this pharmacy?

A. Expired /Defective item recording format □Yes □No

B. Vaccine stock recording books □Yes □No

2.2.Are the following LMIS tools used in this pharmacy?

A. Expired /Defective item recording format □Yes □No

B. Vaccine ledgers books □Yes □No

2.3.The LMIS forms include?

A Quantity received □Yes □No

B Stock on hand □Yes □No

C Quantities dispensed/issued □Yes □No

D Loses and adjustments □Yes □No

E Other (specify) _____ □Yes □No

2.4.Issue/receipt vouchers files are maintained?

□Yes □No

2.5.Are monthly reports (VRRF) being prepared and summit regularly?

□Yes □No

2.6.Is vaccines logistic related data used for decision making in your health facility?

□Yes □No

2.7.Stock register maintained till date according to procedure?

□Yes □No

2.8.Does the vaccine inventory match stock register?

□Yes □No

2.9.Is there any product stock out during last reporting month?

□Yes □No

2.10. Are there certain commodities that your organization frequently experiences stock out of before resupply? (If no, skip to 2.12)

□Yes □No

2.11. What are those commodities that you frequently stock out of before resupply?

1

2

3

2.12. For Which purpose do you maintain or keep sufficient inventory?

A	Safety stock	□Yes	□No
B	Maintenance of supply	□Yes	□No
C	Based on complementarity of the product	□Yes	□No
D	Others (Specify) _____		

2.13. Which of the following is being frequently considered to determine your level of inventory (how much to stock)?

A	Based on target coverage?	□Yes	□No
B	Based on Storage requirements?	□Yes	□No
C	Based on Expiration date?	□Yes	□No
D	Based on VVM stage?	□Yes	□No
E	Others (Specify) _____		

2.14. How are your order quantities determined?

A Inventory control policy

B Speculation

C Simple observation

D Other means (specify) _____

2.15. On average, approximately how long does it take between ordering and receiving products from your supplier?

A. Average lead time in days/hrs if push modality

□<10 days □ 10-15 days □>15 days

B. Average lead time in days/hrs if pull modality

□<10 days □ 10-15 days □>15 days

2.16. What affects the delivery lead time?

A	Order quantity	□Yes	No
B	Shortage at supplier	□Yes	□No
C	Attention of pharmacies	□Yes	□No

D Other (*specify*) _____

2.17. What type of inventory control system is usuallyused by the pharmacy?

□Pull □ Push

2.18. Is there conditional push from your EPSA?

□Yes □No

2.19. Did you perform physical inventory?

□Yes □No

2.20. How frequent the physical inventory is done?

A. Annually B. Semi-annually C. Cyclic

2.21. Do you practice periodic stock reconciliation by comparing the actual (physical inventory) and recorded stocks?

□Yes □No

2.22. How frequent the reconciliation is done?

A Annually B. Semi-annually C. Cyclic

2.23. Who is directly supplying vaccines?

A EPSA

B Zonal health office

C Wereda health office

D EPSA and Wereda health office

E Others Specify _____

2.24. Who is responsible for transporting vaccines to this facility?

A EPSA

B The facility

C Woreda Health office

D Other (specify) _____

NB: - Push modality- the quantity to issue is calculated at the point of issue, which may be the central level or an intermediate level.

Pull modality-the quantity to order is calculated by the facility placing the order (the recipient).

3. Storage Management Practices of Vaccines

No	Descriptions	Observation		Comment
		Yes	No	
1	Do you have a functioning refrigerator(s) to store vaccines?			
2	Are refrigerators located away from any surrounding objects (approximately ½ meter)?			
3	Functional voltage stabilizer is available with refrigerator			
4	Thermometer is working?			
5	Working thermometer is placed inside the refrigerator			
6	Daily vaccine temperature monitoring chart maintained (monthly chart available)			
7	For how many days do vaccine monitoring chart is not recorded in the last one months			
8	To record the actual temperature, look at the internal thermometer inside the refrigerator ideal temperature is between 0 and +8 degrees centigrade. (Note if thermometer is broken or missing.)			Temperature (in centigrade)
9	Vaccine are stored in the right place in the right way (in basket not on floor)			
10	Vaccines are stored and organized in a manner accessible for first-to-expire, first-out (FEFO) or First-in first			

	out(FIFO) counting and general management			
11	Vaccines are in good condition, not crushed due to mishandling			
12	Only vaccines and diluent are kept inside the refrigerator?			
13	Electricity back-up available? (Generator/UPS/solar etc.)			
14	Electricity back-up functional			
15	The facility makes it a practice to separate damaged and/or expired products from usable products and removes them from inventory.			
16	Fire safety equipment(fire extinguisher, sand) is available and accessible (any item identified as being used to promote fire safety should be considered			
17	Are updated fire extinguisher			
18	How to utilize the fire extinguisher(demonstration)			

4.Vaccines Logistics Management Information System

4.1.Is there any documented policy or guideline for managing and using the logistics management information system (LMIS)?

□Yes □No

4.2.What type of guidelines do you use? ----------

4.3.Do you use and fill out the following logistics recording forms to manage vaccines?

A. Health post report and resupply form (HPMRR) □Yes □No
B. Vaccine Reporting and resupply form (VRRF) □Yes □No
C. Expired registration forms □Yes □No
D. Vaccines balance recording book □Yes □No
E. Others----------

4.4.What form do you use for requesting/ordering vaccines from suppliers?

A. Gov't requesting voucher (Model 20)
B. IFRR
C. VRRF
D. Facility's own form
E. Other (specify) _____

4.5.What form do you use for receiving vaccines from suppliers?

A. Gov't receiving voucher (Model 19)
B. Do not used
C. Other (specify) _____

4.6. What form do health post use to request vaccines from heath facilities?

A. Gov't requesting voucher (Model 20)
B. HPMRR
C. Other (specify) _____

4.7.What forms do you use for issuing of vaccines to health post in the facility?

A. Gov't distribution voucher (Model 22)
B. HPMRR
C. Facility's own form

D. Other (specify) _____

4.8. Do you report vaccines to EPSA or Wereda Health office?

□Yes □No (If no, skip to 5.13)

4.9. What form do you use for reporting of vaccines to EPSA?

A. VRRF

B. Facility's own form

C. Other (specify) _____

4.10. The report of vaccines includes the following?

A. stock on hand	□Yes	□ No
B. quantities used	□Yes	□ No
C. losses and adjustments	□Yes	□No
D. VVM stage	□Yes	□No
E. Expired date	□Yes	□No

4.11. How often is the report for vaccine sent to EPSA/WorHO?

A. Monthly

B. Bimonthly

C. Other (specify) _____

4.12. When was the last time you sent the report for vaccines to EPSA/WoHO?

A. Never

B. Within the last month

C. 2 months ago

D. Others (specify) _____

4.13. How often are you supposed to send the report for vaccines to EPSA/WoHO?

A. Monthly

B. Bimonthly

C. Other (specify) _____

4.14. How did you learn to complete logistics forms/records used at this facility?

A. Never learned

B. During a logistics workshop

C. On-the-job training

D. On-the-job (self-learning)

E. Other (specify) _____

4.15. From whom do you get Supervision mostly?

A. EPSA

B. WoHO

C. Zonal health office

D. Partners

E. Other (specify).....

4.16. How often you get supervision on vaccines logistics? Check feedback

A. Monthly

B. Bimonthly

C. Quarterly

D. Every 4 months

E. Semi-annually

F. Annually

G. Other (specify).....

4.17. How do you rate the level of support you receive?

Very good Good □ Fair □ Poor □ Very poor

5. Questions on perceived Challenges of Vaccines Logistics System Management

Please indicate the extent to which you agree with the following statement by ticking the appropriate answer using the scale below:

Where, (***1=strongly Disagree (SD); 2=Disagree (DA); 3=Neutral-NE (Neither agree nor disagree); 4=Agree (AG) and 5=stronglyAgree (SA)***)

S.N	Challenges	SD	DA	NE	AG	SA
1	Difficulty obtaining continuous supplies					
2	Lack of access to transportation					
3	Unknown demand					
4	Product quality					
5	Invoice and real product information inconsistency					
6	Lack of knowledge in vaccines storage practices					
7	Lack of training in logistics system					
8	Lack of training in vaccines logistics system					
9	Inadequate refrigerator for storage of vaccines in the facilities					
10	Lack of accountability for stock-outs and wastage of vaccines in the facility					
11	power interruption					
12	The shortage of human resources in the facility					
13	Staff turnover					
14	Poor communication and coordination with key stake holders (health bureau/office, suppliers, NGO‟s)					
15	There are Shortage of Recording forms					
16	There are Wastage of vaccine opened/unopened					

Thank you for your time and cooperation.

Semi structured guiding for key informant interview

1: Back ground information of the key informant

2.1. Age …….

2.2. Sex □ Female □ Male

2.3. Highest level of education ……

2.4. Total Work experience ……..

2.5. Work experience in the current position ----------

2.6. Current position in the health facility……..

2: Guiding questions for in-depth interview with head of facilities and EPI focal person

2.1. In your own opinion, how do you assess the EPI program in your facilities----------
---
---.

2.2. How do you assess EPI logistics system in your facilities----------
---
---.

2.3. How do you assess the vaccine inventory management systems in your health facility?Probing (1): With respect to:

a. Availability and using recording and reporting forms?
b. Physical inventory and reconciliation?
c. Reporting essential data?

Probing (2): What facilitates for the current level of strength in the vaccines inventory management practice in your facility and what barriers do you encountered?

Probing (3): What is your recommendation for improving the vaccines inventory management practice further?

2.4. How do you assess the vaccines storage condition in your health facility?

Probing (1): With respect to:

a. The size and design of the store?

b. Equipment and furniture?

c. Handling of vaccines and sanitation?

d. Recording temperature and VVM?

Probing (2): What facilitates for the current level of strength in the vaccine storage and storage practice in your facility and what barriers do you encountered?

Probing (3): What is your recommendation for improving the vaccines storage practice further?

2.5. How do you assess the LMIS to managing vaccines in the health facility?

Probing (1): With respect to:

a. Using logistics recording forms?

b. Using computer software?

c. Reporting of the stock status and consumption of vaccines?

Probing (2): What conditions facilitates for using vaccines LMIS and what barriers do you encountered?

Probing (3): What is your recommendation for improving the vaccines LMIS further?

2.6. What do you finally recommend to strength the EPI systems? --------------------------------
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--.

Thank you for your time and cooperation.

APPENDIX B: List of Health Centers Included in the Study

S.N	Name of health facilities	Wereda
1	Negele health centers	Guna
2	Abajama health centers	Guna
3	Bolo health centers	Chole
4	Moye health centers	Chole
5	Abomsa Hospital	Merti
6	Habe health centers	Robe
7	Diksis hamda health centers	Diksis
8	Halila Health center	Sude
9	Bele health centers	Bele gasgar
10	Bele gesgar Hospital	Bele gasgar
11	Welargi health centers	Hetosa
12	Boru jawi health centers	Hetosa
13	Itaya health centers	Hetosa
14	Deneb gudo health centers	Merti
15	Abomsa health centers	Merti
16	Golgota health center	Merti
17	Ogolcho health centers	Ziway Dugda
18	Benben health centers	Sire
19	Kersa health centers	Munesa
20	Ego health centers	Munesa
21	Gobesa health centers	Shirka
22	Sole health centers	Shirka
23	Sagure health centers	Digelu and tijo
24	Bokoji Hospital	Bokoji Town

APPENDIX C: Sampling Frame

Sampling frame for health facilities surveyed in Arsi Zone, Ethiopia, March 2019