Effect of Cold Chain Management Practice on Vaccine Availability: The Case of Ethiopian Pharmaceutical Supply Agency Addis Ababa and Health Facilities in Addis Ababa.

By; Firew Ayele

A Thesis Submitted to The Logistics and Supply Chain Management Department Addis Ababa University College of Business and Economics School of Commerce. In Partial Fulfillment of The Requirements for The Degree of Master in Logistics and Supply Chain Management (LSCM).

Advisor; Dr. Zelalem Bayisa

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Approved by board of examiners

Advisor	**Signature**	**Date**
Internal Examiner	**Signature**	**Date**
External Examiner	**Signature**	**Date**
Chairman of graduate committee	**Signature**	**Date**

DECLARATIONS

I, Firew Ayele, announce this research paper entitled “Effect of cold Chain management practice on vaccine availability: the case of Ethiopian Pharmaceutical Supply Agency Addis Ababa and Health Facilities in Addis Ababa.” is my own and I dare to say original research work that has not been produced by others in any other universities for any other requirements in any form. To this end, I acknowledged all sources of information that I used to produce the study appropriately and I would say perfectly.

Firew Ayele	_____	_____
Student Researcher	Signature	Date

LETTER OF CERTIFICATION

This is to certify that Firew Ayele has carried out her thesis work on the topic entitled “Effect of cold Chain management practice on vaccine availability: the case of Ethiopian Pharmaceutical Supply Agency Addis Ababa and Health Facilities in Addis Ababa.” under my guidance and supervision. Accordingly, I here assure you that her work is appropriate and standard enough to be submitted for the award of Master of Arts in Logistics and Supply Chain Management.

Zelalem Bayisa (PhD) _____ _____

Research Advisor Signature Date

ACKNOWLEDGMENTS

First and primary I would love to thank God for everything. Next, I would love to be well known by all who participated on this study. I am additionally very thankful to my consultant Zelalem Bayisa (PhD) for his valuable guidance and consultation on this thesis. His willingness to provide his time so generously has been very an awful lot appreciated. I well known the vital position performed through EPSA staffs to assist with inside the information series process. I would love to provide my unique way to Wonde whose encouragement, steerage and aid from the preliminary to the final degree became with me. Finally, I have to explicit my very profound gratitude to my own circle of relatives presenting me with unfailing aid and non-stop encouragement during my years of study. This accomplishment could now no longer were feasible without them.

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ABBREVIATIONS

CDC: Center for Disease Prevention and Control;

EPI: Expanded Program for Immunizations;

GAVI: Global Alliance for Vaccine and Immunizations;

HCMIS: Health Commodity Management Information System;

ISCL: Immunizations Supply Chain Logistics System;

ISCM: Immunization Supply chain Management;

EFMOH: Ethiopian Federal Ministry Health;

EPSA: Ethiopian Pharmaceutical Supply Agency;

PLMP: Pharmaceutical Logistics Master Plan;

PFSA: Pharmaceutical fund and supply agency

UNICEF: United Nations Children's Fund;

UNOPS; United Nation for Project Service;

WHO: World Health Organization;

VVM: Vaccine Vial Monitor.

ABSTRACT

In this study, the researcher observed the cold chain management practice and availability of vaccines in public health facilities of Addis Ababa. *Quantitative methodology was used in this study with explanatory study design to produce answers to the research questions. Questionnaire was used to collect primary data from cold chain responsible personnel in selected health facilities. To determine the sample size for selecting health facilities the researcher employed a sample determination formula developed by Cochranin 1963. Additionally, the study used simple random sampling In order to select the respondents. Accordingly, an aggregate of 81 respondents were selected and participated in this study and out of these, data were obtained from 79 respondents. Data were collected through questionnaire and analyzed using descriptive statistics (such as frequency and mean)and inferential statistics (correlation was used so as to assess the relationship between cold chain management practices and availability of vaccines, and Ordinal regression equation was used to test the effect of cold chain management practices on vaccine availability Presented by ordinal regression analysis. Storage system and distribution system were found to have a positive and significant effect on availability of vaccines. In the meantime capacity has negative significant effect on availability of vaccines.*

Based on the findings of the study it will not be unwise to conclude that distribution, stock management and capacity in the cold chain management should be improved so as to bring a change in the availability of vaccines in the health facilities.

The researcher proposed recommendations on cold chain storage conditions must be closely checked and enhanced so that vaccine safety is ensured by having fully working and sufficient storage facilities. On top of that, the researcher recommend others to conduct similar research by expanding their scope to include main vaccine value chain components with respect to private and other governmental health facilities to find out actual vaccine availability.

Key words: Availability, Stock Management, Capacity, Distribution

CHAPTER ONE 1: INTRODUCTION

1.1 Background of the study

Regarding engagement that is personnel's the immunization provide chain logistics in all GAVI eligible Countries, generally unqualified health employees are performing the mission of (Steele, 2014). According to the (WHO, 2011) report, 50% of GAVI nations that are eligible for vaccine wastage fee in excess of WHO's recommendation and 20 percent states of Nigeria had experienced vaccine stock out. In this report that is equal round 2.8 million vaccine doses are misplaced in five nations due to cold chain and much less than 10 % of countries meet WHO advice for tremendous vaccine management practices. The record also dictates 5 percent of GAVI countries that are eligible underachieving on ISCL and much less than 25 percentages of countries are operating at even a fashionable that is minimal the criteria of maintenance, inventory management and distribution. Furthermore, only 29 percentages of the countries that are national a minimal general for temperature manage (WHO, 2014).

Similarly, vaccine wastage evaluation completed in India shows, wastage of all level of the supply chain for a length that is six-month that maximum wastage appear at the session Site (BCG vaccine has the wastage that is most of 61 percentage (UNICEF, 2010).

Immunization is one of the most health that is successful is public available today, as it saves lives and protects against serious illness. The effectiveness of the programs, however, is strongly reliant on the correct management of the vaccination supply chain, which includes storage that is shipping that is safe and handling of vaccines (Steele, 2014).

On top of this, EPSA Addis Ababa hub start vaccine distribution for regions, Zones, Woredas and directly to the health services at 2017. In line with this, the health commodity management information system that is present data system (HCMIS) software which EPSA was once the use of it for managing the information machine for pharmaceuticals, end up one of the important device for managing the information machine and stock control of vaccines.

Low commitment that is political low stages of investment, poorly maintained chain that is cold chain lack of human resource, bad ailment surveillance and reporting structures which are key factors of the logistics approach are some of the bottleneck located in the system (Monicah W., 2015).

According to (WHO, Health Canada Drafting Group Meeting on Scienti¦c and Regulatory Considerations on the Stability Evaluation of Vaccines under Controlled Temperature Ottawa, Canada, 2012) document the average stock holding factor of Ethiopia, which is conducted at grant chain level, used to be speculated to make bigger the wastage charge (WHO, Health Canada Drafting Group Meeting on Scienti¦c and Regulatory Considerations on the Stability Evaluation of Vaccines under Controlled Temperature Ottawa, Canada, 2012).

WHO mentioned that in Ethiopia 30 percentage of cold chain refrigerators are nonfunctional due to lack of maintenance (WHO, 2014). According to WHO`s report, introduction of new vaccine to countries that are African also increased storage requirement escalating the storage that is existing.

Immunization supply chains necessitate particular knowledge and skills on the part that is right of chain professionals. They require cold rooms or refrigerators in storage facilities, as well as power and technicians to keep them working. And they require information systems able to track vaccine specific data, such as vaccine monitor that is vial VVM status, or chain that is cold (CCE) temperature excursion (Prevention, 2014).

A case study achieved in Nairobi`s chain that is cold logistics on the security of vaccine suggests up to 52 percentage of respondents conformed there was validation that is once poor qualification of storage facility and monitoring device. There was no one-of-a-kind storage gear for one-of-a-kind vaccine up to 41 percent of the corporations and as a result that is total a hazard of cross illness and temperature excursions throughout storage which has compromised the fine of vaccine.

The research verified that authenticate systems with regard to standardization of storage facility temperature enquiries, sensors and thermometer were normally poor alongside the supply chain with only 34% practice(Monicah W., 2015). In decrease profits countries of Africa, efforts to implement a supply chain that is efficient is cold chain manner are often hampered by means of terrible health supply systems.

Generally, as evidences shows from the administrative reviews and surveys, the EPI in Ethiopia showed improvement that is revolutionary the years that are past. However, in addition intensified efforts are required to amplify EPI insurance and vaccine that is subsequently forestall and related morbidity and mortality in the country.

In order to increase coverage, limit vaccination dropout rate, and reduce gaps in coverage between areas and districts extra location population targeted techniques are required. Tailored actions are required in areas/regions with consistently coverage that is low. Actions are also required to improve records fantastic so as to make accuracy that is certain of facts and statistics technology for action. (WHO, EPI Annual Report for WHO Ethiopia, 2018). WHO in 2019, will focal point often in the four areas that are huge contribute greater to quantity that is high of children.

The immunization supply chain and logistic (ISCL) and system, according to the CDC report, were designed in the 1980s. It has enabled the attainment of appropriate vaccination coverage since its start; employing strategies that are coping overcome enduing obstacles in vaccine storage, delivery, and management (WHO, 2014). A vaccine that is strong chain that enhances immunization (GAVI) eligible countries like Ethiopia, take good ISCL as a backbone for its mission to be achieved (Steele, 2014) in all worldwide alliances for vaccination projects. The temperature should be safe according to the standard at all points throughout the supply chain. However, failing to follow to the cold chain that is correct will result in decreased vaccination efficacy, insufficient protection, and possibly a danger to the health of children. "It is better not to vaccinate than to administer vaccine that has been mistreated," according to the CDC (CDC, “Vaccine storage and handling toolkit,”, 2019).

The Federal Ministry of health of Ethiopian estimated the need for appropriate cold chain of vaccine collectively with the inception of pharmaceutical logistics Management Program (PLMP) in 2007(EFMOH, 2013), and in order to adopt an end to end supply chain of this program. To enhance vaccine administration and distribution system, in 2014, federal minister of health agreed to begin the formal transfer of duty for administration of vaccine and cold chain. The cold chain with other health commodities to the Ethiopian will be provide by pharmaceutical Supply Agency (PFSA, 2014) where the transition from current management system was once performed in a phase based approach. Commencing vaccine distribution from these Phase I Hubs to Zones require forecasting of vaccine requirement for the catchment areas the hubs serve, submission of those forecasts the use of Vaccine Request Forms (VRF) to EPSA Central/FMOH EPI team, and transport of vaccines from EPSA Central to the hubs, as per their requests.

1.2 Statement of the Problem

According to the (WHO, 2011) report, 50% of GAVI eligible countries reported a vaccine wastage rate in excess of WHO's recommendation. In this same report, around 2.8 million vaccine doses are lost in five countries due to cold chain failure and less than 10 percent of countries meet WHO recommendation for effective vaccine management practices.

Less than 25% countries continuous with WHO foreign places bases are functioning minimally in step with maintenance, inventory manipulate, and income trends. In addition, 29% of countries meet minimal temperature monitoring requirements. In 2011, a cold chain failure resulted with inside the lack of 2.8 million vaccines at five international sites (WHO, 2014). WHO and (UNICEF) expect a predictable rate of decrease in developing global places to be round 50% (Lloyd, 1999). Staff's willpower to cold chain logistics for vaccination in all GAVI-eligible global places is commonly finished via way of untrained healthcare experts (Steele, 2014).

The document moreover states that five% of GAVI-eligible international locations are beneath ISCL and much less than 25% meet minimal maintenance, stock control, and distribution standards. In addition, best 29% of global places come across the marginal temperature control standards (WHO, 2014).

In India Vaccine waste drafts achieved, show that 6 months of waste in any deference ranges of the cold chain produces the largest waste with inside the session (the largest waste of BCG vaccine) is 61% (UNICEF, 2010).

A vaccine management case look at achieved at Nairobi's Cold Chain Supply Logistics confirmed that as much as 41% of materials did not have different reparation for each vaccine, so there was a risk of mutual infection and temperature variations at some point of stores, which affected the extreme potency of the vaccine. Studies have proven that verification structures associated with calibration of storage facility temperature examinations, sensors, and thermometers are commonly poor along the cold chain, with totally 34% having wonderful practices. It was demonstrated (Monicah W., 2015).

According to the cold chain device inventories completed in 2013, about 38% of the refrigerators on the clinic stage and 36% of refrigerators on the administrative degree (woreda to region) have been non-functional (FMOH, 2015). Lack of reporting tool inventory miss information and vaccine wastage are not traceable (JSI, 2015). Although, studies are signifying that such bad management of vaccines should give up bring overstocking of vaccines on the valuable degree while sub-country wide cold rooms aren't keeping potent vaccines (Kaufmann et al., 2011; WHO, 2014).

The entire rate of a vaccine according to entirely immunized child in growing global places is $38.75 (WHO, 2014). Ethiopia has a population of 3 million children, and US $116 million (US $2 billion) is spent on vaccines every and each 12 months (FMOH, 2013). A big amount of cash is allocated each 12 months for vaccine procurement with the resource of partners and the Ethiopian government. However, in Ethiopia, the supply of vaccines on the country wide degree is not extreme issue. Weak vaccine stock and inventory control had been said on the nearby and company shipping degree (FMOH, 2015).

Vaccine distribution in Ethiopia consists of many distribution steps with 5 range of stock dividing line (FMOH, 2013; WHO, 2014). This form of tool can result in vaccine waste and expired motive overstocking at a few distribution points.

Send-on in complicated offer chains, techniques can increase the danger of bottlenecks and disasters (Kaufmann, Miller, & Cheyne, 2011). Assessing Cold Chain world-wide overall performance enables an initiative to identify success, become aware of whether the organization apprehends its processes, identify consumer requirements, identify jams and the location upgrades are necessary, and make sure selections are based on statistics, to expose if deliberate upgrades really happened. Lacking a standard belief of vaccine cold chain universal overall performance and the related causal factors limits the group's capacity to understand the brilliant opportunities for enhancing cold chain management overall performance.

Thus, this research will test the practice of management of vaccines, in a good way to survey its effect on the availability of vaccines on the service delivery level (public health institutions). This study will address vaccine availability depending on cold chain management practice primarily based totally on empirical records integrating pretty some statistical approaches.

1.3. Research Questions

1. How Knowledge of staff affects availability of vaccine?
2. How storage capacities affect vaccine availability?
3. How information system affects vaccine Availability?
4. How Stock management practice affects Vaccine availability?
5. How distribution systems affect vaccine availability?

1.3.1 General Objective

To assess the effect of cold chain management practice on availability of vaccine at EPSA Addis Ababa and health Facilities.

1.3.2 Specific Objectives

1 To assess the effect of knowledge of staffs on Vaccine availability at the study area.

2 To assess the effect of storage capacity on vaccine availability at the study area.

3 To assess the effect of information system practice on vaccine availability at the study area.

4 To assess effect of vaccine stock management practice on vaccine availability at the study area.

5 To assess the effect of distribution system on vaccine availability at the study area.

1.5 Significance of the study

The intention of the study will to assess the vaccine Cold Chain management practice in EPSA and health facilities in terms of vaccine availability. Therefore, the study has practical significance to assess the practice of the vaccine cold chain management as well as the challenges faced in it. The result of this study will help EPSA and health facilities working to make some changes and to understand how those performance indicators will affect vaccine availability and it will also help to provide for researchers, academics and students reliable data about Vaccine cold chain management performance measurement of EPSA and health facilities working with.

1.6 Scope of the study

The scope of the research will be EPSA Addis Ababa Hub and Facilities working with, only addresses the Performance vaccine management system in terms of vaccine availability. The study will not include the Quantification, Procurement, and Shipping of vaccines up to central EPSA which means the study will not include averring all central EPSA inbound and outbound logistics systems. In addition, the study will not include the end customers (patients) use of vaccines or coverage of vaccines and children's protection from the disease.

1.7 Definition of terms

Stock out – a situation in which the demand or requirement for an item cannot be fulfilled from the current inventory.

Overstock - excess inventory, is the result of poor management of stock demand or of material flow in process management.

Minimum Stock Level- The level of minimum stock is generally fixed at 25% of the total estimate of vaccines need for a given supply period.

Real-time data - is information that is delivered immediately after collection.

Vaccine Availability- measures the total number of unexpired vaccine available in a health facility to the vaccines in a defined list.

Cold Chain Capacity- is the temperature controlled space needed at a vaccine store or service – delivery point to store or transport vaccine and diluents volumes.

Distribution System-is the division and movement of vaccines from the premises of the manufacturers to the end users to an intermediate point by means of various transportation methods, via various storage and/or health establishments.

Stock Management System- a system of stock management must be in place to record vaccines received, issued or used, damaged and the current balance.

Information System- is immunization information system is confidential, population-based, computerized databases that record all immunization doses administered by participating providers residing within a given geographical area.

1.8 Organization of the Study

Generally, the study will organize into different chapters.

It contains only 5 chapters Chapter one starts with a general introduction about the research followed by a statement of the problem and continues with the research objectives and questions, the scope, and limitations of the study, significance of the study, and the organization of the study. Chapter two reviews related studies and literatures on vaccine Cold Chain capacity, Distribution System, Information management System, , Knowledge of staff, Stock Management System and Availability of vaccine and Chapter three provides the methodology used in the study. Chapter four results and discussion, finally chapter five deals with conclusion of the study and recommendation.

CHAPTER 2: LITRATURE REVIEW

The relevant literature on the study's primary subjects is examined in this chapter. This chapter lays out the theoretical underpinnings of the inquiry. With an emphasis on the study's aims and theoretical thresholds, the chapter examines related and current studies on the concept of the cold chain management practice and vaccine availability. The global perspective of vaccination distribution and management, as well as vaccine cold chain management in Ethiopia were reviewed here. At this point many from world perspective, African and Ethiopian related research papers, books and published materials reviewed. The historical perspectives and the study's conceptual framework are discussed in this chapter.

2.1. **Health Professionals Knowledge on Vaccines**

Cold chain staffs are usually trained in specialized operations such as warehouse management, cold chain record keeping and, providing commodity security, rather than the higher-order planning, analytical, and performance management skills that supply chain managers require. According to research conducted in many countries, primary health care facilities have insufficient knowledge and procedures addressing cold chain management (de Timóteo Mavimbe & Bjune, 2007, 2007). Cold chain managers should have a good planning skill and ensuring staff's knowledge regarding vaccine. Transporting vaccines without prior understanding of how to manage them can have a significant impact on their potency, resulting in vaccine waste and, as a result, an increase in their price.

Installation and maintenance of cold chain equipment demands the availability of appropriately qualified workers, replacement parts, a method to monitor apparatus performance, and the capability to reply rapidly to interruptions and failures. Despite the fact that existing supply chains should already have maintenance strategies in place, previous cold chain audits have revealed consistent flaw (PATH, 2008). It's a never-ending task to develop, procure, provide, and manage shipment and storage goods, such as appropriate vehicles, freezers, and cold boxes.

2.2. Cold Chain Capacity

Vaccines may lose their usefulness if they become too warm or too cold at any time. Vaccines naturally damage over time, and storage outside of the suggested temperature range – including during transport – may speed up loss of potency, which cannot be reversed. The result from such situation may be lack of immune response for vaccinated individual plus poor protection from disease. Inappropriate storage and transport also results in wastage and unnecessary costs to the NHS (WHO, March, 2017).

Only 46 (or 76.7 percent) of the 60 health institutes had working refrigerators. Only 35% (twenty one institutions) have a backup generator, and 46.6% (twenty eight institutions) own either car or motorcycle to transport vaccines when power is interrupted. in this study the proper storage temperature for vaccine (2 °C – 8 °C) in refrigerator's known only by 48.3% of respondents, and the results of this study revealed that only 23 (38.3%) of respondents knew enough about vaccine cold chain management. The findings of this study also revealed that 35 (58.3%) of vaccine cold chain management practices were satisfactory, while the remaining 25 (41.7%) were not (Bogale, 2019)

2.3 Information Management system

In many countries, there is a lack of accurate forecasts of the target population and region, as well as reliable statistics on past vaccine use. Population estimates, birth rates, infant mortality rates, vaccine disposal rates, and utilization assessments over the past few years are used to predict national vaccine usage (Kaufmann et al ., 2011). Inaccurate combinations of estimates result in repeated inaccurate vaccination predictions each year, as even the best-organized census data from poor countries is updated only every 10 years. Mistakes can lead to vaccine shortages and over orders, which can lead to logistics burdens and additional costs in certain countries. It seems that the excess rate is high(EFMOH, 2013).Census counts that are inaccurate or outdated, population movements, and unanticipated changes in birth rates all add to the problem. Health managers found locally may try to balance using this head counts, but this introduces biases of

their own such as overstated numbers to safeguard an adequate supply of vaccines and deflated numbers to make coverage rates appear high (EFMOH, 2013).

There is a noticeable lack of coordination between those who finance and buy the vaccines to ship them to the poor countries and the supply-chain managers and storekeepers who are in charge of collecting and distributing the supplies. The limits faced by vaccine officials in impoverished nations are little understood by financing and procurement players. Supply-chain planners and managers are infrequently engaged or involved in the plans that result in incoming vaccine shipments (Kaufmann et al., 2011).

2.4 Stock Management system

One of the core functions of the vaccine supply chain is to keep vaccine products properly refrigerated along every step in their journey. While simple in theory, maintaining proper temperatures for products that can tolerate neither excessive heat nor cold is practically challenging in hot or cold climate areas, low means of transportation, and interrupted electricity. Temperature monitoring, then, is a critical tool that managers use to assess vaccine handling quality, detect malfunctioning equipment, and prevent temperature fluctuations that can negatively impact vaccine potency and safety. (PATH, 2013) and (WHO, Imunization delivery, 2013).

2.5. Distribution System

Well-maintained statistics may be used to evaluate the exceptional of the vaccine cold chain, display the overall performance of cold chain system through the years and reveal compliance with true vaccine distribution practices. In number one vaccine stores, non-stop temperature monitoring is required. Regardless of the temperature monitoring tool used, temperatures in constant cold chain management places have to remain recorded manually two times daily morning and afternoon, seven days per week in big vaccine stores and as a minimum 5 days per week in smaller sub countrywide vaccine stores and health centers. According to WHO,

manually recording of temperature two times an afternoon is a trademark of assigned employees for this particular project and who may be capable of deliver reaction immediately (WHO, 2011).

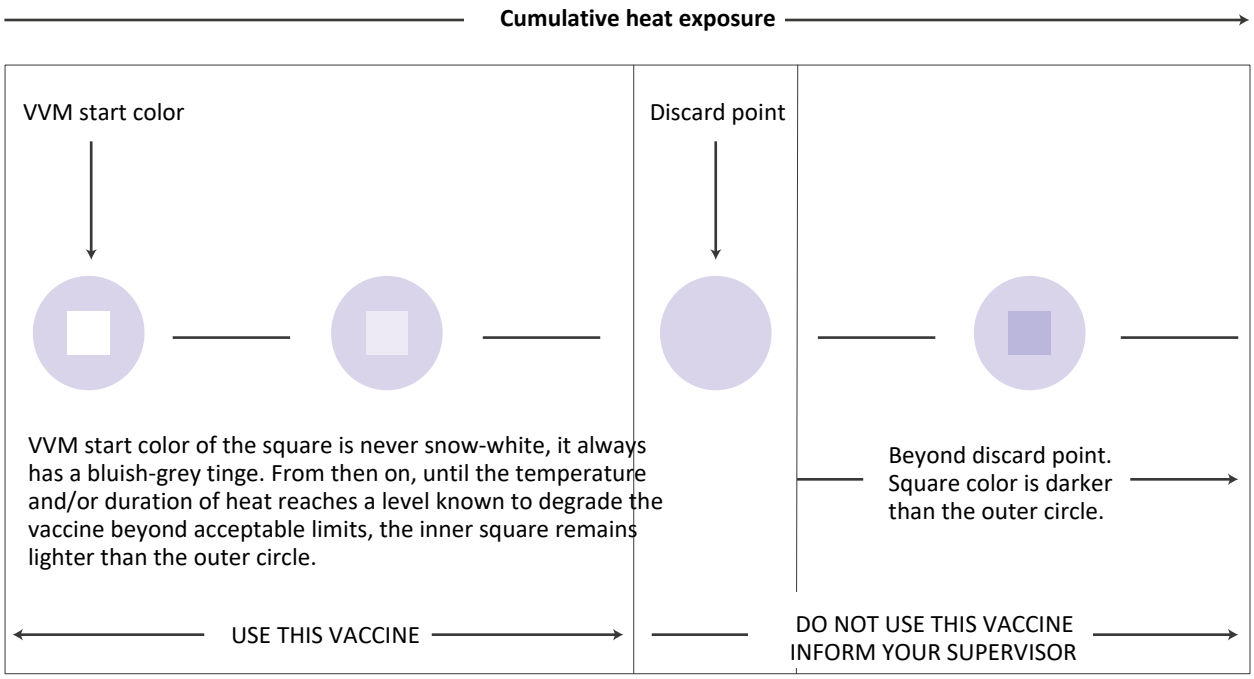
A well-trained staff, reliable storage and temperature monitoring equipment, accurate vaccine inventory management are the three main elements effective cold chain relies on. ACIP's. "Vaccine exposed to wrong temperatures that is involuntarily administered should generally be repeated." Is a statement made by General Best Practice Guidelines for Immunization (CDC, ACIP, May 15, 2022).

A breach in the cold chain can result in people having excess doses, increased expenses for providers, and a loss of public trust in vaccinations. Patients who refuse revaccination risk being defenseless against deadly, vaccine-preventable infections. The appearance of vaccines isn't always a trustworthy indicator of how well they've been preserved. Inactivated vaccines, for example, may not look frozen even when subjected to freezing temperatures, indicating that their potency has been decreased or destroyed. Providers may guarantee that patients receive high-quality vaccine that has not been tampered with by following a few easy procedures and employing CDC-recommended storage and handling guidelines (CDC, 2021).

Temperature monitoring devices are recommended by the WHO based on the unique cold chain equipment application and monitoring purpose. The Performance, Quality, and Safety (PQS) criteria and verification processes established by the World Health Organization (WHO) establish basic technical and usability standards for these devices. Although the performance quality and durability of these devices are unknown, the variety of available devices extends beyond those that are officially prequalified. Market performance monitoring and updating parameters regularly have been done by (WHO) to keep up with advanced technology and changing customer needs (WHO, 2015).

Vaccine vial monitors (VVMs) are the simplest temperature monitoring system that mechanically accompanies vaccines all through the complete deliver chain. A VVM is a chemical indicator label that's implemented to a vaccine vial, ampoule or different kind of number one box via way of means of the vaccine manufacturer.

Figure.1 Vaccine vial display shade alternate collection and interpretation



The fundamental goal of VVMs is to prevent the administration of heat-damaged vaccinations. The VVM status is also used to determine whether vaccines can be safely maintained following a cold chain faller, reducing vaccine waste. VVM status also aids in determining the order in which vaccines should be used: a batch of vaccine with VVMs that show high heat exposure but have not yet reached their discard points should be distributed and used ahead of a batch with lesser heat exposure, even if the expiration date is later. VVM status should be checked before shipping and manually documented on arrival vouchers at retailers and health facilities to maintain vaccination traceability in the supply chain. VVMs should be examined as well (WHO, July, 2015).

2.7. Availability of Vaccine

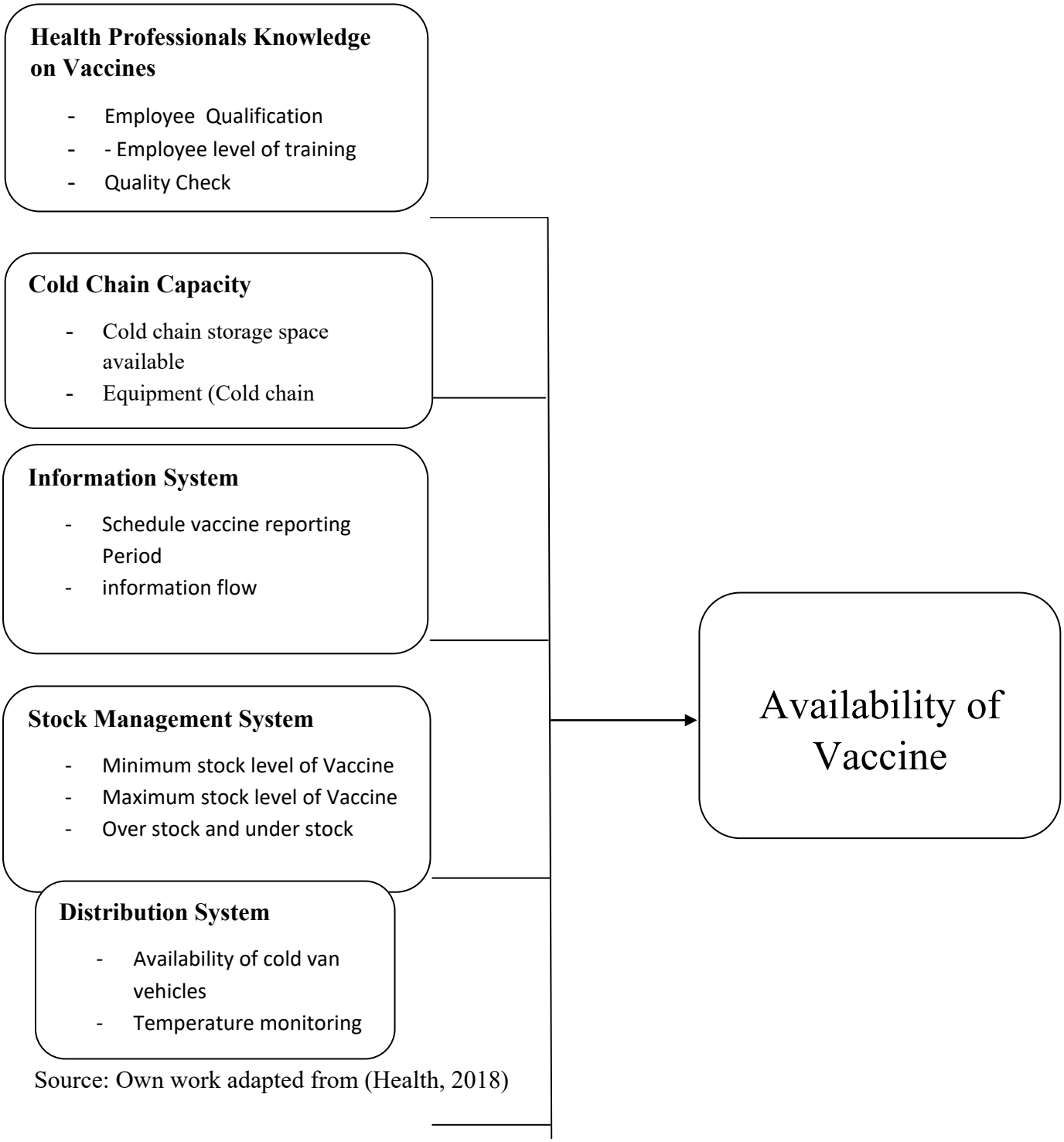
This Global Challenge Report has examined factors that impact the availability of innovative vaccines on a global scale, especially in developing countries. Up to know, it has been observed at the various components of vaccine innovation and production, namely R&D, the regulatory pathway, production, and distribution. In doing so, it has noted several impediments that exist throughout this lengthy process, which the private and the public sectors address through a range of mechanisms. It has tested the contribution of policies, inclusive of pull mechanisms and strategic IP management, in stimulating competition, innovation, and the large diffusion of recent vaccines. To summarize, the essential venture is to manipulate IP, collectively with the complicated set of associated problems affecting availability and access, in methods that enhance human welfare, at the same time as contributing to the belief of SDG 3: Ensure healthful lives and sell welfare for all at any age (chalange, 2017).

The temperature range for keeping and exporting immunizations should be based on manufacturer data, according to the WHO. It's crucial to know how long and at what temperature each vaccination may be stored. Vaccines can be stored indefinitely at room temperature (between 2 and 8 degrees Celsius). However, only a few vaccinations may be stored at negative temperatures (between -15 and 25°C) (CDC, April 12, 2022).

As (Adida, Dey, & Mamani, April 8, 2012) pointed out, the emergence of operational challenges on the supply side and unfavorable network effects on the consuming side are the two main reasons why reaching an optimal level of vaccine coverage is challenging. These two factors must be addressed in order to create the best vaccination supply solution. There are many restrictions that must be considered when planning the distribution of vaccines. This includes the impact of vaccine planning and presentations on cold chain requirements, vaccine transport while maintaining the cold chain, immunization-related information systems, vaccine supply chain technical capabilities, vaccines, and more, cost and waste, as mentioned by (Zaffran et al., 2013).These difficulties must be solved in order to go forward.

Conceptual Frame work

Figure 2: Conceptual Framework



Source: Own work adapted from (Health, 2018)

3. CHAPTER THREE: METHODOLOGY

This chapter deals how the research was conducted to achieve the objectives of the study. It consists of the research design, method of data collection, sampling design, data collection instrument and method of data analysis.

3.1 Study area

The study was conducted in the largest and capital city of Ethiopia, Addis Ababa. Based on the Central Statistical Agency Population Projection result of 2020/21, Addis Ababa has an estimated total population of 3,770,554 (Ministry of Health, 2021). It is administratively sub subdivided into 11 sub-cities. Currently, there are 102 functional public health centers, 13 public hospitals and 2 EPSA hubs (Ministry of Health, 2021). The study area of this thesis will be the Ethiopian Pharmaceuticals Supply Agency Addis Ababa Hub and public health facilities in Addis Ababa.

3.2 Research design

This study followed a quantitative technique with an explanatory take a look at layout to generate solutions to the studies questions. This studies layout became desired as it seeks to set up motive and impact relationships from a pattern of human beings who've been decided on to symbolize a described population, however without experimental manipulation (Burns & R.., 2008).The facts became accrued all on the equal time (or inside a quick time frame). So that, it could be taken into consideration as an institution-primarily based totally cross-sectional take a look at layout with a purpose to be used to conduct, assess, and describe the nature, condition, and diploma of the prevailing scenario of immunization Cold Chain exercise of the EPSA and health facilities.

Research approach

The study mainly focuses on the assessment of vaccine Cold Chain management in EPSA Addis Ababa Hub and public health facilities in Addis Ababa. Therefore a quantitative research approach that involves retrospective facility-based quantitative methods was used.

3.3 Population and sample

To determine the sample size for selecting health centers in this study the researcher employed a sample determination formula developed by Cochran in 1963.

$$n_o = \frac{Z^2 pq}{e^2}$$

Where n_0 is the sample size, Z^2 is the abscissa of the normal curve that cuts off an area α at the tails (1 – α) equals the desired confidence level, e is the desired level of precision, p is the estimated proportion of an attribute that is present in the population, and q is 1-p. Therefore in this research

$$n_0 = \frac{1.96^2 * (0.5)*(0.5)}{(0.05)2} = 384.16 \sim 385$$

Since the population is small then the sample size can be reduced slightly. This is because a given sample size provides proportionately more information for a small population than for a large population. The sample size (n_0) can be adjusted using the following formula.

$$n = 385/ (1+ ((385-1)/86)) = 80.81 \sim 81$$

Therefore, using the formula, the sample size of the study with 95 confidence level and 0.5 level of variability is calculated to be 81.

Population of a study is explained as a comprehensive group of individuals, institutions, objects and so forth which have a common characteristics that are the interest of a researcher (Rafeedale, 2013). So according to the above definition the population of this study was 69 health centers, 2 EPSA and 10 Hospitals.

3.5 Data source and type

Data was collected from vaccine administrator staff or vaccination personnel. For this study questionnaire was used as a means of investigation. The questionnaire consists of three parts It is a 5-pointLikertscale, which is divided into four parts as follows. The first part of the survey is the Demographics of the respondents. Request for personal data Samples of gender, age, education, profession, etc. were included. Part 2 of Surveys is a practice of cold chain management practice of the study area questions about Storage, Distribution, information systems, and technical and cold chain capabilities of the facilities related to cold Chain management is included in this part. Part 3 asks about the availability of vaccines.

3.6 Data collection procedures

The procedure for the data collected in this survey is that the researcher initially contacted the respondents to get their consent. Once their approval is obtained, the questionnaire is distributed to each participant. Finally, the survey data collected and checked the integrity of the data.

3.7 Ethical considerations

A formal letter written from Addis Ababa University College of business and economics school of commerce to sampled public health facilities requesting the study. The data collection done after getting consent from medical directors of the health facilities, EPI focal and pharmacy professionals who were involved in the study. Besides, the names of the health facilities assessed other information have been kept confidential throughout the process of data collection, analysis, presentation, and interpretation of results.

3.8 Reliability and Validity

The purpose of this phase is to explain the reliability of the measurement tools used in this research. The motive of this segment is to give an explanation for the reliability of the dimension equipment used in this research. This is essential due to the fact reliability shows whether or not the instrument's measurements are correct. There aren't errors, so you get dependable results. The maximum generally used technique in this literature for assessing scale reliability and balance is to apply Chronbach Alpha statistics. It identifies the variety wherein the factors are related as a set. A Low Chronbach alpha fee method that the objects not measure the identical composition. The excessive alpha fee of Chronbach indicates this object measures and displays the composition very well. Ideally, Chronbach Alpha needs to be closed to 0.70 to create a dependable scale (Burns & Burns, 2008). Therefore, forty-three inner reliability Item scales evaluates the usage of Cronbach's alpha factor. The scale gave an alpha 0.886, which is very acceptable.

3.9 Data analysis method

The information from this survey have been analyzed the use of pc software (SPSS: Statistics for Social Science Package) model 20.0.

The statistical strategies carried out are:

- Respondents' demographic historical past facts changed into analyzed and presented

Use descriptive records within side the shape of frequency and percentage.

- Cold chain management practices and evaluation of vaccine availability descriptive records within side the shape of imply and widespread deviation has been used.
- Analyzed the impact of cold chain management practices on vaccine availability Presented through ordinal regression evaluation.
- Survey scores have been analyzed the use of a 5-factor score scale or a 5-factor score scale Likert scale.

4. CHAPTER FOUR: DATA PRESENTATION, ANALYSIS, AND DISCUSSION

This chapter covers data analysis, research findings (results), and the researcher's interpretation of the findings based on the findings. The general features or demographic profile offered by descriptive statistics are covered in this chapter. Correlation analysis, as a side note, is used to show the relationship between the variables. Finally, the results of multiple regression will be provided in order to estimate the value of vaccination availability using independent variables, which will be evaluated in this chapter.

4.1 Response rate

In Addis Ababa, a total of 81 questionnaires were delivered to government health facilities, with 79 of them being totally completed and returned. The remaining 2 questionnaires were not collected due to refusal to respond to the questions. This resulted in a response rate of 97.5 percent. According to Mugenda, the statistically relevant response rate for analysis should be at least 50% (Mugenda, O.M. and Mugend, 2003). As a result, the study's response rate can be judged adequate.

4.2Demographic characteristics of the participants

The study sought to determine the general characteristics or the demographic profile of the study participants by using five variables that were exhibited in table 1, and they were analyzed in frequency statistics accordingly.

Table1. Demographic characteristics

Demographic characteristics			
		Frequency	Percent
Gender	Male	23	29.1
	Female	56	70.9
	Total	79	100.0
Profession	Pharmacist	5	6.3
	Druggist	24	30.4
	Nurse	50	63.3

	Total	79	100.0
Education	Diploma	27	34.2
	Degree	49	62.0
	Masters	3	3.8
	Total	79	100.0
Experience	6Month-1Year	3	3.8
	1Year-3Year	8	10.1
	3Year-5Year	22	27.8
	>5Year	46	58.2
	Total	79	100.0
Type of Institution	Health Center	68	86.1
	Hospital	9	11.4
	EPSA Addis Ababa	2	2.5
	Total	79	100.0

Survey data 2022

Table 1 shows that 23 of the participants were male and 56 were female, accounting for 29.1% and 70.9 percent of the total. Pharmacists 5 (63. 3%), Druggists (24.4%), and Nurses (50%) were the professions of the respondent's. Diploma 27 (34.2%), Degree 49 (62%), and Masters 3 (3.8 percent) were the educational backgrounds of study participants. Based on these findings, it is feasible to conclude that the majority of respondents have a thorough comprehension of the study's goal in general and the questionnaire's items in particular, which is a strong indicator of the study's quality.

When we look at respondents work experience 6 month-1 Year 3 (3.8%), 1 year – 3 year 8 (10.1%), 3 year – 5 year 22 (27.8%), and above 5 year 46 (58.2%).But in general the data implies the respondents had a reasonable experience in their job which enables them to evaluate the vaccine cold chain management and availability of vaccines.

Finally type of institutions surveyed were Health center 68 (86.1%), Hospital 9 (11.4), EPSA Addis Ababa 2 (2.5%).

4.3 Descriptive statistics

Respondents were asked to assess cold chain management practice and vaccine availability. The measurement is based on a five-level Likert scale of all from 1 to 5 I strongly agree. The arithmetic mean estimate is based on the following assumptions: If the average is between 0 and 1.5, it means that the respondents strongly opposed the following: If the average is [1.50-2.50], this means that the respondents did not agree with the average. Between [2.50 and 3.50] means that the respondents are neutral, and [the average between 3.50 and 3.50 is 4.50) means that the respondents agreed, and an average of 4.50 and above indicates the respondents completely agreed (Burns & R.., 2008).

Therefore, the mean average results and their respective variables were presented, analyzed, and interpreted individually as follows:

4.3.1. Knowledge of staff in Vaccine Management

Table 2 Mean score of Knowledge of staff in Vaccine Management

No of Items	N	Mean	Std. Deviation
1. There is adequate knowledge about vaccine characteristics	79	4.13	0.822
2. There is sufficient knowledge about how to complete the vaccine requisition form.	79	3.92	0.944
3. There is sufficient knowledge about how to calculate the wastage rate.	79	3.96	1.006
4 The health workers know how to conduct the shake test.	79	3.85	0.921
5. There is sufficient knowledge about the Min-Max range of vaccines.	79	3.95	0.932
6. There is sufficient knowledge about how to use multiple-dose vials.	79	3.86	1.034
Knowledge of staff in Vaccine Management	79	3.95	0.94

Source survey data 2022

Table 1 illustrates that the respondents agreed on their adequate knowledge about vaccine characteristics with (mean=4.13, s.d=0.822). They agreed on their sufficient knowledge about how to complete the vaccine requisition form with (mean=3.92, s.d=0.944), There is sufficient knowledge about how to calculate the wastage rate. (Mean=3.96, s.d=1.006). The health workers know how to conduct the shake test (mean=3.85, s.d=0.921). There is sufficient knowledge about the Min-Max range of vaccines. (Mean=3.95,s.d=0.932). There is sufficient knowledge about how to use multiple-dose vials (mean=3.86, s.d=1.034). The average Knowledge and skill in vaccine management is (mean =3.95, sd=0.94).

4.3.2. Cold chain capacity

Table 3 Mean score of Cold chain capacity

	No of items	**N**	**Mean**	**Std. Deviation**
1	There is sufficient +2°c to +8°c storage capacity for vaccine storage.	79	4.37	0.989
2	Emergency contact details (name, phone #, etc.) are posted in the vaccine store.	79	4.00	0.974
3	The health facility prepared and posted a contingency plan.	79	4.11	0.934
4	The responsible health worker knows what to do in the event of an emergency.	79	4.23	0.784
5	All ice-lined refrigerators are fitted with the correct vaccine storage baskets.	79	4.19	0.786
6	A standby generator is required and available.	79	4.14	1.009
7	There is a written planned preventive maintenance (PPM) program (daily, weekly, and monthly).	79	4.15	0.907

8	Vaccines are correctly stored.	79	4.01	1.104
9	The dry store is clean, dry, and pest-free.	79	3.61	0.668
	Cold chain capacity	79	4.09	0.91

Table 2 illustrates that the respondents agreed on the storage capacity for vaccine with (mean=4.37, s.d=0.989). They agreed on Emergency contact details (name, phone #, etc.) are posted in the vaccine store. (Mean=4.00, s.d=0.974).The health facility prepared and posted a contingency plan. (Mean=4.11,s.d=0.934). The responsible health worker knows what to do in the event of an emergency (mean=4.23, s.d=0.784). All ice-lined refrigerators are fitted with the correct vaccine storage baskets. (Mean=4.19, s.d=0.786). A standby generator is required and available. (Mean=4.14, s.d=1.009). There is a written planned preventive maintenance (PPM) program (daily, weekly, and monthly). (mean=4.145s.d=0.907). Vaccines are correctly stored (mean=4.01 s. d=1.104).The dry store is clean, dry, and pest-free (mean=43.61 s. d=0.668).
The average Cold chain capacity is (mean=4.09 s.d=0.91).

4.3.3. Information System

Table 4 Mean score of Information system

Column1	No of Items	N	Mean	Std. Deviation
1	The facility has proper vaccine forecasting.	79	3.39	0.926
2	Consumption reports are regularly prepared and reported to the appropriate organization.	79	3.86	0.828
3	Vaccine stock balance and physical count of sample vaccine are equal.	79	3.54	0.844
4	Vaccine requisition forms are used for ordering vaccines.	79	4.04	0.884
5	SOPs are available to ensure a proper Information system.	79	3.92	0.764
6	SOPs are followed to ensure a proper Information	79	3.94	0.806

	system.			
7	There is an adequate inventory management system in the health facility	79	3.96	0.792
8	Vaccine wastage reports are regularly prepared and reported to the appropriate organization	79	3.94	0.882
	Information System	79	3.82	0.84

Table 3 illustrates that the respondents agreed on proper vaccine forecasting with (mean=3.39, s. d=0.926). Consumption reports are regularly prepared and reported to the appropriate organization (mean=3.86, s. d 0.828). Vaccine stock balance and physical count of sample vaccine are equal (mean=3.54, s. d 0.844). Vaccine requisition forms are used for ordering vaccines (mean=4.04, s. d 0.844). SOPs are available to ensure a proper Information system (mean=3.92, s. d 0.764). SOPs are followed to ensure a proper Information system (mean=3.94, s. d 0.806). There is an adequate inventory control system in the health facility (mean=3.96, s. d 0.792). Vaccine wastage reports are regularly prepared and reported to the appropriate organization (mean=3.94, s. d 0.882). The average Information System is (mean=3.82 s. d=0.84).

4.3.4. Stock Management System

Table 5 Mean score of Stock Management System

Column 1	**No of items**	**N**	**Mean**	**Std. Deviation**
1	There is standard vaccine requisition forms used for ordering vaccines, monthly or Quarterly.	79	4.11	0.816
2	There is type, presentation (vial size), Quantity in doses, manufacturer, batch or lot number, VVM status of vaccine, and diluents recorded for each vaccine.	79	4.10	0.826

3	There are immunization supplies recorded (AD syringe, Mixing syringes, safety box) in vaccine ledger book at all time of transaction.	79	3.92	0.874
4	The facility has a completed arrival and/or issues a voucher for every delivery which took place during the last month.	79	4.09	0.720
5	The facility properly recorded wasted vaccines (Expired, VVM change, Freezing, etc.) in the ledger book in the last completed month.	79	3.95	0.986
6	The facility conducted a physical count in the last completed month.	79	4.01	0.840
7	The facility calculates wastage rates for each vaccine in the completed month.	79	4.04	0.839
	Stock Management System	79	4.03	0.84

Table 4 illustrates that there is standard vaccine requisition forms used for ordering vaccines, monthly or Quarterly with (mean=4.11, s. d=0.816).There is type, presentation (vial size), Quantity in doses, manufacturer, batch or lot number, VVM status of vaccine, and diluents recorded for each vaccine(mean=4.10, s. d=0.826).There are immunization supplies recorded(mean=3.92, s. d=0.874).The facility has a completed arrival and/or issues a voucher for every delivery which took place during the last month(mean=4.09, s. d=0.720).The facility properly recorded wasted vaccines(mean=3.95, s. d=0.986).The facility conducted a physical count in the last completed month (mean=4.01, s. d=0.840).The facility calculates wastage rates for each vaccine in the completed month(mean=4.04, s. d=0.84).The average Stock Management System is (mean=4.03 s. d=0.84).

4.3.5 Distribution System

T able 6 Mean score of Distribution System

	Item list	N	Mean	Std. Deviation
1	There are special vehicles for the transportation of cold chain items.	79	3.71	0.922
2	There is a temperature monitoring system during transportation.	79	3.61	0.838
3	Temperature readings remain between 2-8oCduring transportation.	79	3.81	0.893
4	The vaccine distribution schedule timetable is available (Known).	79	3.87	0.774
5	On-time delivery is done within recommended timelines.	79	3.75	0.869
6	SOPs are available to ensure proper transport conditions.	79	3.77	0.816
	Distribution System	79	3.75	0.85

Table 5 illustrates that the respondents agreed on their special vehicles for the transportation of cold chain items (mean=3.71 s. d=0.922).There is a temperature monitoring system during transportation (mean=3.61 s. d=0.838). Temperature readings remain between 2-8^{o}Cduring transportation (mean=3.81 s. d=0.893). The vaccine distribution schedule timetable is available (mean=3.87 s. d=0.774).On-time delivery is done within recommended timelines (mean=3.75 s. d=0.869). SOPs are available to ensure proper transport conditions (mean=3.75 s. d=0.816). The average distribution system is (mean=3.75 s. d=0.85).

4.3.6. **Availability of Vaccine**

Table7. Availability of Vaccine

		N	Mean	Std. Deviation
1	There is bundling for all Vaccines, diluents, Syringes, droppers, and safety boxes available proportionally.	79	3.86	0.828
2	Vaccine stocks are sufficient throughout the completed one month (no stock outs).	79	3.52	0.904
	Availability of Vaccine Management System	79	3.69	0.87

The above table shows that there is bundling for all Vaccines, diluents, Syringes, droppers, and safety boxes available proportionally.(mean=3.86,s.d=0.828).vaccine stocks are sufficient throughout the completed one month (no stock outs) (mean=3.52,s.d=0.904).On average Availability of Vaccine Management System(mean=3.69, s.d=0.87).

4.5 Regression analysis of study variables

A standard multiple regressions was performed between availability of vaccine as the dependent variable and Storage system Transportation system Technical capacity and Information system as independent variables.

Table 9 Case Processing Summary

		N	Marginal Percentage
Availability	2.00	1	1.3%
	2.50	2	2.5%
	3.00	22	27.8%
	3.50	22	27.8%
	4.00	14	17.7%
	4.50	7	8.9%
	5.00	11	13.9%
Valid		79	100.0%
Missing		0	
Total		79	

Table 10 Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	261.698			
Final	219.865	41.833	5	.000

Link function: Logit.

The Case Processing Summary tells the proportion of cases falling at each level of the dependent variable. The Model Fitting Information (see right) contains the -2 Log Likelihood for an Intercept only (or null) model and the Full Model (containing the full set of predictors). We also have a likelihood ratio chi-square test to test whether there is a significant improvement in fit of the Final model relative to the Intercept only model. In this case, we see a significant improvement in fit of the Final model over the null model [$\chi^2(4)=41.833$, $p<.001$].

Table 11. Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	364.805	463	1.000
Deviance	219.865	463	1.000

Link function: Logit.

The "Goodness of Fit" table contains the Deviance and Pearson chi-square tests, which are useful for determining whether a model exhibits good fit to the data. Non-significant test results are indicators that the model fits the data well (Andy P Field, 2018). [Note: They do not always necessarily agree, as in the case we see here. So the results are somewhat mixed.] In this analysis, we see that both the Pearson chi-square test [$\chi^2(463)=364.805$, $p=1$] and the deviance test [$\chi^2(463)=219.865$, $p=1$] were both non-significant. These results suggest good model fit.

Table 12 Pseudo R-Square

Cox and Snell	.411
Nagelkerke	.427
McFadden	.160

Link function: Logit.

These are pseudo-R-square values that are treated as rough analogues to the R-square value in OLS regression. In general, there is no strong guidance in the literature on how these should be used or interpreted (Hahs-Vaugn, 2012) (Osborne, Jason W., 2015) (Thomas J. Smith. Cornelius M, 2013). As such, one should interpret these with caution.

Table 13 Parameter Estimates

Parameter Estimates			
	Estimate	Std. Error	Sig.
Knowledge & skill in Vaccine Management	0.508	0.364	0.163

Cold chain capacity	-0.99	0.498	0.047
Information system	-0.243	0.597	0.684
Stock Management System	1.285	0.565	0.023
Distribution	1.687	0.507	0.001

Parameter Estimates			
	Estimate	Std. Error	Sig.
Knowledge & skill in Vaccine Management	0.508	0.364	0.163
Cold chain capacity	-0.99	0.498	0.047
Information system	-0.243	0.597	0.684
Stock Management System	1.285	0.565	0.023
Distribution	1.687	0.507	0.001

Source survey 2022

Each of the independent variables in the model has its own regression coefficients and significance tests. The regression coefficients are directly translated as the predicted change in log odds of being in a higher (rather than lower) group/category on the dependent variable per unit increase on the independent variable (controlling for the remaining independent variables).As such…

A positive Estimate is interpreted as follows: There is an anticipated rise (of a given amount) in the log chances of dropping at a higher level of the dependent variable for every one unit increase on the independent variable. More broadly, this means that as scores on an independent measure rise, the likelihood of sliding to a greater level on the dependent variable rises as well. A negative Estimate is interpreted as follows: There is a predicted decrease (of a given amount) in

the log chances of dropping at a higher level of the dependent variable for every one unit rise on the independent variable. More broadly, this means that if scores on an independent measure rise, the likelihood of sliding to a higher level on the dependent variable decreases. In this table, the threshold estimates are given as intercepts. (Carl Benedikt Frey and Michael A. Osborne, 2017)States that these estimates can be interpreted as the “log odds of being in a particular group or lower when scores on the other variable(s) are zero”.

From the above table we found that:

1. Cold chain Capacity was a significant negative predictor of Interest in the next topic. For every one unit increase on cold chain capacity, there is a predicted decrease of .026 in the log odds of vaccine availability. This indicates that facilities scoring higher on capacity were more likely to indicate less interest in vaccine availability.

2. Stock Management System was a significant positive predictor of Interest in the next topic. For every one unit increase on capacity, there is a predicted decrease of 1.285 in the log odds of vaccine availability. This indicates that facilities scoring higher on Stock management system were more likely to indicate more interest in vaccine availability.

3. Distribution Syestem was a significant positive predictor of Interest in the next topic. For every one unit increase on capacity, there is a predicted increase of 1.687 in the log odds of vaccine availability. This indicates that facilities scoring higher on Distribution were more likely to indicate high interest in vaccine availability.

4.6 Discussion

This section contains in-depth talks of the research project. The current study's findings are explored in relation to the fundamental questions raised in chapter one. It also offers possible reasons for the above-mentioned findings. It was able to conclude from this research that vaccines are not being maintained properly to ensure maximum potency. Vaccines should be preserved at all times, starting at the plant where they are made and continuing through every stage until they are administered to children and mothers.

Knowledge of staff on Vaccine Management

In the prevailing research the respondents claimed that maximum of them have good enough knowledge on vaccine management. Additionally, these research contributors have a terrific information and talent on Vaccine coping with, offering for quit customers and soliciting for refill. Meanwhile this end result did now no longer in shape with different research achieved in distinct countries. In Tanzania, a research confirmed that majority of respondents have been no longer attended any schooling on vaccine, distribution and coping with strategies of vaccines (Mohamed Makuru, 2012). A research achieved on cold chain management information and practices in number one health care centers in Niassa, Mozambique indicated that 60% of the medical examiners had no pre- provider schooling in vaccine cold chain management and coping with (deTimóteo Mavimbe &Bjune, 2007).

According to the research at pharmaceutical vendors in Nairobi County 41% of respondents have without a doubt no unique schooling in cold chain (Njuguna, 2015). This way that maximum corporations aren't technically successful to deal with cold chain items and make sure their safety.

Cold chain Capacity

(Samant et al., 2007) confirmed facilities having generator was 65% of public health centers .This was in assessment to the prevailing the research where respondent agreed that everyone ice-coated fridges are geared up with the best vaccine containing baskets, a standby generator is needed and available, the accountable medical expert is aware of what to do with inside the occasion of an emergency, and the immunization area is clean, dry, and pest-free.

Even if they disagreed about how vaccines should be stored in the refrigerator and were unconcerned about storage capacity, the respondents in this poll agreed that their health facility had a dedicated vaccination storage area. While standard vaccine refrigerators were found in the majority of the healthcare institutions examined, just half of the visited healthcare facilities and retailers had excellent vaccine arranging practices, according to a study done in Tanzania's Cost area (Mugenda, O.M. and Mugend, 2003).

Stock Management System

Excessive heat or cold lowers the potency (strength) of vaccines, making them more likely to be skipped. The storage environment of vaccines at Addis Ababa's health centers is not ideal for ensuring the safety and availability of cold chain products. Controlling storage conditions and temperature is critical for maintaining the quality of cold chain goods and protecting patients from receiving substandard or ineffective medicines as a result of poor storage management (WHO, July, 2015).

Distribution System

In this study we understood that the transportation of vaccines follow the established procedures This is a result of availability of special vehicles for the transportation of cold chain items, there is a temperature monitoring system during transportation, SOPs are available to ensure proper transport conditions, and temperature readings remain between 2-8^{o}Cduring transportation. A similar study conducted in Nairobi`s cold chain supply logistics on the safety of vaccine shows up to 52 percent of respondents conformed there was poor validation and qualification of storage facility and monitoring device. There was no different storage equipment for different vaccine up to 41 percent of the organizations and hence run a risk of cross contamination and temperature excursions during storage which has compromised the quality of vaccine. The research confirmed that validate systems with respect to calibration of storage facility temperature probes and sensors and thermometer were generally poor along the supply chain with only 34 percent having satisfactory practice (Monicah W., 2015).

We discovered that vaccine availability has a moderate link with knowledge and skill in vaccine management (0.41 coefficient at 0.00 level), stock management system (0.531 coefficient at 0.00 level), and distribution (0.532 coefficient at 0.00 level). Meanwhile, there is a minor association between cold chain capacity and availability, with a value of 0.212 at the 0.01 level. With a value of 0.264 at 0.00, information systems have a weak positive connection with availability. Cold chain capacity and stock management system have a correlation of 0.461, which is significant at the 0.00 level. This indicates that cold chain

capacity and stock management systems have moderately good relations. In line with this study, a similar study conducted in Addis Ababa found that vaccination availability is marginally connected with storage, distribution, and information system.

The availability of vaccination in health centers was found to be positively influenced by storage, distribution, and information systems. Other studies have identified various deficiencies in storage and distribution systems as a major risk factor related with vaccination shortages (Bell, 2001).

5. CHAPTER FIVE: SUMMERY, CONCLUSION AND RECOMMENDATION

This chapter provides the summary of major findings, conclusions and recommendation of the study

5.1 Summaries on Findings

In this Research, the researcher found for the cold chain management practice and availability of vaccines in public health facilities of Addis Ababa. In order to gain those objectives, statistics have been accumulated from the cold chain accountable personnel with inside the health facility. From the demographic traits of respondents', the majorities (70.9%) have been female contributors and the remaining (29.1%) turned into male. In cognizant to their academic level, the contributors had at the least degree and it's miles viable to mention they have been educated. Coming to career and paintings enjoy of the respondents, that they'd good enough of each, which moderately growth the validity (as an entire the quality) of these studies. In descriptive data the effects display that the respondents desired to agree on Knowledge of staff in vaccine management, cold chain capacity, Information System, Stock management system and Distribution system.

The end result suggests that each one the variables are correlated every different after the distinctive analyses of the statistics it's finish that the maximum of the variables are slight definitely affected. There is big affiliation among the unbiased variables' cold chain management device, distribution device and potential with the based variable availability of vaccines. Other variables have been discovered to be insignificantly related to availability of vaccines in public health facilities of Addis Ababa.

5.2 **CONCLUSION**

In this study, the important determinant elements recognized on cold chain management practices primarily based totally on cold chain accountable personals' reaction. which contains of 5 additives; Knowledge in vaccine management, cold chain potential, Information System, Stock management system. Besides, their effect at the availability of vaccines was studied. Five important studies questions have been developed and addressed on these studies. All additives of cold chain management practices have been rated above average. In different words, vaccination availability turned into now no longer assured because of terrible cold chain management strategies in health facility. Respondents agreed in rating the supply of vaccines of their health facilities primarily based totally on the evaluation accomplished on vaccine availability in health facility. This does now no longer assure that the carrier is according to the guidelines' recommendations and it can obstruct the health facility' immunization services. Storage system and distribution system have been discovered to have a high quality and big impact on availability of vaccines. In the meantime capacity has poor big impact on availability of vaccines. Based on the findings of the look at it's going to now no longer be unwise to finish that distribution, inventory control and potential with inside the cold chain management ought to be progressed a good way to bring extrude with inside the availability of vaccines with inside the health facilities.

5.3. **RECOMMENDATION**

The researcher proposed the subsequent objects as sensible pointers based on the study's findings, which, if implemented, may want to result in inexperienced and effective cold chain management. The distribution system EPSS Addis Ababa hub doing should be supported by sufficient vehicles equipped with automated temperature monitoring device. Investing on Distribution system at EPSS will have direct impact on vaccine availability. The stock management system at every health facilities should be supported because; it does have a direct effect on vaccine availability.

So FMOH, UNICEF and others who can support health facilities should support on stock management system to improve vaccine availability. Meanwhile according to the respondents' response, supporting on cold chain capacity will have no impact on vaccine availability. This means Addis Ababa health facilities cold chain capacity is not a major problem in this study. But maintaining Cold chain capacity is a continuous process, so maintaining cold chain capacity is curtail for reliability of cold chain management system.

5.4 Suggestion for Further Study Future

Researches may observe broadening their coverage to encompass private health institutions and different governmental health facilities, similarly to public health facilities in Addis Ababa. Additional studies on cold chain management techniques, in particular on vaccine wastage rates to determine actual vaccine wastage, in addition to assessment studies among public and business centers, can be conducted.

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ADDIS ABABA UNIVERSITY COLLEGE OF BUSINESS AND ECONOMICS SCHOOL OF COMMERCE FOR DEGREE OF MASTER IN LOGISTICS AND SUPPLY CHAIN MANAGEMENT (LSCM)

Questionnaire for effect of Vaccine cold Chain Management practice on Vaccine availability in EPSA Addis Ababa Hubs and facilities working with.

Good day. I am Firew Ayele a student from Addis Ababa University, College of Business and Economics School of Commerce, and I am carrying out a research on effect of Vaccine cold Chain Management practice on Vaccine availability in Addis Ababa. You have been identified as one of the key persons for this study and therefore you are requested to give information honestly on Vaccine supply chain management as per the questionnaire.

The purpose of this questionnaire is to collect data on effect of vaccine cold chain management practice on vaccine availability at EPSA Addis Ababa hubs and health facilities found in Addis Ababa. The findings will assist in forming strategies and opportunities for improvement. Please express your opinions honestly. Your responses will remain confidential and anonymous and will only be used for purposes of the research in aggregated forms. Your participation and assistance in completing this study is highly appreciated.

The questions take only few minutes to complete so you are kindly requested to fill all questions completely.

Thank you in advance for your cooperation!!

Name: - Firew Ayele

Phone: +251-913-76-8772

E-Mail:- fireaye@gmail.com

Instructions: - Kindly provide responses by ticking in the boxes as applicable and by filling in the spaces provided.

SECTION A: Background

Q1. Gender? Male☐ Female☐

Q2. What is your profession? Druggist☐ pharmacist☐ Doctor☐ Nurse ☐ Other (specify)

Q3. What is your highest education attained? Certificate☐ Diploma☐ Degree☐ Masters☐

Q4.your work experience? Less than 6 months☐ 6 months but less than 1 year☐ 1 year but less than 3 years ☐ 3 years but less than 5 years☐ above 5 years ☐

Q5. Health facility type? health center ☐ hospital ☐ EPSA Addis Ababa ☐

Part two: vaccine distribution system

Please rate to what extent you agree on the following vaccine distribution system components are applicable to your organization. The scale below will be applicable: 1 – Strongly disagree 2 – Disagree 3- Neither agree nor disagree 4- Agree 5 – Strongly agree

s. NO	Knowledge& Skill on Vaccine Management	1	2	3	4	5
1	There is adequate knowledge about vaccine characteristics.					
2	There is sufficient knowledge about how to complete vaccine requisition form.					
3	There is sufficient knowledge about how to calculate wastage rate.					
4	The health workers know how to conduct the shake test.					
5	There is sufficient knowledge about the Min-Max range of vaccines.					
6	There is sufficient knowledge about how to use multiple-dose vials.					
	Cold Chain Capacity	1	2	3	4	5
7	There is sufficient +2°c to +8°c storage capacity for vaccine storage.					
8	Emergency contact details (name, phone # etc.) posted in the vaccine store.					
9	The health facility prepared and posted contingency plan.					
10	The responsible health worker know what to do in the event of an emergency.					

11	All ice-lined refrigerators fitted with the correct vaccine storage baskets.					
12	Standby generator is required and available.					
13	There a written planned preventive maintenance (PPM) programme (daily, weekly, monthly).					
14	Vaccines are correctly stored.					
15	The dry store is clean, dry and pest-free.					
	Information system	1	2	3	4	5
16	The facility has proper vaccine forecasting.					
17	Consumption reports are regularly prepared and reported to the appropriate organization.					
18	Vaccine stock balance and physical count of sample vaccine are equal.					
19	Vaccine requisition forms are used for ordering vaccine.					
20	SOPs are followed to ensure proper Information system.					
21	There is adequate inventory control system in the health facility					
22	Vaccine wastage reports are regularly prepared and reported to the appropriate organization					
	Stock Management System	1	2	3	4	5
23	There is standard vaccine requisition forms used for ordering vaccine, monthly or Quarterly.					
24	There is type, presentation (vial size), Quantity in doses, manufacturer, batch or lot number, VVM status of vaccine and diluents recorded for each vaccine.					
25	There are immunization supplies recorded (AD syringe, Mixing syringes, safety box) in vaccine ledger book at all time of transaction.					
26	The facility have a completed arrival and/or issue voucher for every delivery which took place during the last month.					

27	The facility properly recorded wasted vaccine (Expired, VVM change, Freezing, etc.) in the ledger book in the last completed one month.					
28	The facility conducted physical count in the last completed one month.					
29	The facilities calculate wastage rates for each vaccine in the completed month.					
	Distribution System	1	2	3	4	5
30	There are special vehicles for transportation of cold chain items.					
31	There is temperature monitoring system during transportation.					
32	Temperature readings remain between 2-8^{o}Cduring transportation.					
33	Vaccine distribution schedule time table is available (Known).					
34	On time delivery is done within recommended timelines.					
35	SOPs are available to ensure proper transport conditions.					
	Availability of Vaccine Management System	1	2	3	4	5
36	There is bundling for all Vaccines, diluents, Syringes, Dropper and safety box available proportionally.					
37	Vaccine stocks sufficient throughout the completed one month (no stock outs).					

APENDEX 3

Data output SPSS

Regression

Table 9

Case Processing Summary

		N	Marginal Percentage
Availability	2.00	1	1.3%
	2.50	2	2.5%
	3.00	22	27.8%
	3.50	22	27.8%
	4.00	14	17.7%
	4.50	7	8.9%
	5.00	11	13.9%
Valid		79	100.0%
Missing		0	
Total		79	

Table 10

Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	261.698			
Final	219.865	41.833	5	.000

Link function: Logit.

Table 11

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	364.805	463	1.000
Deviance	219.865	463	1.000

Link function: Logit.

Table 12

Pseudo R-Square

Cox and Snell	.411
Nagelkerke	.427
McFadden	.160

Link function: Logit.

Table 13

Parameter Estimates			
	Estimate	Std. Error	Sig.
Knowledge & skill in Vaccine Management	0.508	0.364	0.163
Cold chain capacity	-0.99	0.498	0.047
Information system	-0.243	0.597	0.684
Stock Management System	1.285	0.565	0.023
Distribution System	1.687	0.507	0.001