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Immunization and Health Supply Chain  
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***VACCINE WASTAGE ASSESSMENT IN JUBKE STATE OF SOUTH SUDAN***

Dissertation submitted to the University of Rwanda, in partial fulfilment of the requirements for the degree of Masters in Health Supply Chain Management (MSc HSCM)

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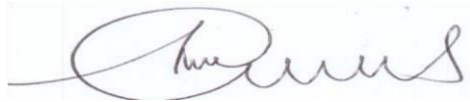
This dissertation is the original of my work and has never been submitted for degree in any university

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## Dedication

*This research is dedicated to my late parents, they were my true lovers in my life. To my lovely wife and my children you are dedicated your time in supporting me to complete this study.*

## Acknowledgment

This is to acknowledge the contributions of experts in Health supply chain management perspectives especially the staff of center of excellence for vaccine immunization and health supply chain for their keens administration. My special thanks goes to my supervisors Dr Mulatedzi Makhado, co-supervisor Dr Kashi Babara Carasso and my former manager and technical advisor to EPI program in South Sudan Dr Evans Mokaya. Your inputs in this journey is a great success to my research project and also to entirely career. I also acknowledge the support from my UNICEF colleague Dr Motuma Abeshu who encourage me to work hard for my success.

## Abstract

### Introduction

Vaccines are expensive commodities. If their temperature ranges are compromised, they lose their potency and cannot be regained. This research was a descriptive study on vaccine wastage assessment in immunization services delivery in Jubek state of South Sudan. It is paramount for healthcare professionals (vaccinators) to follow policies and guidelines and procedures set out by the EPI program in South Sudan. The success of any EPI program definitely depends on how well the health workers' knowledge on wastage policies, quality of stock management and adherence to policies and procedures.

### Methodology

Facility records based descriptive cross-sectional study was carried out in immunization services delivery in Jubek state of South Sudan. All vaccination records were reviewed for selected antigens. A structured questionnaire between January to December 2018 were included in the study. Number of doses issued (start balance +doses received) and the number of children vaccinated in that period were all obtained from the facility registers. The wastage rate for each antigen was calculated.

### Results

Nearly half of the facilities assessed had poor documentation practice that led to inaccurate vaccine stock records, a total of 138,720 doses of vaccines issued for (BCG, Penta, OPV, Measles, IPV and TT) were collected. Wastage rate for each antigen was calculated, the average wastage rate for BCG 64%, Measles 51%, Penta 24%, OPV 15%, IPV 12% and TT 12% across each level of health care setting ( Hospital, PHCC & PHCU).

### Discussions

In the study finding, there was an evidence of discrepancies between tally sheets, monthly summary and district health information system (DHIS). The wastage rate for lyophilized vaccines (BCG & Measles 64% & 51% respectively). It is higher than the national EPI policy and guidelines for vaccine management.

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## List of abbreviations and acronyms

CDC	Center for Diseases control and prevention
CHD	County Health Department
CMS	Central Medical Store
CMYP	Comprehensive Multi-year Plan EEFO
EEFO	Early Expiry First out
EVM	Effective Vaccine Management
EPI	Expanded Program on Immunization
GAVI	Global Alliance, vaccine immunization
GDP	Gross Domestic Product
HPF	Health Pooled Fund
HOSP	Hospital
HF	Health Facility
MOH	Ministry of Health
NVS	National Vaccine Store
PHCC	Primary Health care Centers
PHCU	Primary Health Care Units
SOPs	Standard Operating Procedures
UNICEF	United Nations International Children's Emergency Fund
VWR	Vaccine Wastage Rate
WB	World Bank
WHA	World Health Assembly
WHO	World Health Organization

## Chapter one: Introduction

### Background of the study

Immunization is the central pillar of universal health coverage providing an infrastructure on which an effective and equitable health system can be constructed and saves 2-3 million lives every year (1). In 2007, United Nations International Children's Emergency Fund (UNICEF) reported that 75-100% of vaccine shipment were exposed to freezing temperature which accounted for 31% of the UNICEF budget and in the same document World Health Organization (WHO) recommended that vaccines must be kept between +2°C-+8°C with exception of oral polio vaccine (2)

If vaccines are stored in an inappropriate temperature range which is outside +2°C-+8°C they will lose their potency which cannot be regained. If vaccines are damaged, there are implications that will cost the program, namely eligible children will miss their intended doses due to unavailability of vaccines at the facilities. It will cost the program additional millions of dollars which are outside their budget to procure additional vaccines to save those children (3). In 2015, 1.2 million doses of trivalent vaccine were lost through expiry at cold chain in former western Equatoria state in South Sudan that caused Expanded Program on Immunization (EPI) of thousands of United State (US) dollars for disposal.

Vaccine utilization monitoring is an important process to the EPI program. Monitoring of vaccines utilization helps the various levels of planning to correctly forecast the vaccine need and therefore reducing the stock out and stock lows. This reduces the missed opportunities for vaccination. Understanding the reasons for vaccine wastage would help the country to put in place mitigation measures to address avoidable vaccine loses. The vaccine usage rate is defined as the percentage number of children vaccinated that outweighed the vaccine wasted from the total doses supplied at a time period while wastage on the other hand is defined as the total number of doses supplied but never administered. The WHO guidelines for program managers on vaccine monitoring at country level defined vaccine use as the proportion of the vaccine supply that is actually administered to a child or mother (3).

In any EPI, vaccine wastage is unavoidable and can occur during transportation/distribution, storage and at immunization service delivery points. Study conducted by WHO showed that South Sudan was amongst African countries that have unnecessary wastages due to invalid vaccine doses that resulted from vaccinating older children (4) A temperature study conducted in April 2019 revealed that vaccines were exposed to higher temperature of 30 °C when transported from national vaccines store to State level contributing to vaccines wastage (5)

### Background of EPI program in South Sudan

The vision of EPI program is to ensure that population of South Sudan are free from vaccine preventable diseases and its mission is to contribute to health sector development plan (HSDP) in reducing morbidity, mortality and disabilities due to vaccines preventable diseases compressive multi-year plan.(6). Immunization supply chain system in South Sudan consists of four levels

namely national, state, county health department (CHD) and health facility. The distribution and procurement of vaccines and supplies is done jointly by UNICEF/WHO under the leadership of the Ministry of Health. In South Sudan, vaccines are received on quarterly basis due to insufficient storage capacity at the national vaccine store (NVS). United Nations International Children's Emergency Fund plays a role in providing technical and financial support to the national immunization program, transportation of vaccines and mentoring of staff. South Sudan government allocated 4% of its Gross Domestic Products (GDP) to the public health services, only 0.001% was allocated to the Ministry of Health budget for national immunization in 2019.(6) The country immunization program is funded by donors such as Health Pooled Fund (HPF), global alliance for vaccine (Gavi), United Nations (UN), World Bank and Global Fund to strengthen its health system. Based on the above mentioned information it would be better to quantify the amount of wastages to maximize the use of limited resources and enable donor to maximize their investment in EPI program.

South Sudan comprehensive multi-year plan proposed that vaccine wastage rate shall be 20% across all antigens used in routine immunization. (7).This wastage rate proposed must be maintained accordingly.

### Global perspective

More than 116 millions of children received three doses of DTP<sub>3</sub> coverage in 2017 and approximately 113 countries have introduced new vaccines aiming to vaccinate additional children. Between 2010 and 2017, the number of under-vaccinated children was over by 1.8 million. (8) In African region, immunization has made progressive contribution in eradication of polio, elimination and control of vaccines preventable diseases that has led to high universal coverage, though the regional coverage still low at 76% in 2015. The government expenditure on health in African countries has increased to 130% in 2010. Despite the global success, 19.9 million children were reported under-vaccinated in 2017.(8) South Sudan was among the six African countries that have stagnant DTP<sub>3</sub> coverage of 26% in 2017 & 2018 respectively, and also amongst the nine countries that had not yet achieved elimination of maternal and neonatal tetanus elimination targeted for 2020. (8)

The effective vaccine assessment has been conducted in only 14 countries namely Afghanistan, Rwanda, Tanzania, Moldova, Armenia, Albania Sri Lanka, Burkina Faso, Malawi., Uzbekistan, Sudan, Vietnam, Yemen and Zimbabwe with composite score of  $\geq 80\%$ .(1) In 2014 & 2015, Pakistan EPI program discarded 1.3 million doses of Pentavalent vaccine worth USD 3.4 million dollars(9)

We have also seen successful reduction of measles and polio cases globally and South Sudan is among those countries to be certified for polio free by November 2019. Several studies have been

conducted on vaccine wastage such as in Gambia, Nigeria, South Africa, India and Bangladesh which have all provided strategies on how to minimize the vaccine wastage.

## 1.2 PROBLEM STATEMENT

According to comprehensive multi-year plan 2017-2022, the vaccine wastage rate should not be more than 20 % (7) and reports from supportive supervision showed more than 80% vaccine wastage. This high wastage rate could jeopardize the program performance of EPI program. The poor knowledge of shake test, vaccine wastage, and multi-dose vial policy were some the elements identified in effective vaccine management assessment 2012 & 2019. The wastage can cost EPI program millions of dollars if left without proper investigation. South Sudan depends on donors support and the country is expected to comply with global alliance for vaccine (GAVI) to minimize their wastage. This study will investigate and inform the stakeholders about findings and the way forward for the improvement of the immunization supply chain system in the country.

Vaccine wastage is a critical indicator for immunization forecasting needs and therefore it is important parameter in determining the immunization status in the country. Any high vaccine wastage rate is a cost to immunization program WHO (3).

## 1.3. Justification of the study

South Sudan does not have peer-reviewed literature on vaccine wastage, and therefore this study will contribute to the establishment of the baseline data on vaccine wastage rate for the program.

One of the objectives of the National Health Policy of the Republic of South Sudan is to strengthen the stock management systems in Central Medical Stores (CMS) and health facilities to minimize expiries, damages, pilferage, and wastage. High vaccine wastage inflates vaccine demand and therefore high costs to satisfy the requirements which will affect procurement of other health commodities. (10) A reduction in vaccine wastage will contribute towards ensuring government's commitment to ensure equitable access and rational use of quality essential medicines. The study will therefore assess the underlying causes contributing to vaccines wastage in immunization services delivery at facilities in Jubek state, Juba, South Sudan. The study will also provide some information on baseline data for vaccine wastage to allow the program for better planning, implementation, as well as incorporating some of the proposed interventions to EPI annual work plan

#### 1.4 General objective.

To assess the vaccine wastage rate in immunization service delivery facilities in Jubek State of South Sudan

##### 1.4.1 Specific objectives

1. To quantify the level of vaccine wastage rate by antigen for period January to December 2018.
2. To assess the knowledge of health workers on vaccines management
3. To determine the vaccine wastage rates and the factors that contributed to vaccine wastage rate in Jubek state of South Sudan.

##### 1.4.2 Research questions

1. To what extent is the vaccine wastage rate in line with South Sudan EPI Policy and guidelines?
2. Where does vaccine wastage occur in the immunization supply chain system?
3. What are the underlying causes of vaccine wastage in the immunization service delivery facilities in Jubek State?

## CHAPTER TWO: LITERATURE REVIEW.

### The EPI program in South Sudan

Expanded Program on Immunization in South Sudan was established during operation lifeline Sudan (OLS) in the liberation period with support from UNICEF. In 2006 the EPI South Sudan became independent from Sudan. UNICEF/WHO continued to provide technical and financial support to the program. The program started with BCG, DTP, Measles, oral polio vaccine and TT vaccines; now DTP was switched to Pentavalent (DTPHEB+Hib) and then later additional vaccine inactivated polio vaccine (IPV) was introduced in 2015 to bring the total to 6 vaccines in routine immunization program.

South Sudan EPI performance showed a progressive decline in routine immunization DTP\_3/Penta from 71% in 2012, 55% in 2013 and 26% in 2016. Out of 80 counties in South Sudan, only 9 counties (11%) achieved coverage of >80% (11). EPI coverage survey 2017 reported 45% of <1 year and fully child of only 34% (11). South Sudan reported a low administrative coverage for DPT\_3 45% (2016,) 59% 2017 and 56% 2018. The reason for attaining low immunization coverage is unknown; it may be due to low vaccine utilization, population movement or inaccessibility. This study will also determine the cause of vaccine wastage in order to provide the baseline for wastage and propose strategies to minimize the vaccine wastage.

### Global and local vaccine wastage trends

Vaccine wastage, usually measured as rate, is defined as a proportion of vaccine supplied but never administered. WHO guidelines for program managers on vaccine wastage at country levels estimated that 50% of the vaccines produced globally is wasted. High wastage rate results in excessive demand which in turn leads to increased procurement and an inflated supply chain associated with cost of vaccines (12). Acceptable wastage levels vary between programs in the light of experience and the analysis of local situations. The WHO considers the discard of remaining doses in lyophilized vaccine vials to be an unavoidable reason for wastage. Reasons for wastage that are considered avoidable include: vaccine expiration, vial breakage, inappropriate vial freezing, discarding liquid vaccine before 28 days, prolonged heat exposure and theft of the vaccines.(13)

There are several studies conducted on vaccine wastage assessments across the world. However, few studies have been conducted in the East and Southern Africa WHO region, where South Sudan is situated. A study conducted in Bangladesh revealed that vaccine wastage rate is attributed to vaccination session size where few children are targeted and higher doses are discarded. The study concluded that strategies need to be deployed that range from either optimizing the frequency of immunization sessions by reducing the number of sessions or re-group outreach sessions to vaccinate many children in a day (14). The vaccine wastage assessment in five India states revealed that wastage rates vary from state to other and among different vaccines. Highest vaccine wastage occurred at service delivery level with 27% for DPT and 61% for BCG at outreach session site.

Measles wastage rate in supply chain was 3.5%, others <1 %. Poor documentation of vaccine wastage at supply chain is one of the responsible factors for this very low value. Session size, vial size, formulation (liquid vs. lyophilized, oral vs. injectable) also influences vaccine wastage (15). Another study conducted in rural setting in Gambia found that vaccine wastage rate is high in unopened vials due to poor stock management and the study further showed that health workers assessed did not follow first expiry first out (FEFO) principle and this contributed to vaccine wastage in Gambia public health facilities. The study concluded that wastage data are not captured routinely despite that vaccine wastage rate data are important in local forecasting and quantification processes (15).

Study conducted in India about assessment of vaccine wastage revealed that there is poor documentation of vaccine wastage across the immunization supply chain system and the higher wastage rate mostly occurred in service delivery points, implying that health workers did not follow multi-dose vial policy (16). Another study conducted in Nigeria showed half of the health facilities assessed had incomplete vaccine stock records (17).

Study conducted in rural central India showed that there was discrepancies in vaccine wastage rate compared to India universal immunization program and WHO systematic vaccine wastage. The study concluded that BCG wastage was higher (66.8%) than other antigens (18).

Wastage is divided into program wastage (avoidable) and operational wastage (unavoidable). Program wastage is a wastage attributed to poor management where vaccines are exposed to heat/freezing temperature, cold chain failure, missing inventory, theft or breakage. Operational wastage is a wastage that happened due to remaining doses discarded after six hours or reached discarded points, vials contaminated before use, ineligible dose or poor vaccine reconstitution. Operational wastages are unavoidable because the system does not want missed opportunity for vaccination (MOV).

WHO guidelines for vaccine wastage monitoring at country level highlighted that improved procurement practice, changing the vial size, vaccine vial monitor (VVM), ice-pack conditioning and standardized immunization session are some of the strategies for reducing vaccine wastage rate in EPI program if proper monitoring is maintained.(3)

## 2.2 Overview of the topic

South Sudan got independence in July 2011, the country is severely suffering from vaccine preventable diseases and its health system has deteriorated. South Sudan EPI coverage survey 2012 reported that only 45% of <1 year received DPT\_3 and fully immunized child of 34% and dropout rate was reported to be 23%, this means that there is poor health care system across the country and more effort is needed.(11)

### 2.3 Determinants of associated factors

National EPI coverage surveys in 2012 & 2017 has revealed that 34% and 18.9% of children were fully immunized. These percentages showed that there are still number of unvaccinated children and therefore proper mechanism is required to address that gap.

The effective vaccine management assessment in 2012 (EVMA) revealed that, out of nine indicators assessed, distribution was reported to be the weakest with a score of 25%. This strategies is to strengthening the vaccine management practices (7).

### Summary of the literature reviews

Vaccines are expensive health commodities and are essential interventions in reducing morbidity and mortality in preventing vaccine preventable diseases. Several studies conducted in different countries such as Nigeria, Gambia, Bangladesh, South Africa, Indonesia, Tunisia and India showed that the causes of vaccine wastage was due to poor documentations, vial size, knowledge gaps, lack of monitoring temperature of the fridge and lack of alignment to policy (SOPs). It was also noted that health workers do not follow the multi-dose vial policy and open vials which increases wastage after the session (e.g. BCG and Measles are discarded after six hours or at the end of the session whichever comes first). The study will focus on vaccine wastage in selected health facilities in Jubek state. The study will establish a baseline for vaccine wastage rate, identify underlying factors that drives wastage, and also suggest possible recommendations for the program.

### 2.4 Conceptual framework

This conceptual framework enlisted here was to find out the dependent and independent variables that includes forecasting, vaccine cold chain storage, transport and vaccine utilization. These variables are regarded as key underlying factors for vaccine wastage. This conceptual framework was used to guide those predicting underlying factors such as:

2.4.1 Forecasting

2.4.2 Vaccine cold chain

2.4.3 Vaccine transport

2.4.4 Vaccine utilization



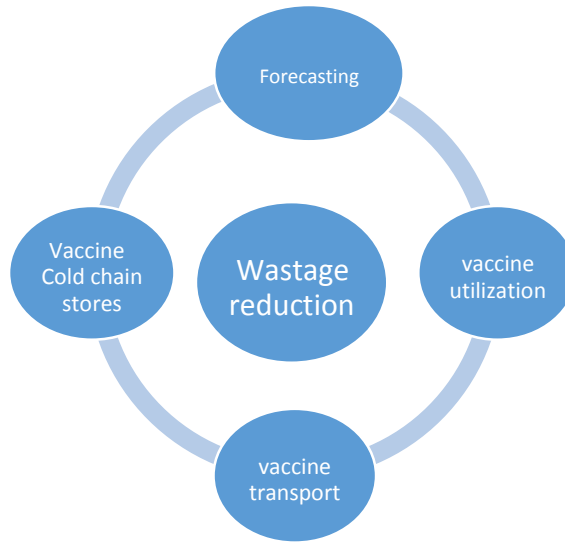


Figure 1: Conceptual framework

#### 2.4.1. Forecasting:

This is an important activity in ensuring that the estimation of needs are according to target population of particular health facility. One of the South Sudan national policy goals and objectives is to strengthen and sustain routine immunization services for children and women of childbearing age (10). Non-alignment to this policy may result in increased vaccine wastage. Poor forecasting might result into either overestimating or underestimation which may have a negative impact on the program.

#### 2.4.2 Vaccine Cold chain

Vaccine cold chain is the process of keeping vaccines on recommended temperature range. Study conducted in Lao peoples Republic in 2018 shows vaccines were exposed to temperature  $>8^{\circ}\text{C}$  and  $<0^{\circ}\text{C}$  in district stores (19). In order to maintain effective and efficient vaccines storage and distribution practices, the temperature monitoring of cold chain needs to be maintained throughout the vaccine supply chain. The WHO's pre-qualified temperature monitoring devices are recommended for vaccine storage (20).

Wastage can occur at any level of supply chain system, but wastage at storage points can be avoided. Stock management tools used for vaccine management and the temperature monitoring was part of the stock monitoring practice for vaccine wastage. The study administered a structured questionnaire to health personnel to assess their knowledge, attitudes and practice on vaccine management.

Center for diseases control and prevention (CDC) recommended that vaccines quality is the shared responsibility of every one from the time of manufacturing the vaccine until the last mile when it is administered to a child (21).

### 2.4.3. Vaccine transport

Vaccines are sensitive commodity, if distributed/transported outside their recommended temperature from +2c°-+8c° they will be destroyed by heat/freezing and their potency will also be lose. Distributing vaccine supplies using frozen ice-pack may expose vaccines to the risk of freezing. A Study conducted in Tunisia reported that frozen ice-packs were used to transport vaccines from national to lower level. The results showed vaccines were exposed to freezing temperature. The same study also reported that 60% of cold chain equipment had negative temperature excursion that approximately recorded 335 temperature alarm (22). South Sudan national immunization supply chain transport the vaccines from national to states on quarterly basis and from states to counties and to health facilities on monthly basis. Temperature monitoring study conducted in South Sudan in 2019 showed vaccines exposure to high temperature of 19.7% during transport from national to sub-national level. The reasons quoted was due to delay in receipt at the point of destination (20).

### 2.4.4. Vaccine utilization

South Sudan had low immunization coverage for three consecutive years. A study conducted in three countries, Botswana, Dominican Republic and Greece cited the reasons as the lack of information as causes of low vaccine uptake (19). National EPI coverage survey 2017 reported lack of information and distances are main causes of low vaccine utilization (11).

## CHAPTER THREE: METHODS

### 3.1 introduction

This chapter described the process by which the data were collected, analyzed and presented in tables and graphs. The study location, study design, target population, data collection methods, and sources of data, ethical clearance, validity and reliability of the research materials are described.

### 3.1 study location

The study was conducted in Juba city within the former central Equatoria state currently Jubek. The current Jubek state consist of 13 counties namely Lado, Luri, Mangala Gondokoro Rajaf, Lobonok, .Wonduruba, Bungu Ganji, Dollo, Rokon, Lyri, and Oponi. The health facilities were selected from three counties of Rajaf, Luri and Lado. They were categorized into urban, urban slum and rural with total population of 602,438 according to population census 2008.

### 3.2 study Design.

A cross-sectional design involving quantitative and qualitative study was deployed. The data was collected through structured questionnaire that were administered by researcher. The intention was to assess the knowledge, attitude and practices of the health workers. This answered the objective number 3 stated above. The second assessment tool was based on desk review. The researcher reviewed the facility based records such as vaccine registers, fridge tags, tally sheets and monthly summary forms. The results of this facility based records was used to calculate the vaccine wastage rate for each antigen and assess the underlying factors contributed to vaccine wastage rate. This method answered the specific objectives number 1 & 3.

### 3.3 Study population

There are 33 health facilities that are offering immunization services in Jubek state. However, due to logistical and security concerns only a few of the facilities were visited for this study. The study targeted ten health facilities from different levels of care offering immunization delivery in Jubek state namely; Juba teaching hospital, Al Sabah Children Hospital, Military hospital, Nyakuron PHCC, Lologo PHCC, Gurei PHCC, Jabel PHCU, Gumbo PHCU and Nesitu PHCU.

#### 3.3.1 Inclusion criteria

The study was conducted in facilities that met the criteria which were: no security concerns around the facility, was offering immunization services, had cold chain, had at least one vaccinator, and the vaccine records were available.

### 3.3.2 Exclusion criteria

Health facilities that did not have records, had no cold chain, no human resource available (vaccinator) and private health facilities were excluded from the study.

### 3.4 Sampling:

There are 33 health facilities that offer immunization services in Jubek state. 15 out of the 33 health facilities who had cold chain and accessible were selected for this study. Using convenience and simple random sampling, ten facilities were selected for the study i.e., 3 hospitals, 5 primary healthcare centers (PHCCs) and 2 primary healthcare units (PHCUs). Lottery was done by putting health facilities in the box and selected randomly and the results based on the number picked from the box and registered.

### 3.5. Ethical consideration:

Ethical clearance was obtained from the Ministry of Health, Republic of South Sudan and University of Rwanda ethical committee before commencement of data collection.

## 3.5 Data collection Methods

### 3.5.1 Primary data

The data on knowledge, attitude and practices (KAP) among health workers was collected using a structured questionnaire that was administered by the study personnel to health workers who were directly managing vaccines and supplies at each facility in the study. The researcher recorded the responses from the respondent. The information was used to assess the knowledge, attitude and practice of the health workers. The questionnaire was adapted from WHO vaccine management tool and EVM assessment tool for assessing key performance indicators regarding knowledge of health workers on vaccine management practice. The tools were primarily administered in English. However, for health workers who did not understand English, the research team was able to translate the tools into Arabic. Data on cold chain and vaccine management was collected through direct observation and review of facility records.

### 3.5.2 Secondary data

Data on vaccine utilization was extracted from facility records for the last one year before the commencement of the study. The records included; the monthly vaccine performance reports, tally sheets, registers books, temperature logbooks, temperature monitoring charts and fridge tags.

## 3.6 Validity and Reliability of the Research materials

### 3.6.1 Pre-testing

The questionnaire was pre-tested in 3 facilities that were not part of the study to ensure validity and reliability of the questionnaires before the commencement of the study.

### 3.7 Data collection and analysis process

Data collected was entered into excel sheet after which cleaning for double entry, wrong entries was done.

### 3.8. Data analysis and interpretation

Data analysis was done using SPSS. Descriptive analysis data is presented as percentages in tables and graphs

#### Calculation of the vaccine wastage

To obtain the vaccines wastage rate, we summed up the balance brought forward from the last month with the received balance in a period minus the closing balance at the end month. This gave the total doses issued in a period. Therefore vaccines wastage rate can be calculated by adding the total doses issued minus the total number of children immunized divided by the total doses issued multiply by 100%. Please see from the annex attached below.

For supply chain storage; the formula applied is as follows

Vaccine wastage for unopened vial = (Doses discarded unopened during review period/

(Start balance + doses received) – (closing balance) x 100%

For service level points; the formula applied is as follows

Vaccine wastage in open vial = Total doses opened for use- number of children immunized for the period/ (start balance +doses received) - (closing balance) x 100

Vaccine usage rate = # children immunized/start balance +doses received – end balance x 100

## Chapter four.

The finding was grouped according to objectives stated in the previous chapter. It was started with demographic information followed by objective 2 that assess the knowledge, attitudes and practice of the health workers, then objectives 1 & 3 are emerged together because information was obtained from facility based records.

### 4.1. Demographic data:

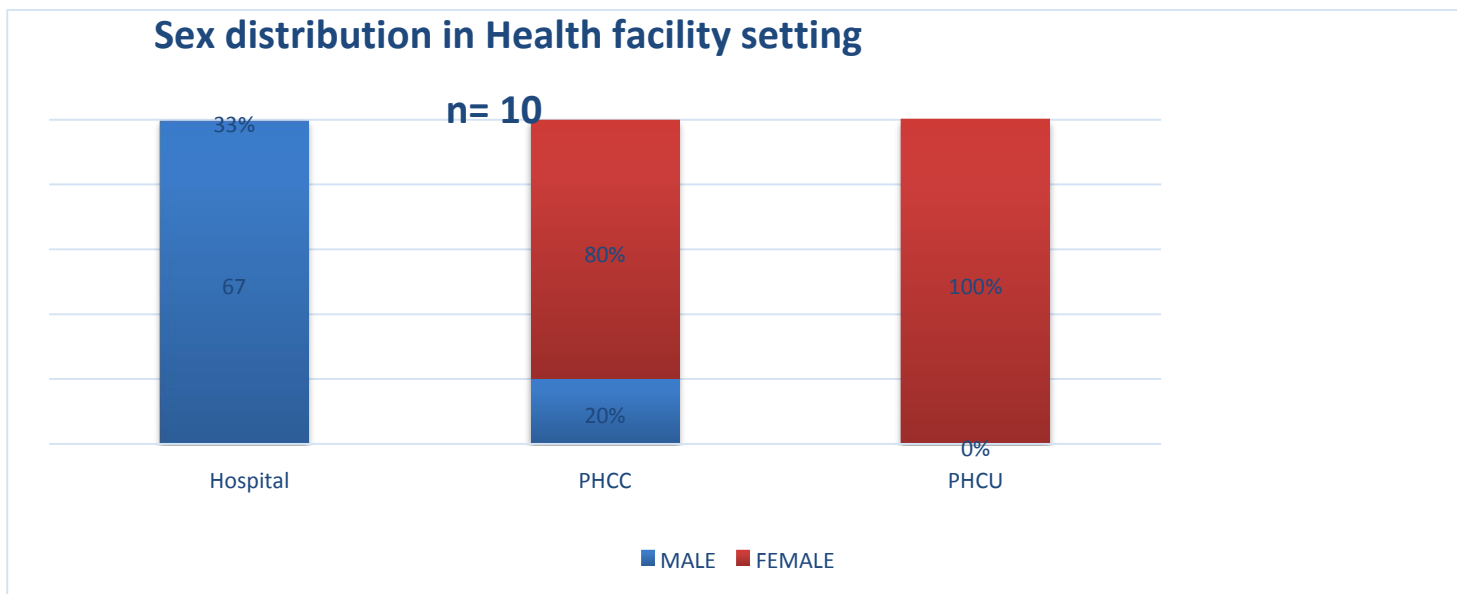


Figure 1 shows sex distribution among the health facility

#### 1) **Objective number 2 was to assess the knowledge, attitude and practices of the health workers.**

The tool used to assess the knowledge, attitudes and practices was administered to facility vaccinator. The tool contains number of criteria that assessed the knowledge, attitudes and practices of the health workers on vaccine management. The result obtained from the assessment showed majority of the health workers are familiar with the practices. Ranging from standard operating procedures alignment of 67%, knowledge on shake test, multi-dose vial policy, temperature sensitivity and correct vaccine storage and handling were scored 80%. In other hand, there was no contingency plan in place in case of emergency. When asked health worker what to do in case of emergency they can explained verbally. But there was no written document available in the assessed facilities for the health workers to follow taking in account of the staff high turnover in the country. Today the facility

employed staff and tomorrow the staff leaves for better pay. This challenges affects the routine immunization activities and the entirely EPI performance. The assessment also found that there was no vaccine wastage data for forecasting needs. Majority of health facilities visited did not have vaccine wastage data available for forecasting needs. There was no reports of vaccine damaged by heat or freezing in the ten facilities assessed storage points. No vaccines damaged during transport when health workers conducted outreaches sessions. This does not showed that there is proper vaccine management practice. WHO recommended that vaccines can be damaged when recommended temperature were exposed outside the ranges.

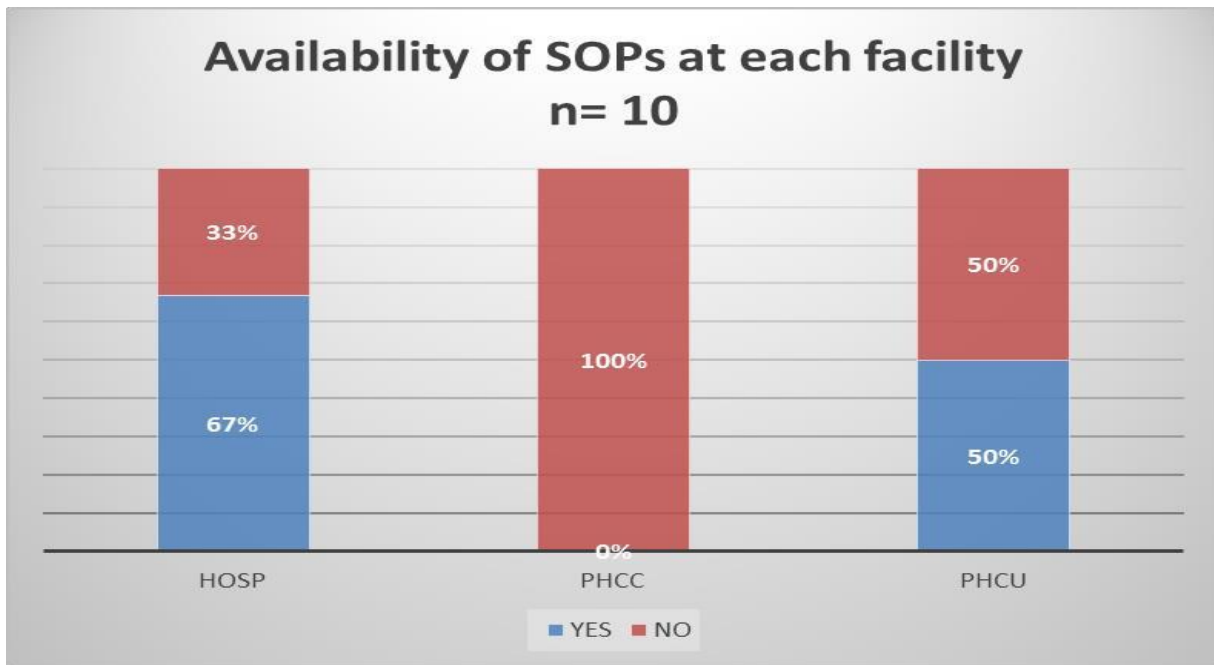


Figure 2 availability of sops at health facility setting

Results on Standard Operating procedures are presented in figure 2. Of the three types of facilities where assessment was made, hospitals had the highest number of compliance to the standard Operating Procedures as depicted on the graph.

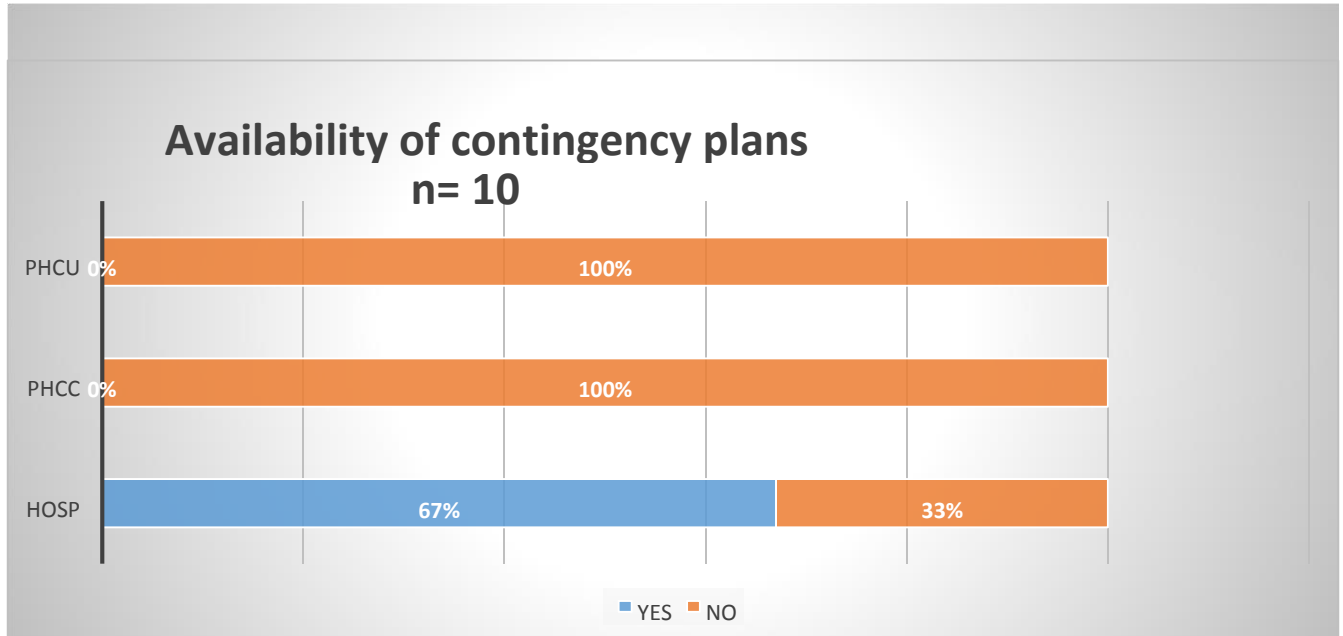
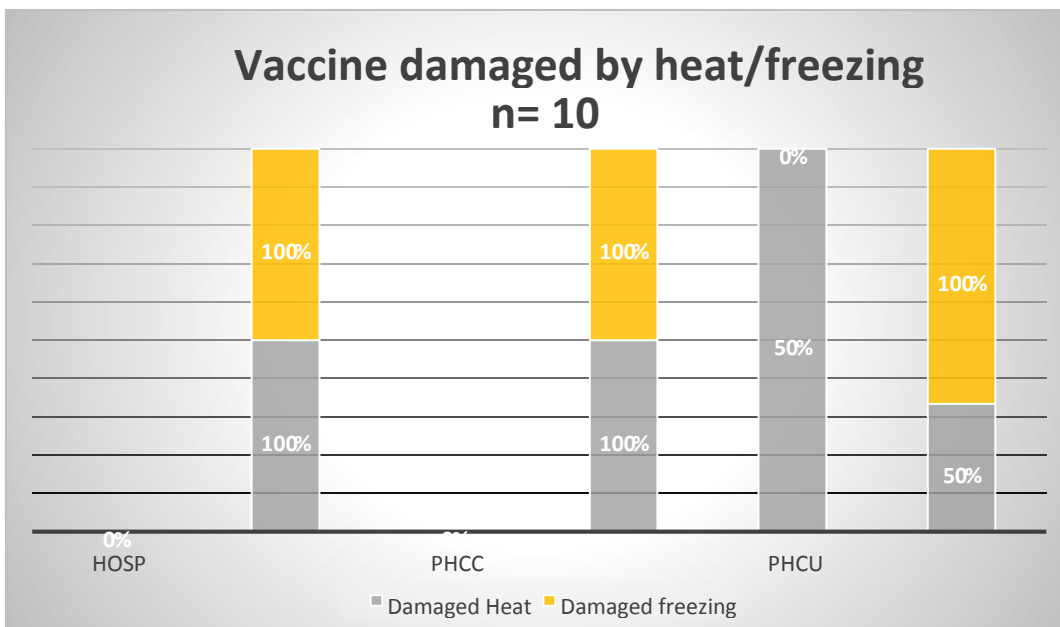


Figure 3 shows the availability of contingency plan

In this figure3 of the three facilities assessed on availability of contingency plans, the high numbers conforms to have contingency plans in place was hospitals setting. None had plan in PHCC/PHCU.





*Figure 4 shows the vaccine wastage by heat/freezing*

Vaccine damaged by either heat/freezing was assessed in the three facilities. The results revealed compliance on vaccine temperature sensitivity in two health facilities. Only 50% of vaccines damaged by heat occurred in PHCU.

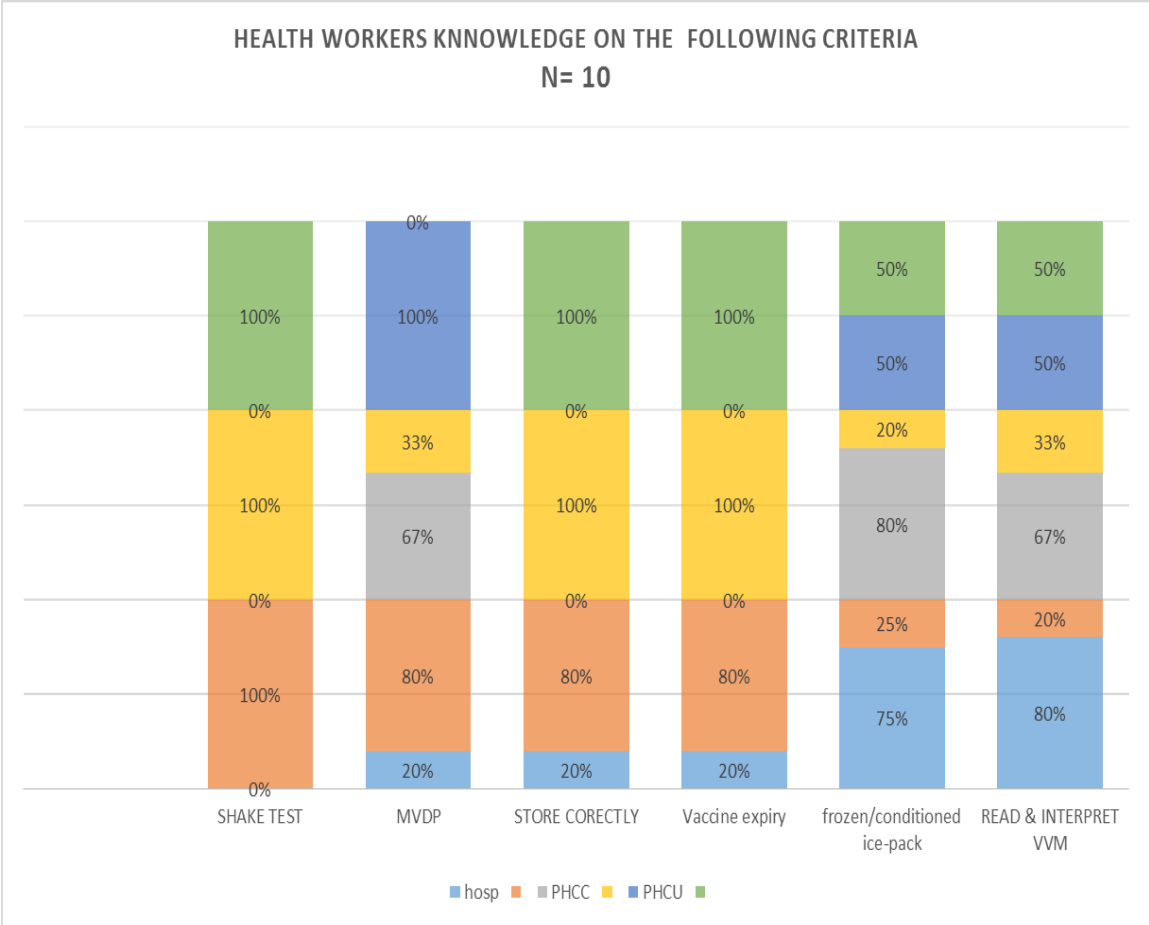


Figure 5 shows the criteria assessed on vaccine management

Majority of the health workers in the three layer of the facilities are compliance to these following criteria. They had best knowledge on shake test, multi-doses vial policy, correct storage temperature, stock rotation based expiry, conditioned/frozen ice-pack and interpret of vaccine vial monitor.

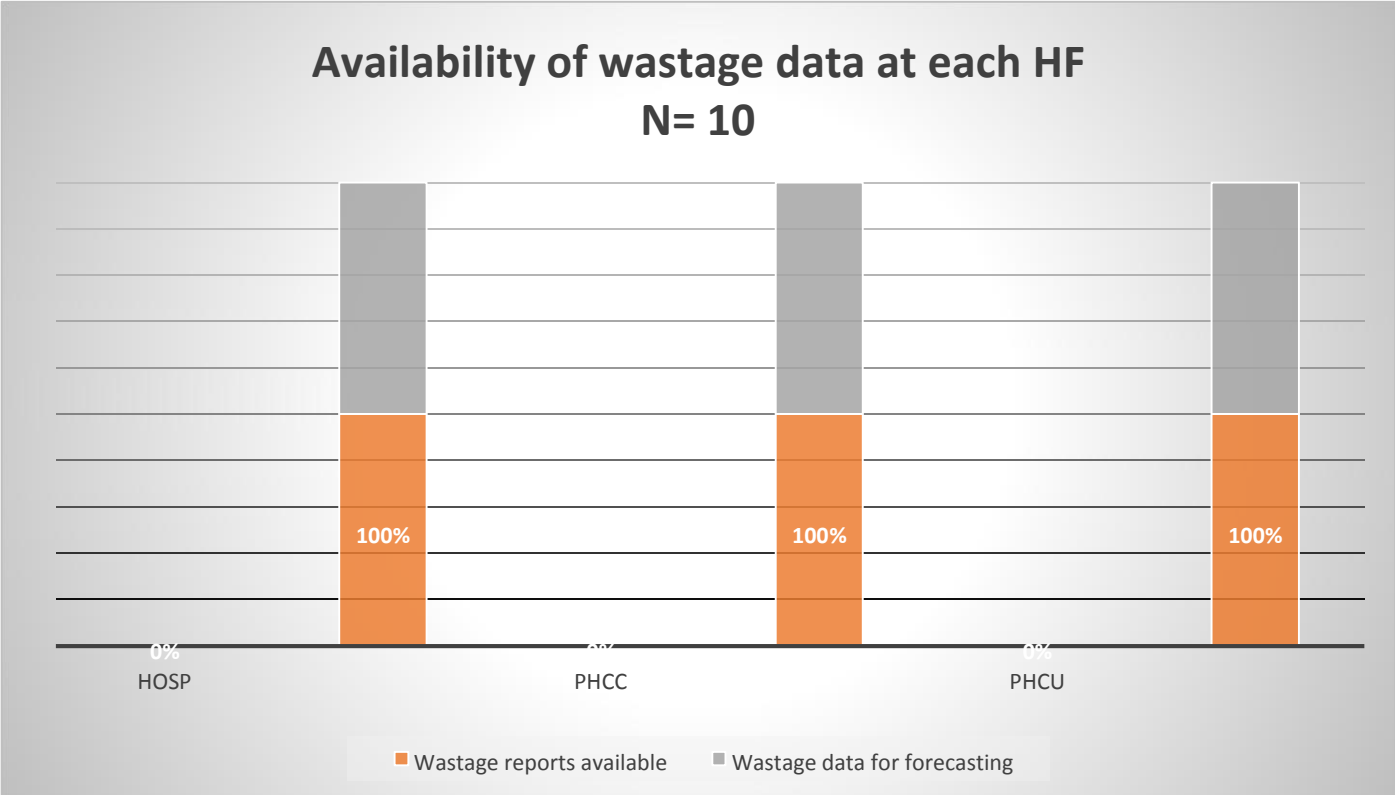


Figure 6 shows availability of vaccine wastage data for vaccine forecasting needs

This figure described the present and absence of wastage data for forecasting needs. Of the three facilities assessed on vaccine wastage data, none had wastage data for forecasting needs. The reasons assessed was that health workers do not trained on how to record data for decision making process.

**2) The objective number one was to quantify the level of vaccine wastage rate from January to December 2018**

The data used to quantify the vaccine wastage rate was obtained from the facility registers and monthly summary forms. The number of doses issued for each antigen was extracted from the facility registers and number of children immunized in a period was also obtained from the same facility register books. The vaccine wastage rate for each antigen was calculated from the total doses issued in a period against versus the number of children immunized in a period then multiplied by 100% to get the wastage rate per each antigen. These wastage rate were plotted in graph against each antigen per each facility to compare where are the high wastage rates occurred in each health care setting.

**3. Objective number 3 was to determine the vaccine wastage rate and the factors contributed to vaccine wastage.**

The data used to determine the vaccine wastage rate per each antigen were obtained from the facility registers. It was found that the high vaccine wastage rate occurred more in lyophilized vaccine than the liquid vaccines. The reasons of the vaccine wastage were due to poor documentation of vaccine records and low vaccine utilization in which twenty doses or ten doses vial opened for one child to avoid missed opportunities and the remaining doses discarded. Staff high turnover in which health workers moved from public sector to private sector for better green pasture. Poor forecasting was also cause of vaccine wastage because health facility used population census of 2008 as denominator while majority of population migrated outside the country. The summary of vaccine wastage rates are plotted in the figure below. When calculated the vaccine usage rates for each health care setting. The overall vaccine usage rate was 47% in hospital, 42% in PHCC & 41% in PHCU.

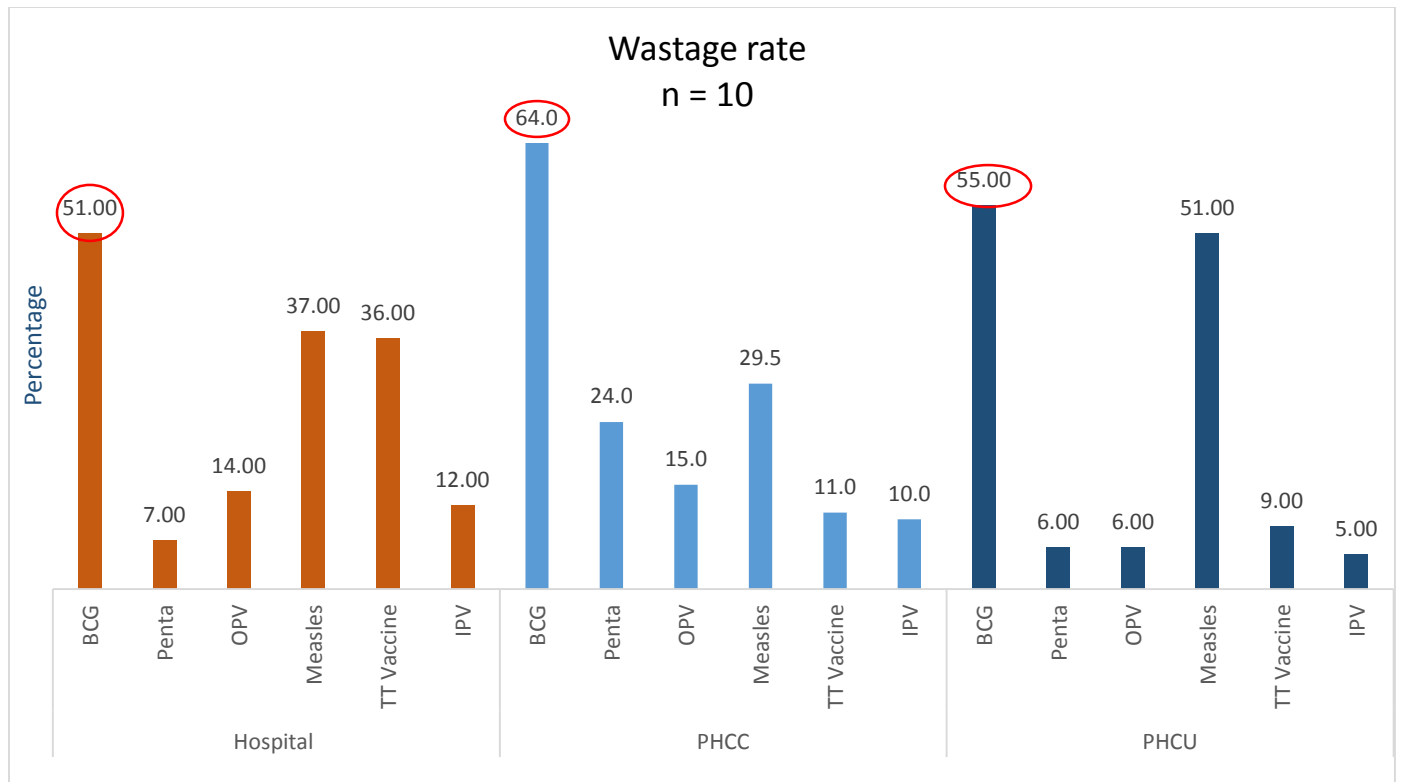


Figure 7 shows the vaccine wastage rate per antigen across each facility

The graph presents above compared the vaccine wastage rate according to the facility. BCG had wastage rate of 64% in PHCC compared to 55% & 51% in PHCU and hospital respectively. Measles wastage rate was found higher (51%) in PHCU compared to hospital and PHCC 37% & 29% respectively. Penta vaccine wastage rate (36%) was found in hospitals compared to other health care setting. The rest of the antigens were found below the recommended standard guidelines with except of Penta vaccine that had 24% wastage rate. The South Sudan guidelines adopted from WHO guidelines for vaccine wastage monitoring at country levels stated that 15% wastage rate for both routine and supplementary immunization activities.

### **The study limitation.**

This study research was supposed to be conducted in former ten states of South Sudan that have cold chain stores. But due to time factor and limited funding since the researcher was self- sponsor, the research was conducted in one state hub out of ten former states. Another limitation was also linked to human resources availability. Facility that have no vaccinator or in-charge but fall in selection criteria was dropped. Some facilities that were inaccessible or had insecurity during the time of visited were also omitted. During data cleaning and analysis, it was found that some data were inaccurate and cannot used for calculating the vaccine wastage rates. After cleaning data, researcher was able to generate 138,720 doses from three healthcare setting. These quantities obtained were used to calculate the vaccine wastage per each antigen. Please see the annex attached below for more information about the quantities.

## Discussions/Conclusions

When compared the vaccine wastage rate in the three layer of healthcare system, it was found that there is different vaccine wastage rate occurred in each health care setting. The higher wastage was found in PHCC more than hospitals and PHCUs. This is because in PHCC/PHCU where the immunization services offered are far from the communities, and hence the magnitudes of vaccines wastage is predictable higher. More vaccine vials opened and low vaccine utilization rate. Another problem identified was illiteracy of the mothers and caregivers knowledge on vaccine benefits and the religious leaders influence. Vaccine hesitancy were also found as one of the major setback in vaccine utilization when investigated the factors contributed to wastage. Reports generated during supplementary immunization activities said one of religious leader prevented their children to be vaccinated. The reasons reported was that vaccines caused infertility. WHO guidelines for monitoring vaccine wastage at country level stated that, if immunization coverage remains the same and the vaccine wastage increases it means that there is forecasting problem. National immunization coverage remains low for consecutive years, with WHO/UNICEF national estimate of 26% for 2017, 2018 respectively. More vaccines are procured annually based on projected population census 2008, but the immunization coverage cannot changed. Looking into South Sudan situation analysis, majority of population migrated out of the country and living as refugees in neighboring countries meanwhile their services are considered in national forecast.

What was found differently when analyzing the vaccine wastage rate per antigens, it was clearly indicated that lyophilized vaccines have higher wastage rates than liquids vaccines. This is because vaccines are frequently opened even if one child visited the health facility to avoid missed opportunities to vaccinate. Despite that some health facilities might have had low immunization services turnover, this poses risk of losing vaccines. The low vaccines wastage rates seen from figure 7 above cannot be justified that there is quality vaccine management practices. There was major issues in documentation practices. This need for further intervention from the leadership of the South Sudan Ministry of health. Even in countries where there is proper immunization supply chain system in place and attained high immunization coverage their wastage rates cannot be as low as found in this study. My argument to this issue is that there is still improper documentations mechanisms in place. The data quality issue remains major problem in immunization supply chain system. Health workers are getting pressure on partners supporting the health. Immunization outreaches activities supported by partners. When conducting outreaches sessions whether they vaccinated or not vaccinated children they must produce data for the partners for them to be paid. These data at the end of day are reflected as number of the children immunized. The wastage rates were found lower than EPI policy and WHO guidelines for monitoring vaccine wastage in country level. When calculated the vaccine usage rates from the total number of children immunized for the period against the start balance and total doses received in the period were found to be 47%, 42% & 41% respectively for hospitals, PHCC & PHCU. This means that more vaccines are wasted than the number of children saved with vaccines. The program needs to focus more interventions to address the catastrophic wastages across the immunization supply chain levels.

## Recommendations

- 1) Review the annual forecast on vaccines and supplies.
- 2) Revised the facility denominator.
- 3) Self-audit among the health workers.
- 4) Monitoring the vaccine use through regular visit and provide on-job training.
- 5) Advocacy for resources mobilization to conduct data quality assessment.
- 6) Monthly vaccine utilization reporting system.



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Annex 1

type of HF	Antigen	Start balance	Doses Received	closing balance	Total Doses issued	# Children immunized	Wastage rate
Hospital	BCG	6060	8580	5600	9040	4468	51.00
	Penta	3,155	7,760	3,230	7685	7161	7.00
	OPV	6,785	13,180	5,850	14115	10,717	14.00
	Measles	3,550	3,410	4,370	2590	1,825	37.00
	TT Vaccine	1,580	2,010	1,400	2190	1,868	36.00
	IPV	1,190	2,605	1,305	2490	2,180	12.00
PHCC	BCG	23,242	14,960	20,870	17332	6,240	64.0
	Penta	19,399	21,960	9,550	31809	23,859	24.0
	OPV	22,703	27,110	22,080	27733	23,723	15.0
	Measles	3,550	3,410	4,370	2590	1,825	29.5
	TT Vaccine	5,000	6,135	4,812	6323	5,615	11.0
	IPV	4,830	6,420	4,410	6840	6,160	10.0
PHCU	BCG	440	1,300	440	1300	578	55.00
	Penta	1,000	2,000	847	2153	1,611	6.00
	OPV	1,500	2,500	1,830	2170	1,600	6.00
	Measles	370	750	370	750	365	51.00
	TT Vaccine	500	1,000	380	1120	333	9.00
	IPV	130	500	140	490	465	5.00
Total doses issued		104,984	125,590	91,854	138,720	100,593	

Appendix 1A showing a structured questionnaire for knowledge, attitude and practice.



**REPUBLIC OF SOUTH SUDAN**  
**MINISTRY OF HEALTH/RSS/JUBA**

**INTERVIEW GUIDE QUESTIONNAIRE FOR VACCINE ASSESSMENT IN JUBEK STATE**

<b>PART ONE</b>		<b>THE HEALTH FACILITY DETAILS</b>			
	<b>Type of HF</b>			<b>Payam</b>	
	<b>County</b>			<b>State</b>	
	<b>PART TWO:</b>	<b>Demographic information</b>			
1	Age:		Sex	<input type="checkbox"/> (1) Male	<input type="checkbox"/> (2) Female
2	Marital Status	<input type="checkbox"/> (1) Single	<input type="checkbox"/> (2) Married	<input type="checkbox"/> (3) Divorced	<input type="checkbox"/> please tick only one (4) Widow/Widower
3	Level of Education	<input type="checkbox"/> Primary	<input type="checkbox"/> Secondary	<input type="checkbox"/> Tertiary/Clinical Training School	<input type="checkbox"/> vocational training
4.	Current Position/job s	<input type="checkbox"/> Nurse / Midwife <input type="checkbox"/> Vaccinator		<input type="checkbox"/> EPI Supervisor <input type="checkbox"/> Cold chain officer/Assistant	<input type="checkbox"/> Cold chain manager
5	Religion	<input type="checkbox"/> Christian		<input type="checkbox"/> Muslim	<input type="checkbox"/> Other (Specify)
		<b>PART THREE: ASSESSMENT OF FORECASTING AND NATIONAL POLICY GUIDELINES</b>			

6	Are there available standard operating procedures for vaccine needs at your health facility/store?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	Are there contingency plan in case of emergency?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
7	Are there vaccine requisition form for ordering and receiving vaccine	<input type="checkbox"/> Yes	<input type="checkbox"/> No
8	Are there vaccines and diluents recorded as per standards?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
9	Are the vaccine and diluents, expiry date VVMs status recorded correctly?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
10	. Is the fridge recorded correctly?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
11	Is there correct method for estimating vaccine needs at this facility?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
12	Are vaccine and diluent batch no, manufacturer recorded accordingly?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<b>PART FOUR: ASSESSMENT OF VACCINE COLD CHAIN STORE</b>			
13	Do you have vaccine damage by heat for the last 6- months?	<input type="checkbox"/> Yes How much quantities?	<input type="checkbox"/> NO
14	Do you experience vaccine damage by freezing for the last 6 months?	<input type="checkbox"/> Yes How much quantities?	<input type="checkbox"/> No
15	What is the recommended temperature range for all vaccines?	<input type="checkbox"/> Yes (+2°C-8°C)	<input type="checkbox"/> No
16	Is the temperature monitoring chart updated twice daily?	<input type="checkbox"/> Yes	<input type="checkbox"/> Yes
17	Do you know how to read and interpret vaccine vial monitors (VVM)?	<input type="checkbox"/> Yes if yes, ask the health worker to demonstrate	<input type="checkbox"/> No

18	Are vaccines stored correctly in which freeze sensitive vaccine are kept away from the evaporator?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<b>PART FIVE: ASSESSMNT OF VACCINE TRANSPORTATION</b>			
19	Do you have standard passive containers for vaccine distribution?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
20	Is there vaccine distribution according to early expiry first out or first expiry first out principle (EEFO/FEFO) in this facility?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
21	Do you carry out ice-pack conditioning when distribution vaccine/ conducting immunization session?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
22	Can you differentiate between frozen ice-pack and conditioning icepack?	<input type="checkbox"/> Yes if yes, <i>Ask the health worker to demonstrate</i>	<input type="checkbox"/> No
23	Have ever had any vaccine damage during transportation?	<input type="checkbox"/> Yes if yes how Much quantities?	<input type="checkbox"/> No
<b>PART SEVEN: ASSESSMENT OF VACCINE UTILIZATION</b>			
24	Do you have an expiry of vaccines and supplies in your facility?	<input type="checkbox"/> Yes If yes which antigen, quantities recorded	<input type="checkbox"/> No
25	Are there vaccine wastage monitoring report available at this facility?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
26	Are there vaccine wastage data available for vaccine forecasting needs?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
27	Are you aware about MDVP?	<input type="checkbox"/> Yes if yes demonstrate it	<input type="checkbox"/> No
28	As the MDVP been adopted in this facility?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
29	Do you know how to conduct shake test?	<input type="checkbox"/> Yes if yes ask the health worker to demonstrate	<input type="checkbox"/> No
30	Can you make exception to EEFO rule? ( if VVM status)	<input type="checkbox"/> Yes	<input type="checkbox"/> No
31	Have you received any training for in vaccine management?	<input type="checkbox"/> Yes	<input type="checkbox"/> No

Name of data Collector: ..... Date: ..... Signed: .....

Form 1B Ethical approval

# The Republic of South Sudan



## Ministry of Health

MOH/ERB 27/2019

To: James Bol Choul  
University of Rwanda

Date: 7<sup>th</sup> Aug. 2019

### RESEARCH APPROVAL LETTER

Dear Bol

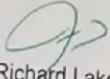
**Subject: Vaccine Wastage Assessment**

I am writing in response to the request for authorization for the study on 'Vaccine Wastage Assessment' in Jubek State.

After a close review of the proposal, I am glad to inform you that the ethical committee at the ministry of Health Republic of South Sudan has approved the study. The Ministry acknowledges the importance of the study to generate data for evidence base that could enable decision makers to come up with plans for better vaccine use in South Sudan.

Please, keep the Ministry of Health- RSS and the State Ministries of health informed in case of any changes regarding the study and on its progress. I look forward to the result, especially the recommendations that will be generated from the study. Note that any information generated from the study should not be published without the consent of the Ministry of Health RSS.

Good luck don't hesitate to get in touch should there be any queries.

  
Dr. Richard Lako Lino Loro  
Director General for Policy, Planning, Budgeting and Research  
Ministry of Health, Republic of South Sudan

CC: Undersecretary- MOH- RSS  
CC: Director General, Preventive Health care - RSS  
CC: Director Generals, State Ministry of Health