District Health Information System (DHIS2 SMS Server) and Routine Immunization (RI) Data in Goronyo LGA, Sokoto State

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Certification

This is to certify that this thesis work District Health Information System (DHIS2 SMS Server) and Routine Immunization (RI) Data in Goronyo LGA, Sokoto State was carried out by **Bello A. Shehu** with Matric Number: **LCU/PG/001551** in the Department of Information Management, Faculty of Basic Medical Sciences, Lead City University, Ibadan, Oyo State, under my supervision.

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Dedication

This research work is dedicated to my loving wife.

Acknowledgement

I give all praise and honor to Almighty God for his goodness, mercies, guidance and protection throughout the period of my study.

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Even though the above mentioned institutions and persons have assisted in the process of this research work, I alone stand responsible for the errors, if any, found in this work.

Abstract

This project is on District Health Information System (DHIS2 SMS Server) and Routine Immunization (RI) Data in Goronyo LGA, Sokoto State. Descriptive research method was used to conduct the research. project is limited to Goronyo LGA, and its covers role of DHIS2 SMS server in strengthening Routine Immunization data in Goronyo LGA, Sokoto state. The target population for this research are mainly any health facility worker who is supporting/attached direct to Routine Immunization unit (Health facility in-charge, Routine Immunization service provider, Assistant RI service provider and RI recorder), working in public health facilities in Goronyo LGA (all 22 health facilities conducting RI in the LGA), sampling method was not use because the researcher was able to reach out all the respondents. Accordingly, 90 questionnaires were issued out to 90 RISP we have in the LGA. Of these figure only 85 were retrieved. Percentage was main method used to analyze the data. Similarly, data was downloaded from DHIS2 RI The research find out that 13 (15%) of respondents know DHIS2 before 2017, while 67 (85%) don't know, but 85 (100%) of respondent received training on DHIS2 during implementation of the software. The significant of this study is to investigating District Health Information System (DHIS2 SMS Server) and Routine Immunization (RI) Data in Goronyo LGA, Sokoto State, which will serves as an addition of knowledge on District Health Information System (DHIS2 SMS server) in the LGA, state and nation in general, similarly, other impact this study, included, it shows how the software helps in RI data analysis, interpretation, storage, retrieval and transmission automatically, this research find out how the DHIS2 SMS server detect incompleteness and error of RI data, the research reveals how the software help health care mangers with data for monitoring and supervision from anywhere.

Keywords: Routine Immunization, District Health Information System (DHIS2), Vaccination, ICT Infrastructure, Routine Immunization Data

Word Count: 295

Table of Content

List of Tables

List of Figures

Chapter One

Introduction

1.1 Background to the Study

Health information system is the source of data for conducting proper planning and informs decision making in health care services, District Health Information System (DHIS2) is a free data management and open source software which deals with capturing, processing, analyzing, validating, transmitting and storing health care data, the software is used by multiple organisations and involve many health care indices, indicators and services, such as malaria, ANC, HIV/AIDs, Tuberculosis, nutrition, Immunization, etc. the software help in strengthening health care data in general[1].

The objectives of establishing University is to provide knowledge, skill and conduct researches, the research is the way of providing ways of solving problems, create and improve new idea, as result of this both lectures and students are conducting research in order to boost knowledge and improve life in general, this is the reason why today, advancement of any country, state or society is defend on the ability to create new knowledge. Therefore, reputation of university would be based on qualitative researches conducted. Some of the common aims for conducting research studies are to expands your knowledge base, gives you the latest information, helps you know what you're up against, builds your credibility, helps you narrow your scope, teaches you better discernment, introduces you to new ideas, helps with problem-solving and encourages curiosity. Similarly, in health care profession, research is important to find out which new method of treatments work better for patients. It plays essential role in discovering new strategy treatments, and making sure that we use existing treatments in the best possible ways. This

research (District Health Information System DHIS2 SMS server and Routine Immunization Data) is very important to the university and country at large, because, Routine Immunization services depend largely on qualitative data and DHIS2 SMS RI server is the software or server which provides qualitative Routine Immunization data which can be used for all Routine Immunization activities[2].

It is the goal of Nigerian government to eradicate vaccine preventable diseases such as POLIO, Measles, Tetanus, Yellow fever, Tuberculosis, etc. this effort can only be achieve by providing effective Routine Immunization services, Routine immunization is the foundation through which Nigeria provides access to lifesaving vaccines and control and eradicate vaccine-preventable diseases. It is the process of timely vaccination on a regular basis with vaccines considered important for Nigeria to reduce morbidity and mortality. This process enables Nigeria's health system to provide Routine Immunization services in order to achieve the goal of eradicating vaccine preventable diseases. One of the essential components of Routine Immunization is data management and a District health information system is the software or server where Routine Immunization data can be stored. DHIS2 RI SMS server is a Web platform for the electronic management of health information systems and Routine Immunization data that enables the creation of digital forms and indicators, storage of data at the national level, generation of reports, and displays of graphics and calculations of aggregate data. DHIS2 can function with a central online server, located in the Secretariat or Ministry of Health, to which other entities are connected through the Internet. Or it can be installed on independent computers to facilitate its use in isolated regions. The software was developed by University of Oslo's Global Health Information Systems Program (HISP) has more than 15 years of experience in developing,

implementing, and providing assistance with computerized health information systems (HIS) to support decision-making in public health and the comprehensive strengthening of the HIS. This program has developed the free DHIS2 software used in provincial and national implementations of the HIS in several countries of Africa, Asia, and the Caribbean[3].

Similarly, District Health Information System (DHIS2) provides data for effective monitoring, evaluation and supervision, surveillance, detection of outbreak, planning, provision of appropriate regulations, health financing, promotion of resources distribution, District Health Information System (DHIS2) is one of the pillars which ensures strengthening health information in general and routine immunization (RI) data in particular. In 2010, Nigeria adopted the use of web-based software District Health Information System, V.2 (DHIS2) as the platform for the National Health Management Information System. The platform supports real-time data reporting and promotes government ownership and accountability. To strengthen its Routine Immunization (RI) component, the US Centers for Disease Control and Prevention (CDC) through its implementing partner, the African Field Epidemiology Network-National Stop Transmission of Polio, in collaboration with the Government of Nigeria, developed the RI module and dashboard and piloted it in Kano state in 2014. The module was scaled up nationally over the next 4 years with funding from the Bill & Melinda Gates Foundation and CDC. One implementation officer was deployed per state for 2 years to support operations[4]. Over 60 000 RI healthcare workers were trained on data collection, entry and interpretation and each local Immunization Officer in the 774 Local Government Areas (LGAs) received a laptop and stock of RI paper data tools. Templates for national-level and

state-level RI bulletins and LGA quarterly performance tools were developed to promote real-time data use for feedback and decision making, and enhance the performance of RI services[5].

By December 2017, the DHIS2 RI module had been rolled out in all 36 states and the Federal Capital Territory, and all states now report their RI data through the RI Module. All states identified at least one government DHIS2 focal person for oversight of the system's reporting and management operations. Government officials routinely collect RI data and use them to improve RI vaccination coverage and in Sokoto state, DHIS2 SMS server was introduced in the last quarter of 2017[6].

What is Routine Immunization: Routine immunization (RI) is the sustainable, reliable and timely interaction between the vaccine, those who deliver it and those who receive it to ensure every person is fully immunized against vaccine-preventable diseases. Strengthening routine immunization is one of the pillars of the polio eradication strategy. In polio-endemic countries, the virus persists in marginalized populations, and where health and immunization services are largely non-existent, and oversight and management are weak. However, the poliovirus cannot survive for long periods outside of the human body[7].

Routine Immunization data is the collecting of raw fact concerning routine immunization services, there are many data collected from routine immunization services such as session plan and session conducted, vaccine received, use and return, number of syringes received use and retune, number of children vaccinated with particular antigen, etc. Routine immunization data allowed know the coverage of different services under routine immunization, such as HB, BCG, OPV, PENTA3 coverage, knowing these indicator can show how success the program was implemented[8].

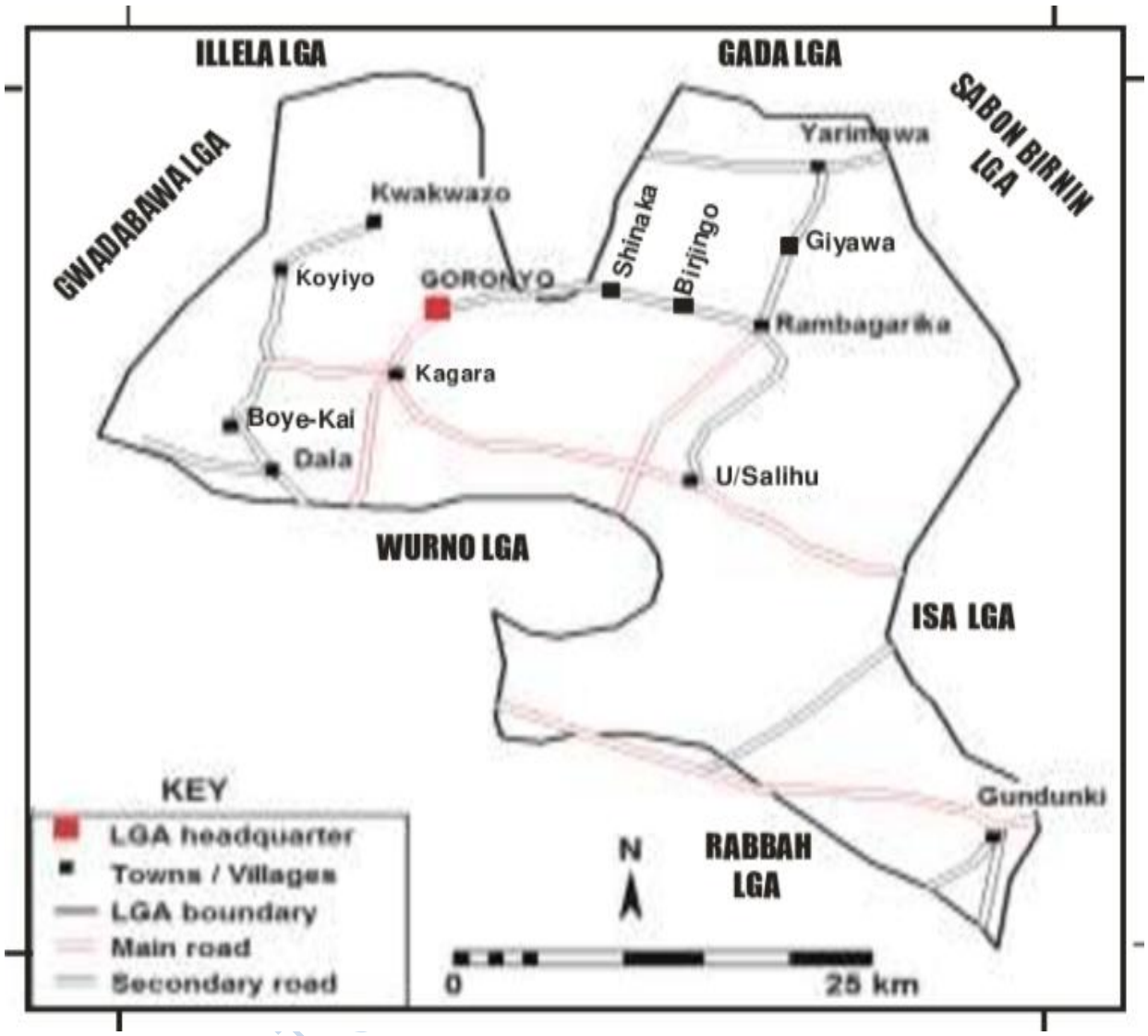
Quality, timely and accessible routine immunization data are essential tool for effective vaccination. Either from community, health facility, LGA, state and national data allow health care professionals/managers to ensure the right vaccines are administered to the right child at the right times.

For example, at a health facility level, data can allow to know and estimate target children, vaccine and other supplies requirement, it is also gives an insight of number of session need to plan in each week etc. Other secondary function of routine immunization data is to take decision, plan, monitor, research and publication. In general, effective routine immunization data is an ingredient for succeeding in routine immunization activities[9]. Routine Immunization data strengthen means to make the data more quality, ability, stronger, effective, efficient, reliable, and complete in such a way that it would serve the purpose (Global CDC story)[10].

History of Goronyo Local Government Area

Goronyo LGA is one of the twenty-three local government areas in Sokoto State. It has an administrative headquarters in Goronyo town. According to the National Population Commission estimate 2020, Goronyo LGA has an estimate of total population of 266,692, with under five years of 53,338, with number of <1 year population of 10,668, the LGA has 4 districts, 11 political wards, 336 settlements, 40 public health facilities, 22 offering Routine Immunization, it has 4 main district heads, 336 settlements, predominant business of the inhabitant is farming, in addition it.

Goronyo LGA, Sokoto State Map Showing bordered LGAs, wards, towns and villages



Map of Goronyo LGA, Sokoto state, it is showing LGAs bordered with Goronyo from all direction, wards, towns and some villages of the LGA, this map was modified from administrative map of Sokoto State, downloaded from Scientific Diagram.

1.2 Statement of the Problem

Immunization against childhood diseases such as diphtheria, pertussis, tetanus, polio and measles are one of the most cost-effective health interventions, preventing childhood morbidity and mortality, especially among children younger than 5 years. In most countries,

routine immunization (RI) services is one of the strategies of eradicating these diseases and it is part of the primary health care system. Increases in a country's immunization coverage often serve as an indicator of improvement of a health system's capacity to deliver essential services to the population. In Nigeria, a child is considered fully vaccinated if he or she has received: 1 dose of Bacille Calmette-Guérin (BCG) vaccination against tuberculosis, 3 doses of Pentavalent (Penta) vaccine to prevent diphtheria, pertussis (whooping cough), tetanus, hepatitis B and Haemophilus influenzae type b, 3 doses of oral poliovirus vaccine (OPV), 1 dose of inactivated poliovirus vaccine (IPV), 1 dose of measles vaccine and 1 dose of yellow fever vaccine. Children should receive these antigens during the first year of life.

Health information systems (DHIS2 SMS server) provide a lot of offer potential benefits for healthcare, including financial benefits and for improving the quality of patient care. The purpose of District Health Information Systems (DHIS2 RI SMS server) is to document Routine Immunization data that are routinely collected in all private and public health facilities in Nigeria. Routine Immunization program is facing problem in data collection, analysis, interpretation, evaluation, storage, retrieval and transmission manually, similarly completeness, accuracy and timeless are some of the factor affecting routine immunization data, more so, most health workers are using manual data processing which is inefficient and led to data entry error, . furthermore, shortage of IT tools, network, knowledge gap are some of the problems associated with the sending RI SMS and reviewing DHIS2 RI SMS server.

1.3 Aim and Objectives of the Study

The aim of this study is to examine the role of DHIS2 SMS server in strengthening Routine Immunization data in Goronyo LGA, Sokoto state. The specific objectives of this study are as follows:

i. determine if DHIS2 SMS server can provide timely data for planning and evidence based decision making of RI activities
ii. examine how sending RI SMS would ensures accuracy, completeness and timely of RI data
iii. assess if DHIS2 SMS data can help health care managers in monitoring and evaluating RI activities.
iv. compare progress of reporting rate of Routine Immunization data over period of time (at least two years).
v. study whether DHIS2 SMS server help to detect RI data entry error.
vi. assess problem associated with sending RI SMS data.

1.4 Research Questions

1. Can the DHIS2 SMS server provide timely RI data for planning?
2. Does the DHIS2 SMS server detect RI data error, incompleteness and lateness of submission?
3. Does the DHIS2 SMS server allow health manager to monitor RI activities from anywhere?
4. Whether DHIS2 SMS can help in validating other RI data tools (RI registers).
5. That the using DHIS2 SMS server provides any quality to RI data.

1.5 Significance of the Study

The study is of great importance in investigating District Health Information System (DHIS2 SMS Server) and Routine Immunization (RI) Data in Goronyo LGA, Sokoto State, which will serve as an addition of knowledge on District Health Information System (DHIS2 SMS server) in the LGA, state and nation in general.

Subsequently, this research is relevant because it would show how the software helps in RI data analysis, interpretation, storage, retrieval and transmission of RI data automatically; show how the software would detect incompleteness and error of RI data; it would help to explain how the server allow monitoring and supervision of RI activities; discuss how the program provide data for planning and informed decision making and serve as a guide to those who are interested in this topic and who may wish to expand and further research.

1.6 Scope of the Study

This research work focuses on District Health Information System (DHIS2 SMS Server) and Routine Immunization (RI) Data in Goronyo LGA, Sokoto State, which was conducted between June–August 2021.Specifically, this research focuses studying on how the District Health Information System (DHSI2 SMS server) increase quality of RI data and how it provides effective RI data to healthcare managers for planning and evidence base decision making in order to eradicate vaccine preventable diseases, likewise, other areas this research covered include;

i. Evaluate how the software provides timely data for planning and evidence based decision making of RI activities
ii. Examine how the flat form allow to monitor RI activities from any where
iii. Investigate how the server detect error and completeness of RI data

iv. Study how the software provides data for validating other RI data tools such as RI child register, tally register, immunization summary register, RI monitoring chart etc.

v. Analyze how the RI data can be send to DHIS2 RI server from point of service

vi. Examine how RI data quality can be achieve by using DHIS2 SMS software

1.7 Limitations of the Study

The researcher experience many shortcoming during the research, these include; Lack of previous research on this particular topic, this software (DHIS1 SMS server) is a new software introduced into Routine Immunization data collection, and the software was introduced in Sokoto State in the last quarter of 2017, therefore, there is no research on this subject conducted in Sokoto State, as result of this, the researcher face a lot of difficulties in obtaining previous literature which talk about this topic. Another limitation of this research is sample size: The researcher produce 90 questionnaires only, which the sample size is small, the research for producing 90 questionnaires was because, the researcher focuses questionnaires to only health workers working under Routine Immunization unit only, in Goronyo LGA of Sokoto State, there is 22 health facilities offering RI services only, therefore, the questionnaires were distributed to health facility in-charge, Routine Immunization service provider, Assistant Routine Immunization service provider and RI recorder, out of 90 questionnaires distributed 85 were completed and returned.

Ethical Approval; before obtaining ethical approval from Ministry of Health Sokoto to use and publish DHIS2 SMS RI data it took long time, this resulted delay in commencement of the research. The researcher face security challenges: in the process of collecting data, the researcher experience difficulties in reaching some RI health facilities especially riverside, hard to reach and security compromise settlements.

1.8 Operational Definition of Terms

This section defines some of the terms which we regard as being central to be study at hand.

Routine Immunization: is the day to day immunization given to the children under 2 years and women of child bearing age with recommended vaccine, route, dosage and time.

Routine Immunization Service Provide: A health worker who is providing routine immunization services.

Vaccination is a simple, safe, and effective way of protecting people against harmful diseases, before they come into contact with them.

DHIS2: The District Health Information System (DHIS2) is the information system used for the collection, compilation, analysis and dissemination of data from lower tiers to higher tiers.

SMS: (short message service) is a text messaging service component of most telephone, Internet, and mobile device systems.

Server: An electronic central safe keeping location of data where two or more computers and computer components are connected to send and share data/information

Data Strengthen: is the process of improving the quality of data such as reliability, accuracy, timeless and completeness.

ICT Infrastructure: Everything that supports the flow and processing of information that include network infrastructure, technology policy, computers and ICT services in an organization.

Management Support That activeness and enthusiastic willingness to promote the system, build support and overcome resistance amongst the multiple user groups with the aim of ensuring that the system is actually installed and used for evidence-based decision making.

Data Presentation can be refers as the process of arranging/organizing data in tables, chart or graph, this would allowed to analyze, interpret and discuss finding of data collected during research.

Data Analysis is a process of inspecting, cleansing, transforming, and modeling data with the goal of discovering useful information, informing conclusions, and supporting decision-making.

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Chapter Two

Literature Review

The reason for conducting literature review is to study previous research and literature in order to establish more evidence during and other research work, also literature review can allow researcher to add more knowledge from the previous research.

2.4 Conceptual Review

2.1.1 Immunization

2.1.1 Routine Immunization

2.1.2 Schedule of Routine Immunization

2.1.4 Importance of Routine Immunization

2.2 Theoretical Review

2.2.1 District Health Information System (DHIS)

2.2.2 Versions of DHIS

2.2.3 Conceptual Review of DHIS2

2.2.4 How does the DHIS2 works

2.2.5 Features of DHIS2

2.2.6 Users of DHIS2

2.3 Empirical Review

2.3.1 Difference between DHIS2 General Server and DHIS2 RI Server

2.3.2 How to send SMS RI data to DHIS2 SMS Server

2.3.3 Example of RI SMS Data Codes

2.3.4 How to log in into DHIS2 SMS Server

2.3.5 Different components which constitute DHIS2 SMS Server

2.4 Summary of Gaps in Literature

Endnotes

2.1 Conceptual Review

African countries including Nigeria have been declared wild poliovirus (WPV) free August 2020. The greatest milestone in the history of Polio eradication was achieved in the year 2020 with certification of the country and by extension[1]. African region as wild polio-free after more than four years without reporting a case. The region is now the fifth of the six WHO regions –representing over 90% of the world's population – free of the wild poliovirus, moving the world closer to achieving global polio eradication. At the end of 2020 773 (99.9%) of the 774 LGAs had reported at least one AFP case with a national Non-Polio Acute Flaccid Paralysis (NPAFP) rate of 6.1/100,000 Under 15 and Stool adequacy of 94%. There was a decline in the detection and reporting of AFP cases in the year, this is largely due to disruption of health interventions as a result of COVID 19 outbreak to address this challenge a contingency plan was developed the guide the surveillance based on the dynamics of the outbreak[2].

2.1.1 Immunization

Immunization is the process by which a person becomes protected against a disease through vaccination[3]. This term is often used interchangeably with vaccination or inoculation, vaccine or antigen is the preparation that is used to increase or stimulate the body's immune response against diseases by inactivating the disease and introduce into the body, therefore, body would be familiar with the disease before the real one enters into the body, vaccine can be usually given either orally or injectable using syringe and needle given at different route, site and dose, strategy for immunization is vaccination, vaccination is a simple, safe, and effective way of protecting you against harmful diseases, before you come into contact with them. It uses your body's natural defenses to build resistance to specific infections and makes your immune system stronger. Immunization, or

immunization, is the process by which an individual's immune system becomes fortified against an infectious agent (known as the immunogen)[4].

When this system is exposed to molecules that are foreign to the body, called non-self, it will orchestrate an immune response, and it will also develop the ability to quickly respond to a subsequent encounter because of immunological memory. This is a function of the adaptive immune system. Therefore, by exposing a human, or an animal, to an immunogen in a controlled way, its body can learn to protect itself: this is called active immunization.

The most important elements of the immune system that are improved by immunization are the T cells, B cells, and the antibodies B cells produce. Memory B cells and memory T cells are responsible for a swift response to a second encounter with a foreign molecule. Passive immunization is direct introduction of these elements into the body, instead of production of these elements by the body itself.

Immunization is done through various techniques, most commonly vaccination. Vaccines against microorganisms that cause diseases can prepare the body's immune system, thus helping to fight or prevent an infection. The fact that mutations can cause cancer cells to produce proteins or other molecules that are known to the body forms the theoretical basis for therapeutic cancer vaccines. Other molecules can be used for immunization as well, for example in experimental vaccines against nicotine (NicVAX) or the hormone ghrelin in experiments to create an obesity vaccine. Immunizations are often widely stated as less risky and an easier way to become immune to a particular disease than risking a milder form of the disease itself. They are important for both adults and children in that they can protect us from the many diseases out there[5]. Immunization not only protects children against deadly diseases but also helps in developing children's immune systems. Through

the use of immunizations, some infections and diseases have almost completely been eradicated throughout the World. One example is polio.

Thanks to dedicated health care professionals and the parents of children who vaccinated on schedule, polio has been eliminated in the U.S. since 1979. Polio is still found in other parts of the world so certain people could still be at risk of getting it. This includes those people who have never had the vaccine, those who didn't receive all doses of the vaccine, or those traveling to areas of the world where polio is still prevalent. Active immunization/vaccination has been named one of the "Ten Great Public Health Achievements in the 20th Century.

Vaccines train your immune system to create antibodies, just as it does when it's exposed to a disease. However, because vaccines contain only killed or weakened forms of germs like viruses or bacteria, they do not cause the disease or put you at risk of its complications. Vaccines reduce risks of getting a disease by working with your body's natural defenses to build protection. When you get a vaccine, your immune system responds. It recognizes the invading germ, such as the virus or bacteria.

Produces antibodies: Antibodies are proteins produced naturally by the immune system to fight disease. Remembers the disease and how to fight it. If you are then exposed to the germ in the future, your immune system can quickly destroy it before you become unwell. The vaccine is therefore a safe and clever way to produce an immune response in the body, without causing illness. Our immune systems are designed to remember. Once exposed to one or more doses of a vaccine, we typically remain protected against a disease for years, decades or even a lifetime. This is what makes vaccines so effective. Rather than treating a disease after it occurs, vaccines prevent us in the first instance from getting sick.

Active immunization can occur naturally when a person comes in contact with, for example, a microbe. The immune system will eventually create antibodies and other defenses against the microbe. The next time, the immune response against this microbe can be very efficient; this is the case in many of the childhood infections that a person only contracts once, but then is immune.

Passive immunization is where pre-synthesized elements of the immune system are transferred to a person so that the body does not need to produce these elements itself. Currently, antibodies can be used for passive immunization. This method of immunization begins to work very quickly, but it is short lasting, because the antibodies are naturally broken down, and if there are no B cells to produce more antibodies, they will disappear[6].

2.1.2 Routine Immunization

Routine childhood immunization remains an important strategy for achieving polio and other vaccine preventable diseases eradication and maintaining a polio-free world[7]. It is the goal of Nigerian government to ensure every child receive complete doses of immunization before reaching the age of five and women of child bearing age, this goal can only be achieve through many strategies such as house to house immunization plus days, intensive surveillance and effective routine immunization. Routine immunization is the foundation through which countries provide access to lifesaving vaccines and control and eradicate vaccine-preventable diseases. It is the process of timely vaccination on a regular basis with vaccines considered important for a given country to reduce morbidity and mortality.

This process is enabled by a country's health system and maintained through a set of management subsystems needed to continuously supply the full complement of scheduled vaccines, monitor their safety, control population coverage, and measure their

epidemiological impact. Polio (also known as poliomyelitis) is a highly contagious disease caused by a virus that attacks the nervous system. Children younger than 5 years old are more likely to contract the virus than any other group. According to the World Health Organization (WHO), 1 in 200 polio infections will result in permanent paralysis[8]. However, thanks to the global polio eradication initiative in 1988, the following regions are now certified polio-free:

Americas

Europe

Western Pacific

Southeast Asia

But polio is still persistent in Afghanistan, Pakistan, and Nigeria. Eliminating polio will benefit the world in terms of health and economy. The eradication of polio can save at least $40–50 billion over the next 20 years. It's estimated that 95 to 99 percent of people who contract poliovirus are asymptomatic. This is known as subclinical polio[9]. Even without symptoms, people infected with poliovirus can still spread the virus and cause infection in others. Non-paralytic polio. Signs and symptoms of non-paralytic polio can last from one to 10 days. These signs and symptoms can be flu-like and can include:

i. Fever
ii. Sore throat
iii. Headache
iv. Vomiting
v. Fatigue
vi. Meningitis

Non-paralytic polio is also known as abortive polio.

Paralytic polio: About 1 percent of polio cases can develop into paralytic polio. Paralytic polio leads to paralysis in the spinal cord (spinal polio), brainstem (bulbar polio), or both (bulbospinal polio). Initial symptoms are similar to non-paralytic polio. But after a week, more severe symptoms will appear. These symptoms include:

vii. Loss of reflexes
viii. Severe spasms and muscle pain
ix. Loose and floppy limbs, sometimes on just one side of the body
x. Sudden paralysis, temporary or permanent
xi. Deformed limbs, especially the hips, ankles, and feet

It's rare for full paralysis to develop. Less than 1 percent of all polio cases will result in permanent paralysis. In 5–10 percent of the polio paralysis cases, the virus will attack the muscles that help you breathe and cause death. Post-polio syndrome. It's possible for polio to return even after you've recovered. This can occur after 15 to 40 years. Common symptoms of post-polio syndrome (PPS) are:

i. Continuing muscle and joint weakness
ii. Muscle pain that gets worse
iii. Becoming easily exhausted or fatigued
iv. Muscle wasting, also called muscle atrophy
v. Trouble breathing and swallowing
vi. Sleep apnea, or sleep-related breathing problems
vii. Low tolerance of cold temperatures
viii. New onset of weakness in previously uninvolved

ix. Depression

x. Trouble with concentration and memory

How does the poliovirus infect someone: As a highly contagious virus, polio transmits through contact with infected feces? Objects like toys that have come near infected feces can also transmit the virus. Sometimes it can transmit through a sneeze or a cough, as the virus lives in the throat and intestines. This is less common. People living in areas with limited access to running water or flush toilets often contract polio from drinking water contaminated by infected human waste. According to the Mayo Clinic, the virus is so contagious that anyone living with someone who has the virus can catch it too. Pregnant women, people with weakened immune systems — such as those who are HIV-positive — and young children are the most susceptible to the poliovirus.

How do doctors diagnose polio: Your doctor will diagnose polio by looking at your symptoms. They'll perform a physical examination and look for impaired reflexes, back and neck stiffness, or difficulty lifting your head while lying flat. Labs will also test a sample of your throat, stool, or cerebrospinal fluid for the poliovirus. Doctors can only treat the symptoms while the infection runs its course. But since there's no cure, the best way to treat polio is to prevent it with vaccinations. The most common supportive treatments include, bed rest, pain killers, antispasmodic drugs to relax muscles, antibiotics for urinary tract infections, portable ventilators to help with breathing, physical therapy or corrective braces to help with walking, heating pads or warm towels to ease muscle aches and spasms, physical therapy to treat pain in the affected muscles, physical therapy to address breathing and pulmonary problems, pulmonary rehabilitation to increase lung endurance. In advanced cases of leg weakness, you may need a wheelchair or other mobility device.

RI Services in Sokoto State

Essential components of immunization systems align with fundamental health systems components and function within the context of broader health and social welfare systems. Routine immunization contributes significantly in the reduction of childhood mortality among children through vaccination against preventable diseases in Nigeria[10]. This study seeks to assess the determinants of Childhood Routine Immunization coverage in Sokoto State. Findings from the research study indicates that routine immunization coverage is still very low in Sokoto State when compared with the national target of 80% coverage (RI Strategic Plan 2013-2015). Also, this research discovered that about half of the children in Sokoto State, Nigeria are partially or not immunized at all. This clearly indicates that about half of children born in Sokoto State have not received pentavalent vaccine by the time they reach their first birthday. The challenges of immunization coverage in Sokoto State is attributed to Mothers/Caregivers inability to take their child to the health facility, unaware of immunization schedule, unaware of immunization need, absence of vaccinators, forgetfulness, no need felt, fear of AEFI, unaware of place and time, no faith/belief in immunization, lack of vaccines at the health facilities. The study recommends that government should make an extra effort to sensitize caregivers and counseled them on the significance of taking their children to health facilities for vaccination.

Routine Immunization Vaccine and their uses

Hepatitis B is a viral infection that attacks the liver and can cause both acute and chronic disease. The virus is most commonly transmitted from mother to child during birth and

delivery, as well as through contact with blood or other body fluids during sex with an infected partner, unsafe injections or exposures to sharp instruments[11].

Nigeria has the highest population of unimmunized children in the world and is one of few countries with less than half the population covered with essential health services. Low coverage of services poses a threat to the health and well-being of Nigerian children, but this threat becomes even more pronounced against a backdrop of the 'health financing transition', including the transition from support from the Gavi Alliance, the main source of financing for the country's immunization program. The Nigeria Immunization Financing Assessment shows how the factors at multiple levels of government and the health system interact to affect four dimensions of health and immunization financing: adequacy; sustainability; efficiency; and predictability. The findings informed the design of the Nigeria Strategy for Immunization and PHC System Strengthening (NSIPSS), which will be used to guide the country as it transitions from Gavi support. This paper emphasizes the need to implement the NSIPSS in close coordination with the current reforms underway in the health sector. Currently, the government of Nigeria is piloting reforms at federal, state, and local levels to fast track implementation of the National Health Act, which aims to bring additional and 'smarter' domestic resources for health to the facility level. Also needed are systematic linking of health plans to budgets, more efficient allocation of resources, coordinated advocacy, exploration of demand-side barriers to service delivery, capacity building, and strengthened accountability mechanisms that ensure investments in health lead to improved health outcomes. A transition planning process that is grounded, backed by evidence, monitored and adapted regularly, and backed by the highest level of

the government of Nigeria will be critical for changing the trajectory for the children of Nigeria.

WHO estimates that 296 million people were living with chronic hepatitis B infection in 2019, with 1.5 million new infections each year. In 2019, hepatitis B resulted in an estimated 820 000 deaths, mostly from cirrhosis and hepatocellular carcinoma (primary liver cancer). Hepatitis B can be prevented by vaccines that are safe, available and effective. Hepatitis B is a potentially life-threatening liver infection caused by the hepatitis B virus (HBV). It is a major global health problem. It can cause chronic infection and puts people at high risk of death from cirrhosis and liver cancer. A safe and effective vaccine that offers 98% to 100% protection against hepatitis B is available. Preventing hepatitis B infection averts the development of complications including chronic disease and liver cancer[12]. The burden of hepatitis B infection is highest in the WHO Western Pacific Region and the WHO African Region, where 116 million and 81 million people, respectively, are chronically infected. Sixty million people are infected in the WHO Eastern Mediterranean Region, 18 million in the WHO South-East Asia Region, 14 million in the WHO European Region and 5 million in the highly endemic areas, hepatitis B is most commonly spread from mother to child at birth (perinatal transmission) or through horizontal transmission (exposure to infected blood), especially from an infected child to an uninfected child during the first 5 years of life. The development of chronic infection is common in infants infected from their mothers or before the age of 5 years. Hepatitis B is also spread by needlestick injury, tattooing, piercing and exposure to infected blood and body fluids, such as saliva and menstrual, vaginal and seminal fluids. Transmission of the virus may also occur through the reuse of contaminated needles and syringes or sharp objects either in health

care settings, in the community or among persons who inject drugs. Sexual transmission is more prevalent in unvaccinated persons with multiple sexual partners. Hepatitis B infection acquired in adulthood leads to chronic hepatitis in less than 5% of cases, whereas infection in infancy and early childhood leads to chronic hepatitis in about 95% of cases. This is the basis for strengthening and prioritizing infant and childhood vaccination[13].

The hepatitis B virus can survive outside the body for at least 7 days. During this time, the virus can still cause infection if it enters the body of a person who is not protected by the vaccine. The incubation period of the hepatitis B virus ranges from 30 to 180 days. The virus may be detected within 30 to 60 days after infection and can persist and develop into chronic hepatitis B, especially when transmitted in infancy or childhood.

Symptoms

Most people do not experience any symptoms when newly infected. However, some people have acute illness with symptoms that last several weeks, including yellowing of the skin and eyes (jaundice), dark urine, extreme fatigue, nausea, vomiting and abdominal pain. People with acute hepatitis can develop acute liver failure, which can lead to death. Among the long-term complications of HBV infections, a subset of persons develops advanced liver diseases such as cirrhosis and hepatocellular carcinoma, which cause high morbidity and mortality[14].

Bacillus Calmette–Guérin (BCG) vaccine is a vaccine primarily used against tuberculosis (TB). It is named after its inventors Albert Calmette and Camille Guérin. In countries where TB or leprosy is common, one dose is recommended in healthy babies as soon after birth as possible. In areas where TB is not common, only children at high risk are typically immunized, while suspected cases of TB are individually tested for and treated. Adults who

do not have TB and have not been previously immunized but are frequently exposed may be immunized as well. BCG also has some effectiveness against Buruli ulcer infection and other nontuberculous mycobacteria infections[15].

Additionally it is sometimes used as part of the treatment of bladder cancer. Rates of protection against TB infection vary widely and protection lasts up to twenty years. Among children it prevents about 20% from getting infected and among those who do get infected it protects half from developing disease. The vaccine is given by injection into the skin. There is no evidence that additional doses are beneficial. Serious side effects are rare. Often there is redness, swelling, and mild pain at the site of injection. A small ulcer may also form with some scarring after healing. Side effects are more common and potentially more severe in those with poor immune function. It is not safe for use during pregnancy. The vaccine was originally developed from Mycobacterium bovis, which is commonly found in cows. While it has been weakened, it is still live. Immunization against childhood diseases such as diphtheria, pertussis, tetanus, polio and measles are one of the most cost-effective health interventions, preventing childhood morbidity and mortality, especially among children younger than 5 years. In most countries, routine immunization (RI) services is one of the strategies of eradicating these diseases and it is part of the primary health care system. Increases in a country's immunization coverage often serve as an indicator of improvement of a health system's capacity to deliver essential services to the population.. In Nigeria, a child is considered fully vaccinated if he or she has received: 1 dose of Bacille Calmette-Guérin (BCG) vaccination against tuberculosis, 3 doses of Pentavalent (Penta) vaccine to prevent diphtheria, pertussis (whooping cough), tetanus, hepatitis B and Haemophilus influenza type b, 3 doses of oral poliovirus vaccine (OPV), 1

dose of inactivated poliovirus vaccine (IPV), 1 dose of measles vaccine and 1 dose of yellow fever vaccine. Children should receive these antigens during the first year of life[16].

Oral polio vaccine (OPV): OPV consists of a mixture of live attenuated poliovirus strains of each of the three serotypes, selected by their ability to mimic the immune response following infection with wild polioviruses, but with a significantly reduced incidence of spreading to the central nervous system. Three or more spaced doses of OPV are required to generate adequate levels of seroconversion. The action of oral polio vaccine (OPV) is two-pronged. OPV produces antibodies in the blood ('humoral' or serum immunity) to all three types of poliovirus, and in the event of infection, this protects the individual against polio paralysis by preventing the spread of poliovirus to the nervous system[17]. OPV strains also produce a local immune response in the lining ('mucous membrane') of the intestines - the primary site for poliovirus multiplication. The antibodies produced there inhibit the multiplication of subsequent infections of 'wild' (naturally occurring) virus. This intestinal immune response to OPV is probably a reason why mass campaigns with OPV have been shown to stop person-to-person transmission of wild poliovirus. In very rare cases, the administration of OPV results in vaccine-associated paralysis associated with a reversion of the vaccine strains to the more neurovirulent profile of wild poliovirus. In a few instances, such vaccine strains have become both neurovirulent and transmissible and have resulted in infectious poliomyelitis.

Inactivated polio vaccine (IPV): IPV is produced from wild-type poliovirus strains of each serotype that have been inactivated (killed) with formalin. As an injectable vaccine, it can be administered alone or in combination with other vaccines (e.g., diphtheria, tetanus, pertussis, hepatitis B, and haemophilus influenza)[18]. Generally three spaced doses are

administered to generate adequate levels of seroconversion, and most countries, a booster dose is added during late childhood. IPV has been used successfully in the polio eradication programs in a few countries, notably in Scandinavia and the Netherlands, but until recently most countries have used the oral polio vaccine. IPV provides serum immunity to all three types of poliovirus, resulting in protection against paralytic poliomyelitis. Most studies indicate that the degree of mucosal immunity in the intestine is significantly less than that provided by OPV, although this difference may be less pronounced in the pharyngeal mucosal lining. Adverse events following administration of IPV are very mild and transient. Due to the risks associated with the large quantities of poliovirus needed for IPV production, following the global cessation of poliovirus transmission high level (BSL-3/polio) containment of all manufacturing and quality control areas where live virus is handled must be implemented. Both of these vaccine can be used to prevent poliomyelitis, Poliomyelitis is a crippling disease that results from infection with any one of the three related poliovirus types (referred to as types P1, P2, and P3), members of the enterovirus (picornavirus) family[19]. Poliovirus is transmitted from one person to another by oral contact with secretions or faecal material from an infected person. Once viral reproduction is established in the mucosal surfaces of the nasopharynx, poliovirus can multiply in specialized cells in the intestines and enter the blood stream to invade the central nervous system, where it spreads along nerve fibres. When it multiplies in the nervous system, the virus can destroy nerve cells (motor neurons) which activate skeletal muscles. These nerve cells cannot regenerate, and the affected muscles lose their function due to a lack of nervous enervation a condition known as acute flaccid paralysis (AFP).

Typically, in patients with poliomyelitis muscles of the legs are affected more often than the arm muscles. More extensive paralysis, involving the trunk and muscles of the thorax and abdomen, can result in quadriplegia. In the most severe cases (bulbar polio), poliovirus attacks the motor neurons of the brain stem - reducing breathing capacity and causing difficulty in swallowing and speaking. Without respiratory support, bulbar polio can result in death. It can strike at any age, but affects mainly children under three (over 50% of all cases). Poliomyelitis is a crippling disease that results from infection with any one of the three related poliovirus types (referred to as types P1, P2, and P3), members of the enterovirus (picornavirus) family. Poliovirus is transmitted from one person to another by oral contact with secretions or faecal material from an infected person. Once viral reproduction is established in the mucosal surfaces of the nasopharynx, poliovirus can multiply in specialized cells in the intestines and enter the blood stream to invade the central nervous system, where it spreads along nerve fibres. When it multiplies in the nervous system, the virus can destroy nerve cells (motor neurons) which activate skeletal muscles. These nerve cells cannot regenerate, and the affected muscles lose their function due to a lack of nervous enervation - a condition known as acute flaccid paralysis (AFP)[20].

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Poliovirus infection can provide lifelong immunity against the disease, but this protection is limited to the particular type of poliovirus involved (Type 1, 2, or 3)[21]. Infection with one type does not protect an individual against infection with the other two types. Pentavalent vaccine, also known as a 5-in-1 vaccine, is a combination vaccine with five individual vaccines conjugated into one. Pentavalent vaccine frequently refers to the 5-in-1 vaccine protecting against diphtheria, tetanus, whooping cough, hepatitis B and Haemophilus influenzae type B, which is generally used in middle- and low-income countries, where polio vaccine is given separately. Another pentavalent vaccine is the 5-in-1 vaccine that protects against diphtheria, tetanus, whooping cough, polio, and Haemophilus influenza type B. Pneumococcal vaccines are vaccines against the bacterium Streptococcus pneumoniae. Their use can prevent some cases of pneumonia, meningitis, and sepsis. There are two types of pneumococcal vaccines: conjugate vaccines and polysaccharide vaccines. They are given by injection either into a muscle or just under the skin. Pneumococcal vaccines are vaccines against the bacterium Streptococcus pneumoniae. Their use can prevent some cases of pneumonia, meningitis, and sepsis. There are two types of pneumococcal vaccines: conjugate vaccines and polysaccharide vaccines. They are given by injection either into a muscle or just under the skin, The World Health Organization (WHO) recommends the use of the conjugate vaccine in the routine immunizations given to children. This includes those with HIV/AIDS. The recommended three or four doses are between 71 and 93% effective at preventing severe pneumococcal disease. The polysaccharide vaccines, while effective in healthy adults, are not effective in children less than two years old or those with poor immune function. These vaccines are generally safe.

With the conjugate vaccine about 10% of babies develop redness at the site of injection, fever, or change in sleep. Severe allergies are very rare[22].

Measles Vaccine: Measles is a highly contagious, serious disease caused by a virus. Before the introduction of measles vaccine in 1963 and widespread vaccination, major epidemics occurred approximately every 2–3 years and measles caused an estimated 2.6 million deaths each year. More than 140 000 people died from measles in 2018 – mostly children under the age of 5 years, despite the availability of a safe and effective vaccine. Measles is caused by a virus in the paramyxovirus family and it is normally passed through direct contact and through the air[23]. The virus infects the respiratory tract, then spreads throughout the body. Measles is a human disease and is not known to occur in animals. Accelerated immunization activities have had a major impact on reducing measles deaths. During 2000– 2018, measles vaccination prevented an estimated 23.2 million deaths. Global measles deaths have decreased by 73% from an estimated 536 000 in 2000 to 142,000 in 2018.

Yellow fever vaccine is a vaccine that protects against yellow fever. Yellow fever is a viral infection that occurs in Africa and South America. Most people begin to develop immunity within ten days of vaccination and 99 percent are protected within one month, and this appears to be lifelong[24]. The vaccine can be used to control outbreaks of disease. It is given either by injection into a muscle or just under the skin. The World Health Organization (WHO) recommends routine immunization in all countries where the disease is common. This should typically occur between nine and twelve months of age. Those traveling to areas where the disease occurs should also be immunized. Additional doses after the first are generally not needed. The yellow fever vaccine is generally safe. This includes in those

with HIV infection but without symptoms. Mild side effects may include headache, muscle pains, pain at the injection site, fever, and rash. Severe allergies occur in about eight per million doses, serious neurological problems occur in about four per million doses, and organ failure occurs in about three per million doses. It appears to be safe in pregnancy and is therefore recommended among those who will be potentially exposed. It should not be given to those with very poor immune function.

MenA Vaccine: the MenAfriVac vaccine, which was developed to meet the specific needs of the meningitis belt, Meningococcal meningitis is most prevalent in the sub-Saharan "meningitis belt". This area stretches from Senegal in the West to Ethiopia in the East, with an at-risk population of about 500 million[25]. Meningitis is a devastating disease with a high case fatality rate and leading to serious long-term complications (sequelae). Meningitis remains a major global public-health challenge. Epidemics of meningitis are seen across the world, particularly in sub-Saharan Africa. Many organisms can cause meningitis including bacteria, viruses, fungi, and parasites. Bacterial meningitis is of particular concern. Around 1 in 10 people who get this type of meningitis die and 1 in 5 have severe complications. Safe affordable vaccines are the most effective way to deliver long-lasting protection. Epidemics occur in the dry season, from December to June. An epidemic wave can last two to three years, dying out during the intervening rainy seasons. Those at highest risk of infection are infants, children and young adults. Meningococcal meningitis can kill within hours. 10% of those infected die within two days even when antibiotics are available. One in four survivors is left with permanent disabilities such as paralysis, blindness, hearing loss, seizures and intellectual disability[26].

Antigens are the components derived from the structure of disease-causing organisms, which are recognized as 'foreign' by the immune system and trigger a protective immune response to the vaccine. Stabilizers are used to help the vaccine maintain its effectiveness during storage. Vaccine stability is essential, particularly where the cold chain is unreliable. Instability can cause loss of antigenicity and decreased infectivity of LAV. Factors affecting stability are temperature and acidity or alkalinity of the vaccine (pH). Bacterial vaccines can become unstable due to hydrolysis and aggregation of protein and carbohydrate molecules. Stabilizing agents include MgCl2 (for OPV), MgSO4 (for measles), lactose-sorbitol and sorbitol-gelatine[27].

Adjuvants are added to vaccines to stimulate the production of antibodies against the vaccine to make it more effective. Adjuvants have been used for decades to improve the immune response to vaccine antigens, most often in inactivated (killed) vaccines. In conventional vaccines, adding adjuvants into vaccine formulations is aimed at enhancing, accelerating and prolonging the specific immune response to vaccine antigens. Newly developed purified subunit or synthetic vaccines using biosynthetic, recombinant, and other modern technology are poor vaccine antigens and require adjuvants to provoke the desired immune response. Chemically, adjuvants are a highly heterogeneous group of compounds with only one thing in common: their ability to enhance the immune response. They are highly variable in terms of how they affect the immune system and how serious their adverse reactions are, due to the resulting hyperactivation of the immune system[28].

Antibiotics (in trace amounts) are used during the manufacturing phase to prevent bacterial contamination of the tissue culture cells in which the viruses are grown. Usually only trace

amounts appear in vaccines, for example, MMR vaccine and IPV each contain less than 25 micrograms of neomycin per dose (less than 0.000025 g).

Used during the manufacturing phase to prevent bacterial contamination of tissue culture cells in which viruses are grown. Usually only trace amounts appear in vaccines, for example, MMR and IPV vaccines each contain less that 25 micrograms of neomycin per dose, Persons known to be allergic to neomycin should be closely observed after vaccination so any allergic reaction can be immediately treated. Preservatives are added to multidose vaccines to prevent bacterial and fungal growth. They include a variety of substances, for example Thiomersal, Formaldehyde, or Phenol derivatives.

Thiomersal: Very commonly used preservative. Thiomersal is an ethyl mercury-containing compound. It has been in use since the 1930s and no harmful effects have been reported for doses used in vaccination except for minor reactions (e.g. redness, swelling at injection site). It is used in multidose vials and for single dose vials in many countries as it helps reduce storage requirements/costs. Thiomersal has been subjected to intense scrutiny, as it contains ethyl mercury. The Global Advisory Committee on Vaccine Safety continuously reviews the safety aspects of Thiomersal[29]. So far, there is no evidence of toxicity when exposed to Thiomersal in vaccines. Even trace amounts of thiomersal seem to have no impact on the neurological development of infants.

Formaldehyde used to inactivate viruses (e.g. IPV) and to detoxify bacterial toxins, such as the toxins used to make diphtheria and tetanus vaccines[30]. During production, a purification process removes almost all formaldehyde in vaccines. The amount of formaldehyde in vaccines is several hundred times lower than the amount known to do harm to humans, even infants. E.g., DTP-HepB + Hib "5-in-1" vaccine contains less than 0.02%

formaldehyde per dose, or less than 200 parts per million. The route of administration is the path by which a vaccine (or drug) is brought into contact with the body. This is a critical factor for success of the immunization. A substance must be transported from the site of entry to the part of the body where its action is desired to take place. Using the body's transport mechanisms for this purpose, however, is not trivial.

Intramuscular (IM) injection administers the vaccine into the muscle mass. Vaccines containing adjuvants should be injected IM to reduce adverse local effects.

Subcutaneous (SC) injection administers the vaccine into the subcutaneous layer above the muscle and below the skin.

Intradermal (ID) injection administers the vaccine in the topmost layer of the skin. BCG is the only vaccine with this route of administration. Intradermal injection of BCG vaccine reduces the risk of neurovascular injury. Health workers say that BCG is the most difficult vaccine to administer due to the small size of newborns' arms. A short narrow needle (15 mm, 26 gauge) is needed for BCG vaccine. All other vaccines are given with a longer, wider needle (commonly 25 mm, 23 gauge), either SC or IM.

Contraindication A condition that makes a particular treatment or procedure, such as vaccination with a particular vaccine, inadvisable.

Contraindications can be permanent, such as known allergies to a vaccine component, or temporary, such as an acute febrile illness. to vaccination is a rare condition in a recipient that increases the risk for a serious adverse reaction. Ignoring contraindications can lead to avoidable vaccine reactions. Most contraindications are temporary, and the vaccination can be administered later.

The only contraindication applicable to all vaccines is a history of a severe allergic reaction after a prior dose of vaccine or to a vaccine constituent. Precautions are not contraindications, but are events or conditions to be considered in determining if the benefits of the vaccine outweigh the risks. Precautions stated in product labelling can sometimes be inappropriately used as absolute contraindications, resulting in missed opportunities to vaccinate.

Anaphylaxis: An acute, multi-system, allergic reaction (IgE mediated) to a substance, such as vaccination, drugs, and food. Symptoms of anaphylaxis may include breathing difficulties, loss of consciousness, and a drop in blood pressure. This condition can be fatal and requires immediate medical attention. is a very rare allergic reaction (one in a million vaccinees), unexpected, and can be fatal if not dealt with adequately. Vaccine antigens and components can cause this allergic reaction. These reactions can be local *(or localized)* Restricted or limited to a specific body part or region or *Systemic* Relating to a system, or affecting the entire body or an entire organism (e.g., fever). and can include mild-to-severe anaphylaxis or anaphylactic-like responses (e.g. generalized *Urticaria (also known as hives).* The eruption of red marks on the skin that are usually accompanied by itching. This condition can be caused by an allergy (e.g., food, vaccine, drugs), stress, infection, or physical agents (e.g., heat, cold). or hives, wheezing, swelling of the mouth and throat, breathing difficulties, *Hypotension* Low blood pressure and shock).

Reports of anaphylaxis are less common in low- and middle-income countries compared to high-income countries, probably because of reduced surveillance sensitivity and as the event may not be recognized (i.e. death attributed to another factor).

People may be *Immunocompromised (also immunosupression)* Unable to mount a normal immune response. This condition can be genetic, or caused by disease (like HIV infection or cancer) by certain drugs (such as those used in chemotherapy and organ transplantation). Individuals whose immune systems are severely compromised should not receive LAV vaccines. due to HIV/AIDS, *Congenital* A condition that is present at birth, though not necessarily hereditary. Immune deficiencies or *Drug (or medicine).* Any substance in a pharmaceutical product that is used to modify or exploit physiological systems or pathological states for the benefit of the recipient. The term drug/medicinal product is used in a wider sense to include the whole formulated and registered product, including the presentation and packaging, and the accompanying information. Vaccines are drugs/medicines. Treatments such as chemotherapy for cancer or other conditions or high dose steroids. The potential risks of live vaccines need to be weighed against the benefits in immune compromised individuals who may be particularly vulnerable to the vaccine-preventable disease. Concerns are that they may not respond adequately to subunit and inactivated vaccination and that LAV vaccines are potentially pathogenic.

Routine childhood vaccinations – except BCG vaccination– are not contraindicated in children with asymptomatic HIV-infection; however, timing of vaccination may be earlier or more frequent in this subgroup. Beyond the true vaccine reactions that are well documented and have been illustrated throughout this module, the notion that vaccines could be responsible for serious health problems has led to many allegations and many scientific reviews. Some allegations often based on unfounded rumours or poor science have, at times, profoundly affected the performance of immunization programmes and limited the ability to prevent serious diseases[31].

For other health conditions, the scientific evidence available is insufficient to conclude that the association is real, but also insufficient to exclude a link. Systematic study of such conditions can be made difficult as the frequency of a true reaction can be extremely low, or effects would be very mild or they occur many years after vaccination. In recent years, the availability of large computerized databases has allowed testing of many of those potential delayed associations, demonstrating nearly ubiquitously that there is no evidence for a link. Under recommended conditions, all vaccines used in national immunization programmes are safe and effective if used correctly. In practice, however, no vaccine is completely risk-free and adverse events can occasionally result after an immunization. Adverse events can range from minor adverse effects to more severe reactions. They can be a cause of public concerns about vaccine safety. To understand a specific event and to be able to respond appropriately, there are several questions that you need to answer.

Although all vaccines used in NIPs are safe and effective if used correctly, no vaccine is completely risk-free and adverse events will occasionally result after an immunization. An adverse event following immunization (AEFI) is any untoward medical occurrence which follows immunization and which does not necessarily have a causal relationship with the usage of the vaccine. The adverse event may be any unfavorable or unintended sign, abnormal laboratory finding, symptom or disease.

AEFIs are grouped into five categories:

i. Vaccine product-related reaction
ii. Vaccine quality defect-related reaction
iii. Immunization error-related reaction
iv. Immunization anxiety-related reaction

v. Coincidental event

Serious event Seriousness is based on patient/event outcome or action criteria and defines regulatory reporting obligations. An AEFI will be considered serious if:

i. it results in death;

ii. is life-threatening;

iii. requires in-patient hospitalization or prolongation of existing hospitalization;

iv. results in persistent or significant disability/incapacity, or

v. is a congenital anomaly/birth defect.

The ICH E2A and E2D guidelines also state that other situations, such as other important medical events that may jeopardize the patient or may require intervention to prevent one of the outcomes above, should also be considered serious after applying medical and scientific judgment. Those "other situations" are open to interpretation and could vary from jurisdiction to jurisdiction.

Event severity: *Severe* is used to describe the intensity of a specific event (as in *mild*, *moderate* or *severe*); the event itself, however, may be of relatively minor medical significance (e.g. fever is a common relatively minor medical event, but according to its *severity* it can be graded as *mild* fever or *moderate* fever).

A vaccine reaction can be an individual's response to the inherent properties of the vaccine, even when the vaccine has been prepared, handled and administered correctly (*vaccine product-related reactions*). It can also be due to a defect in a vaccine (or its administration device) that occurred during the manufacturing process (*quality defect-related reactions*).

Vaccine reactions can be classified according to their severity into two groups:

Minor reactions usually occur within a few hours of injection. Resolve after short period of time and pose little danger. Local (or localized) Restricted or limited to a specific body part or region. (Includes pain, swelling or redness at the site of injection). Systemic Relating to a system, or affecting the entire body or an entire organism (e.g., fever). (includes fever, malaise, muscle pain, headache or loss of appetite).Severe reactions is a term including serious reactions but also including other severe reactions. Severe reactions usually do not result in long-term problems can be disabling. Minor vaccine reactions local reaction: Swelling/redness at the site of injection. Ideally vaccines will cause no, or only minor (i.e. non-severe), adverse reactions.

Vaccination induces immunity by causing the recipient's immune system to react to antigens contained in the vaccine[32]. Local and systemic reactions such as pain or fever can occur as part of the immune response. In addition, other vaccine components (e.g. adjuvants pharmacological agent (e.g., aluminum salt, oil-in-water emulsions) that modifies the effect of other agents, such as a drug or vaccine, while having few if any direct effects when given by itself. Adjuvants are often included in vaccines to enhance the recipient's immune response to a supplied antigen, while keeping the injected foreign material to a minimum. Stabilizers Compounds that are used to help vaccine maintain its effectiveness during storage. Vaccine stability is essential, particularly where the cold chain is unreliable. Factors affecting stability are temperature and pH., and preservatives Preservatives Compounds that are added to multi-dose vaccine vials to prevent bacterial and fungal growth. The most commonly used product is called thiomersal, a mercury-containing compound.) can trigger reactions. A successful vaccine keeps even minor reactions to a minimum while producing the best possible immune response.

The frequency of vaccine reactions likely to be observed with some of the most commonly used vaccines, and their treatments, are listed below. These reactions typically occur within a day or two of immunization (except for rash reactions after measles vaccine, which can arise up to 6 to 12 days after immunization) and persist from one to a few days. '*Serious*' and '*severe*' are often used as interchangeable terms but they are not. *Severe* is used to describe the intensity of a specific event (as in mild, moderate or severe); the event itself, however, may be of relatively minor medical significance. Seriousness is based on patient/event outcome or action criteria and defines regulatory reporting obligations[33]. An AEFI will be considered *serious* if it results in death, is life-threatening, requires in-patient hospitalization or prolongation of existing hospitalization, results in persistent or significant disability/incapacity, or is a congenital anomaly/birth defect, and any other important medical events that may jeopardize the patient or may require intervention to prevent one of the outcomes above[34].

Immunization errors result from errors in vaccine preparation, handling, storage or administration. They are preventable and detract from the overall benefit of the immunization programme. The identification and correction of these incorrect immunization practices are of great importance. Immunization errors can result in a cluster of events, defined as two or more cases of the same adverse event related in time, place or vaccine administered[35]. These clusters *Cluster* Two or more instances of an event related in time, place, population subgroup, or common exposure (e.g., vaccine). AEFI clusters are usually associated with a particular provider, health facility, and/or a vial of vaccine that has been inappropriately prepared or contaminated are usually associated with a particular provider or health facility, or a vial of vaccine that has been inappropriately prepared or

contaminated. Immunization errors can also affect many vials, for example, freezing vaccine during transport may result in an increase in local reactions.

The term "*immunization anxiety-related reaction*" is used to describe a range of symptoms and signs that may arise around immunization that are related to "*anxiety*" and not to the vaccine product, a defect in the quality of the vaccine or an error of the immunization programme. These reactions are described as AEFIs arising from anxiety about immunization and include vasovagal-mediated reactions, hyperventilation-mediated reactions and stress-related psychiatric reactions or disorder.

Coincidental events occur after a vaccination has been given but are not caused by the vaccine or its administration. Vaccinations are normally scheduled in infancy and early childhood, when illnesses are common and congenital or early neurological conditions become apparent. Coincidental events are inevitable when vaccinating children in these age groups, especially during a mass campaign. Applying the normal incidence of disease and death in these age groups along with the coverage and timing of immunizations allows estimation of the expected numbers of coincidental events after immunization.

Estimates from the WHO Regional Office for the Western Pacific are presented in the table. For example, in Australia, each year there are likely to be 11 coincidental infant deaths the day after immunization. Immediate investigation of a severe adverse event attributed to a vaccine, but not causally related to it, is critical in order to:

- Respond to a community's concern about vaccine safety;
- Maintain public confidence in immunization.

Calculating the expected rate of an adverse event may be helpful during its investigation. Knowing the background rate of this adverse event enables the investigator to compare

expected and post-vaccination rates of the event. An increase or non-increase of the post-vaccination rate may give a clue on whether the event is actually caused by the vaccine. Knowing the background mortality of the AEFI that coincidentally follow vaccination is key when responding to AEFI reports. A mass vaccination campaign is a particular challenge to AEFI surveillance. It involves administration of vaccine doses to a large population over a short period of time. As a result, adverse events may be more noticeable to staff and to the public.

2.1.3 Importance of Routine Immunization

(WHO vaccine safety basic) Each year, vaccines prevent 2 to 3 million deaths every year. An additional 1.5 million deaths could be avoided, however, if global vaccination Inoculation with a vaccine for the purpose of inducing immunity coverage improves[36].

Vaccines promote health: unlike many other health interventions, they help healthy people stay healthy, removing a major obstacle to human development. Vaccines have an expansive reach: they protect individuals, communities, and entire populations. The complete and permanent worldwide reduction to zero new cases of an infectious disease through deliberate efforts; no further control measures are required of smallpox. An acute, highly infectious, often fatal disease caused by a virus and characterized by high fever and aches with subsequent widespread eruption of pimples that blister, produce pus, and form pockmarks. Declared eradicated by the World Health Assembly in 1980 is a case in point). Vaccines have rapid impact: the impact of most vaccines on communities and populations is almost immediate. For example, between 2000 and 2017, vaccination reduced global deaths from measles. Measles is a contagious viral disease marked by fever, the eruption of red circular spots on the skin that can be deadly to young and weakened individuals by

80% worldwide (preventing an estimated 21.1 million deaths). Vaccines save lives and costs: every dollar spent on childhood immunizations yields US$44 in economic benefits. These include savings on medical costs and productivity loss. Immunization reaches more people than any other health or social service and is a vital component of primary health care. It benefits individuals, communities, countries and the world. It is an investment in the future, as it saves lives and protects the health of populations, improves countries' productivity and resilience and enables a safer, healthier, more prosperous world[37].

2.1.4 Routine Immunization Schedule in Nigeria

National Immunization Schedule (NIS) for Infants, Children and Pregnant Women

National Immunization Schedule

Vaccine	When to give	Dose	Route	Site
For Infants				
BCG	At birth or as early as possible till one year of age	0.1ml (0.05ml until 1 month of age)	Intra -dermal	Left Upper Arm
Hepatitis B Birth dose	At birth or as early as possible within 24 hours	0.5 ml	Intramuscular	Antero-lateral side of mid-thigh LEFT
OPV Birth dose	At birth or as early as possible within the first 15 days	2 drops	Oral	-
OPV 1,2 & 3	At 6 weeks, 10 weeks & 14 weeks	2 drops	Oral	-
IPV (inactivated Polio Vaccine)	14 weeks	0.5 ml	Intramuscular	Anterolateral side of mid-thigh-RIGHT
Pentavelant 1, 2 & 3	At 6 weeks, 10 weeks & 14 weeks	0.5 ml	Intramuscular	Anterolateral side of mid-thigh-LEFT
Rota Virus Vaccine	At 6 weeks, 10 weeks & 14 weeks	5 drops	Oral	-
Measles 1st Dose	9 completed months-12 months. (give up to 5 years if not received at 9-12 months age)	0.5 ml	Subcutaneous	Right Upper Arm
Vitamin A, 1st Dose	At 9 months with measles	1 ml (1 lakh IU)	Oral	-
For children				
DPT 1st booster	16-24 months	0.5 ml	Intramuscular	Anterolateral side of mid-thigh-LEFT
OPV Booster	16-24 months	2 drops	Oral	
Measles 2nd dose	16-24 Months	0.5 ml	Subcutaneous	Right Upper Arm
Vitamin A (2nd to 9th dose)	16 months with DPT/OPV booster, then, one dose every 6 month up to the age of 5 years)	2 ml (2 lakh IU)	Oral	-

Source: National Primary Health Care Agency, Abuja, Nigeria 2021

The National Primary Health Care Development Agency (NPHCDA) of the Federal Ministry of Health (FMoH) of Nigeria coordinates RI policies and strategies while the Local Government Areas (LGAs, equivalent of districts) are responsible for the implementation of RI services[3]. Community access to RI services is promoted through the

implementation of at least one fixed-post vaccination session per week, as well as at least one outreach session per week to offer immunization services to residents who live in remote areas. Despite these efforts, results from the 2016 Multiple Indicator Coverage Survey/National Immunization Coverage Survey (MICS/NICS) report that Penta 3 coverage at the national level was 33%, with variation between 3% and 80% across the 36 states and the Federal Capital Territory (FCT). This result is considerably different from the national administrative coverage rate of 78% reported for 2016. This survey result suggests that administrative RI data do not reflect true vaccination coverage for Nigeria. Several factors can contribute to inaccurate and inconsistent administrative data. Examples are erroneous data reporting from health facilities (HFs), incomplete data reporting, delays in recording summarizing vaccination data after RI sessions and poor review and use of RI data locally.

To address these challenges, NPHCDA established the National Emergency Routine Immunization Coordination Center (NERICC) in July 2017. NERICC is a body of governmental personnel and partners tasked with identifying the root causes of low RI coverage, developing strategies to address these challenges and coordinating with state- and LGA-level officials to implement these strategies. One of the proposed strategies was daily reporting of conducted RI sessions using a short message service (SMS) communication methodology.

In Nigeria, SMS communication methodology has been applied in much intervention, including reminder SMS sent to mothers in rural communities on full and timely completion of routine childhood immunization and communication on specific health interventions for purposes of behavioral change. In systematic review conducted on studies

using SMS technology, researchers found out that it helped to enhance frequency of reporting health issues, improved patient medical compliance and appointment reminders, easy to use, relative inexpensiveness and automated message delivery. However, there is no evidence of its use as a reporting platform for RI data from a HF level.

This paper describes the activities put in place to implement a pilot study and test the effectiveness of transmitting RI data via SMS texts. The assumption underlying this project is that data recorded daily at point of service will improve monitoring of data quality compared to data aggregated once per month over multiple RI sessions. Although immunization data are expected to be recorded on the day of administration at HFs, if they are not, error in recall increases as more time passes between the events of interest and their reporting. Daily surveys are often used to collect the most accurate and reliable prospective behavioral data, reduce the risk of selective reporting, and significantly reduce data management efforts. Also, data are less likely to be missing entry when using real-time electronic data collection tools compared to paper-based tools. Finally, recent studies found that participants prefer electronic data collection methods to paper-based strategies. Therefore, we posit that daily real-time reporting of RI data through SMS can benefit program monitoring and overall RI data quality.

The system was designed on a district health information platform to received and interpreted the message sent from health facilities in predefined codes. Infrastructures included in the design included a server to host the database and store every text sent by each health facility, android based software designed to receive the text messages and forward to the server and an interpreter interface that links the messages from the HF to the

DHIS2 platform. On this intervention, the health facilities are the clients, while the DHIS2 platform designed to present the data is the broker.

The system is built on an Android™ platform. At the end of each RI session, trained healthcare workers (HCWs) in each HF send SMS text to the phone number associated with the server. The phone number used to connect and transmit the SMS text identifies each HF. This system uses three servers for data storage: the SMS harvester, the interpreter, and the SMS dashboards server. The SMS harvester collects all SMS texts sent to the system and secures the data from loss. Once the text has been collected and saved, the information is pushed to the interpreter server, which translates the codes into a readable format. The SMS dashboard server populates the dynamic dashboard based on the programmed indicators. Each HF summarizes the number of children vaccinated for each antigen and the number of vaccine doses in vials opened ("vaccine doses opened") during the session. This information is entered in SMS text using pre-determined codes and sent to a pre-assigned number which has been registered with service communication service providers in Nigeria for the purpose of this intervention. This intervention was designed with minimum financial impact on the health facilities such that each text message sent from a HF costs four Naira ($0.01) which is cost of SMS in Nigeria.

However the financial burden of the intervention including the human resource, infrastructure and space was on the Government of Nigeria and partners supporting the intervention. The message is converted to data points and transmitted to a DHIS2 server at to automatically update a database/dashboard (see Fig 1). National, state and LGA level

officers monitor the reporting system and give feedback to all HFs through phone calls and in-person supervisory visits.

2.2 Theoretical Review

2.2.1 District Health Information System (DHIS)

District Health Information System (DHIS2) it is a free software which can be downloaded from internet, it is a software which allowed to capture, store, analyze and retrieve health care data, it is a real time software[38]. DHIS2 was approved by WHO and recommended for capturing and analysis of health care data, the software was first developed by University of Oslo in 2006 and implemented in India in the year 2006. DHIS2 is one of the world's largest health management information system (HMIS) plat form, about 72 low and middle-income countries are using the software, this means that about 2.3 billion people (30% of the world's population) live in these countries where DHIS2 is been used. The software is an Internet enabled application and data can be uploaded without internet but cannot be analyze and retrieve without network that is it can be operated with internet or without internet, but without internet there is limitation of operation. The software was reviewed and revised from time to time in order to add new operations, tools and indicators DHIS2 is software which integrates the collection of many health care services data from various sources into the single platform, such as malaria, Nutrition, HIV/AIDs, ANC, Immunization, etc[5].

The DHIS software was developed from research conducted into Health Information System programme1 at the University of Oslo in 1994. The purpose of its development was to aggregate routinely collected data across all of the public health facilities of a particular country, to facilitate analysis of health services provided in that country at the national

level, forecast required services for future planning purposes, and to evaluate the performance of healthcare workers. The primary goals of the system were to establish a centralized database with reporting capabilities at health centers, define and determine the standards for local and national health centre reports and connect service delivery and other health system input databases[39].

2.2.2 Versions of DHIS

DHIS 1.3 and 1.4 from the history of DHIS, the software witness a lot of changes and update since its design, this is the reason why it is in version, the first version (version 1) series goes back to 1996 and was first developed on the Microsoft Access platform consisting of visual basic for application (VBA) for the interface or program logic (front-end), access as a database (back-end), Excel for reporting and Windows as operating system. DHIS 1.4 (from 2005) is a significant overhaul of the version 1.3 database structure, using various output formats for reporting. It bridges the gap between DHIS 1.3 and 2. DHIS 2 (from 2004) is a continuation of DHIS version 1 developed on open source Java technologies and available as an online web application. The first release, version 2.0, came in February 2008 after three years of development releases, and the most recent (as of October 2019) version is 2.33. DHIS 2 is developed using open-source Java frameworks and tools (https://dhis2.org/).

The DHIS2 version introduced improvements into the system to extend the use of the data and enable ready-made reports to be generated that could cover reporting requirements for health services at all levels, enabling decisions to be made about services at health centres, as well as local, provincial and national health departments[40].

The goal was to create a new version of DHIS that incorporated and made use of modern technology, with an independent Web-based platform and database, but with the capacity to work in offline mode as well, in order to facilitate efficient and effective management of national data and act as a "data warehouse." DHIS2 is an information system with an open source and few hardware requirements. A generic tool rather than a preconfigured database application and an open metadata model with a flexible user interface that allows users to specify their content without the need for programming.

DHIS2 is normally used as the national HIS for the following items: data management and analysis, mapping existing services and recording the facilities, logistics management, monitoring and evaluation of health programmes and mobile tracking of pregnant mothers in rural communities[41]. Comparing DHIS and DHIS2 Both versions (DHIS and DHIS2) are flexible, configurable (easily-set) and open-source systems[42]. Presently, more than 60 countries of the world and 30 countries in Africa and Asia have installed and used this software, these countries are using this software because of WHO recommendation to the software, Nigeria is amongst the countries using DHIS2 as national health information management system software.

Similarly, these dashboard packages empower EPI program managers and district staff to identify gaps in immunization coverage, reduce stock wastage and monitor cold chain metrics and follow up on facility reports. Thanks in part to the use of DHIS2 analytics and data quality tools, some countries have achieved more than 98% completeness of their immunization data (dhis2.org/immunization/). Increasingly, countries are adopting DHIS2 tracker as an Electronic Immunization Registry (EIR) to improve adherence to the national

vaccination schedule and reduce drop-out rates. These tools are designed with integration and sustainability at the forefront, underpinned by WHO recommendations to strengthen national HMIS through integration of immunization, health service delivery and other program data.

Two standard configuration packages are available for immunization: a complete aggregate configuration package that includes data collection and dashboards, and a dashboard configuration package that includes dashboards only. In addition, an AEFI (Adverse Events Following Immunization) tracker package is available. The Immunization system design document describes how the standard configuration for immunization has been configured in DHIS2. The change log describes changes between each version. Also see the EPI Annex to the general installation guide. In addition to the standard configuration packages, an Immunization Analysis DHIS2 app has been developed. This app provides additional analytical outputs, and supplements the standard configuration package. A user manual describing how to install, configure and use the Immunization Analysis app is available.

2.2.3 How does the DHIS2 works

DHIS2 was designed in such a way that it allowed real-time visualization and decision making (https://dhis2.org/pt-br/about), that is within short period of time the data sent would appear in the dash board, which allowed health managers to take decision instantly, it contains different tools such as dashboards, pivot tables, maps and charts. Each tool has sub tool which allow performing further operation, the dashboard app allows users to view different sub tools under and customize dashboards, create powerful visualizations, engage in data analysis and share their interpretations with other users.

DHIS2 is a centralize server, which allows all the data from different health care services to be save, it is a platform where users can enter data from any level such as community and facility levels and can be access locally, nationally and globally using a computer or mobile device. It has a tracker built-in application; the tracker provides geo-coordinate tracking system services, during data collection, tracking system would provide exact position of data collector. DHIS2 software does not capture and analyze data only but also for managing patient care workflows on a facility or community level. For example, within a Tracker program you can configure SMS reminders, track missed appointments and generate visit schedules for individual patients. Tracker also provides a simple tool for sharing critical clinical health data across multiple health facilities, including by linking Tracker to an Electronic Medical Record (EMR) system.

2.2.4 Features of DHIS2

Nigeria is using DHIS2 as national health information systems for data management and analysis purposes, research, as well as for health program monitoring and evaluation[43].

Therefore, DHIS2 contains many features and functions, which allow making many operations, which are as follows:

i. DHIS2 software allow the user to get a complete data management solution based on data warehousing principles and a modular structure which can easily be customised to the different requirements of a management information system, supporting analysis at different levels of the organisational hierarchy.

ii. Customisation and local adaptation through the user interface. No programming required to start using DHIS2 in a new setting (country, region, district etc.).

iii. Provide data entry tools which can either be in the form of standard lists or tables, or can be customised to replicate paper forms.

iv. Provide different kinds of tools for data validation and improvement of data quality.

v. Provide easy to use - one-click reports with charts and tables for selected indicators or summary reports using the design of the data collection tools. Allow for integration with popular external report design tools (e.g. Jasper Reports) to add more custom or advanced reports.

vi. Flexible and dynamic (on-the-fly) data analysis in the analytics modules (i.e. GIS, Pivot Tables, Data Visualizer, Event reports, etc.).

vii. A user-specific dashboard for quick access to the relevant monitoring and evaluation tools including indicator charts and links to favourite reports, maps and other key resources in the system.

viii. Easy to use user-interfaces for metadata management e.g. for adding/editing datasets or health facilities. No programming needed to set up the system in a new setting.

ix. Functionality to design and modify calculated indicator formulas.

x. User management module for passwords, security, and fine-grained access control (user roles).

xi. Messages can be sent to system users for feedback and notifications. Messages can also be delivered to email and SMS.

xii. Users can share and discuss their data in charts and reports using Interpretations, enabling an active information-driven user community.

xiii. Functionalities of export-import of data and metadata, supporting synchronisation of offline installations as well as interoperability with other applications.

xiv. Using the DHIS2 Web-API, allow for integration with external software and extension of the core platform through the use of custom apps.

xv. Further modules can be developed and integrated as per user needs, either as part of the DHIS2 portal user interface or a more loosely-coupled external application interacting through the DHIS2 Web-API. (Key features and purpose of DHIS2.

2.2.5 Uses of DHIS2

DHIS2 provides different aspects of the information cycle in routine which include:

- Collecting immunization data from the grass root.
- Immunization data running quality checks.
- Immunization data access at multiple levels.
- Immunization data reporting.
- Making graphs and maps and other forms of analysis.
- Enabling comparison across time (for example, previous months) and space (for example, across facilities and districts).
- See trends (displaying data in time series to see their min and max levels).

2.3 Empirical Review

2.3.1 Different between DHIS2 General Server and RI DHIS2 SMS server

Presently, in Sokoto state, there are two dhis2 platform uses (DHIS2 General and SMS server). The dhis2 general server is the main flat form which contains data elements from all sector of health care (ANC, malaria, nutrition, tuberculosis, family planning, disease surveillance etc.) including RI data. This flat form allows entering, analyzing, monitoring,

viewing and validating all type of data. While, DHIS2 SMS server is created mainly to deal with RI data only, that is no any other data enters into DHIS2 SMS server beside RI data, DHIS2 general server contains more tools and operation compared with SMS server, consequently, SMS server was created out of general server in order to deal with RI data only. In DHIS2 general server, data would be entered by LGA monitoring and evaluation officer using health facility vaccine utilization summary form (version 2019) and NHIMS monthly summary form (version 2019) monthly direct to the server, while in DHIS2 SMS server, RI provider has the responsibility of sending SMS to the server in every session. SMS is the only way of sending data to this server.

It is possible to get variation between RI data in general DHIS2 and SMS server, especially if the data recorded in RI registers differ from SMS sent to the server, this is the reason why at the end of each month, data validation would be conducted during RI monthly meeting, this would ensure validity of data recorded in the register and one reported in the server.

2.3.2 How to send SMS RI Data to DHIS2 SMS Server

The SMS RI data can be sent to DHIS2 SMS server via SMS, routine immunization service provider (RISP) is the officer with the responsibility of sending SMS to the server, before he can be able to send the SMS, DHIS2 administrator would configure three phone numbers (Health facility in-charge, RISP and assistant RISP). The purpose of adding more than one phone number is to have backup in case of any failure the second or third number would be use in sending the SMS, therefore the server can recognize the SMS from configured number only, also, each RISP would be given a number which would be used for sending SMS (Health Facility Guide on SMS Dada Reporting).

2.3.3 Example of RI SMS Data Codes

The following are the codes use to send an SMS (RI data) to DHIS2 server (wk a1b2)

wk: means week, the server automatically attached the current week:

a: mean number of fixed session plan to conduct, example, if the service provider plan 1 fixed session he would text a1, if 2 fixed sessions a2 etc.

b: means outreach session, if it is 1 outreach session plan, service provider would text b1, if it 2 text b2 etc., example, the interpretation for this code (wk a1b1) is, this week my plan is to conduct 1 fixed and 1 outreach session(Health Facility Guide on SMS Dada Reporting),

Similarly, the following are the codes use to send number of children immunize and vaccine use during the session:

Table 2.0: Code: FS a2 b2 c4 d4 e3 f3 g4 h4 i4 j4 k20 l20 m20 n10 o10 p0 q0

S/NO	CODE	Meaning
12	FS	Fixed post
2	a2	2 children vaccinated with BCG
3	b2	2 children vaccinated with OPV0
4	c4	4 children vaccinated with OPV1
5	d4	4 children vaccinated with PENTA1
6	e3	3 children vaccinated with OPV2
7	f3	3 children vaccinated with PENTA2
8	g4	4 children vaccinated with OPV3
9	h4	4 children vaccinated with PCV3
10	i4	4 children vaccinated with Measles
11	j4	4 children vaccinated with Yellow fever

12	k20	20 doses of BCG open
13	l20	20 doses of OPV open
14	m20	20 doses of PENTA open
15	n10	10 doses of IPV open
16	o10	10 doses of Measles open
17	p0	No supervisor during the session
18	q0	No stock out of any antigen during the session

Source: Health facility guide on SMS data reporting printed and supported by NSTOP/CDC/AFENET

The above data can change, it depend on number of client track inoculated and vaccine use, NOTE: these codes are case sensitive and any mistake can lead to the failure of the SMS that is the data cannot reach the server, if the message is typed correctly it would reach the server and can be access. After sending the RI data to the server, at the management level, LGA team can login and access the data.

DHIS2 Server specifications: DHIS2 is a database intensive application and requires that your server has an appropriate amount of RAM, number of CPU cores and a fast disk. These recommendations should be considered as rules-of-thumb and not exact measures. DHIS2 scales linearly on the amount of RAM and number of CPU cores so the more you can afford, the better the application will perform. RAM: At least 1 GB memory per 1 million captured data records per month or per 1000 concurrent users. At least 4 GB for a small instance, 12 GB for a medium instance. CPU cores: 4 CPU cores for a small instance, 8 CPU cores for a medium or large instance. Disk: Ideally use an SSD. Otherwise use a 7200 rpm disk. Minimum read speed is 150 Mb/s, 200 Mb/s is good, 350 Mb/s or better is ideal. In terms of disk space, at least 60 GB is recommended, but will depend entirely on

the amount of data which is contained in the data value tables. Analytics tables require a significant amount of disk space. Plan ahead and ensure that your server can be upgraded with more disk space as it becomes needed.

DHIS2 RI SMS Software requirements: DHIS2 versions require the following software versions to operate.

i. An operating system for which a Java JDK or JRE version 8 or 11 exists. Linux is recommended.
ii. Java JDK. OpenJDK is recommended.
iii. For DHIS 2 version 2.35 version and later, JDK 11 is recommended and JDK 8 or later is required.
iv. For DHIS 2 versions older than 2.35, JDK 8 is required.
v. PostgreSQL database version 9.6 or later. A later PostgreSQL version such as version 13 is recommended.
vi. Post GIS database extension version 2.2 or later.
vii. Tomcat servlet container version 8.5.50 or later, or other Servlet API 3.1 compliant servlet containers.

Local offline analytics in TEI Dashboard this version of the app includes the display of charts and tables in the domain of a Tracked Entity Instance. In the TEI Dashboard the "Indicators" tab has been replaced by the Analytics tab. In this section the app will display:

- One value: either a Data Element or a Program Indicator
- Feedback
- Charts to display evolution of one data element or program indicator across time in repeatable stages.

- Column Plain Chart (no background)
- Line Plain Chart (no background)
- Line Child Growth Chart (WHO models background): weight for age, height for age, weight for height

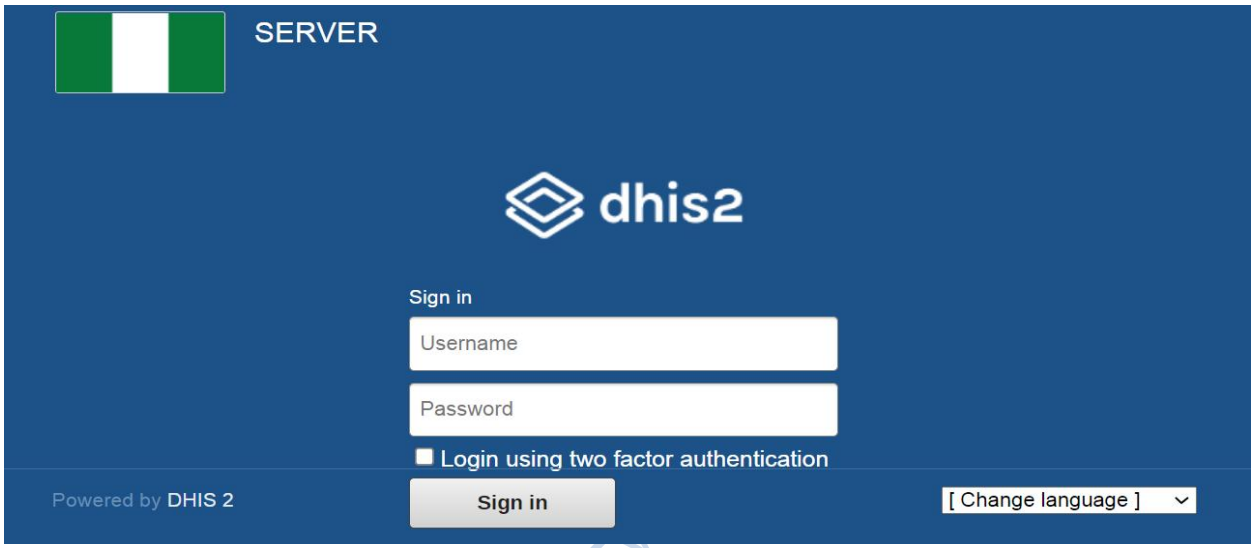
Since 2017, UiO has partnered with the WHO as a Collaborating Centre for Innovation and Implementation Research on HIS strengthening. Through this partnership, UiO has developed a suite of DHIS2 tools and metadata packages that support countries to adopt WHO immunization program standards into national HMIS. More than 30 countries in Africa and Asia have installed the WHO recommended DHIS2 dashboard packages into their national HMIS. Along with the WHO Immunization Analysis App and WHO Data Quality Tool for DHIS2, these dashboard packages empower EPI program managers and district staff to identify gaps in immunization coverage, reduce stock wastage and monitor cold chain metrics and follow up on facility reports. Thanks in part to the use of DHIS2 analytics and data quality tools, some countries have achieved more than 98% completeness of their immunization data. Increasingly, countries are adopting DHIS2 tracker as an Electronic Immunization Registry (EIR) to improve adherence to the national vaccination schedule and reduce drop-out rates. These tools are designed with integration and sustainability at the forefront, underpinned by WHO recommendations to strengthen national HMIS through integration of immunization, health service delivery and other program data.

2.3.4 How to Login into DHIS2 RI SMS Server

Before logging into the server, you need authorization from database administration, one of his responsibilities is to create user name and password for the users, more so, user needs server address

when the server address is typed in the searching bar of any searching engine it would led the user direct to the server login window, from which the user would login by inputting user name and password.

Figure 2.1 This is the window view of sign in of dhis2 RI SMS server



Source: 7/72021 https://www.nericcdhis2.com/dhis-web-commons/security/login.action

This is the window view of sign in of dhis2 SMS server.

After signing into the server it allows the user to conduct different operations and tasks using many tools such as dashboard, pivot table, data visualize, GIS, event report, event visualize, data quality, mobile, each of these has particular function to performs, example:

- **Dashboard:** In DHIS2 dashboard is the quick access view of different analytical objects such as chart, tables, reports, maps etc. Further operation can be conducted in each object example, chart can explore, resize, interpret, share, store, remove, etc. dashboard object can be printed, modified and downloaded

Title Bar: DHIS2 SMS server **title bar** is a horizontal bar placed at the top window view of dashboard, it is a graphical user interface (GUI) which displays the title of DHIS2 SMS

server, it contains icons such as software logo, name of current document, inbox, outbox, app menu, and name of country NG (Nigeria)

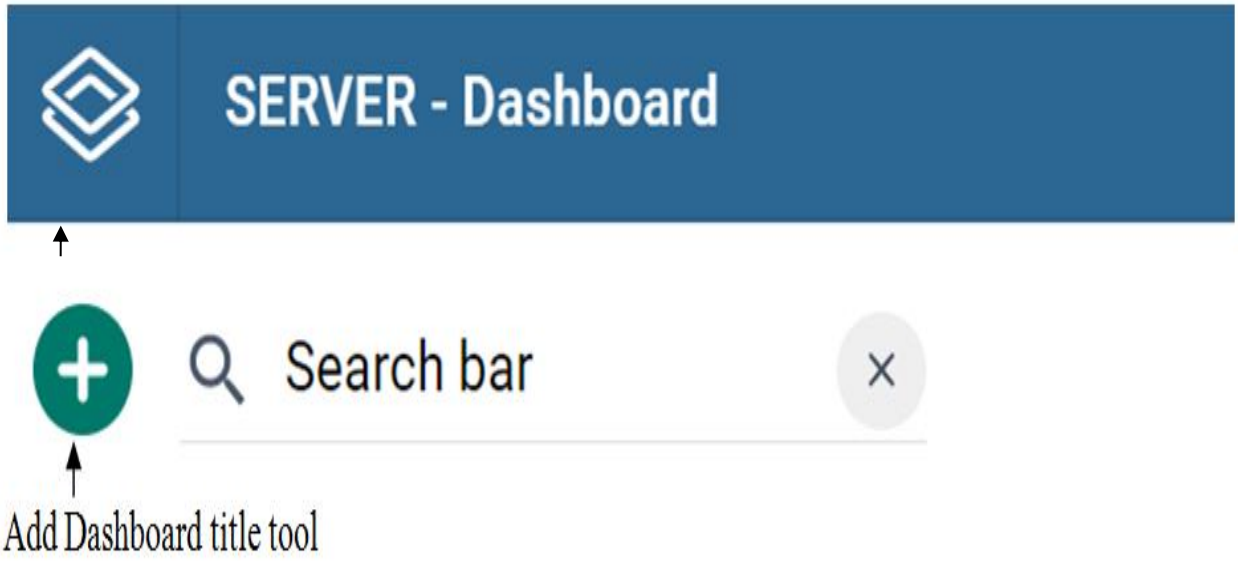
On top of the dashboard, title bar is displayed

Figure 2.2

Source: DHIS2 SMS server 9/9/2021 https://www.nericcdhis2.com/dhis-web-dashboard/#/

- Title bar contains DHIS2 SMS logo, current status (dashboard) inbox, outbox, apps, title of a country, Nigeria (NG)
- Inbox: this is an icon which contains all the mail sent to database administrator from RI service providers; it is a channel of communication and making any enquiry, suggestion and recommendation to database administrators by RI service providers. All the mail sent to the database administrator would come direct to this location
- Outbox: this is an icon which allow RI service provider to send mail to database administration, it is a channel of communication
- Search bar: A search bar is a DHIS2 SMS software tool which is located on the top of the software, main function of search bar is to lookup particular data or table by typing name of subject or an object need to look up in search bar, example, searching for session plan, fix session, outreach session, children vaccinated with BCG, etc.

Figure 2.3 DHIS2 SMS Server Dashboard

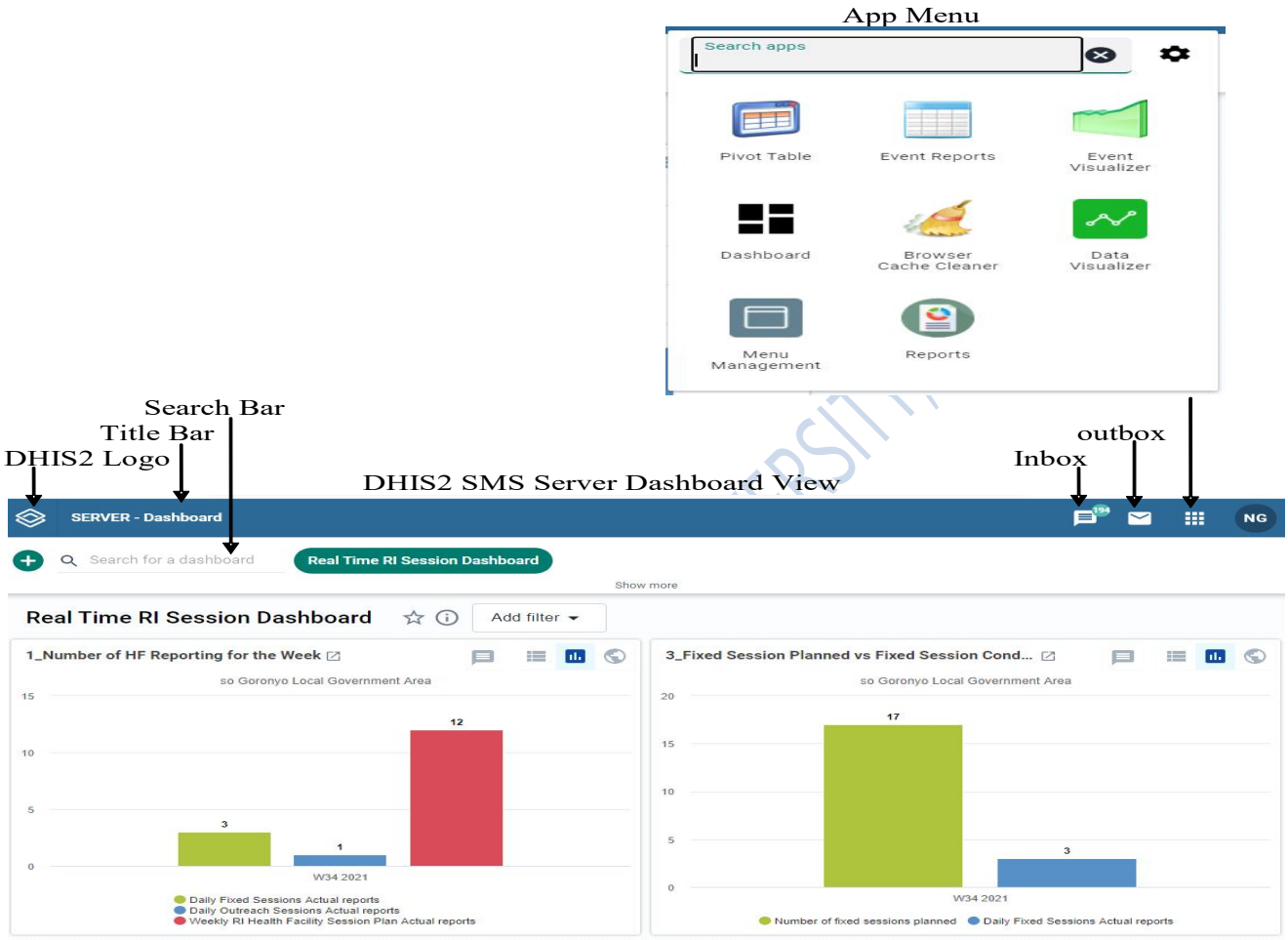


Source: DHIS2 SMS server 9/9/2021 https://www.nericcdhis2.com/dhis-web-dashboard/#/

- Add Dashboard title: this is DHIS2 SMS tool, which allow to add or rename dashboard title

Figure 2.4

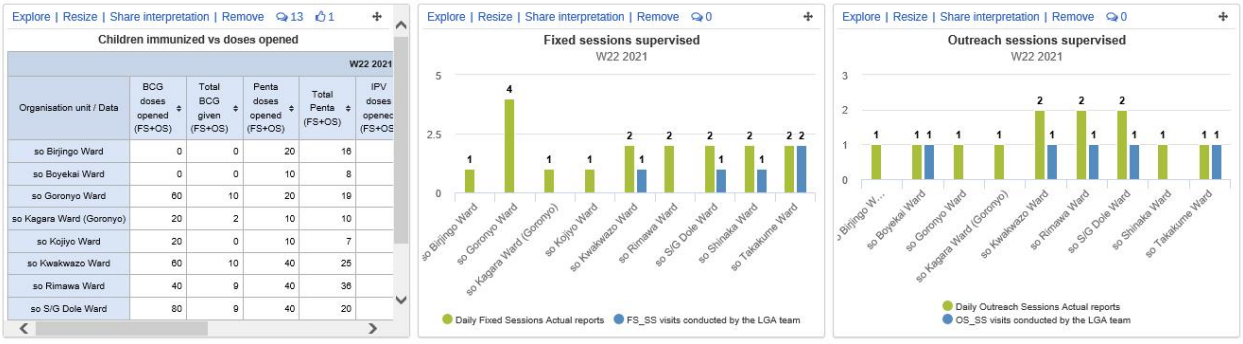
The following is the example of DHIS2 SMS server dashboard



Source: DHIS2 SMS server 9/9/2021 https://www.nericcdhis2.com/dhis-web-dashboard/#/

Above chart is showing the number of health facilities sent plan, fix and outreach sessions, the second chart is showing the health facilities sent their plan and fix session conducted, third chart is showing the number of plan and outreach session conducted.

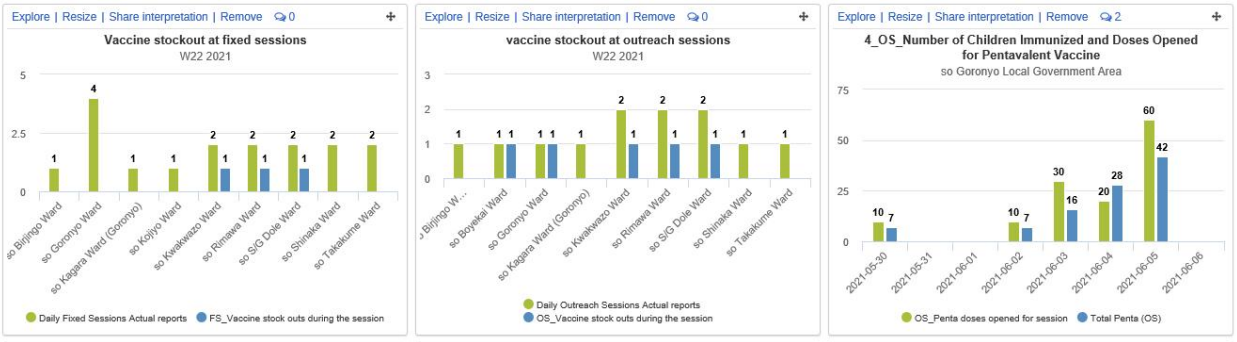
Figure 2.5 dashboard view



Source: DHIS2 SMS server 9/9/2021 https://www.nericcdhis2.com/dhis-web-dashboard/#/

The first table in the dashboard is showing the number of vial open, use and children vaccinated, middle chart is showing the fixed session supervised and the last one is showing the number of outreached session supervised,

Figure 2.7 Dashboard Chart View



Source: DHIS2 SMS server 9/9/2021 https://www.nericcdhis2.com/dhis-web-dashboard/#/

The first chart is showing vaccine stock out during fixed sessions, the middle chart is showing vaccine stock out during outreached sessions, while, the last chart is showing number of children immunized and doses opened for pentavalent vaccine.

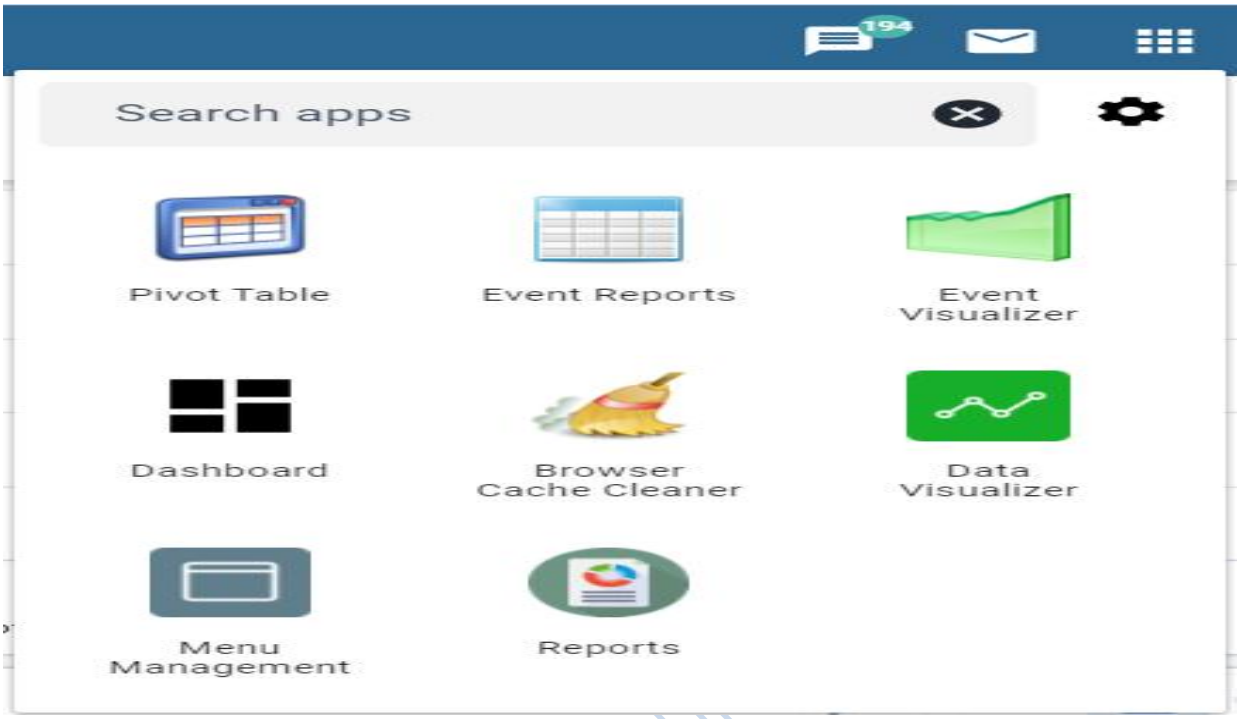
DHIS2 SMS software dashboard is a tool used for information management quick view, like car dashboard where condition of a car may be monitored, the same to DHIS2 SMS dashboard, it is a tool which organized, analyze, stored and display important key performance indicators from different data set and display into one single viewer or window, dashboard allows users to have quick access and easy understanding of analyzed data, dashboard mostly displayed in graphical layout, which is in form of graph or chart, it is easy to monitor, identify trends and challenges of routine immunization services and take decision timely. In DHIS2 SMS software, dashboard is displayed at home status of the software, that is by logging in into the software, the first home view is dashboard, data items under dashboard can be further used to analyze and manipulated in different form and downloaded into different format.

Primary functions of DHIS2 SMS software dashboard are to:

- Monitoring routine immunization activities
- Track key performance indicators
- Tracking timely, completeness and accuracy of RI data submitted and identifying defaulters
- View data for comparison and take informed decision

DHIS2 SMS dashboard display many data sets such as number of sessions plan to conduct, fix session planned and conducted, outreach session planned and conducted, vaccine open and children immunize with different antigen (BCG, HB, OPV, PENTA, IPV, Measles, Yellow fever, MenA). Number of supervision conducted by LGA team to HFs etc.

Figure 2.8 App Hub: is an icon in the title bar which deals with application under DHIS2 SMS Software



Source: DHIS2 SMS server 9/9/2021 **https://www.nericcdhis2.com/dhis-web-dashboard/#/**

In **DHIS2 SMS server, App Hub** is a centre or part of the software which provides links to additional tools, menus, icons and data operation of DHIS2 platform, the apps allows to perform different operation in DHIS2 SMS software, apps hub contains the following sub apps:

- Pivot table
- Event reports
- Event visualize
- Dashboard
- Browser cache cleaner
- Data visualize

- Menu management
- Reports

Each of these apps has particular function and operation to perform in DHIS2 SMS server, example:

Pivot table: A pivot table is a dynamic tool for data analysis which lets you summarize and arrange data according to its dimensions. It allows you to arrange your data based on your need and request, that is it can allows you to view data in form of table for particular data elements, indicator and data sets, instate of view data in chart or graph forms, you can also view data based on particular period such as day, week, month quarter or year, similarly, pivot table can allow to view data on each level for instance, national, state, LGA, ward and facility levels. The following is the example of pivot table which shows different antigen open and children immunized.

Figure 2.9 This is the logo for pivot table

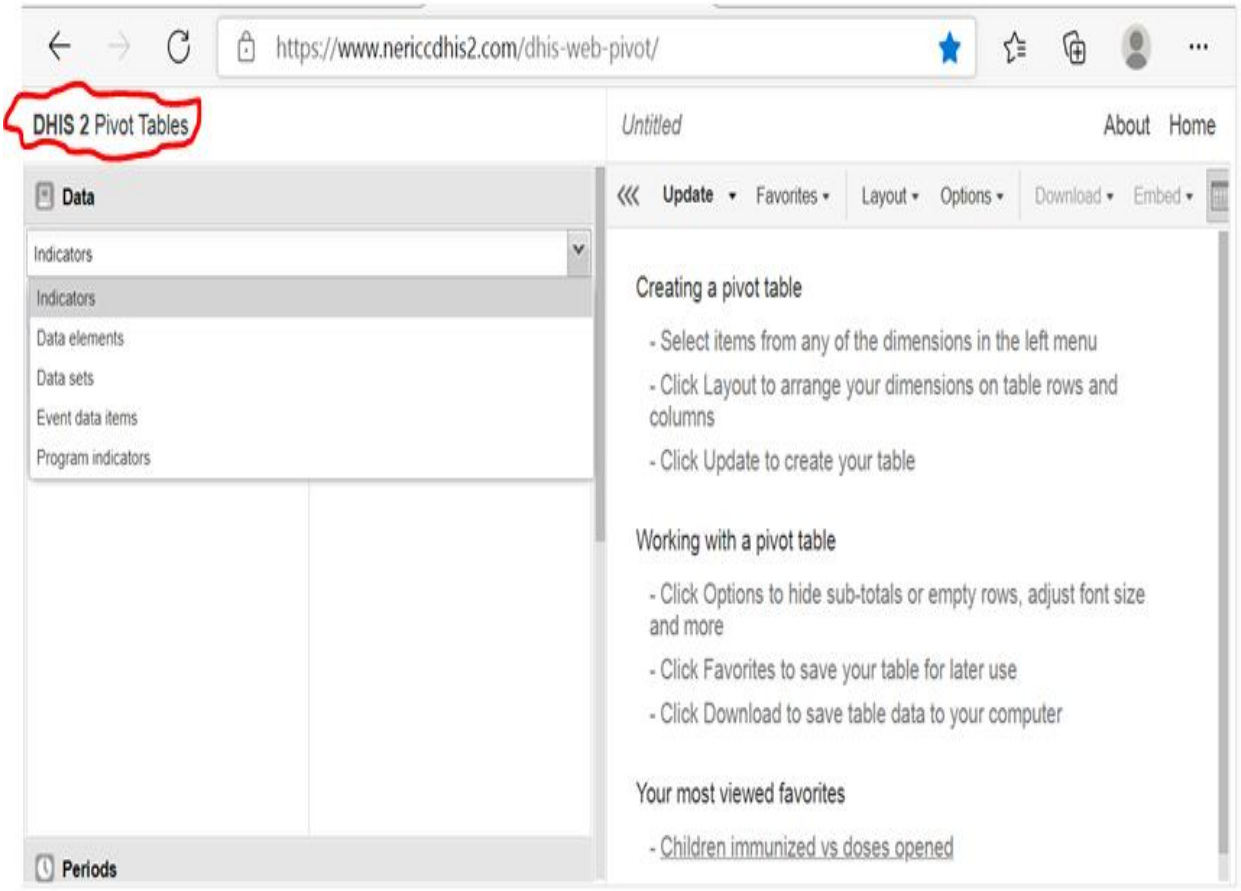
Source: DHIS2 SMS server 8/8/2021 https://www.nericcdhis2.com/dhis-web-pivot/index.html

Pivot Table view In DHIS2 SMS server, a pivot table is a tool use for data analysis which allows arranging RI data based on the need of the user, pivot table lets you summarize and arrange data according to its dimensions in a table. Examples, name of health facilities should be in column dimension and data element should be in row dimension.

From these dimensions you can freely select dimension items to include in the pivot table. You can create additional dimensions in DHIS2 with the group set functionality. This allows for different aggregation pathways, such as aggregation by "Partner" or facility type. With the Pivot Table app, you can create pivot tables based on all available data dimensions in DHIS2. A pivot table is a dynamic tool for data analysis which lets you summarize and arrange data according to its dimensions. Examples of data dimensions in DHIS2 are:

A pivot table can arrange data dimensions on columns, rows, and as filters. When you place a data dimension on columns, the pivot table will display one column per dimension item. If you place multiple data dimensions on columns, the pivot table displays one column for all combinations of the items in the selected dimensions. When you place a data dimension on rows, the pivot table displays one row per dimension item in a similar fashion. The dimensions you select as filters will not be included in the pivot table, but will aggregate and filter the table data based on the selected filter items. Practically, if this icon of pivot table is click, it would take user to the following window.

Figure 2.10



Source: DHIS2 SMS server 8/8/2021 https://www.nericcdhis2.com/dhis-web-pivot/index.html

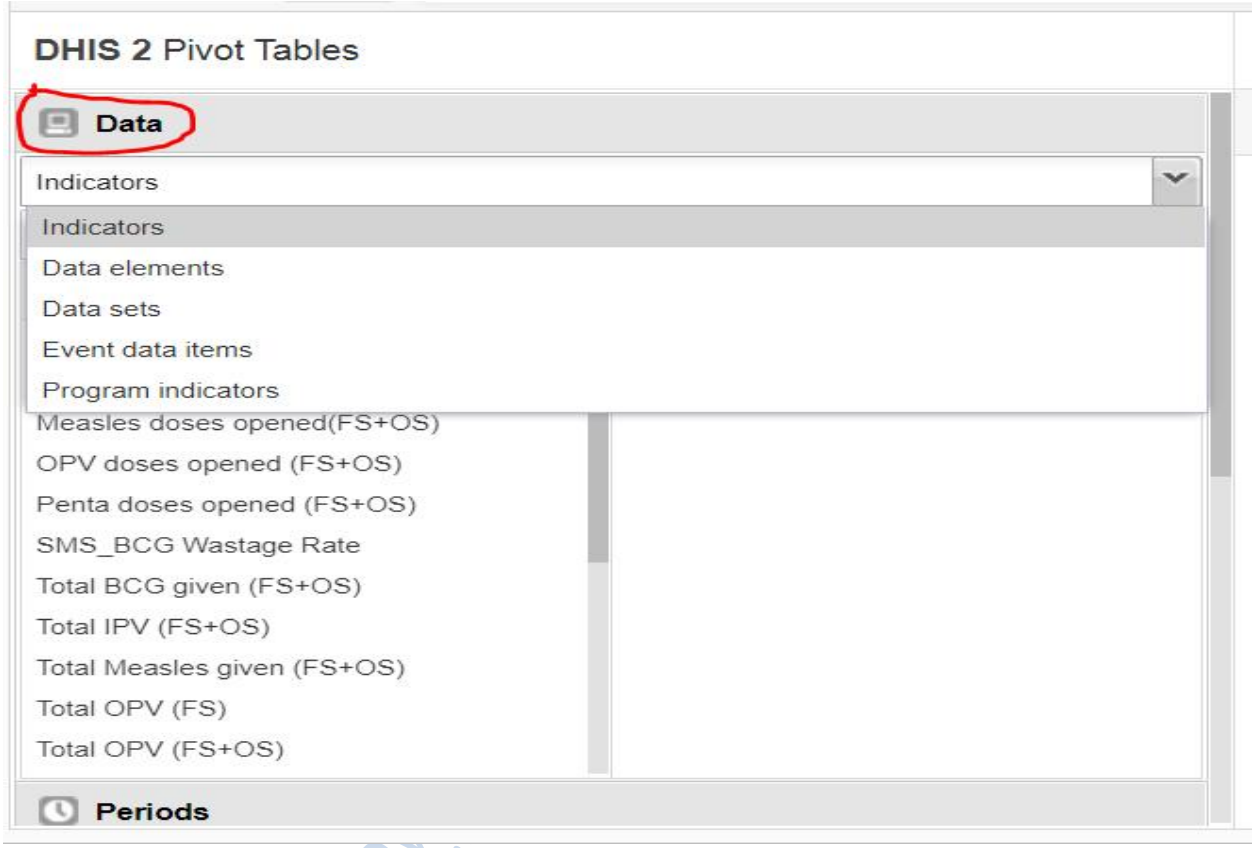
Pivot table comprises the following components

- Data
- Period
- Organisational level

In pivot table, a data is an organ which allow user to organize particular data needs to analyze, such as, indicators, data elements, data sets, event data items and program indicators. In DHIS2, the indicator is a core element of data analysis. An indicator is a calculated formula based on a combination of data elements, category options, possibly

constants and a factor. There are two forms of indicators, those with a denominator and those which do not have a denominator.

Figure 2.11 Window view of element under pivot table



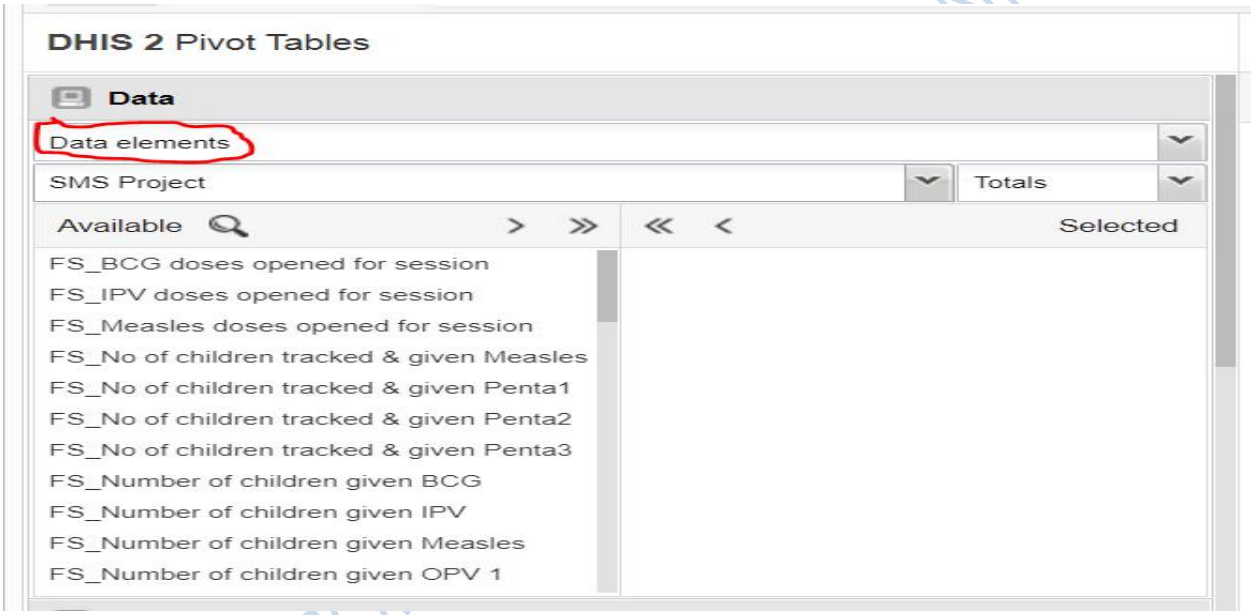
Source: DHIS2 SMS server 8/8/2021 https://www.nericcdhis2.com/dhis-web-pivot/index.html

Data elements

The data element is together with the organisation unit the most important building block of a DHIS2 database. It represents the dimension and explains what is being collected or analyzed. The data element is together with the organisation unit the most important building block of a DHIS2 database. It represents the dimension and explains what is being collected or analysed. In some contexts this is referred to an indicator, however in DHIS2 this meta-data element of data collection and analysis is referred to as a data element. The data element often represents a count of some event and its name describes what is being

counted, e.g. "BCG doses open in fix session " or "IPV doses open in fix session". When data is collected, validated, analysed or presented it is the data elements or expressions built with data elements that describe what phenomenon, event or case the data is registered for. Hence the data elements become important for all aspects of the system and decide not only how data is collected, but more importantly how the data is represented in the database and how data can be analysed and presented.

Figure 2.12: Window view of elements under pivot table



Source: DHIS2 SMS server 8/8/2021 https://www.nericcdhis2.com/dhis-web-pivot/index.html

Data sets: All data entry in DHIS2 is organized through the use of data sets. A data set is a collection of data elements grouped together for data collection, and in the case of distributed installs they also define chunks of data for export and import between instances of DHIS2 (e.g. from a district office local installation to a national server). All data entry in DHIS2 is organized through the use of data sets. A data set is a collection of data elements grouped together for data collection, and in the case of distributed installs they also define

chunks of data for export and import between instances of DHIS2 (e.g. from a district office local installation to a national server). Data sets are not linked directly to the data values, only through their data elements and frequencies, and as such a data set can be modified, deleted or added at any point in time without affecting the raw data already captured in the system, but such changes will of course affect how new data will be collected.

A data set has a period type which controls the data collection frequency, which can be daily, weekly, monthly, quarterly, six-monthly, or yearly. Both the data elements to include in the data set and the period type is defined by the user, together with a name, short name, and code. If calculated fields are needed in the collection form (and not only in the reports), then indicators can be assigned to the data set as well, but these can only be used in custom forms (see further down). In order to use a data set to collect data for a specific organisation unit the user must assign the organisation unit to the data set. This mechanism controls which organisation units can use which data sets, and at the same time defines the target values for data completeness (e.g. how many health facilities in a district are expected to submit the RCH data set every month).

A data element can belong to multiple data sets, but this requires careful thinking as it may lead to overlapping and inconstant data being collected if e.g. the data sets are given different frequencies and are used by the same organisation units.

Figure 2.13 Window view of pivot table element (Data set)

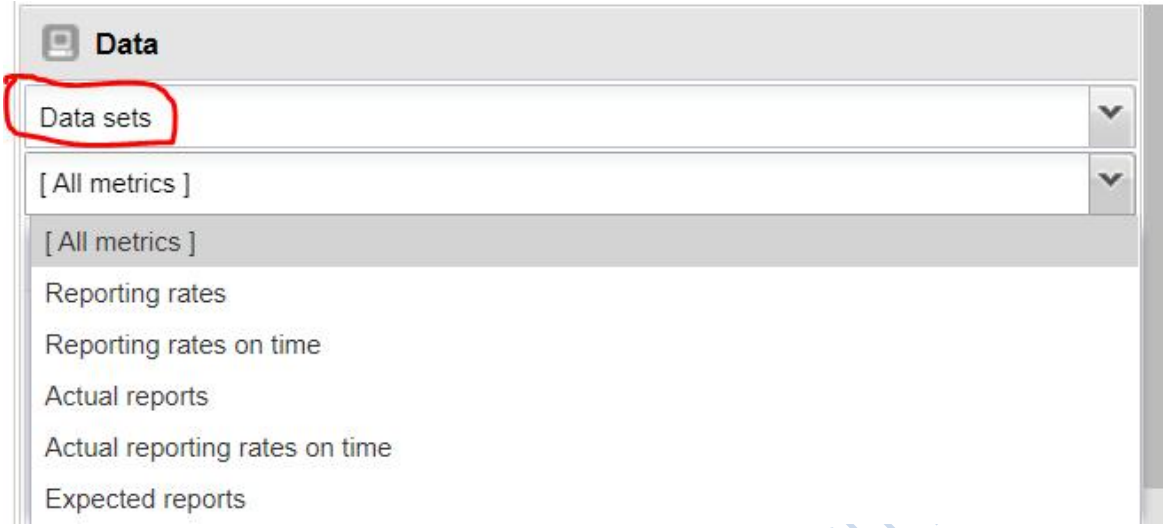
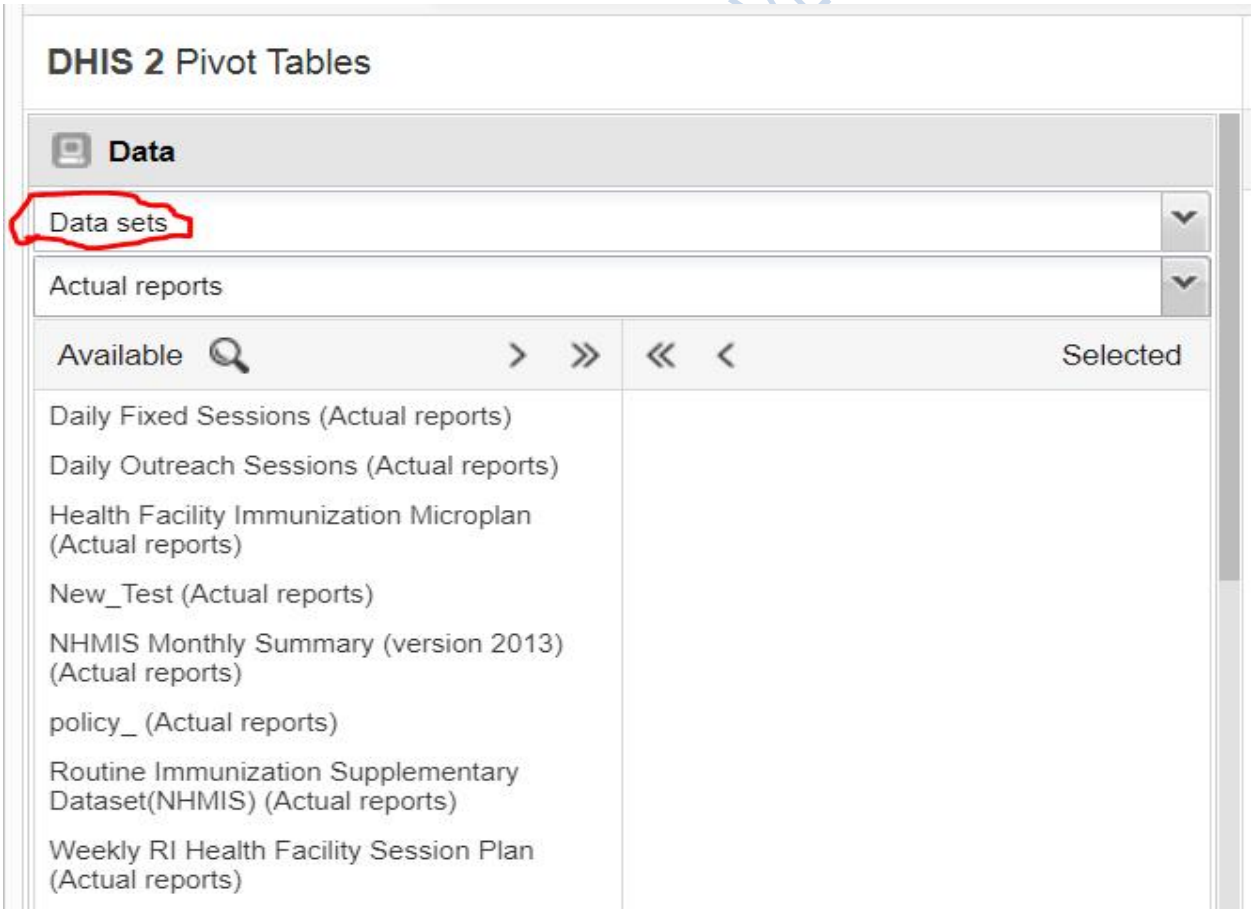


Figure 2.14



Source: DHIS2 SMS server 8/8/2021 https://www.nericcdhis2.com/dhis-web-pivot/index.html

Event Data Items

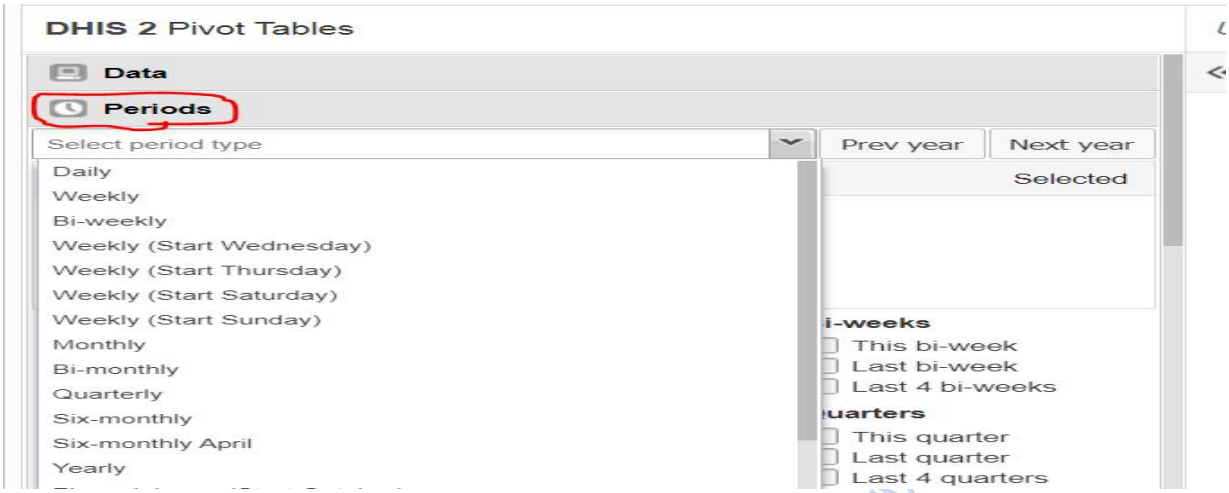
The event layer displays the geographical location of events registered in the DHIS2 tracker. Provided that events have associated point or polygon coordinates, you can use this layer to drill down from the aggregated data displayed in the thematic layers to the underlying individual events or cases. You can also display aggregated events at the facility or at the boundary level. You do this through a thematic layer using event data items. The Maps App is introduced in release 2.29 and serves as a replacement of the GIS App offering a more intuitive and user-friendly interface. The mapping engine from version 2.34 is based on WebGL (Web Graphics Library) technology, capable of showing thousands of features on a map simultaneously.

With the Maps app you can overlay multiple layers and choose among different base maps. You can create thematic maps of areas and points, view facilities based on classifications, and visualize catchment areas for each facility. You can add labels to areas and points, and search and filter using various criteria. You can move points and set locations on the fly. Maps can be saved as favorites and shared with other users and groups, or downloaded as an image.

Period: Basically In DHIS2 SMS server, datasets, data element can be viewed on period type, which can be either daily, weekly, monthly, quarterly, yearly and so on, this means that RI data can be viewed, analyzed and downloaded according to period type.

Period is the component of pivot table, which deals with specifying particular data period, it is used to specify amount of time that the data is representing,

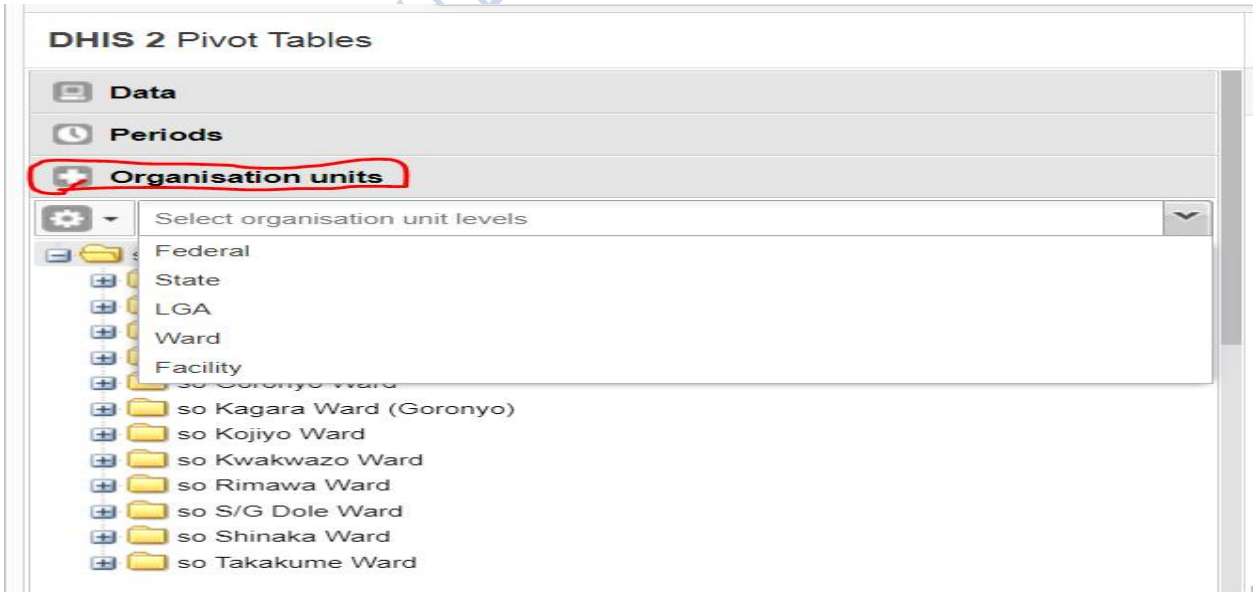
Figure 2.14



Source: DHIS2 SMS server 8/8/2021 https://www.nericcdhis2.com/dhis-web-pivot/index.html

- ***Organisational Unit***: is a pivot table tool, which allow the user to select specific level of organisation data need to view it data, example, by clicking organisation level it allows you to select either federal, state, LGA, ward or facility level, if a user select any of the organisational level the data of that level would display

Figure 2.15 Pivot Table View



Source: DHIS2 SMS server 8/8/2021 https://www.nericcdhis2.com/dhis-web-pivot/index.html

Title bar also contains NG which means Nigeria, as it was mentioned that about 72 countries are presently using this software, therefore, these alphabet can be use abbreviate name of a country, Nigeria is using NG.

Figure 2.16 DHIS2 Title Bar view

Source: DHIS2 SMS server 8/8/2021 https://www.nericcdhis2.com/dhis-web-pivot/index.html

NG menus contents:

- ***NERICC:*** The National Emergency Routine Immunization Coordination Centre (NERICC) was established after a state of public health concern was made on routine immunization on June 17th by the ED NPHCDA and partners. The centre was inaugurated on 4th of July 2017, with the objectives to; . Improve detection and responsiveness in the resolution of RI gaps.

The following are the profile of NG:

Setting: is the process of making specific changes to the appearance of software, in DHIS2 SMS server, setting can allows to change language, color and default name of the user.

User account: is the functions which deals with changing user name, password, that is authentication ID.

Help: DHIS2 SMS server Help section provides information about server documentation DHIS2 documentation is organised into four broad categories. Such as use, implement, develop, manage, browse by topic, tutorial, user story and Single Page documents and previous versions:

✓ Use

Want to know about background and purpose of DHIS2? Or need instructions on how to use it? These guides explain how to perform tasks such as data entry, meta-data set-up, import and export of data, aggregation, reporting and other topics related to the usage of the software.

✓ Implement

Setting up a DHIS2 instance in a new country? Or implementing a new health program? These guides cover everything you should know before you start using DHIS2 to manage your data.

✓ Develop

The developer manuals provide a detailed description of the DHIS2 core API and functionality, as well as the Android DHIS2 Software Development Kit (SDK). They serve as essential resources for developers building upon the DHIS2 platform.

✓ Manage

Are you a system administrator managing a DHIS2 instance? The system administration guide aims to provide support for the installation and maintenance of the DHIS2 platform.

✓ Browse by topic

Metadata Packages (WHO Health Data Toolkit)

WHO Health Data Toolkit consists of DHIS2 metadata and tools to support adoption of WHO health data standards into national routine health management information systems. This section contains documentation for the available packages.

✓ Tutorials

Here you will find a few tips and trick to help you become a DHIS2 power user.

✓ User Stories

Read some stories from users and implementers in the field and learn how they are using DHIS2 to solve a variety of problems.

✓ Single Page documents and previous versions

Here you will find links to our documentation as single-page html and pdf documents for easier sharing. You will also find documentation for previous versions of DHIS2.

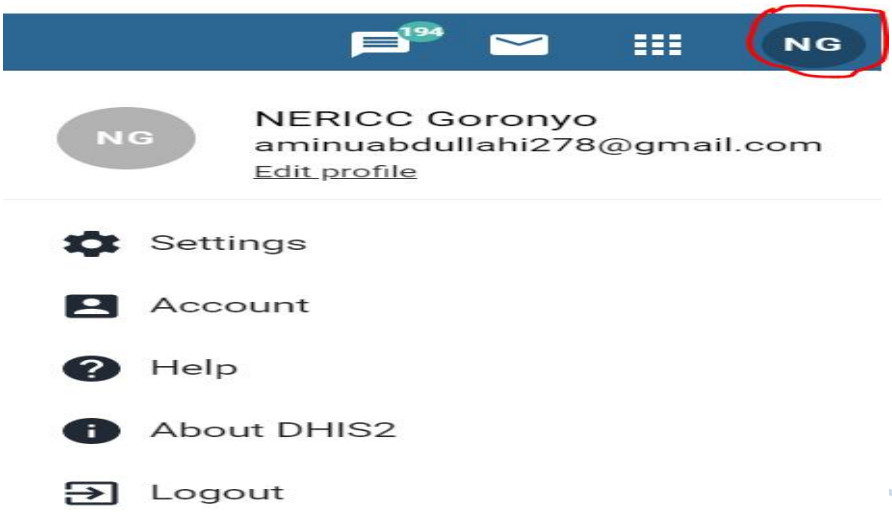
- ***View Single Page index***

The DHIS2 documentation is a collective effort and has been developed by the development team and users. While the guides strive to be complete, there may be certain functionalities which have been omitted or which have yet to be documented.

- ***About DHIS2***: is the item under NG, which deals with providing hint or brief information about the software
- ***Logout*** DHIS2 SMS server logout user management is a feature which allows for multiple users to access the system simultaneously, each with a defined set of permissions.
- These permissions can be finely tuned so that certain users can only enter data, while others may generate reports. When logout is clicked it would take user into signing in of the software

Window view of NG and its properties

Figure 2.18 DHIS2 Setting View



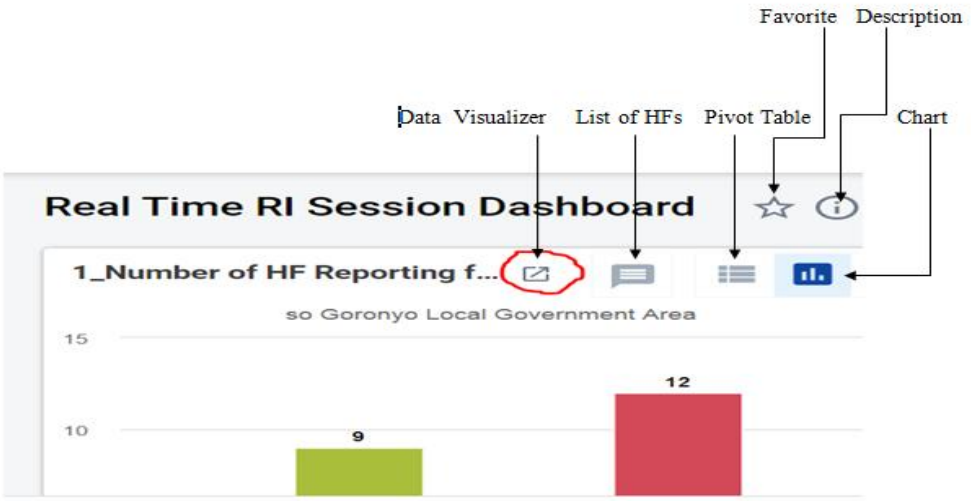
Source: DHIS2 SMS server 8/8/2021 https://www.nericcdhis2.com/dhis-web-pivot/index.html

- ***Data visualization***

Data visualization is the graphical representation of information and data. With visual elements like charts, graphs, and maps, data visualization tools provide an accessible way to see and understand trends, outliers, and patterns in data. Example of data from visualize

A graph showing data visualizer and other elements

Figure 2.19 DHIS2 Dashboard



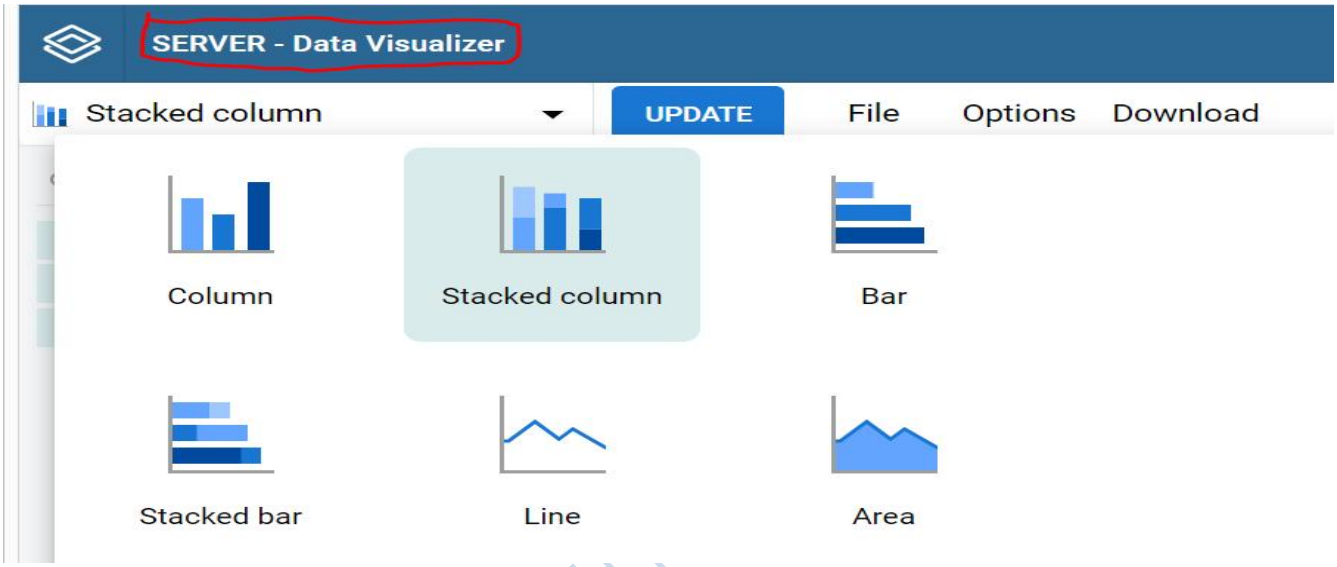
View

Source: DHIS2 SMS server 8/8/2021 https://www.nericcdhis2.com/dhis-web-pivot/index.html

Figure 2.19 DHIS2 Data Visualizer

Data visualizer contains the following tools

Column: Data visualizer **column chart** is a vertical bar chart used in DHIS2 SMS server to represent data in column chart.

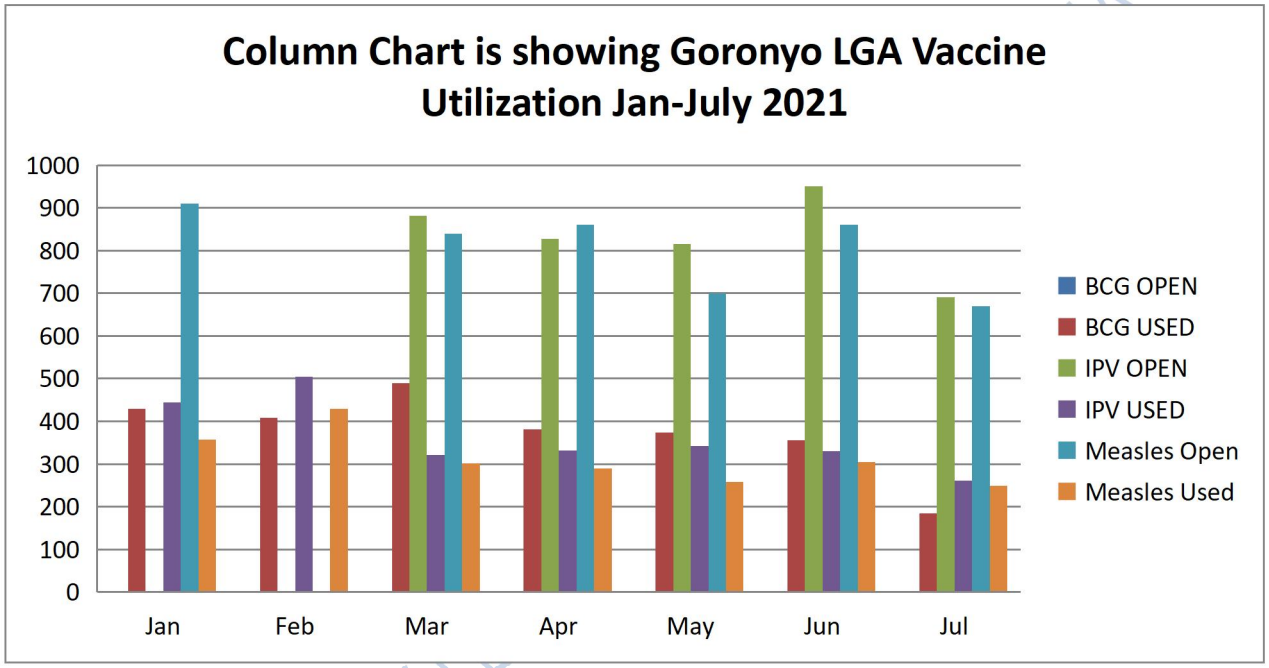


Source: DHIS2 SMS server 8/8/2021 https://www.nericcdhis2.com/dhis-web-pivot/index.html

A column chart is used to compare data values of related categories. It can also be used to compare data over a period. Value of each category is encoded by the length of the column. Since all columns start from the same baseline of zero, it is easy to compare them against each other. Column charts are most useful to compare different categories by a single measure. Comparisons allow end users to judge how each category is performing relative to the others. By sorting the columns, users can gain a quick understanding of the highest and lowest categories. However be wary that not all data can be sorted, and if forcefully sorted, it comes with some sacrifice in the data. Like, months of a year need to be in sequence to represent itself properly. But, if sorted by the measure, time sequence is lost, which is a major sacrifice.

Column charts are excellent for mapping data sets over a period of time. Understanding changes happening over a period of time is relatively more natural for the human mind. It's worth noting that a line chart (the most common type chart for time-series data) can be replaced anytime by a column chart, however the converse isn't always true.

Figure 2.20 Example of DHIS2 SMS Server Column Chart

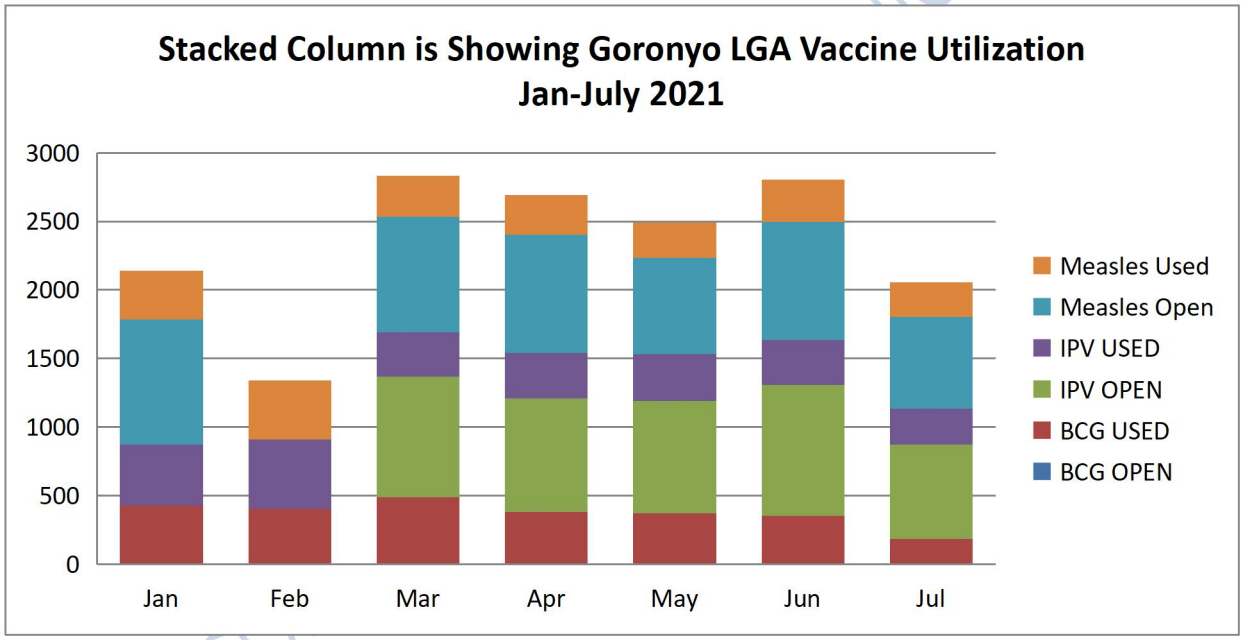


Source: DHIS2 SMS server 8/8/2021 https://www.nericcdhis2.com/dhis-web-pivot/index.html

Stacked column: A stacked column chart in visualizer of DHIS2 SMS server is a tool for presenting a data which involved more than 1 category of data that need to be represented in a bar chart. Stacked column charts are those chart options that allow a user to combine one group's data and then show that data in different segments that correspond to different sections amongst the same group. Stacked charts basically make the column charts one on another column chart, and the charts that are prepared as stacked are like fixing one bar chart on another chart.

Stacked column charts are very helpful in showing the magnitude of how much contribution to the total is coming from the different members of a category (a part-to-whole perspective of the data). All business data needs to get compared, whether it's for different timelines, geographies, and products, or between multiple members of the same group. Stacked column charts are a straightforward way to see such data.

Figure 2.21 Example of DHIS2 SMS Server Stacked Column



Source: DHIS2 SMS server 8/8/2021 https://www.nericcdhis2.com/dhis-web-pivot/index.html

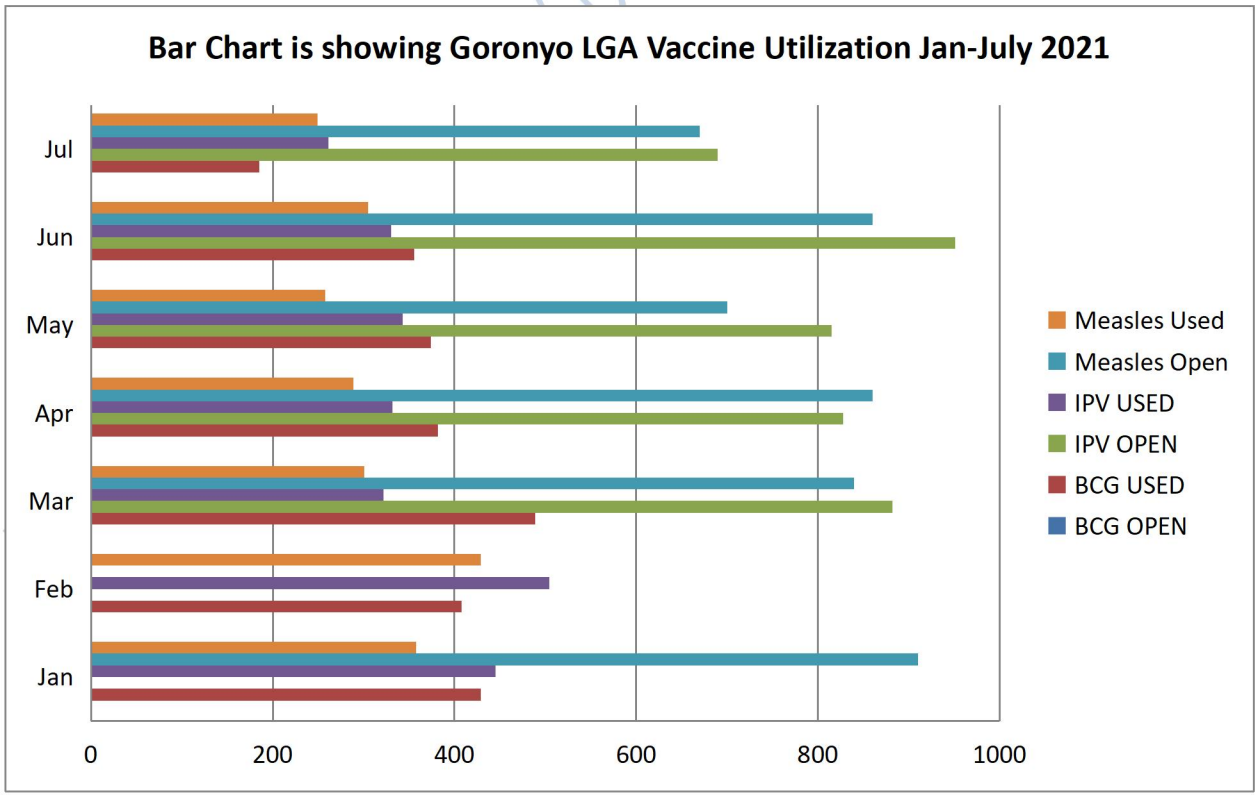
1. **Bar Chart:**

In DHIS2 SMS server, a bar chart or bar graph is an analysis tool use to present data in chart or graph with rectangular bars with heights or lengths proportional to the values that they represent. The bars can be plotted vertically or horizontally. A vertical bar chart is sometimes called a column chart.

A bar chart can be used to make comparison between two or more categories of data. One axis of the chart shows the specific categories being compared, and the other axis

represents a measured value. Some bar graphs present bars clustered in groups of more than one, showing the values of more than one measured variable. Bar graphs/charts provide a visual presentation of categorical data. Categorical data is a grouping of data into discrete groups, such as months of the year, age group, shoe sizes, and animals. These categories are usually qualitative. In a column (vertical) bar chart, categories appear along the horizontal axis and the height of the bar corresponds to the value of each category. Bar charts have a discrete domain of categories, and are usually scaled so that all the data can fit on the chart. When there is no natural ordering of the categories being compared, bars on the chart may be arranged in any order. Bar charts arranged from highest to lowest incidence are called Pareto charts.

Figure 2.22 The Following is the example of Dhis2 SMS Server Bar Chart



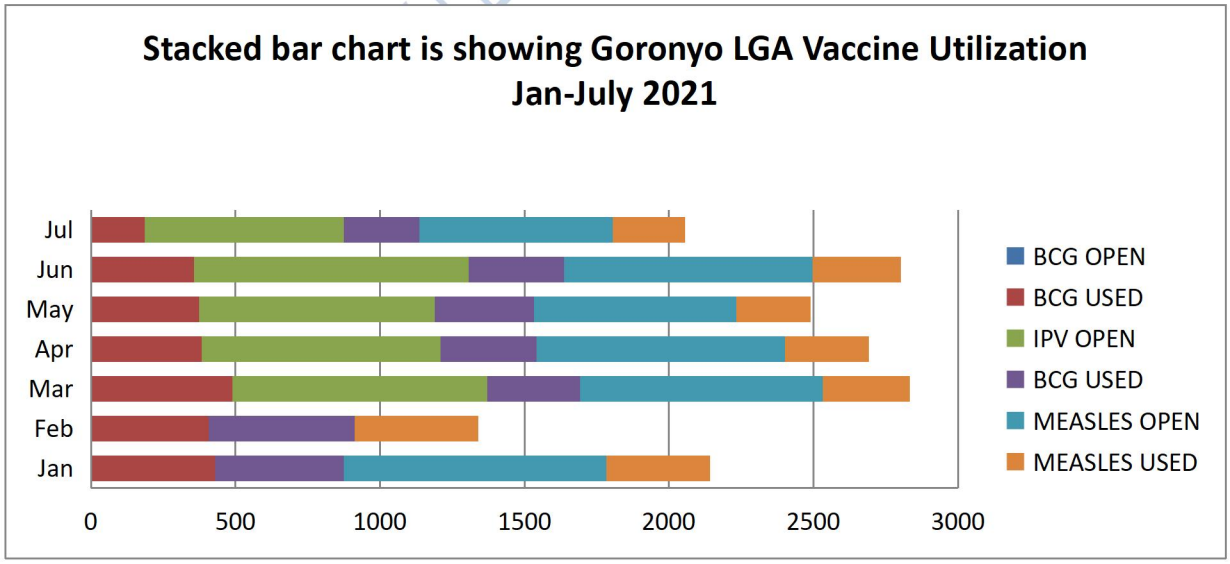
Source: DHIS2 SMS server 8/8/2021 https://www.nericcdhis2.com/dhis-web-pivot/index.html

2. Stacked bar

A **stacked column** chart in visualizer of DHIS2 SMS server is a tool for presenting a data which involved more than 1 category of data that need to be represented in a bar chart. Stacked column charts are those chart options that allow a user to combine one group's data and then show that data in different segments that correspond to different sections amongst the same group. Stacked charts basically make the column charts one on another column chart, and the charts that are prepared as stacked are like fixing one bar chart on another chart.

Stacked column charts are very helpful in showing the magnitude of how much contribution to the total is coming from the different members of a category (a part-to-whole perspective of the data). All business data needs to get compared, whether it's for different timelines, geographies, and products, or between multiple members of the same group. Stacked column charts are a straightforward way to see such data[44].

Figure 2.22 showing example of DHIS2 SMS Server Stacked Bar Chart

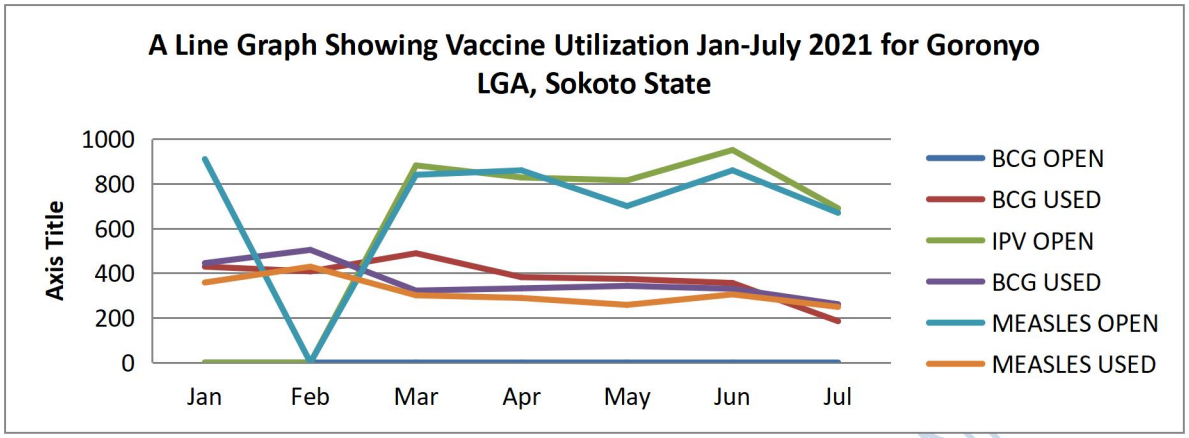


Source: DHIS2 SMS server 8/8/2021 https://www.nericcdhis2.com/dhis-web-pivot/index.html

Line Graph: In DHIS2 SMS server, a line graph, or some time called as line chart, is a type of chart used to visualize the value of vaccine open, children immunize, dropout, wastage, etc. it can be used to show changes over a period of time. A line graph is commonly used to display change over time as a series of data points connected by straight line segments on two axes. Example, comparison of BCG vaccine open and children immunize for the months of Jan, Feb and March. The line graph therefore helps to determine the relationship between two sets of values, with one data set always being dependent on the other set.

Line graphs are drawn so that the independent data are on the horizontal a-axis (e.g. time) and the dependent data are on the vertical y-axis. Line graphs are used to track changes over short and long periods of time. There is some debate about the degree of measurement between time points. Some say the data must be measured nearly continually in order for the lines to be accurate representations. Others feel a monthly measurement is sufficient, even though the line implies data at points where no measurement was taken. Line graphs are useful in that they show data variables and trends very clearly and can help to make predictions about the results of data not yet recorded. They can also be used to display several dependent variables against one independent variable. When comparing data sets, line graphs are useful when comparing more than two or more variables using different time. Example, compare BCG, OPV, PENTA vaccine open during the months of March, April and June. This comparison can show changes that occur during this period.

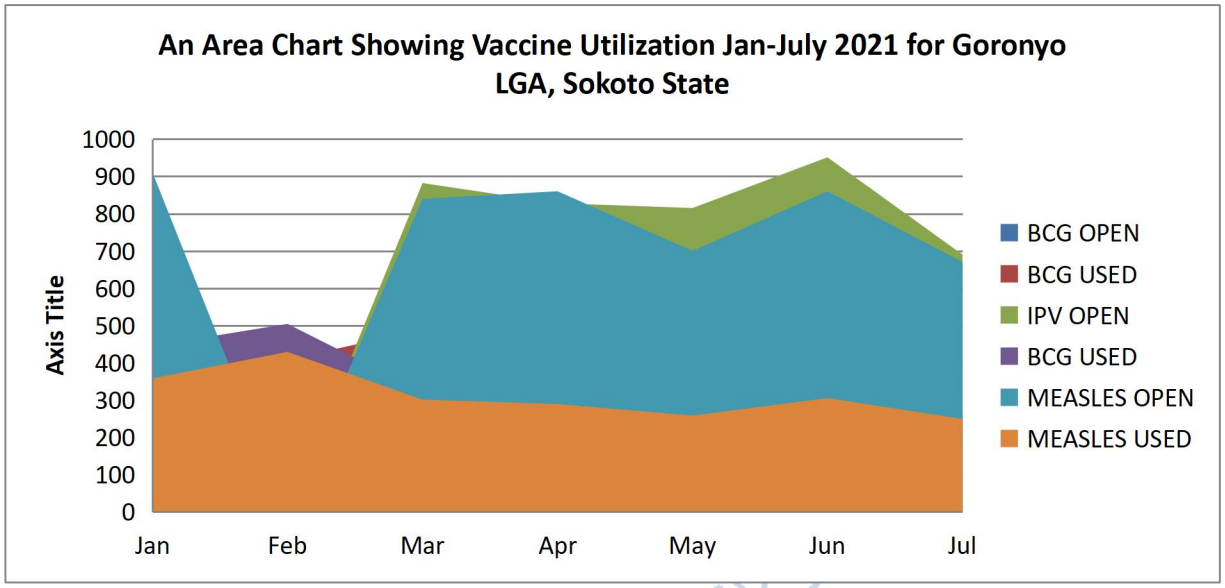
Figure 2.23 The Chart is showing an example of DHIS2 SMS Server Line Graph



Source: DHIS2 SMS server 8/8/2021 https://www.nericcdhis2.com/dhis-web-pivot/index.html

Area Chart: In district health information system (DHIS2) SMS server, an area chart is one way visual representation of data that change over time. An area chart is showing how situation changes from time to time, example, how does the number of plan and conducted RI sessions changes from week 1 to week 4 of a particular month. An **area chart** represents the change in one or more quantities over time. It's similar to a line graph. In both area charts and line graphs, data points are plotted and then connected by line segments to show the value of a quantity at several different times. Area charts are a good choice to use when you want to show a trend over time, but aren't as concerned with showing exact values.

Figure 2.24 Example of DHIS2 SMS Server Area Chart



Source: DHIS2 SMS server 8/8/2021 https://www.nericcdhis2.com/dhis-web-pivot/index.html

GIS Tool: DHIS2 SMS server has Geographical Information System tool, this feature is very powerful web-based Geographic Information System (GIS), it is integrated in this software in order to support in tracking geo-coordinate of a location, which help in locating a place through the built-in Maps app, which lets you do thematic mapping of areas and points, view facilities based on classifications, visualize catchment areas for each facility, and even geolocate individual cases for contact tracing during a disease outbreak.

You can define custom legend sets and link them to indicators. The DHIS2 Maps app lets you put labels on areas and points and search and filter based on various criteria. You can move points and set locations on-the-fly. You can overlay multiple layers, use Bing Maps as background layer, and import other GIS-based data sets to allow for joint analysis with population, climate, and other data types. Maps can be saved as favorites and shared with other people, and added to your DHIS2 dashboard.

Events: In the Event is a toll in dhis2 SMS serve, which capture app you register events that occurred at a particular time and place. An event can happen at any given point in time. This stands in contrast to routine data, which can be captured for predefined, regular intervals. Events are sometimes called cases or records. In DHIS2, events are linked to a program. The Event Capture app lets you select the organisation unit and program and specify a date when an event happened, before entering information for the event. The Event Capture app works online and offline. If the Internet connectivity drops, you can continue to capture events. The events will be stored locally in your web browser (client). When connectivity has returned, the system will ask you to upload the locally stored data. The system then sends the data to the server where the data is stored.

Indicators: In DHIS2, the indicator is a core element of data analysis. An indicator is a calculated formula based on a combination of data elements, category options, possibly constants and a factor. There are two forms of indicators, those with a denominator and those which do not have a denominator. Calculated totals, which may be composed of multiple data elements, do not have denominators. Indicators which are defined with both numerators and denominators are typically more useful for analysis. Because they are proportions, they are comparable across time and space, which is very important since units of analysis and comparison, such as districts, vary in size and change over time. A district with population of 1000 people may have fewer cases of a given disease than a district with a population of 10,000. However, the incidence values of a given disease will be comparable between the two districts because of the use of the respective populations for each district.

Indicators thus allow comparison, and are the prime tool for data analysis. DHIS2 should provide relevant indicators for analysis for all health programs, not just the raw data. Most report modules in DHIS2 support both data elements and indicators and you can also combine these in custom reports. Example of indicators

- BCG doses opened (fixed and outreached)
- Total BCG given (fixed and outreached)
- OPV doses opened (fixed and outreached)
- OPV given (fixed and outreached)
- IPV doses opened (fixed and outreached)
- IPV given (fixed and outreached)
- Measles doses opened (fixed and outreached)
- Measles given (fixed and outreached)
- Penta doses opened (fixed and outreached)
- Penta given (fixed and outreached)

Data Element: A data element can be part of indicators, data element provide more comprehensive information on indicators, that is indicators is a summary of data element, while data element is details of indicators, example, indicator provide total number of BCG open both fixed and outreached, but data element provide data on total BCG open during fixed only, and BCG open during outreached only.

Data Set: A data set is a collection of data elements grouped together for data collection, and in the case of distributed installs they also define chunks of data for export and import

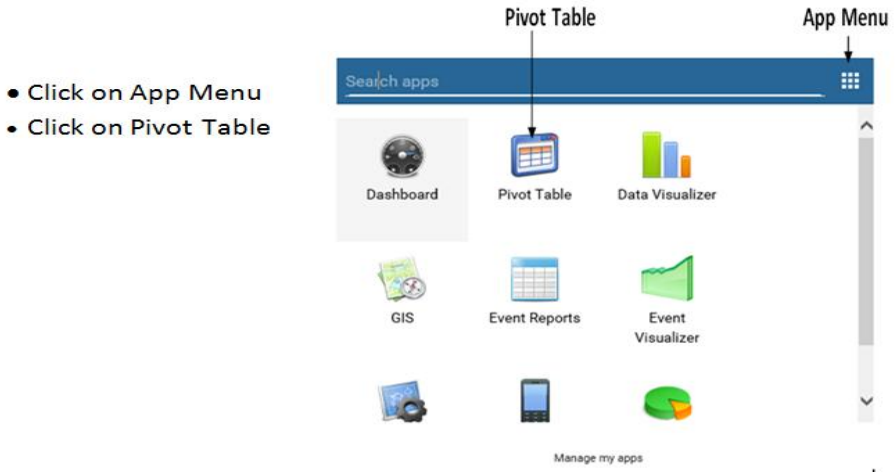
between instances of DHIS2 (e.g. reporting rate, reporting rate on time, actual report, actual report on time, actual expected report from health facility, ward or LGA).

Data set can allow viewing the actual report sent to the server such as number of fixed and outreached plan to conduct within the week

2.3.5 How to download and manipulate RI data from DHIS2 SMS server using Pivot Table

DHIS 2 SMS server enables you to download and manipulate (restructuring, deleting, adding) RI data based on user needs, DHIS2 SMS server allows multiple user to sign in at once and collect, manage and analyze RI data in different format. It lets you generate statistical report report, store and retrieve information when need arise; it allows to track defaulters and completeness of report of all health facilities. The following is the procedure for down loading data of actual session plan and conducted both fixed and outreached. After logging into the server using user name and password provided by DHIS2 server administrator.

Figure 2.24 Step One

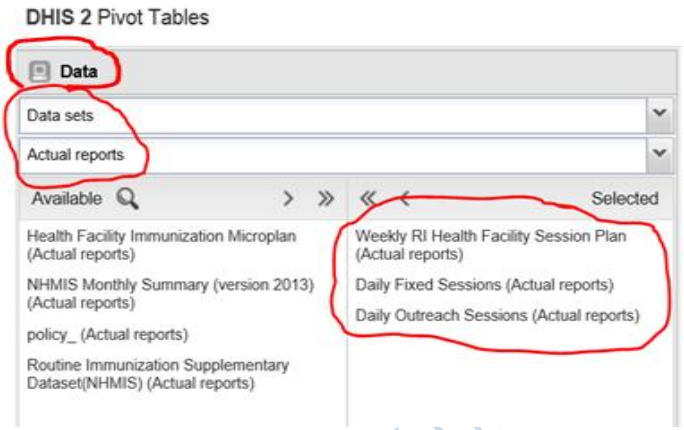


Source: DHIS2 SMS server 8/8/2021

Step Two:

- ✓ Click data
- ✓ Select data sets
- ✓ Select actual report

Figure 2.23 DHIS2 Pivot Table View



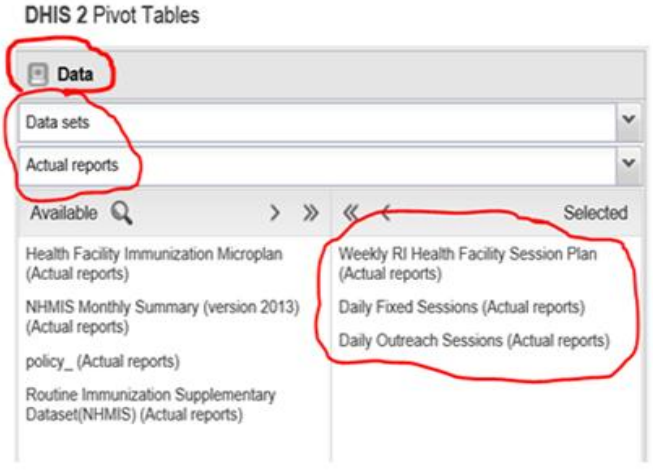
Source: DHIS2 SMS server 8/8/2021 https://www.nericcdhis2.com/dhis-web-pivot/index.html

Figure 2.24 Data Sets and Actual Reports View

Step

Four

- Click on Data
- Click on dropdown
- Select Data sets
- Select Actual report Out of all data sets
- Double click on data items in the left hand side, each data item double clicked would move to right hand side
- Weekly RI Health Facility Session Plan
- Daily Fixed Sessions (Actual report)
- Daily Outreach Sessions (Actual reports)

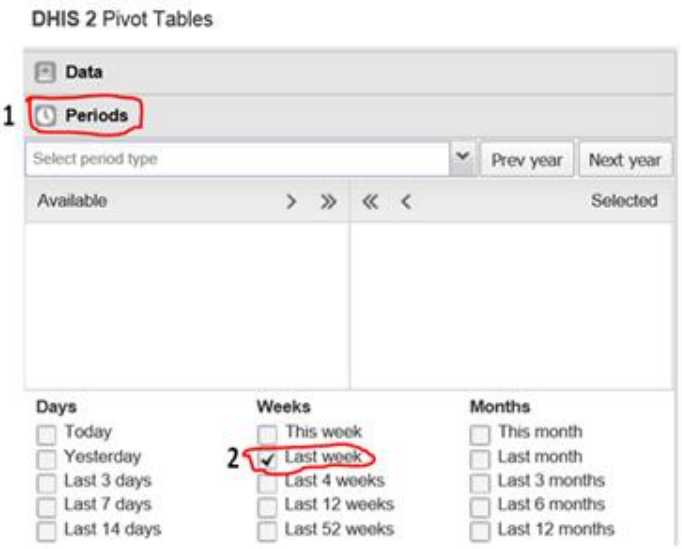


Source: DHIS2 SMS server 8/8/2021 https://www.nericcdhis2.com/dhis-web-pivot/index.html

Figure 2.25 How to Select Period

Period: This data set would allow to select day, week, month or year need to review, example, if today is selected all data loaded/sent to the server today would be seen and retrieved, same to week, month or year,
In order to select the period

- Click on period
- Select appropriate period need to view, analyze and download, either this today, this week, last week, this month, this year or last year

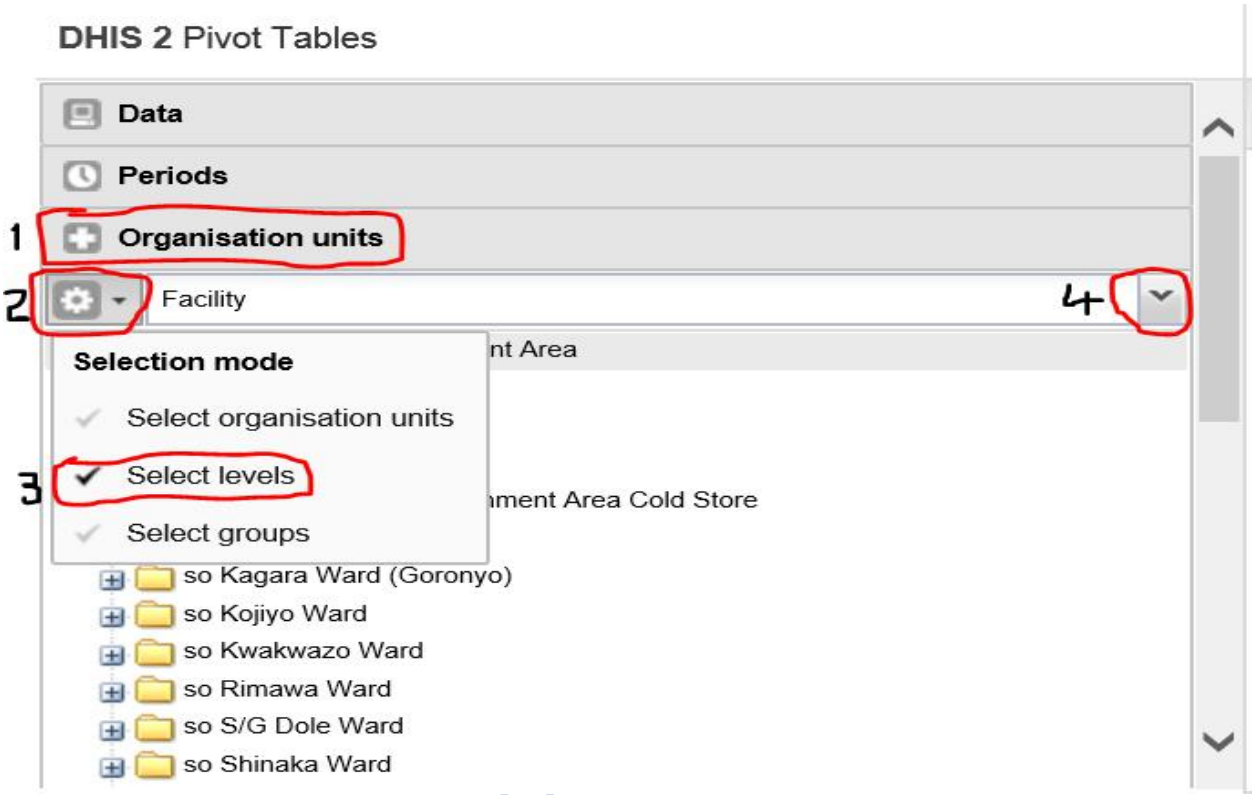


Source: DHIS2 SMS server 8/8/2021 https://www.nericcdhis2.com/dhis-web-pivot/index.html

Organisational Units: This is the element which deal with selecting the level of organisation, such as federal level, state level, LGA level, ward level or health facility level, this operation would allow to view, retrieve, analyze or download data at these levels, the procedure for making this operation is as follows

- Click on organisation units
- Click on drop down menu,
- Click and select levels
- Go to drop down dialog box, select level you need either federal, state, LGA or health facility

Figure 2.26



Source: DHIS2 SMS server 8/8/2021 https://www.nericcdhis2.com/dhis-web-pivot/index.html

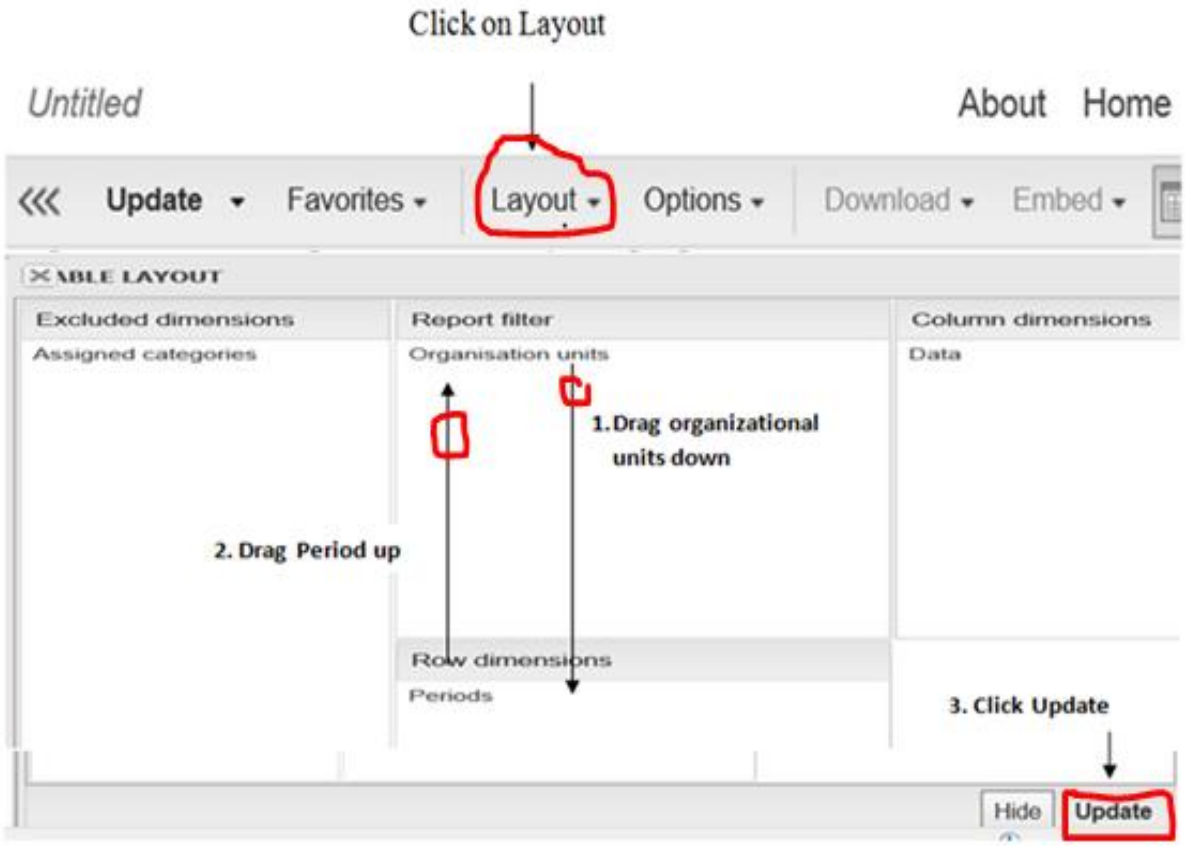
Layout: is a tool with the function of arranging the direction and dimension of data in a table, that is to change direction of rows to columns, example, header of a table contains field such as name of health facility, fixed session plan, fixed session conducted, outreach plan, outreach conducted, vaccine doses open, children immunize, etc.

How to arrange layout of pivot table

- Click on layout
- Drag organisational level to row dimension (from up to down)
- Drag period to report filter (from down to up)

- Click update

Figure 2.27 How to arrange layout



Source: DHIS2 SMS server 8/8/2021 https://www.nericcdhis2.com/dhis-web-pivot/index.html

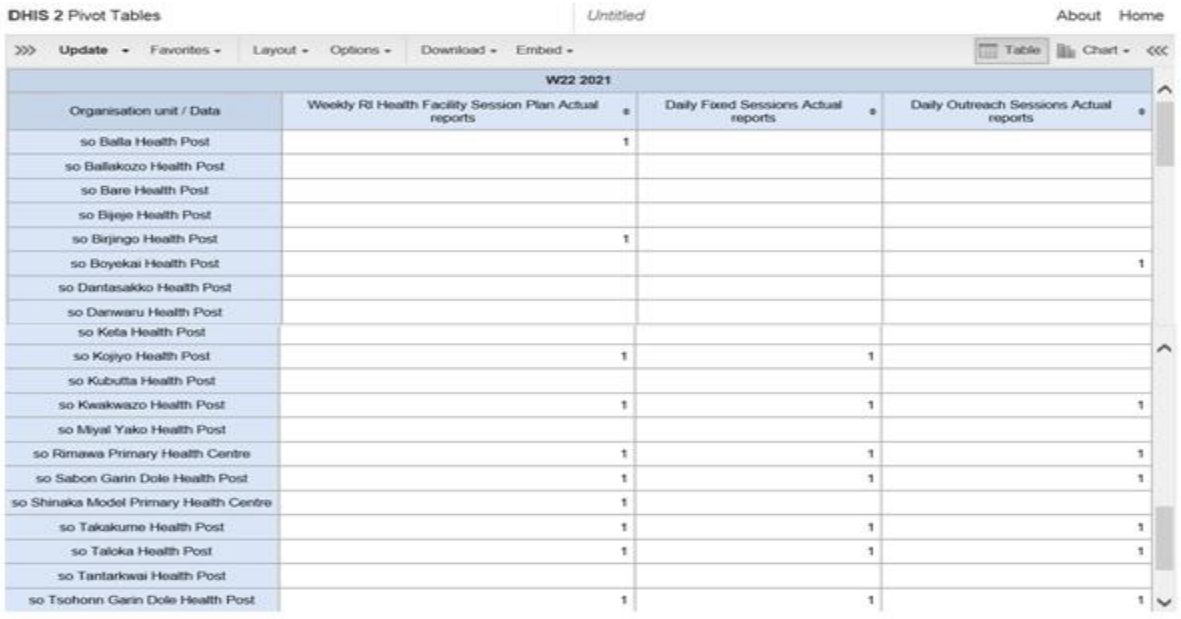
This is the outcome of the analysis

After clicking update the below table would appear, the table below is showing the data for week 22 of 2021 (31st May -6th June 2021), the column dimension is showing name of health facilities, actual session planned to conduct, fixed session conducted, and outreach sessions conducted. The table is showing health facilities sending their plan and conducted sessions, example, Balla health post sent their plan, but does not sent conducted sessions (fixed and outreach), Kojiyo health post sent their plan, fixed session but no data for outreach session.

Reference to the previous explanation on how to sent RI SMS, I explained to you that, the code for sending SMS is wk a1b1, which mean, this week the health facility would conduct 1 fixed and 1 outreach, similarly, if the fixed is more than 1, a1 should be change to a2, if outreach is more than 1, like 2, the code should be written as b2 etc.

Consequently, Kwakwazo health post sent its complete report, planned to conduct 1 fixed and 1 outreach, data from this table can allow to do deep dive analysis, the table also, can be converted into other format, such as excel, PDF, chart, etc. example, in order to convert this table into excel for further analysis go to download.

Figure 2.28 DHIS2 SMS Server Outcome of Planned, Fixed and Outreached Sessions



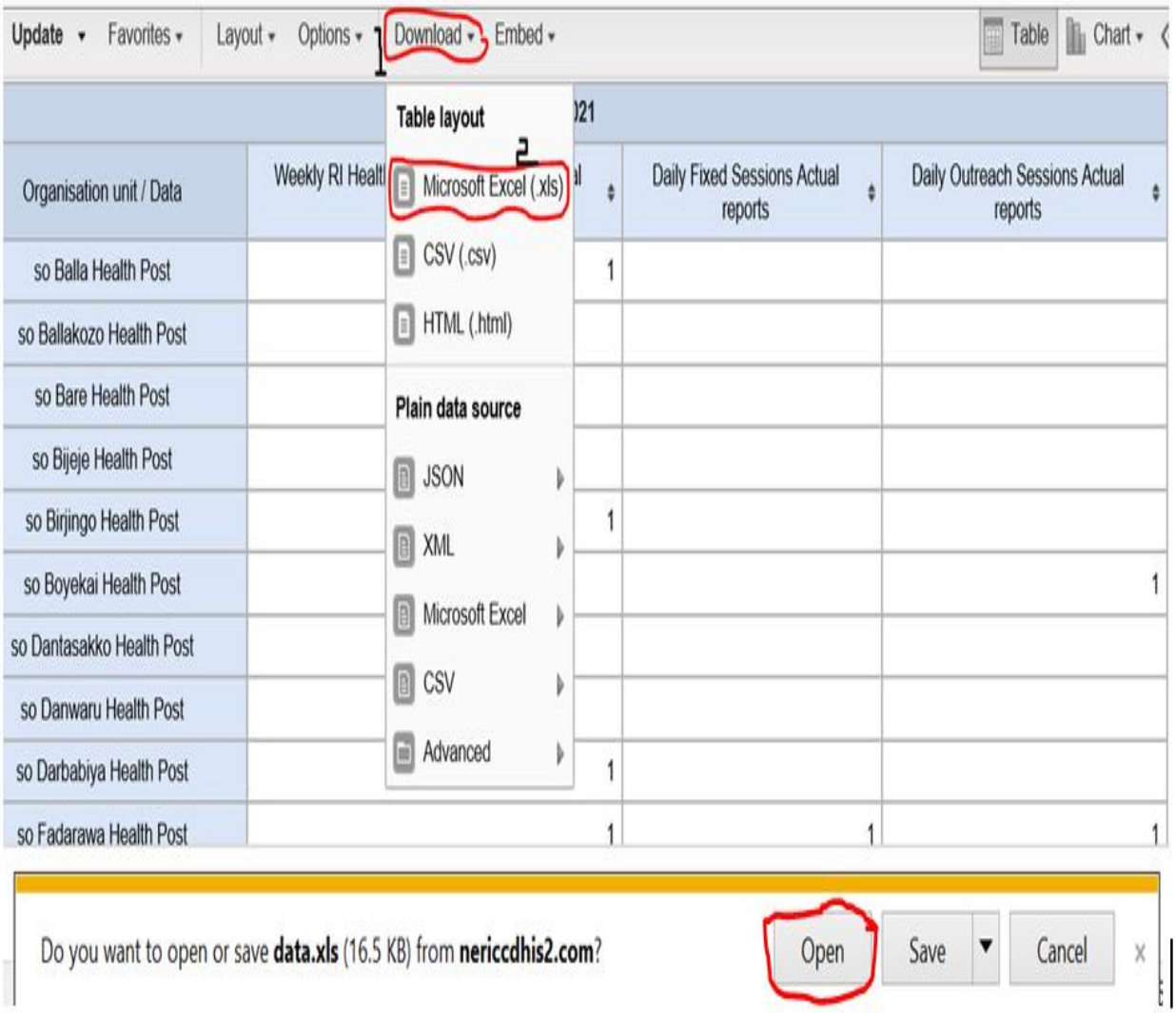
Organisation unit / Data	W22 2021		
	Weekly RI Health Facility Session Plan Actual reports	Daily Fixed Sessions Actual reports	Daily Outreach Sessions Actual reports
so Balla Health Post	1		
so Ballakozo Health Post			
so Bare Health Post			
so Bijeje Health Post			
so Birjingo Health Post	1		
so Boyekai Health Post			1
so Dantasakko Health Post			
so Danwaru Health Post			
so Keta Health Post			
so Kojiyo Health Post	1	1	
so Kubutta Health Post			
so Kwakwazo Health Post	1	1	1
so Miyal Yako Health Post			
so Rimawa Primary Health Centre	1	1	1
so Sabon Garin Dole Health Post	1	1	1
so Shinaka Model Primary Health Centre	1		
so Takakume Health Post	1	1	1
so Taloka Health Post	1	1	1
so Tantarkwai Health Post			
so Tsohonn Garin Dole Health Post	1	1	1

Source: DHIS2 SMS server 8/8/2021 https://www.nericcdhis2.com/dhis-web-pivot/index.html

How to download pivot table into excel

- Click on download
- Choice the format you want, example (Microsoft Excel)
- Click Open

Figure 2.29 How to Convert Pivot Table in Excel Format



Source: DHIS2 SMS server 8/8/2021 https://www.nericcdhis2.com/dhis-web-pivot/index.html

The table below is the excel format of the initial data downloaded from SMS server (table above), data can be manipulated and analyzed in many forms, example, out of 22 health facilities offering RI in Goronyo LGA only 19 (86%) sent plan session, 17 (77%) sent fixed session conducted, while 12 (55%) sent outreach conducted.

GORONYO LGA RI SMS WK22 2021			
Organisation unit	**PLAN**	**FIXED**	**OUTREACH**
so Balla Health Post	1		
so Birjingo Health Post	1		
so Boyekai Health Post			1
so Darbabiya Health Post	1		
so Fadarawa Health Post	1	1	1
so Falaliya Health Post	1	1	1
so Giyawa Health Post	1		
so Gorau Health Post	1	1	
so Goronyo General Hospital	1	3	
so Kagara Health post	1	1	1
so Kojiyo Health Post	1	1	
so Kwakwazo Health Post	1	1	1
so Rimawa Primary Health Centre	1	1	1
so SabonGarin Dole Health Post	1	1	1
so Shinaka Model Primary Health Centre	1		
so Takakume Health Post	1	1	1
so Taloka Health Post	1	1	1
so Tantarkwai Health Post			
so TsohonnGarin Dole Health Post	1	1	1
so Tuluske Health Post	1	1	1

so Warankai Health Post	1	1	1
so Zamace Health Post		1	
TOTAL	**19**	**17**	**12**

Source: DHIS2 SMS server 8/8/2021 https://www.nericcdhis2.com/dhis-web-pivot/index.html

Figure 2.30 Downloaded Data from Pivot Table into Excel Format

Key

	Complete Report
	Partial Report
	No Report

Endnotes

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Chapter Three

Research Methodology

3.1 Research Design

This research is on District Health Information System (DHIS2 SMS server) and Routine Immunization data, the aim of the study is to explore how the software increase the quality of RI data and how it provides timely data to healthcare managers for planning and informed decision making in order to eradicate vaccine preventable diseases, such as polio, tuberculosis, Yellow fever, Measles etc. The researcher uses descriptive research analysis, where the researcher used two methods of data collection, questionnaire and downloaded data from DHIS2 SMS server[1]. Reasons for using these method of data collection was because, to ensure responses of those providing Routine Immunization services were obtained and data send to the DHIS2 server is collected and analyzed[2].

3.2 Population of the Study

Since the researcher is interested in knowing how the software increase the quality of RI data and timely data to healthcare managers for planning and informed decision making in order to eradicate vaccine preventable diseases, such as polio, tuberculosis, Yellow fever, Measles etc. Two method of data collection were used, these methods were questionnaire and downloading data from DHIS2 SMS server. For questionnaire, total sample size was used in distributing questionnaires, where 90 questionnaires were distributed to all the 90 health workers supporting or attached direct to RI unit of entire 22 health facilities offering Routine Immunization in Goronyo LGA, Sokoto state and 85 completed questionnaires were returned, the categories of health workers targeted were, health facility in-charge,

Routine Immunization service provider, Assistant Routine Immunization provider, RI recorder[3].

The reason for producing 90 questionnaires was because, there is total of 90 health workers only supporting/attached to RI unit in the entire 22 health facilities offering RI in the LGA.

Population distribution of questionnaires is:

S/NO	Position	Number
1.	Health Facility In-charge	23
2.	Routine Immunization Provider	23
3.	Assistant RI Provider	22
4.	RI Recorder	22
	Total	90

As well, the researcher downloaded RI data from DHIS2 SMS server for at least 1 year August 2020 – July 2021 downloaded, some of the data downloaded include, various data set, data type and indicators, example, number of session plan, number of fixed session conducted, vaccine open and children immunize, etc. The reason for downloading data for one year only was because it is the most recent data and would yield more interested result.

Before downloading data from the DHIS2 SMS server, permission to use official data was requested from Director Health planning, Ministry of Health, Sokoto and approval letter was attached at the end of this project.

3.3 Sample and Sample Technique

In Goronyo LGA there is total of 40 health facilities out of which 22 offering Routine Immunization, sample technique used for this research was total sample of all health

worker working under Routine Immunization or supporting the services, similarly, the researcher downloaded data from DHIS2 SMS server for period of 2 years July 2019 to June 2020 and July 2020 –June 2021.

Table 3.1 List of Health Facilities and their respective ward of Goronyo LGA, Sokoto State

LGA	Name of Ward	Name of Health Facility
Goronyo LGA, Sokoto state	Birjingo	Birjingo HP
		Warankai HP
	Boyekai	Boyekai HP
	Giyawa	PHC Giyawa
	Goronyo	GH Goronyo
		Taloka HP
	Kagara	Kagara HP
		Balla HP
	Kojiyo	Kojiyo HP
		Darbabiya HP
	Kwakwazo	Kwakwazo HP
		Tantarkwai HP
	Rimawa	Fadarawa HP
		PHC Rimawa
		Falaliya HP
	S/G Dole	PHC S/Garin Dole
		TsohomGarin Dole HP
	Shinaka	MPHC Shinaka
		Tuluske HP
		Zamache HP
	Takakume	Takakume HP
		Gorau HP
	Number of Ward=11	Number of HFs Conducting RI=22

Source: from DHIS2 SMS server July 2021

3.4 Sample Size

The researcher use total sample size of 90 health workers in Goronyo LGA working under Routine Immunization unit the categorization is as follows:

S/NO	POSITION	NUMBER
1.	Health Facility In-charge	23
2.	Routine Immunization Provider	23
3.	Assistant RI Provider	22
4.	RI Recorder	22
	Total	90

3.5 Description of Research Instrument

The instrument use in collecting data during this research was questionnaire and data downloaded from DHIS2 RI SMS server, Excel package was used in summarizing and analyzing the data collected and downloaded, data was arrange in tables, different chart were used in evaluating the data and descriptive (percentage) analysis was applied in explaining the finding of the research.

3.6 Validity of Instrument

Questionnaire used during the research was designed in such a way that it would capture all the necessary information needed for the research, also, data downloaded is reliable because it was sent to the server by Routine Immunization service providers and it can allow to make many comparison based on our research objectives.

3.7 Reliability of the Instrument

The instrument used during this research (questionnaire) was reviewed several time in order to ensure all necessary data is collected based on the objectives of the research.

3.8 Method of Data Collection

Data collected from questionnaire and downloaded from DHIS2 RI SMS data was analyzed using Microsoft Excel, percentage was used in describing the findings.

Endnotes

1. B. M. Shanti. *Research Methodology Hand Book*, Support of Edu-creation Publishing, Dwarka, New Delhi, India, 2011.

2. P. M. Shyama. *A Guide to Research Methodology*: *An Overview of Research Problems, Tasks and Methods,* **CRC Press**, 2019.

3. L., Patricial. *Research Design*, The Guiliford Press, USA, 2017.

Chapter Four

Results and Discussion of Findings

This chapter would deal with data presentation, analysis and discussion of finding based on the collected from questionnaires administered to health workers providing Routine Immunization and data downloaded from DHIS2 SMS server of Goronyo LGA, Sokoto State.

4.1 Data Presentation

Total of 90 questionnaires were distributed to 90 health workers conducting Routine Immunization in Goronyo LGA, (HF in-charge, RI service provider, assistant RI service provider, RI recorder) reason for choosing these personnel is because they are concerned with RI services and involved in sending RI SMS data. Total of 85 questionnaires were recovered. Therefore, my analysis was based on 85 respondents.

The following is the data presentation, analysis and discussion of findings:

Table 4.1 Age of Respondents

S/NO	Level of Education	Number of Respondent	Percentage (%)
1	20 – 30	28	32%
2	31 – 40	36	42%
3	41 - 50	18	21%
4	51 – 60	3	5%
Total		85	100%

Data source: Field Work (all RI Health Facilities in Goronyo LGA, Sokoto, June 2021)

Table 4.1 above is showing the age group of the respondents in which largest percentage of respondents were between 31-40 years numbering 36 occupying 42%, while the lowest were between 51-60 amounted to 3 equivalents to 5%. This shows that most of the routine immunization service providers are middle age, and there is possibility of more productivity of services.

Table 4.2 For how long are you working under RI unit

S/NO	Year	Number of Respondent	Percentage (%)
1	0-5	39	46%
2	6-10	28	33%
3	11-20	14	16%
4	21 – Above	4	5%
Total		85	100%

Data Source: Field Work (all RI Health Facilities in Goronyo LGA, Sokoto, June 2021)

Table 4.2 is a bio data showing working experience of respondents in regard to RI services, highest were those between 0-5 years, which were 39 respondents equivalent to 46% and the lowest were those between 21 and above years with 4 personnel which was only 4%, this analysis is showing that, most of the personnel working under RI services were newly recruited to the unit.

Table 4.3 Health Profession

S/NO	Level of Education	Number of Respondent	Percentage (%)
1	SCHEW	33	38%
2	JCHEW	27	32%
3	Environmental	11	13%
4	Health Records	14	17%
Total		85	100%

Data Source: Field Work (all RI Health Facilities in Goronyo LGA, Sokoto, June 2021

The table 4.3 is showing the profession of respondents, 33 of the respondents ware SCHEW with 38% and the lowest were environmental health extension workers with 11 respondents, equivalent to 13%. This shows that larger percentage of personnel working under the unit were senior community health extension workers, which are qualified to do the job.

Table 4.4 Does your Health Facility conduct Routine Immunization services?

S/No	Responses	Number of Respondents	Percentage %
1.	Yes	85	100%
2.	No	0	0%
Total		**85**	**100%**

Data Source: Field Work (all RI Health Facilities in Goronyo LGA, Sokoto, June 2021

The above table 4.4 is showing the number of number of respondents who's their health facility conducted RI services; the result shows that all the respondent's health facilities conduct RI services.

Table 4.5 Do you know DHIS2 before 2017?

S/No	Responses	Number of Respondents	Percentage %
1.	Yes	13	15%
2.	No	72	85%
Total		**85**	**100%**

Data Source: Field Work (all RI Health Facilities in Goronyo LGA, Sokoto, June 2021)

Table 4.5 displays the data on the level of knowledge about DHIS2 before implementation of the software in the LGA, where table 4.2.5 shows that 13 (15%) of respondents know DHIS2 before 2017, while 72 (85%) don't know.

Table 4.6 Do you received Training on how to send RI SMS to DHIS2 RI Server during Implementation of Software?

S/No	Responses	Number of Respondents	Percentage %
1.	Yes	85	100%
2.	No	0	0%
Total		**85**	**100%**

Data Source: Field Work (all RI Health Facilities in Goronyo LGA, Sokoto, June 2021

The table 4.6 above established that all the respondents received training on how to send SMS to DHIS2 before implementation of the software, this revealed that, there is an expectation that every staff involved in the training can able to send the RI SMS data effectively.

Table 4.7 The Training Received above was it adequate

S/No	Responses	Number of Respondents	Percentage %
1.	Yes	79	93%
2.	No	6	7%
Total		**85**	**100%**

Data Source: Field Work (all RI Health Facilities in Goronyo LGA, Sokoto, June 2021)

Table 4.7 above, 79 of the respondents accepted that the training received about DHIS2 SMS server was adequate, which is 93%, while 6 respondents said the training is not adequate for them equivalent to 7%.

Table 4.8 Do you know how to send RI SMS data to the server effectively?

S/No	Responses	Number of Respondents	Percentage %
1.	Yes	81	95%
2.	No	4	5%
Total		**85**	**100%**

Data Source: Field Work (all RI Health Facilities in Goronyo LGA, Sokoto, June 2021)

Analysis for table 4.8 is showing that 81 respondents (95%) know how to send SMS to the server effectively, while 4 personnel (5%) don't know how to send the data effectively, this result is showing that. Large percentage of respondents can able to send RI SMS effectively; therefore data quality would improve, because there is strong relationship between knowledge/skill and performance.

Table 4.9 Do you sent your RI SMS Data to the DHIS2 RI Server regularly?

S/No	Responses	Number of Respondents	Percentage %
1.	Yes	75	88%
2.	No	10	12%
Total		**85**	**100%**

Data Source: Field Work (all RI Health Facilities in Goronyo LGA, Sokoto, June 2021)

The table 4.9 above is displaying the analysis of question which asked about either the respondent is sending his RI SMS data to DHIS2 RI server regularly, the result indicated that, 75 (88%) of respondents were sending their data regularly, while, 10 (12%) not regularly. Amongst the objectives of this study is to investigate how RISP send their RI SMS to DHIS2 RI server, sending regular RI SMS to DHIS2 server would ensure timely reporting of data, this is an indicator which shows that more than 88% of RISPs are sending their RI SMS regularly.

Table 4.10 I believe sending RI SMS at the point of service would ensure accuracy, completeness and timely of RI data

S/No	Responses	Number of Respondents	Percentage %
1.	Yes	72	85%
2.	No	13	15%
Total		**85**	**100%**

Data Source: Field Work (all RI Health Facilities in Goronyo LGA, Sokoto, June 2021)

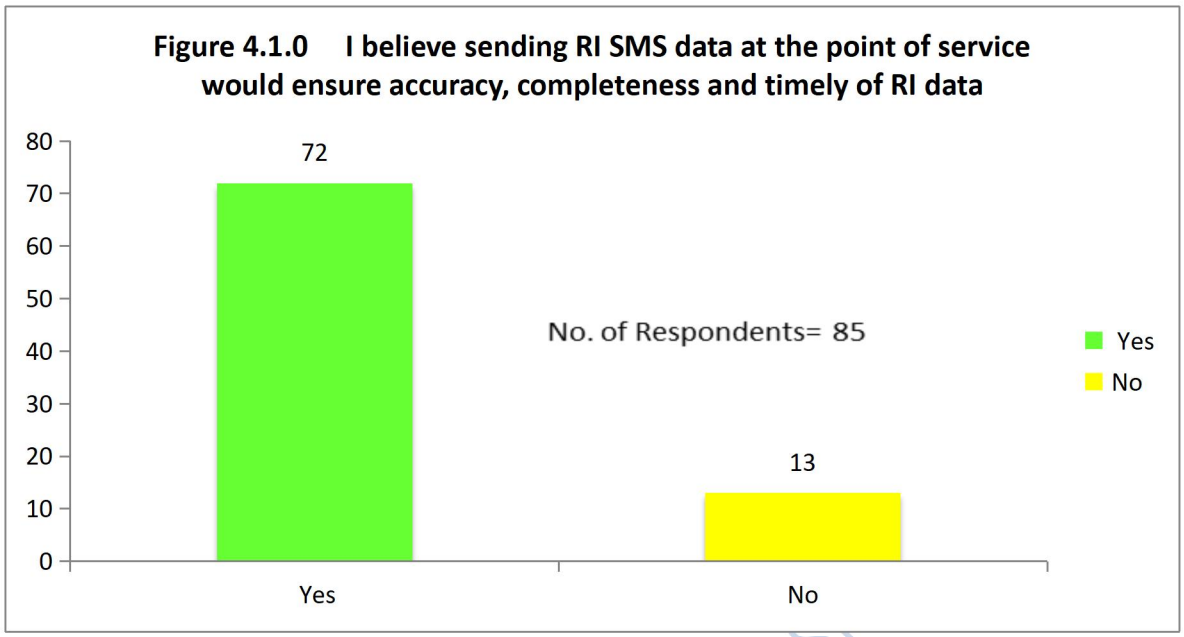

Table 4.11: Analysis of this table and figure 4.1 show that, 72 respondents (85%) agreed with the statement, while 13 (15%) disagreed with the statement that, sending RI SMS at the point of service would ensure accuracy, completeness and timely of RI data, generally, about 85% of respondents agreed that sending RI SMS to DHIS2 SMS server would ensures accuracy, completeness and timely RI data and it is an indicator that DHIS2 SMS server is essential in providing timely RI data. Similarly having timely data allow health managers to take action and plan RI activities timely.

Therefore, one of the research hypotheses of this study is interested in knowing whether DHIS2 SMS server is essential in providing timely RI data for planning or not, the above table and analysis revealed that majority of the respondent agreed that DHIS2 SMS server is essential in providing accurate, complete and timely data, this would allow health manager to plan RI activities effectively.

Table 4.12 Do you believe that sending RI SMS to DHIS2 SMS Server provide quality to RI Data?

S/No	Responses	Number of Respondents	Percentage %
1.	Yes	81	95%
2.	No	4	5%
Total		**85**	**100%**

Data Source: Field Work (all RI Health Facilities in Goronyo LGA, Sokoto, June 2021)

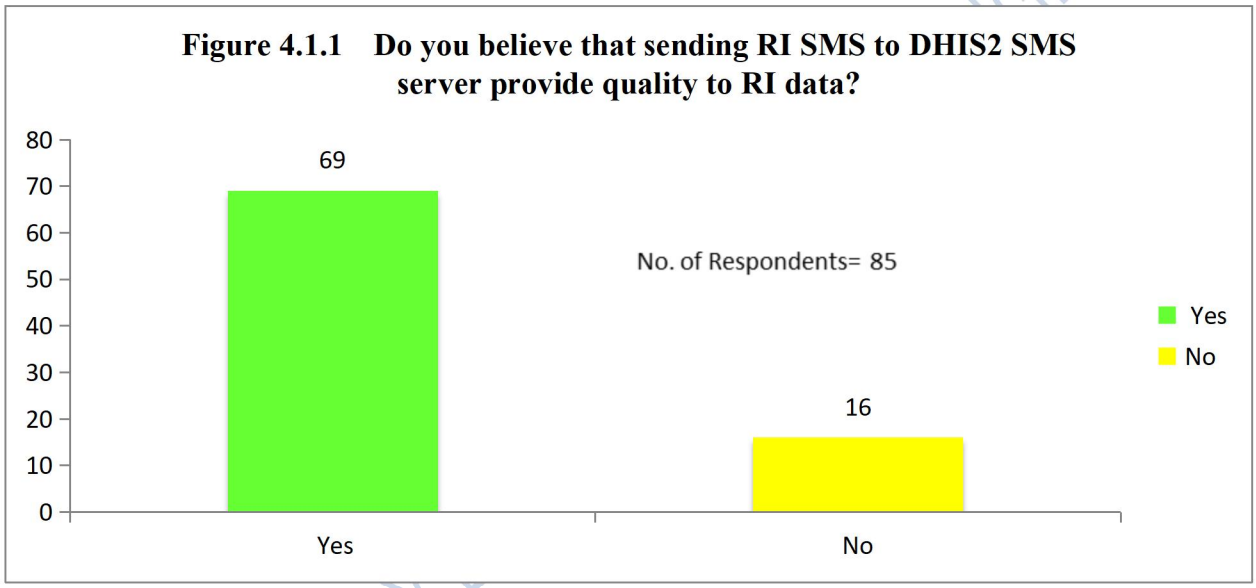

Table 4.12 one of the objectives of this study is to assess the role of DHIS2 SMS server in strengthen RI data, therefore, the researcher in his questionnaire included a question which asked, do you believe that sending RI SMS to DHIS2 SMS server provide quality to RI data, table 4.2.11 and figure 4.1.1 are displaying responses about this question, which revealed that, 69 (81%) said yes, 16 (19%) disagree, analysis of this data shows that larger percentage of respondent accepted with the statement, while those who have not agree are less than 20%. Subsequently, this analysis answers our question and supports the idea that, sending RI SMS to DHIS2 server would increases the quality of RI data.

Table 4.13 Sending RI SMS to DHIS2 SMS server at the point of Service would ensure Data is the same across all RI Registers?

S/No	Responses	Number of Respondents	Percentage %
1.	Yes	76	89%
2.	No	9	11%
Total		**85**	**100%**

Data Source: Field Work (all RI Health Facilities in Goronyo LGA, Sokoto, June 2021)

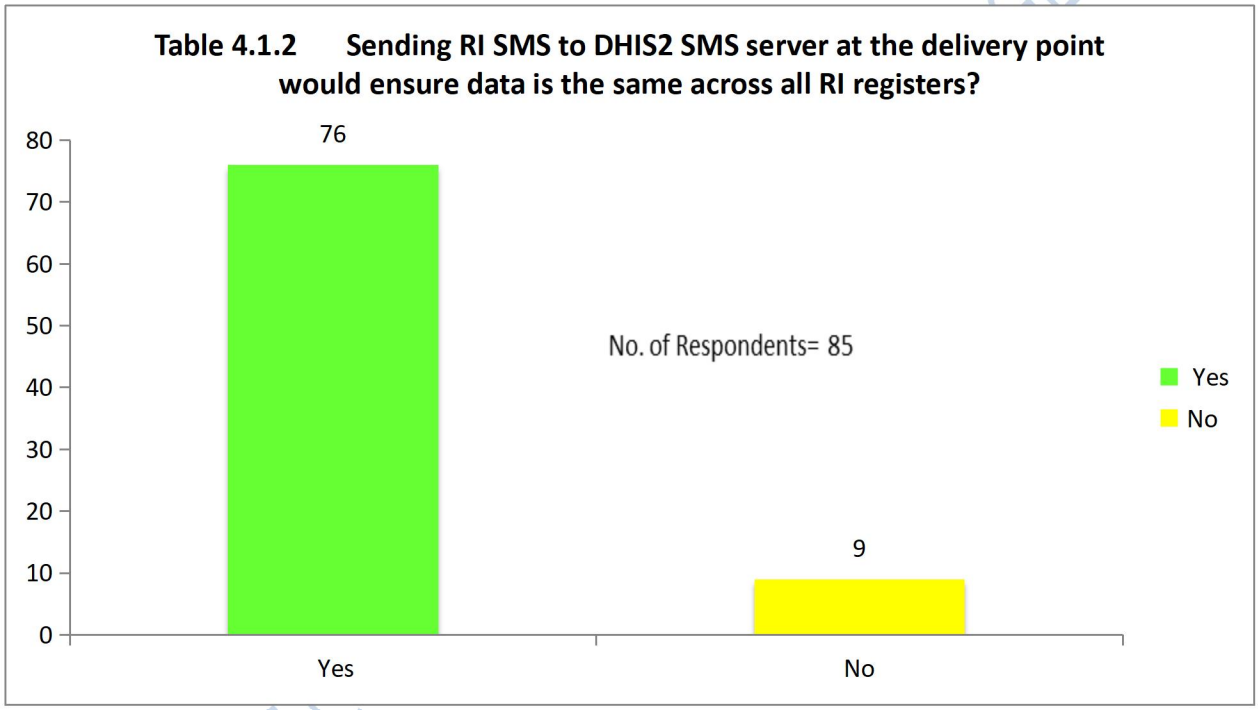

Table 4.13 and figure 4.1.2 is displaying data on whether sending RI SMS to DHIS2 SMS server at the delivery point would ensure data is the same across all RI registers, the analysis reveal that 76 (89%) said yes, while 9 (11%) of the respondent said no to the statement. Normally, by having uniformity and consistency of data across all RI data tools such as RI child register, tally, summary, National Health Management Information System (NHIMS), and RI monitoring means the data is strengthen, standard and qualitative, it

would improve the quality of RI data. This means that DHIS2 SMS is essential in quality of RI data.

Table 4.14 Do you believe that DHIS2 SMS data would support the validation of other RI data tools (RI registers)?

S/No	Responses	Number of Respondents	Percentage %
1.	Yes	77	91%
2.	No	8	9%
Total		**85**	**100%**

Data Source: Field Work (all RI Health Facilities in Goronyo LGA, Sokoto, June 2021)

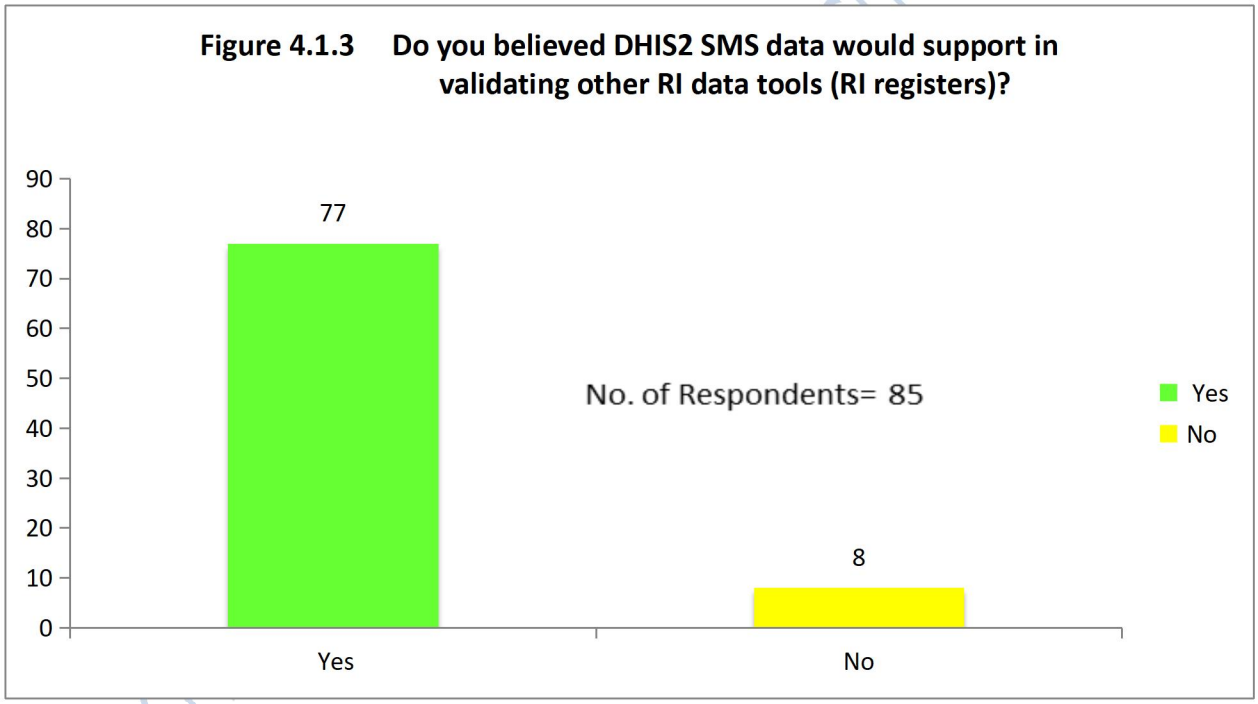

Table 4.14.Objective number 4 of this study is to assess whether DHIS2 SMS can help in validating other RI data tools (RI registers), according to data collected and analyzed above, it shows that, 77 (91%) out of 85 agreed that DHIS2 SMS data can support in validating other RI data tools or registers, while 8 (9%) of the respondents does not agreed with the statement, this

means that there is strong believe amongst the respondents that DHIS2 SMS server support in validating other RI data tools.

Table 4.15 That the RI data quality can be achieve by using DHIS2 SMS Software

S/No	Responses	Number of Respondents	Percentage %
1.	Yes	78	92%
2.	No	7	8%
Total		**85**	**100%**

Data Source: Field Work (all RI Health Facilities in Goronyo LGA, Sokoto, June 2021)

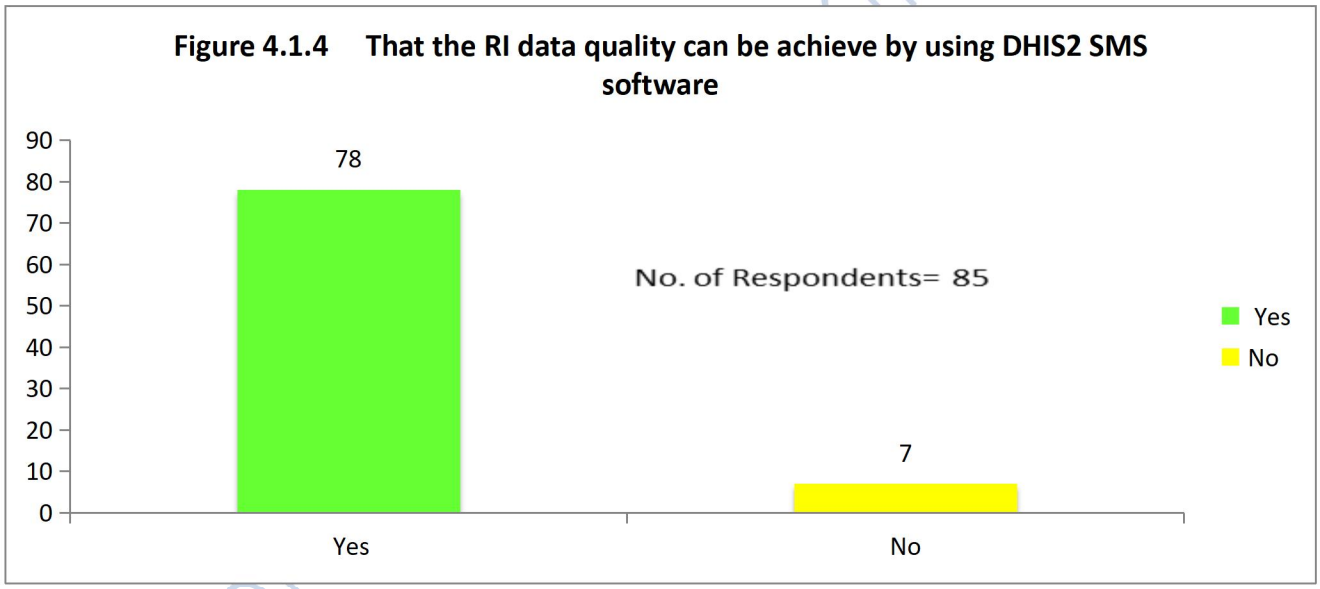

Table 4.15 and figure 4.1.4 is showing the outcome of the question which asked whether RI data quality can be achieve by using DHIS2 SMS software, 78 respondents (92%) said yes that the RI data quality can be achieved by using DHIS2 software; while, 7 (8%) said no, this means RI data quality can be achieve by using DHIS2 SMS software.

Table 4.15 DHIS2 SMS Server is a source for quality RI Data?

S/No	Responses	Number of Respondents	Percentage %
1.	Yes	83	98%
2.	No	2	2%
Total		**85**	**100%**

Data Source: Field Work (all RI Health Facilities in Goronyo LGA, Sokoto, June 2021)

The table 4.15 above is displaying question on DHIS2 SMS server is a source of quality RI data, this is where 83 respondents answered yes and 2 say no. the answer revealed that DHIS2 server is a source for quality RI data.

Table 4.16 DHIS2 RI SMS Data is reliable, because it is been sent from point of Service.

S/No	Responses	Number of Respondents	Percentage %
1.	Yes	79	97%
2.	No	6	3%
Total		**85**	**100%**

Data Source: Field Work (all RI Health Facilities in Goronyo LGA, Sokoto, June 2021)

Table 4.16 provides data on reliability of DHIS2 RI SMS data, this where 76 (97%) accepted that DHIS2 RI SMS data is reliable, while, 6 (3%) does not agree with the statement, this shows that majority of respondents agree that DHIS2 RI SMS data is reliable, especially because the data can be sent immediately after completing the session.

Table 4.17 How would you Rate the Level of DHIS2 SMS Software Performance?

S/No	Responses	Number of Respondents	Percentage %
1.	Very Good	61	72%
2.	Good	19	22%
3.	Poor	5	6%
4.	Very Poor	0	0%
Total		**85**	**100%**

Data Source: Field Work (all RI Health Facilities in Goronyo LGA, Sokoto, June 2021)

Table of 4.17 this table contains responses performance of the software, 61 (72%) rate the software as very good, 19 (22%) good and 5 (6%) poor.

According to this analysis majority of the respondents rate the software as very good and good. This means the software is capable of general data processes, data strengthening inclusive.

Table 4.18: Do you experience network challenges during sending RI SMS

S/No	Responses	Number of Respondents	Percentage %
1.	Yes	24	28%
2.	No	61	72%
Total		**85**	**100%**

Data Source: Field Work (all RI Health Facilities in Goronyo LGA, Sokoto, June 2021)

Table 4.18 this table contains data on network challenges during sending RI SMS, the responses shows that, 24 (28%) of respondents do experience network challenges during sending RI SMS, at the same time, 61 respondents equivalent to 72% were not experiencing any network challenges.

One of the objective of this research is to investigate problem associated with the use of DHIS2 SMS server, in general, the analysis of this table shows that, 72% of RI service providers were not experiencing any challenging, 28% experience challenges of network in sending SMS to DHIS2 server, therefore, the research found that, still some are experiencing network challenges during sending RI SMS data to DHIS2 SMS server.

Table 4.19 Phone I am using is

S/No	Responses	Number of Respondents	Percentage %
1.	Personal	85	100%
2.	Official	0	0%
Total		**85**	**100%**

Data Source: Field Work (all RI Health Facilities in Goronyo LGA, Sokoto, June 2021)

Table 4.19 is displaying data on the owner of the phone used in sending SMS data, the result is indicating that all the phone used in sending RI SMS data belong to RISP (personal), is not provided by government or any organisation.

Similarly, this table is revealing that, RI SMS project is facing challenges in terms of working tools, because no phone is provided for sending RI SMS, all RISPs are using their phone in sending RI SMS to DHIS2 SMS server.

Section Two DHIS2 SMS Server Data Presentation and Analysis

This section also deals with data downloaded from DHIS2 SMS server in order to make more analysis and provide further evidence that DHIS2 SMS server contributed in strengthen RI data in Goronyo LGA, Sokoto State, Nigeria.

Table 4.20: This table displays data for two years July 2019 to June 2020 and July 2020 – June 2021 for comparison between these two years for plan session, fix and outreach conducted.

Table 4.20: This table displays data for two years July 2019 to June 2020 and July 2020 –June 2021 for comparison between these two years for plan session, fix and outreach conducted

S/N0	Health Facility Name	Plan Sessions Jul 2019 to Jun 2020	Plan Session Jul 2020 to Jun 2021	% Increase	Fixed Sessions Jul 2019 to Jun 2020	Fix Session Jul 2020 to Jun 2021	% Increase	OS Sessions Jul 2019 to	OS Session Jul 2020	% Increase
1	Balla Health Post	26	31	16%	27	36	25%	28	31	10%
2	Birjingo Health Post	25	42	40%	20	32	38%	21	37	43%
3	Boyekai Health Post	26	46	43%	30	61	51%	22	69	68%
4	Darbabiya Health Post	26	45	42%	24	58	59%	26	50	48%
5	Fadarawa Health Post	26	44	41%	22	56	61%	18	35	49%
6	Falaliya Health Post	25	45	44%	24	56	57%	24	33	27%
7	Giyawa Health Post	25	37	32%	17	24	29%	17	16	-6%
8	Gorau Health Post	25	50	50%	25	62	60%	31	53	42%
9	Goronyo General Hospital	26	50	48%	102	219	53%	0	4	100%
10	Kagara Health post	26	52	50%	25	58	57%	30	61	51%
11	Kojiyo Health Post	26	40	35%	26	44	41%	24	24	0%
12	Kwakwazo Health Post	26	44	41%	25	63	60%	25	47	47%
13	Rimawa P H Centre	26	50	48%	22	55	60%	25	69	64%
14	SabonGarin Dole H Post	25	49	49%	26	46	43%	25	55	55%
15	Shinaka MPHC	26	44	41%	23	38	39%	24	37	35%
16	Takakume Health Post	26	48	46%	26	70	63%	19	42	55%
17	Taloka Health Post	25	48	48%	25	59	58%	31	53	42%
18	Tantarkwai Health Post	21	27	22%	10	17	41%	9	17	47%
19	TsohonnGarin Dole HPost	23	45	49%	21	48	56%	17	28	39%
20	Tuluske Health Post	25	50	50%	25	64	61%	27	64	58%

Source: downloaded from DHIS2 SMS Server on 12/8/2021 (www.nericcdhis2.com)

Table 4.20 is displaying data downloaded from DHIS2 SMS server, which make comparison of data of two years July 2019 to June 2020 and July 2020 –June 2021 for plan session, fix and outreach sessions conducted, analysis of the data is showing an increase between 2020-2021 for all three data sets analyzed (plan, fix and outreach sessions conducted). One of the primary aim of this research is to compare progress of reporting rate of RI data over period of time (at least two years), analysis of this table is showing how the software help in increasing data reported, because the data is showing an increase between 2020 and 2021, example, at LGA level there is an increase of 43% of plan session sent, 54% for fix session conducted and 46% of outreached conducted and reported to the server.

Table 4.21

Session Plan, Fixed and Outreached Session Conducted and Sent to DHIS2 SMS server Between August 2020-July 2021 Goronyo LGA, Sokoto State

S/NO	Health Facility Name	Plan session sent	% of Plan Session Sent	Fixed Session Conducted	% of Fixed Session Conducted	Outreached Session Conducted	% of Outreached Session Conducted
1	Balla Health Post	28	54%	34	65%	18	35%
2	Birjingo Health Post	39	75%	29	56%	34	65%
3	Boyekai Health Post	46	88%	60	115%	72	138%
4	Darbabiya Health Post	45	87%	56	108%	47	90%
5	Fadarawa Health Post	44	85%	54	104%	32	62%
6	Falaliya Health Post	46	88%	56	108%	31	60%
7	Giyawa Health Post	35	67%	22	42%	14	27%
8	Gorau Health Post	50	96%	62	119%	51	98%
9	Goronyo G H	50	12%	221	53%	4	8%

10	Kagara Health post	51	98%	58	112%	60	115%
11	Kojiyo Health Post	36	69%	40	77%	20	38%
12	Kwakwazo Health Post	44	85%	62	119%	46	88%
13	Rimawa P H C	50	96%	55	106%	68	131%
14	SabonGarin Dole Hth Post	48	92%	45	87%	56	108%
15	Shinaka MPHC	45	87%	36	69%	35	67%
16	Takakume Health Post	47	90%	67	129%	42	81%
17	Taloka Health Post	49	94%	57	110%	53	102%
18	Tantarkwai Health Post	1	2%	6	12%	3	6%
19	TsohonnGarin Dole H Post	45	87%	46	88%	29	56%
20	Tuluske Health Post	51	98%	61	117%	64	123%
21	Warankai Health Post	47	90%	51	98%	42	81%
22	Zamace Health Post	42	81%	52	100%	24	46%
	TOTAL	**939**		**1230**		**845**	

Source: downloaded from DHIS2 SMS Server on 12/8/2021(www.nericcdhis2.com)

Table 4.21: The above table contains data on RI sessions planned, fixed and outreach sessions conducted, the table contains data for one year between August 2020 –July 2021, this data can be used to examine accuracy, completeness and evaluate performance of each HF, example, by using this data it is possible to know the HF which defaulted from sending plan sessions, normally, each health facility is expected to send total of 52 sessions each year, but it is possible to have more than 52 session, this is due to other campaigns which occur during the year.

Analysis of this table revealed that, Kagara and Tuluske health post are the highest (98%) in sending their plan session and the lowest are General Hospital Goronyo and Tantarkwai health post with 12% and 2% respectively. This analysis shows that no health facility reached 100% of sending its plan session. Also, data generating from DHIS2 SMS server discovered that, some health facilities are more than 100%, in fixed session conducted, this is possible especially if other campaigns were conducted, this would increase session conducted particularly fixed sessions.

By considering objective and research question of this study, which said, that the DHIS2 SMS data would support in validating other RI data tools (registers), from the above table, the answer is yes, because this data would support in validating/comparing between what is sent to DHIS2 SMS server other RI data tools, such as routine immunization child register, RI tally, summary, NHIMS register, RI monitoring chart etc.

Table 4.22

Data from DHIS2 SMS Server Showing the number of BCG Vaccine open, Children Vaccinated, and Wastage Rate for each HF Conducting RI in Goronyo LGA, Sokoto State, Between August 2020-July 2021

S/NO	Health Facility Name	BCG doses opened (FS+OS)	Children Vaccinated with BCG	BCG Wastage Rate in %	BCG accepted Wastage Rate
1	Balla Health Post	248	41	84%	75%
2	Birjingo Health Post	851	176	79%	75%
3	Boyekai Health Post	2042	297	86%	75%

4	Darbabiya Health Post	1360	183	87%	75%
5	Fadarawa Health Post	1500	157	90%	75%
6	Falaliya Health Post	930	175	81%	75%
7	Giyawa Health Post	800	205	74%	75%
8	Gorau Health Post	730	126	83%	75%
9	Goronyo General Hospital	2140	484	77%	75%
10	Kagara Health post	1160	187	84%	75%
11	Kojiyo Health Post	550	102	82%	75%
12	Kwakwazo Health Post	1900	365	81%	75%
13	Rimawa P Health Centre	1080	216	80%	75%
14	SabonGarin Dole HPost	1940	231	88%	75%
15	Shinaka MPHC	760	124	84%	75%
16	Takakume Health Post	1550	370	76%	75%
17	Taloka Health Post	740	111	85%	75%
18	Tantarkwai Health Post	180	20	89%	75%
19	TsohonnGarin Dole HPost	780	150	81%	75%
20	Tuluske Health Post	1160	408	65%	75%
21	Warankai Health Post	40	0	100%	75%
22	Zamace Health Post	700	383	45%	75%
	Total	23141	4511		

Source: downloaded from DHIS2 SMS Server on 12/8/2021(www.nericcdhis2.com)

Table 4.22: Generally, this table is displaying data on BCG (Bacillus Calmette–Guérin) vaccine utilization that is BCG vaccine open, children immunize, wastage rate and acceptable wastage rate, the data would allow to compare between what occurs and what is accepted. Only 3 health facilities namely PHC Giyawa, Tuluske health post and Zamace health post 74%, 65% and 45% respectively are in normal wastage rate, which is equivalent to 14% of health facilities are in normal range, while 86% of all health facilities are not in normal range of BCG vaccine wastage within the period under review. Reason for using BCG data is because it is the first antigen supposed to give a child at birth or as much as possible after birth.

Therefore, DHIS2 SMS server stands as a tool for monitoring and evaluation, likewise, it can be used to detect data entry error, this data can allow conducting deep dive analysis to explore a problem and why this situation occurs with the aim of taking informed decision and plan of action. Amongst the objective of this project is study whether DHIS2 SMS server help to detect RI data entry error.

Similarly, one of the research hypothesis of this study is to examine whether DHIS2 SMS server is needed in order to detect RI data error, this table reveal many data entry error, example, Balla Health Post open 248 BCG doses, which it supposed to be 240 doses, Birjingo Health open 851 BCG doses in state of 860 doses, Boyekai Health Post open 2042 BCG doses, which supposed to be 2040 doses, etc. Normally, BCG vaccine vial comes in 20 doses, therefore, any fraction is an error such as 248, 851 and 2042, therefore, this shows that this software is needed in detecting data error entry, likewise, detecting, reducing and correcting data error is part of data quality.

Table 4.23

Data from DHIS2 SMS Server Showing the number of IPV Vaccine opened, Children vaccinated and Wastage Rate from all HFs Conducting RI in Goronyo LGA, Sokoto State, Between August 2020-July 2021

S/NO	Health Facility Name	IPV doses opened (FS+OS)	Children Vaccinated with IPV	IPV Wastage Rate in %	IPV accepted Wastage Rate
1	Balla Health Post	190	104	55%	2%
2	Birjingo Health Post	470	185	39%	2%
3	Boyekai Health Post	1310	472	36%	2%
4	Darbabiya Health Post	560	176	31%	2%
5	Fadarawa Health Post	850	185	22%	2%
6	Falaliya Health Post	400	267	67%	2%
7	Giyawa Health Post	360	114	32%	2%
8	Gorau Health Post	191	209	109%	2%
9	Goronyo General Hospital	796	434	55%	2%
10	Kagara Health post	335	218	65%	2%
11	Kojiyo Health Post	280	161	58%	2%
12	Kwakwazo Health Post	1082	301	28%	2%
13	Rimawa P H C	500	336	67%	2%
14	SabonGarin Dole H Post	1020	223	22%	2%
15	Shinaka MPHC	422	180	43%	2%
16	Takakume Health Post	880	274	31%	2%
17	Taloka Health Post	360	224	62%	2%

18	Tantarkwai Health Post	90	19	21%	2%
19	TsohonnGarin Dole HP	355	183	52%	2%
20	Tuluske Health Post	482	315	65%	2%
21	Warankai Health Post	800	163	20%	2%
22	Zamace Health Post	680	100	15%	2%
		Total	12413	4843	

Source: downloaded from DHIS2 SMS Server on 12/8/2021(www.nericcdhis2.com)

Table 4.23: This table displays data on IPV (Inactivated polio vaccine), that is vaccine open, children immunize, wastage rate and acceptable wastage rate, reason for using this antigen in this research is because, it determines dropout or children started immunization (BCG) and does not reach PENTA3, PCV and IPV.

Analysis of the above table shows that 100% none of the health facility is in normal range of IPV vaccine wastage rate, this situation need to be investigated, because this wastage is very high.

Table 4.24

Data from DHIS2 SMS Server Showing the number of Measles Vaccine opened, Children vaccinated and Wastage Rate from all HFs Conducting RI in Goronyo LGA, Sokoto State, Between August 2020-July 2021

S/NO	Health Facility Name	Measles doses opened (FS+OS)	Children Vaccinated with Measles	Measles Wastage Rate in %	Measles accepted Wastage Rate
1	Balla Health Post	210	99	47%	75%
2	Birjingo Health Post	470	159	34%	75%
3	Boyekai Health Post	1282	755	59%	75%

4	Darbabiya Health Post	473	150	32%	75%
5	Fadarawa Health Post	830	205	25%	75%
6	Falaliya Health Post	435	245	56%	75%
7	Giyawa Health Post	180	323	179%	75%
8	Gorau Health Post	330	203	62%	75%
9	Goronyo General Hospital	762	268	35%	75%
10	Kagara Health post	370	134	36%	75%
11	Kojiyo Health Post	251	123	49%	75%
12	Kwakwazo Health Post	1043	298	29%	75%
13	Rimawa Primary H Centre	820	435	53%	75%
14	SabonGarin Dole H Post	1040	281	27%	75%
15	Shinaka MPHC	463	118	25%	75%
16	Takakume Health Post	680	290	43%	75%
17	Taloka Health Post	700	253	36%	75%
18	Tantarkwai Health Post	90	21	23%	75%
19	TsohonnGarin Dole H Post	280	143	51%	75%
20	Tuluske Health Post	460	249	54%	75%
21	Warankai Health Post	130	93	72%	75%
22	Zamace Health Post	180	131	73%	75%
	Total	11479	4976		

Source: downloaded from DHIS2 SMS Server on 12/8/2021(www.nericcdhis2.com)

Table 4.24: Research question four asked, whether DHIS2 SMS server allows detecting error and quality issues of RI data, this table provided answer for the question

This table contains data on Measles vaccine open, children vaccinated, wastage rate and normal wastage, the data was downloaded from DHIS2 SMS server.

The analysis of the data shows that, there is an error and quality issues to this data, some health facilities make error in sending doses open, example, Boyekai HP 1282 in state of 1280, Fadarawa HP 473 in state of 470, Falaliya HP 435 in state of 430, General Hospital Goronyo 762 in state of 760, Kojiyo HP 251 in state of 250, Kwakwazo 1043 in state of 1040 and MPHC Shinaka 463 in state of 463.

Normally, Measles vaccine is in 10 doses/vial, and it is in powder form and should be discarded six hours after reconstitution, it is not expected to see any fraction, it must be in tenth, also, the analysis shows that 7 equivalent to 32% of health facilities have data error and quality. This means that, DHIS2 SMS server can be used to detect RI data error and quality issues, which the software plays important role in strengthen RI data.

Table 4.25

Vaccine Stock out During Fixed and Outreached sessions in Week 31

(2nd - 8th August, 2021) in Goronyo LGA, Sokoto State, Nigeria

S/NO	Health Facility Name	Fixed	Outreach
1	Balla Health Post	0	0
2	Birjingo Health Post	1	1
3	Boyekai Health Post	1	0

4	Darbabiya Health Post	1	1
5	Fadarawa Health Post	1	0
6	Falaliya Health Post	2	0
7	Giyawa Health Post	0	0
8	Gorau Health Post	1	1
9	Goronyo General Hospital	5	0
10	Kagara Health post	1	0
11	Kojiyo Health Post	0	0
12	Kwakwazo Health Post	1	1
13	Rimawa Primary Health Centre	1	0
14	SabonGarin Dole Health Post	1	0
15	Shinaka MPHC	0	1
16	Takakume Health Post	0	1
17	Taloka Health Post	1	0
18	Tantarkwai Health Post	0	0
19	TsohonnGarin Dole Health Post	1	0
20	Tuluske Health Post	0	1
21	Warankai Health Post	0	1
22	Zamace Health Post	0	0
Total		18	8

Source: downloaded from DHIS2 SMS Server on 12/8/2021(www.nericcdhis2.com)

Table 4.25: This table contains data downloaded from DHIS2 SMS server, it deals with raw data on vaccine stock out that is shortage of one or more vaccine during fixed or outreach session, this data would be used to access whether DHIS2 SMS server contributes to the timely analysis of RI data.

The table contains data range from 0-5, interpretation of these figures means, any 0 means there is shortage of one or more vaccine during fixed or outreach, and 1-5 means no shortage of any antigen within the period under review week 31, which is between 2nd - 8th August, 2021,

Analysis of this data is indicating that, 18 (81%) health facilities are not facing shortage of any vaccine, while 4 (19%) health facilities are facing shortage of one or more antigen during fixed session.

Likewise, the outcome of this analysis shows that, only 8 (36%) health facilities fully have all the antigen required during outreach session, at the same time, 14 (64%) of all health facilities in the LGA are facing shortage of one or more antigen during outreach session between 2nd - 8th August, 2021.

The outcome analysis of this table is indicating that, the software (DHIS2 SMS server) is a real time software, which can allow to monitor and the software contributes to the timely analysis of RI data and timely decision can be taken in order to rescuer the situation of vaccine stock out and reduce missing opportunity of eligible children.

Table 4.26

Data downloaded from DHIS2 SMS Server Showing the number of fix and outreach sessions supportive supervision conducted by LGA team and partners in Goronyo LGA, Sokoto State, Between August 2020-July 2021

S/NO	Health Facility Name	Fix Session Visit Conducted	% of Fix Session Conducted	Outreach Session Conducted	% of Outreach Session Conducted
1	Balla Health Post	2	4%	4	8%
2	Birjingo Health Post	12	23%	6	12%
3	Boyekai HP	59	113%	72	138%
4	Darbabiya Health Post	17	33%	8	15%
5	Fadarawa Health Post	24	46%	10	19%
6	Falaliya Health Post	26	50%	11	21%
7	Giyawa Health Post	22	42%	14	27%
8	Gorau Health Post	15	29%	6	12%
9	Goronyo General Hospital	12	23%	0	0%
10	Kagara Health post	5	10%	6	12%
11	Kojiyo Health Post	9	17%	7	13%
12	Kwakwazo Health Post	9	17%	4	8%
13	Rimawa P Health Centre	15	29%	13	25%
14	SabonGarin Dole Health Post	45	87%	56	108%
15	Shinaka MPHC	16	31%	16	31%
16	Takakume Health Post	44	85%	30	58%
17	Taloka Health Post	12	23%	13	25%

18	Tantarkwai Health Post	0	0%	0	0%
19	TsohonnGarin Dole HPost	2	4%	3	6%
20	Tuluske Health Post	7	13%	4	8%
21	Warankai Health Post	7	13%	1	2%
22	Zamace Health Post	13	25%	1	2%
	TOTAL	373	33%	285	25%

Source: downloaded from DHIS2 SMS Server on 12/8/2021 (www.nericcdhis2.com)

Table 4.26: The table above contains data downloaded from DHIS2 SMS server, this table contains data on fix and outreach session supportive supervision conducted by LGA team (Director PHC, Deputy Director PHC, Local Immunization Officer, Assistant LIO, Cold chain officer, Health Educator, disease surveillance officer, etc.) for period of one year August 2020 – July 2021, analysis of the data shows that, only 3 (14%) health facilities received more than 50% of supportive supervision both fix and outreach. This means that, supportive supervision was very low especially period under review.

Endnotes

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Chapter Five

Conclusion

This research study is on DHIS2 SMS Server and Routine Immunization Data in Goronyo LGA, Sokoto State, the aim of the study is to examine how DHIS2 SMS server strengthen routine immunization data, this chapter summarizes the research findings, conclusions and recommendations.

5.1 Summary of Findings

The target of the study is to assess the role of DHIS2 SMS server in strengthening RI data in Goronyo LGA, Sokoto State, Nigeria. The objectives of this study is to show the role of District Health Information System (DHIS2) software in capturing and automatic analysis of routine immunization data (RI), the research intend to provide evidence that DHIS2 SMS software ensures accuracy, completeness and timely submission of RI data, more so, the research would examine how the software provides qualitative data for planning and decision making, another objective of this project is to assess how the software serve as a tool for monitoring RI data and RI services. Based on the research question and objectives of the study, the summary of the findings is discussed. This chapter contains summary of findings.

The World Health Organization (WHO), UNICEF, CDC, and Gavi, the Vaccine Alliance have partnered with many countries of the world Nigeria inclusive on DHIS2 to improve national immunization program coverage through better data collection, analysis, storage and use, the main focuses of the collaboration is to strengthen routine immunization data. Because strengthening RI data can lead to have qualitative and quantitative data monitoring,

evaluation, informed decision and effective planning, at which at the end effective service delivery can be achieved.

CDC-AFENET a USAID Project has contributed a lot in DHIS2 SMS server capacity building to health care workers in Sokoto State, this effort yielded a good result of data quality, this attempt is part of strategy to improve child health and reduce under five mortality rate, which is one of the goals of sustainable development goals. Beside this, health care managers can use the data for planning and effective decision making (https://www.who.int/news/item/15-07-2020). This research is very important in accessing the role of this software in strengthening routine immunization data, in order to have valid evidence for the performance of this software in strengthening RI data, the researcher collected data from two sources, that is 90 questionnaires were distributed to all 90 health workers supporting or working direct under routine immunization unit, which means the whole target population was selected, furthermore, RI data for Goronyo LGA, Sokoto state was downloaded from DHIS2 SMS server for 12 months (August 2020-July 2021) using different indicators, data element and data set. Such as number of sessions plan to conduct, fix session conducted, outreach session conducted, vaccine open and children vaccinated, vaccine wastage for BCG, IPV and Measles, and stock out of one or more vaccine. Microsoft Excel was used in plotting table, inserting chart generating percentage and interprets the data.

Analysis of questionnaires and data downloaded from DHIS2 SMS server are summarized as follows:

This is research summary, which deals with presenting questionnaires data collected from routine immunization service providers (RISP), total of 90 questionnaires were distributed

and 85 were recovered, analysis and interpretation was based on 85 questionnaires returned. Similarly, RI data was downloaded from DHIS2 SMS server for various indicators in order to support my objective, research questions and hypothesis.

The summary of finding is as follows:

This research is useful to the government and donor agencies in formulating policies that would facilitate and increase the routine immunization coverage and eradication of vaccine preventable diseases in the communities. The project is limited to Goronyo LGA, and its covers role of DHIS2 SMS server in strengthening Routine Immunization data in Goronyo LGA, Sokoto state. The target population for this research are mainly any health facility worker who is supporting/attached direct to Routine Immunization unit (Health facility in-charge, Routine Immunization service provider, Assistant RI service provider and RI recorder), working in public health facilities in Goronyo LGA (all 22 health facilities conducting RI in the LGA).

Age group of the respondents of this research were as follows those between 31-40 years numbering 36 occupying 42%, while the lowest were between 51-60 amounted to 3 equivalents to 5%. Respondent working experience revealed that between 6-10 years were 28 respondents equivalent to 33% and the lowest were those between 21 and above years with 4 personnel which was only 4%.

Regard to level of knowledge about DHIS2 before implementation of the software in the LGA, 13 (15%) of respondents know DHIS2 before 2017, while 67 (85%) don't know, but 85 (100%) of respondent received training on DHIS2 during implementation of the software. Similarly, 79 (93%) answered that the training received was adequate, while, 6 (7%) said the training was not adequate. As result of the training received 81 (95%)

respondents know how to send RI SMS data to the server effectively, while 4 (5%) cannot able to send RI SMS effectively. 75 (88%) of respondent were sending there report regularly, while, 5 (12%) were not sending there RI data regularly.

The first objective of this research requested to know the role of DHIS2 SMS server in ensuring timely, accuracy, completeness and timely submission of RI data.

In table 4.1.10 and figure 4.1 data analyzed shows that, 72 respondents equivalent to (85%) agreed with the statement that, sending RI SMS at the point of service would ensure accuracy, completeness and timely of RI data, while 13 (15%) disagreed with the statement that, outcome of this analysis is indicating that DHIS2 SMS server is can provide timely data for planning of RI activities.

The second objective of this study is to assess whether DHIS2 SMS can help in validating other RI data tools (RI registers), according to data collected and analyzed in table 4.1.13, it shows that, 77 (91%) out of 85 agreed that DHIS2 server can support in validating other RI data tools or registers, while 8 (9%) of the respondents does not agreed with the statement, this means that there is strong believe amongst the respondents that DHIS2 SMS server support in validating other RI data tools.

Objective three of this study is intended to examine whether using DHIS2 SMS server provides any quality of RI data, according to data recorded and analyzed in table 4.2.11 revealed that 69 (81%) agreed that, using DHIS2 SMS server can provide quality to RI data, while, 16 (19%) have not agreed that using DHIS2 SMS server provide any quality of RI data, the analysis shows that majority agreed, this means that using DHIS2 SMS server provide quality to RI data.

Objective four of this project is interested in knowing, if DHIS2 SMS server allows health manager to monitor RI activities from anywhere, from all the data downloaded from

DHIS2 SMS server it is showing that, health managers and any one with the access to the DHIS2 server can monitor the RI activities from anywhere, example, table 4.2.25 is displaying data downloaded from DHIS2 SMS server, which make comparison of data of two years July 2019 to June 2020 and July 2020 –June 2021 for plan session, fix and outreach sessions conducted, analysis of the data is showing an increase between 2020-2021 for all three data sets analyzed (plan, fix and outreach sessions conducted).

Analysis of this table is showing an increase between July 2019 to June 2020 and July 2020 –June 2021, example, at LGA level there is an increase of 43% of plan session sent, 54% for fix session conducted and 46% of outreached conducted and reported to the server, this data allow users/health managers to monitor what is going on in health facility, ward and local government levels, this means that DHIS2 SMS server allow health managers to monitor RI activities anywhere.

The fifth objective of this study is aim at examining if DHIS2 SMS server detects RI data error, incompleteness and lateness of submission, refers to table 4.2.21, this table is displaying data on BCG (Bacillus Calmette–Guérin) vaccine utilization that is BCG vaccine open, children immunize, wastage rate and acceptable wastage rate, the data would allow to compare between what occurs and what is accepted. Only 3 health facilities namely PHC Giyawa, Tuluske health post and Zamace health post 74%, 65% and 45% respectively were in normal wastage rate, which is equivalent to 14% of health facilities were in normal range, while 86% of all health facilities are not in normal range of BCG vaccine wastage within the period under review.

Therefore, DHIS2 SMS server stands as a tool or software which allow detecting error, incompleteness and late submission of data, it can allow to conduct deep dive analysis to

explore a problem and why this situation occurs with the aim of taking informed decision and plan of action. This table reveal many data entry error, incompleteness and late submission of RI data, example, Balla Health Post open 248 BCG doses, which it supposed to be 240 doses, Birjingo Health open 851 BCG doses in state of 860 doses, Boyekai Health Post open 2042 BCG doses, which supposed to be 2040 doses, etc. Normally, BCG vaccine vial comes in 20 doses, therefore, any fraction is an error such as 248, 851 and 2042, therefore, this shows that this software is needed in detecting data error entry, likewise, detecting, reducing and correcting data error is part of data quality.

Data consistency and uniformity is an indicator of data strengthening, researcher make an inquiry from the respondents that, whether sending SMS would ensure data is same across all RI registers, data assembled and analyzed in table 4.2.12 and plotted in figure 4.1.12 show that, 57 (67%) strongly agree, 22 (26%) agree, 4 (5%) disagree and 2 (2%) of the respondents strongly disagree. By having uniformity and consistency of data in RI data tools such as RI child register, tally, summary, National Health Management Information System (NHIMS), and RI monitoring means the data is strengthen and standard.

Therefore according to this above analysis, if those with strong agree and agree are more than 90%, this mean that majority of the respondents believe that using DHIS2 SMS server can provide uniformity and consistency of data.

Another indicator for data strengthening is data validity, which is data recorded in the registers are the same with data sent to server electronically, this is the reason why a question was included in the questionnaire which asked RISP whether he believed DHIS2 SMS server data can support in validation other RI data tools, table 4.1.13. contains responses which indicated that, 59 (69%) out of 85 strongly agreed that DHIS2 SMS data can support in validating other RI data tools or

registers, while 21(25%) agree, 5 (6%) disagree, this means that there is strong believe amongst the respondents that DHIS2 SMS server support in validating other RI data tools.

The finding of this research reveals that, DHIS2 SMS server is a source of quality RI data, because data contains in table 4.2.15 shows that, 83 (98%) respondents answered yes and 2 (2%) say no. the answer revealed that DHIS2 server is a source for quality RI data.

Table 4.2.25 make comparison of data downloaded from DHIS2 SMS server for the period of two years (July 2019 to June 2020 and July 2020 –June 2021) for plan session, fix and outreach sessions conducted, analysis of the data showed that there is a significant increase of data reported between these period under review. Conclusively, result of this data indicated that, this software played a very important role in increase the quality of RI SMS data, compared with the manual operation.

5.2 Conclusion

Conclusively, by considering survey data collected from routine immunization service provider and data downloaded from DHIS2 server from various indicators and data set, it provided sufficient evidence that, DHIS2 SMS server played important role in strengthening routine immunization data in Goronyo LGA, Sokoto State. Before the implementation of software in the LGA (2018) data is being recorded and processed manually, which adoption of this software brought tremendous positive changes in many areas of data quality.

This software ensures data is reported timely, because its reject data automatically when not reported timely, in terms of duplication, the software is not accepting two or more the same report, the software play a very important role in accuracy, because it has the function

of showing any mistake of data, similarly, if the report is not complete, the software is capable of showing incomplete report.

5.3 Recommendations

District health information system software (DHIS2 SMS server) is a real time software, which can accept routine immunization raw data process, analyze, interpret, store and retrieve when need arise, the software is a good tool for monitoring, evaluation, supervision and taking informed decision,

The research found many challenges association with the sending RI SMS and used of the software, which include:

i. Operating the software requires computer technical knowledge and skill
ii. Lack of constant internet
iii. Lack of sufficient computers to LGA teams
iv. Lack of dedicated phone for each service provider
v. Network challenges from the server
vi. Low commitment of senior health managers of the LGA (DPHC, DDPHC, Councilor for health) in supportive supervision
vii. Lack of feedback direct from the server to the RISP
viii. Lack of enough funding from the LGA for data subscription to RISPs

The researcher makes the following recommendation in order to improve the operation of RI SMS and software:

i. Regular training and retraining of LGA team and RISPs on DHIS2
ii. Lack of constant internet

iii. Provide computer for each LGA team member for analysis of data collected downloaded from DHIS2

iv. Sokoto State Primary Development Agency and LGA should provide phone to each service provide for sending and reviewing DHIS2 data

v. Senior health managers of the LGA (DPHC, DDPHC, Councilor for health) should show more commitment on the DHIS2 data, by review the platform every week

vi. National Primary Health Care Development Agency should update the software in such a way that I would provide automatic update direct to the RISP using his phone number.

5.4 Contribution to Knowledge

This study focused on identifying the gaps in literature pertaining to District Health Information System (DHIS2 SMS Server) and Routine Immunization Data. Overall, this study offers significant contribution to knowledge and has practical implication for every District in Goronyo Local Government Area, Sokoto State.

5.5 Areas for Further Research

This study focused on District Health Information System (DHIS2 SMS Server) and Routine Immunization Data in Goronyo LGA, Sokoto State, Nigeria. Nevertheless, to further broaden the frontiers of knowledge, further research can focus on other Local Government Areas within the State and outside Sokoto as well.

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Lead City University,
Ibadan, Oyo State, Nigeria
21/05/2021

To
The Honorable Commissioner
Ministry of Health, Sokoto

Through
The Director
Health Planning
Ministry of Health, Sokoto

Sir,

Application for Approval to Conduct Research and Use DHIS2

I hereby apply for the above mentioned subject,

The title of the research topic is "The Role of DHIIS2 (SMS Server) in Strengthening RI Data in Goronyo LGA, Sokoto State.

Attached, find the copy of introduction letter and research proposal.

I hope my application would be considered

Yours faithfully,

Belllo A. Shehu

Approval Letter to Conduct Research and use DHIS2 SMS server from Ministry of Health, Sokoto

MINISTRY OF HEALTH
SOKOTO STATE

Ref: No. SMH/1580/V.IV

06/06/2021

BELLO A. SHEHU
Lead City University,
Ibadan, Oyo State - Nigeria

RE: ETHICAL CLEARANCE ON "THE ROLE OF DHIS2 ((SMS SERVER) IN STRENGTHENING ROUTINE IMMUNIZATION (R.I.) DATA IN GORONYO LGA, SOKOTO STATE" (SKHREC/045)2021)

I am directed to refer to your application on the above and to inform you that, the protocol submitted was reviewed by State Health Research Ethics Committee and found the protocol and other documents related to the survey satisfactory.

In the light of the above, I am further directed to convey the approval of the committee for the conduct of the said survey. It is however, expected that, the results of the survey will be send to the committee for documentation and further necessary action as soon as it is concluded.

Accept the best wishes of the Honourable Commissioner, please.

ABUBAKAR A. DANMAFARA
Director Health Planning, Research and Statistics
For: Honourable Commissioner

Questionnaire

Lead City University, Ibadan, Nigeria

Dear Respondent,

I Shehu A. Bello, final year student (MSc. Health Information Management) from Lead City University Ibadan, Oyo State, Nigeria, intent to conduct a research on the "Role of DHIS2 (SMS Server) on Strengthen Routine Immunization Data in Goronyo LGA, Sokoto State. I hereby requesting you to fill in this questionnaire, the data collected would be used for research and academic purposes.

1. Age of respondent……
2. For how long are you working under RI unit……..
3. Health profession a) JCHEW b) SCHEW c) Environmental d) Other Specify……
4. Designation a) HF in-charge b) RI Provider c) Assistant RI provider d) RI recorder
5. Name of Health Facility……..
6. Does this HF conduct RI services a) yes b) No
7. Do you know DHIS2 before 2017 a) Yes b) No
8. Do you received training on how to send SMS to DHIS2 a) Yes b) No
9. The training received above was it adequate? a) Yes b) No
10. When do you send your session plan

a) Each Monday in the morning b) Each Tuesday in the morning

c) Each Wednesday in the morning d) Sometime pls specify……

11. When do you sent your session conducted

b) Immediately after the session b) Before closing the day work

c) A day after the session d) Sometime pls specify……

12. Do you send above RI SMS data to the server regularly a) Yes b) No c) some time.

13. Does your data in RI registers always correspond with SMS data

a) Yes b) No c) Some time

14. How many times do you send your plan session each week

a) Once in a week b) Twice in a week c) Many time pls. specify……

a) Do you received feedback on the SMS sent a) Yes b) No

15. Do you believe that sending SMS strengthen RI data

a) Strongly Agree b) Agree c) Disagree d) Strongly Disagree

16. I believe sending SMS would ensure timely, completeness and accuracy of RI data

a) Strongly Agree b) Agree c) Disagree d) Strongly Disagree

17. Sending SMS would ensure data is the same across all RI registers

a) Strongly Agree b) Agree c) Disagree d) Strongly Disagree

18. SMS data would support in validating other RI data tools (registers)

a) Strongly Agree b) Agree c) Disagree d) Strongly Disagree

19. Data quality can be achieve by using SMS strategy

a) Strongly Agree b) Agree c) Disagree d) Strongly Disagree

20. SMS data is reliable, because it is been sent from point of service

a) Strongly Agree b) Agree c) Disagree d) Strongly Disagree

21. SMS server is a source for quality RI data

a) True b) False

22. Feedback from SMS server allows me to improve my RI data

a) True b) False

23. My health facility use SMS data to take decision

a) True b) False

24. What challenges are experienced in the sending your RI SMS data

a) Lack of internet data b) Poor network c) Lack of skill/training

25. How would you rate the level of SMS software performance

a) Very Good b) Good c) Poor d) Very Poor

Bio-data

A. Personal Data

i. Full name:	Bello A. SHEHU
ii. Address:	Gidan Kuku, Runjin Sambo, Sokoto North, Sokoto State
iii. Date & Place of birth:	10-10-1973, Sokoto State
iv. Nationality:	Nigerian
v. Name and Address of next of kin:	Fatima Shehu

B. Educational Background:

Primary Education:	Gandu Primary School, Sokoto North, Sokoto State (1979-1985)
Secondary Education	Sokoto Teaching College (1985-1991)
Tertiary education	Usman Danfodiyo University Teaching Hospital, SHIM (1999-2003)

C. Work experience with Date:

Hospital Services Management Board, Sokoto State

D. Awards and Fellowship: Nil

Membership of academic bodies:

Nil

University Compliance Certification

This is to certify that this Thesis by **Bello A. SHEHU** with Matriculation Number **LCU/PG/001551** in the Department of Information Management, Faculty of Basic Medical and Applied Sciences, Lead City University, Ibadan, Oyo State is in full compliance with the approved university format and Style.

_____ _____

Signature **Date**