Assessment of the quality of vaccination data in the centre region health districts of Cameroon: protocol for cross-sectional descriptive study with multivariate logistic regression model

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Abstract

The Immunization Agenda 2030 strategy is guided by four core principles. People-centered: the strategy is tailored to the specific needs, breaking down barriers; Country-owned: progress is initiated locally, with countries setting context-specific targets; Partnership-based: partners coordinate efforts and involve sectors beyond immunization; Data-guided: high-quality data shapes decision-making at all levels.
Cameroon has a national vaccination programme, the expanded programme on immunisation (EPI) to protect its population, especially children, against vaccine-preventable diseases (VPDs). The programme includes key vaccines for polio, measles, diphtheria, pertussis, tetanus, and hepatitis B, and aims to improve access and utilization, particularly in remote areas. Challenges such as incomplete recording, inadequate infrastructures notably poor connectivity, data integrity issues (Inaccuracies, duplications, and reporting errors), and capacity constraints might lead to poor data quality leading to missed opportunities.
Obviously, data play a crucial role in driving informed decision-making and effective implementation of immunization programmes. The present study, thus aims to evaluate the quality of vaccination data in the Yaoundé and Health districts, Centre region of Cameroon. The WHO data self-quality assessment (DSQ) tool will be used to assess especially the data timeliness, accuracy, and completeness as proceeded by the vaccination staff in 2023-2024. Vaccination staff practices will be observed, and a few policymakers will also be interviewed to gain insights into the effectiveness, coverage, and challenges of the vaccination programme in Cameroon. This study is expected to yield outcomes such as assessing the current state of EPI data quality, identifying factors influencing data quality, formulating recommendations to enhance data quality, preparing a comprehensive report, disseminating findings to stakeholders, contributing to existing literature, and ultimately enhancing vaccination data quality in the Centre region, Cameroon.

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I.1 Context

Africa has a high burden of infectious diseases due to viruses, bacteria, protozoa and fungi (such as malaria, tuberculosis, HIV/AIDS, hepatitis viruses, and Ebola virus). These pathogens especially viruses constantly mutate and escape host immune system, necessitating surveillance. Fortunately, most of these diseases facing Africa are vaccine preventable. Vaccination is considered as one of the biggest achievements of the twentieth century and as one of the most cost effective measures in the prevention of childhood diseases [1]. In 1974, the World Health Organization (WHO) launched a worldwide vaccination program known as the Expanded Program on Immunization (EPI), which has been considered one of the major public health interventions aimed at reducing infant morbidity and mortality [2]. During the launching of the EPI in 1976, only about 5% of infants throughout the world were protected against six diseases (diphteria, measles, pertussis, poliomyelitis, tetanus, and tuberculosis) [2]. By 2023, the number of protected infants was more than 80% in many countries. In ten years immunization alone has prevented over 37 million deaths globally [3]. Furthermore, immunization reduces families health expenditures thus improving countries productivity and resilience. Based on the costs of illnesses averted, immunizations return about 16 times the investments [4,5].

Regrettably, despite these benefits, vaccination coverage rates has remained constant in several countries, particularly those in sub-Saharan Africa (SSA), where coverage rates for basically all antigens are considerably lowered compared to other regions [6]. The paucity of timely and high-quality immunization data is one key contributing factor to the above phenomenon in many settings. In many cases, existing data systems cannot guarantee the generation of timely and good-quality data at all levels of the health system, which can have serious consequences for immunization efforts [7,8]. For example, poor data quality can lead to missed opportunities to identify under-immunized children, inaccurate vaccine coverage estimation, and inadequate tracking of defaulters [8]. This, in turn, can undermine investments and increase the risk of vaccine-preventable diseases (VPDs) by failing to identify populations with low vaccination coverage [9].

I.2 Justification

The Immunization Agenda 2030 (IA2030) strategy is driven by four core principles:

- People-centered: It caters to the specific needs of individuals and communities, breaking down barriers to immunization access based on age, location, social norms, cultural aspects, and gender.
- Country-owned: Progress is instigated from the grassroots, with countries setting local, context-specific targets and being held accountable for achieving them.
- Partnership-based: Immunization partners synchronize efforts, coordinate actions, and involve sectors beyond immunization to maximize impact.
- Data-guided: High-quality, purposeful data shapes decision-making at all levels, advancing evidence-based strategies (https://www.immunizationagenda2030.org/core-principles).

These principles form the foundation of IA2030's ambition to bring the benefits of vaccines to all, regardless of location or circumstance.

High-quality immunization data is therefore crucial for effective public health planning, monitoring, and evaluation of immunization programs. GAVI, The Vaccine Alliance, has made data quality a strategic focus area since 2015. However, poor immunization data quality remains a critical problem in many countries [10]. In Cameroon, vaccination data is essential for tracking the coverage and effectiveness of immunization programs, identifying gaps in service delivery, and informing public health policy. Yet, the quality, analysis and use of vaccination data in Cameroon are subject to various challenges [11].

Firstly, issues such as incomplete or inaccurate reporting, lack of standardization, and inconsistent data management practices often compromise the quality of vaccination data in Cameroon. These challenges make it difficult to assess the true coverage and effectiveness of immunization programs, and to identify areas where improvements are needed.

Secondly, the analysis and use of vaccination data in Cameroon are limited by various factors, including inadequate data analysis and dissemination, lack of data-driven decision-making, and insufficient stakeholder engagement. As a result, vaccination data is often not used to its full potential, and public health policies and programs may not be based on the best available evidence.

Although there is a broad agreement on the importance of enhancing immunization data quality, only one comprehensive review has been conducted to examine the underlying factors contributing to poor data quality and potential interventions to address this issue. The review was limited to countries that are eligible for Gavi support, and did not consider articles that did not use standard indicators, which meant that middle-income countries and those with broader definitions of data quality were not included in the review [9,12]. To the best of our knowledge, there is no published

study evaluating the data quality, analysis and use of immunization data in Cameroon. This study aims to give a detailed overview of the quality, analysis, and utilization of vaccination data in Cameroon. Additionally, it will identify factors that affect data quality and propose potential strategies to address them. Our initial focus will be on health districts in Yaoundé, Cameroon.

Evaluating the quality of vaccination data is crucial for understanding the effectiveness of immunization programmes and identifying areas for improvement. Some of the research questions that could be asked are as follows:

Data Completeness and Integrity:

What proportion of the vaccination records are complete and up-to-date?

How does the data capture rates of vaccination among different sub-populations?

Data Collection Methods:

What methodologies are used for collecting vaccination data?

How are traditional data collection methods compared to digital data collection in terms of accuracy and efficiency?

Data Utilization:

How is vaccination data utilized in making public health decisions?

What are the challenges faced in the integration of vaccination data into national health information systems?

Impact Assessment:

How has the introduction of new vaccines affected the overall health outcomes?

What is the correlation between vaccination rates and the incidence of vaccine-preventable diseases?

Equity and Access:

Are there disparities in vaccination coverage across different socioeconomic groups?

What factors contribute to vaccine inequity, and how can they be addressed?

Surveillance and Monitoring:

How effective are the surveillance systems in place for monitoring vaccination coverage?

What improvements can be made to enhance real-time monitoring of vaccination campaigns?

Policy and Governance:

How do policies influence the collection, quality, and accessibility of vaccination data?

What governance mechanisms are in place to ensure the ethical use of vaccination data?

Vaccine Hesitancy:

What are the predominant reasons for vaccine hesitancy in the population?

How does vaccine hesitancy impact the quality and reliability of vaccination data?

Technological Advancements:

How have technological advancements contributed to the quality of vaccination data?

What role do emerging technologies play in improving data collection and analysis?

Global Comparisons:

How does the quality of vaccination data compare with global standards?

What lessons can be learned from other countries with high-quality vaccination data?

Such questions aim to explore various aspects of vaccination data quality, from collection methods to policy implications, and can guide research efforts to strengthen immunization programmes. Is therefore important to tailor these questions to the specific context and needs of the region or country being studied.

I.3 Overall Research question for the current research

What is the current state of vaccination data in the Centre region health districts of Cameroon in terms of quality, analysis, utilization, and technological advancements?

I.4 Hypothesis

It is thus hypothesized that the quality of vaccination data in Cameroon is poor and underutilized due to challenges and limitations in data collection and analysis across the country.

I.5 Objectives

I.5.1 General Objective

This research aims to comprehensively evaluate the quality and use of immunization data in the Centre region of Cameroon. The study will identify the challenges and limitations of data collection and analysis and provide actionable recommendations to improve the quality and use of vaccination data throughout the country.

I.5.2 Specific objectives

The specific objectives of the present study are as follows:

1. To identify the methods utilized by health professionals and vaccination staff in Yaoundé/Centre Region for collecting and transmitting immunization data in 2024 in the context of the Immunization Agenda 2030;

2. To evaluate the accuracy, timeliness, and completeness of vaccination data in the Yaoundé and Centre region Health Districts of Cameroon, using the WHO data self-quality assessment (DSQ) tool;

3. To analyze the factors/determinants associated with poor data quality in the Yaoundé and Centre region Health Districts, using a circumscribed period of 2 years, 2023-2024;

4. To examine the knowledge and practices of vaccination staff and perceptions/recommendations of policymakers concerning data quality in Health Districts of the Centre region of Cameroon.

II. Literature Review

II.1 Knowledge recall

II.1.1 Definition of key words

Vaccination is a medical procedure that involves administering a vaccine to an individual, with the aim of stimulating their immune system and protecting them against certain diseases. The vaccine contains weakened or inactivated pathogens, modified toxins, or specific parts of the pathogen, which enable the immune system to recognize and effectively combat these pathogens [13].

Quality Data refers to data that meets specific criteria and is fit for its intended uses in operations,

decision-making, and planning. High-quality data is accurate, complete, valid, consistent, unique, timely, and aligned with its purpose [14].

Data quality (DQ) describes the degree of business and consumer confidence in data's usefulness based on agreed-upon business requirements. It goes beyond mere data collection and storage, focusing on extracting actionable insights, making informed decisions, and maximizing the value derived from data assets.

Data Analysis is the process of systematically inspecting, cleansing, transforming, and modeling data to discover useful information. It informs conclusions, supports decision-making, and involves techniques such as statistical modeling, knowledge discovery, and predictive analytics.

Data Utilization refers to the effective and meaningful application of data within an organization. It goes beyond understanding data to actively leveraging it for strategic decision-making, operational improvements, innovation, and customer-centric initiatives.

II.1.2 Background on vaccination

Vaccination is one of the most effective public health interventions for protecting individuals, especially children, against vaccine-preventable diseases. It involves immunizing individuals against a specific infectious disease through the administration of a vaccine [13]. It has been established that vaccination helps combat and eliminate potentially deadly infectious diseases, and it is estimated that 2 to 3 million infant deaths are prevented each year through vaccination. However, despite this, 19.7 million children under one year of age do not receive basic vaccines [3]. Additionally, vaccination prevents nearly 75,000 children from suffering from serious physical, mental, or neurological disabilities. Before the availability of vaccines, many children died from diseases such as diphtheria, tetanus, poliomyelitis, and measles. Thanks to vaccination, smallpox was eradicated in 1979, and the incidence of vaccine-preventable diseases has significantly decreased, with the support of immunization programs [9].

II.1.3 Global immunization coverage

Haemophilus influenzae type b (Hib) is responsible for causing meningitis and pneumonia. By the end of 2022, the Hib vaccine had been introduced in 193 Member States. The global coverage for three doses of the Hib vaccine is estimated to be 76%, although there is significant variation between regions. The WHO European Region and South-East Asia Region have estimated coverage rates of 93% and 91% respectively, whereas the WHO Western Pacific Region has a much lower coverage rate of only 32%.

Hepatitis B is a viral infection that primarily affects the liver. The Hepatitis B vaccine for infants has been introduced nationwide in 190 Member States. The global coverage for three doses of the hepatitis B vaccine is estimated to be 84%. Additionally, 113 Member States have introduced a single dose of the hepatitis B vaccine for newborns within the first 24 hours of life, with a global coverage

rate of 45%. The coverage rate is as high as 80% in the WHO Western Pacific Region, but only estimated to be 18% in the WHO African Region (reference).

Papillomavirus (HPV) is the most common viral infection of the reproductive tract and can lead to cervical cancer, as well as other types of cancer and genital warts. By the end of 2022, 130 Member States had included the HPV vaccine in their national immunization services, with 14 new introductions. However, global coverage with the first dose of the HPV vaccine among girls is currently estimated to be only 21%. This represents a significant increase from 16% in 2021, largely due to new introductions and programs that have resumed after interruptions.

Bacterial meningitis is a potentially fatal infection that can leave individuals with long-term complications. Before the introduction of the MenAfriVac vaccine in 2010, *Neisseria meningitidis* serogroup A (NmA) was responsible for the majority of meningitis epidemics in the African meningitis belt. By the end of 2022, more than 350 million people in 24 out of 26 countries in the meningitis belt have been vaccinated with MenAfriVac through campaigns, and 14 countries have included it in their routine immunization schedules. Since 2017, no cases of NmA meningitis have been confirmed in the meningitis belt.

Measles is a highly contagious disease caused by a virus that can lead to serious complications and even death. By the end of 2022, 83% of children had received one dose of measles-containing vaccine by their second birthday. Additionally, 188 Member States have included a second dose of measles vaccine as part of routine immunization, and 74% of children have received two doses according to national schedules.

Mumps is a highly contagious virus that causes swelling and pain in the salivary glands, fever, headache, and muscle aches. Mumps vaccine has been introduced nationwide in 123 Member States.

Pneumococcal diseases include pneumonia, meningitis, and other respiratory infections. The pneumococcal vaccine has been introduced in 155 Member States, with a global coverage rate of 60%. The coverage rates vary significantly between regions, with the WHO European Region having an estimated coverage rate of 83% and the WHO Western Pacific Region having a much lower rate of only 23%.

Polio is a highly infectious viral disease that can cause paralysis. In 2022, 84% of infants worldwide received three doses of polio vaccine. The coverage for the first dose of inactivated polio vaccine (IPV) in countries still using oral polio vaccine (OPV) is also estimated to be 84%. While polio has been eradicated in most countries, it remains endemic in Afghanistan and Pakistan, posing a risk of importation to other countries.

Rotaviruses are a common cause of severe diarrheal disease in young children worldwide. The

rotavirus vaccine has been introduced in 121 countries, with a global coverage rate of 51%.

Rubella is a viral disease that can cause serious birth defects if contracted during early pregnancy. Rubella vaccine has been introduced nationwide in 174 Member States, with a global coverage rate of 68%.

Tetanus is caused by a bacterium that thrives in environments without oxygen, such as dirty wounds or improperly cleaned umbilical cords. Maternal and neonatal tetanus remain public health concerns in 12 countries, primarily in Africa and Asia.

Yellow fever is an acute viral hemorrhagic disease transmitted by infected mosquitoes. As of 2022, yellow fever vaccine has been introduced in routine infant immunization programs in 37 out of the 40 countries and territories at risk. The estimated coverage rate in these countries and territories is 45%.

II.1.4 Overview of the Expanded Programme on Immunization (EPI)

It was only in 1974, during the Alma-Ata conference (now Almaty) convened under the auspices of the WHO, when smallpox eradication was well underway and even the most skeptical became convinced that universal vaccination was possible, that it was recommended to expand vaccination against measles to six other deadly childhood diseases to every child in the world by 1990. This led to the adoption of vaccines against tuberculosis, polio, tetanus, diphtheria, pertussis, and measles. However, the Programme faced various challenges throughout its implementation [15]. One of the main challenges was the lack of awareness among the public and governments about the seriousness of the diseases targeted by the Programme. In addition, ineffective program management, inadequate equipment and skills for vaccine storage and handling, and insufficient monitoring measures to assess the impact of the Program were also encountered. When the EPI was initiated in 1974, less than 5% of children in developing countries were receiving a third dose of DPT and poliomyelitis vaccines during their first year of life [15]. However, significant progress has been made since then. Immunization coverage levels have now surpassed 80% in developing countries, leading to the prevention of millions of cases of the targeted diseases [3].

Immunization efforts have had remarkable success in preventing measles deaths, with over 700,000 deaths prevented in developing countries in 1987 alone. Similarly, neonatal tetanus deaths are now being prevented through maternal immunization and improved childbirth conditions. The efforts to eradicate poliomyelitis have been so successful that the Pan American Health Organization led a campaign to eliminate poliomyelitis from the Americas by 1990 [15].

While these achievements are significant, there is still much work to be done. Measles continues to

claim the lives of nearly 2 million children each year, neonatal tetanus causes the deaths of approximately 800,000 newborns, and pertussis affects nearly 600,000 children. Additionally, there are still 250,000 cases of paralytic poliomyelitis occurring annually.

The major challenges currently faced by the EPI are to accelerate and sustain national immunization efforts in order to address these ongoing issues and further improve global immunization coverage [15].

The Expanded Programme on Immunization in Cameroon

The EPI started in Cameroon as a pilot project coordinated by the Organization for the Coordination of the Fight against Endemics in Central Africa (OCLCEAC) in 1976 [16]. In 1982, this experimental programme, which aims to prevent, control, eliminate, or eradicate vaccine-preventable diseases, became operational nationwide. Its activities were integrated into the minimum package of activities (MPA) of all health facilities in the country in 1993 following the declaration of the reorientation of primary healthcare. Cameroon EPI main targets are children aged 0 to 11 months and pregnant women [16]. EPI Vaccination calendar is presented in figure 1 for children in Cameroon and in figure 2 for adolescent and pregnant women in Cameroon.

Children

Contacts	Age	Vaccines	Route of administration	Target diseases
1st contact 	At birth	BCG	Intradermal	Tuberculosis
		OPV-0	Oral	Poliomyelitis
		HepB-BD	Intramuscular	Viral hepatitis B
2nd contact 	6 weeks (1 and a half months)	DTC-HepB-Hib-1 (Penta)	Intramuscular	Diphtheria, Tetanus, Pertussis, viral hepatitis B, Haemophilus influenzae type b infections
		OPV-1	Oral	Poliomyelitis
		Pneumo 13-1	Intramuscular	Pneumococcal infections
		ROTA-1	Oral	Rotavirus diarrhoea
		Vit A FPP	Oral	Vitamin A deficiency
3rd contact 	10 weeks (2 and a half months)	DTC-HepB-Hib-2	Intramuscular	Diphtheria, Tetanus, Pertussis, viral hepatitis B, Haemophilus influenzae type b infections
		OPV-2	Oral	Poliomyelitis
		Pneumo13-2 ROTA-2	Intramuscular Oral	Pneumococcal infections Rotavirus diarrhoea
		IPTi - 1	Oral	Malaria
4th contact 	14 weeks (3 and a half months)	DTC-HepB-Hib-3	Intramuscular	Diphtheria, Tetanus, Pertussis, viral hepatitis B, Haemophilus influenzae type b infections
		OPV-3 IPV-1	Oral Intramuscular	Poliomyelitis
		Pneumo13-3	Intramuscular	Pneumococcal infections
		ROTA-3	Oral	Rotavirus diarrhoea
		IPTi-2	Oral	Malaria
5th contact 	At 6 months	Vitamine A	Oral	Vitamin A deficiency
		IPTi-3	Oral	Malaria
	At 9 months	MR-1	Subcutaneous	Measles- Rubella
		VAA	Subcutaneous	Yellow fever
		IPTi-4/MILDA	Oral	Malaria
		Vit A	Oral	Vitamin A deficiency
		IPV-2	Intramuscular	Poliomyelitis
	At 12 months	Vitamine A	Oral	Vitamin A deficiency
		Mebendazole	Oral	Intestinal worms
6th contact 	15 months	MR-2	Subcutaneous	Measles and Rubella
		Men A/ACYW135	Intramuscular	Meningitis and other infections severe to meningococci
		IPTi-5	Oral	Malaria

* BD: Birth dose

Figure 1: EPI Vaccination calendar for children in Cameroon [17]

Adolescent

Contact	Age	Vaccin	Route of administration	Preventable disease
Single contact 	9 years*	HPV vaccine against types 6, 11, 16, 18	Intramuscular	Cancer of the cervix, penis, throat, anus Condylomas or genital warts and other associated infections

* single dose (single contact) for HPV vaccine

Pregnant women who did not receive any dose of DTP/Penta during childhood

Doses	Schedule	Duration of protection
Td1 	At first contact or as soon as possible during pregnancy	None
Td2	At least 4 weeks after Td1	1 to 3 years
Td3 	At least 6 months after Td2 or during a subsequent pregnancy after Td2	At least 5 years
Td4 	At least 1 year after Td3 or during a subsequent pregnancy after Td3	At least 10 years
Td5	At least 1 year after Td4 or during a subsequent pregnancy after Td4	For all reproductive years and possibly longer.

Pregnant women who received 3 doses of DTP/Penta during childhood

Doses	Schedule	Route of administration	Duration of protection
Td1	At first contact or as soon as possible during pregnancy	Intramuscular	None
Td2	At least 4 weeks after Td1		1 to 3 years
Td3	At least 6 months after Td2 or during pregnancy after Td2		For all reproductive years and possibly longer

NB: any dose of Td received should not be repeated regardless of the time between the dose received and the dose due.

Covid-19 vaccination schedule

Age	Initial vaccine	Initial/complete vaccination series	Booster dose (given after a complete vaccination series)	Booster vaccine (Choose ONE of these vaccines if applicable)	Route of administration	Target diseases
From 18 years old and above	Pfizer	2 doses 21 days apart	1 dose 6 months after the 2nd dose	Pfizer	Intramuscular	Covid-19 infection
	Johnson & Johnson	Single dose*	6 months after the first dose	Johnson & Johnson ou Pfizer	Intramuscular	Covid-19 infection

* Single dose (single contact) as primary vaccination series for Johnson and Johnson vaccine

NB: the booster of any other Covid-19 vaccine including those administered elsewhere is done with the Pfizer or Johnson & Johnson vaccine.

Figure 2: EPI Vaccination calendar for adolescent and pregnant women in Cameroon [17]

II.1.5 Regional Immunization Technical Advisory Group (RITAG)

The Regional Immunization Technical Advisory Group (RITAG) functions as the primary advisory body to the WHO Regional Office for Africa, offering strategic guidance on vaccines and immunization. RITAG directly reports to the Regional Director for Africa and provides advice on regional policies and strategies related to vaccines and immunization. This includes areas such as vaccine and technology research and development, delivery of immunization services, and the connections between immunization and other healthcare interventions. RITAG's scope extends beyond childhood immunization to cover all vaccine-preventable diseases and age groups. RITAG members are recognized experts in their respective fields and possess a strong understanding of the immunization issues addressed by the group. They have the responsibility to provide WHO with high-quality advice and recommendations based on the topics outlined in the attached terms of reference. The membership of RITAG comprises professionals from various affiliations, including academia, medical professions, clinical practice, research institutes, and governmental bodies such as national immunization programs, public health departments, and regulatory authorities. Members possess expertise in areas like influenza control, diarrheal diseases, respiratory diseases, research, biologics, and safety. The selection of RITAG members is based on qualifications, experience, and their ability to contribute to the objectives of RITAG. The WHO Regional Director for Africa, following the proposal of the selection panel, makes the appointment of members. Members serve an initial term of three years, which can be renewed once. Consideration is given to ensuring appropriate geographical representation and gender balance.

RITAG typically convenes twice a year, alternating between the WHO Regional Office in Brazzaville, Congo, and a country within the region. Members may also be involved in RITAG working groups and actively participate in the preparation of each meeting.

II.1.6 National Immunization Technical Advisory Group (NITAG) in Cameroon.

The primary objective of the National Immunization Technical Advisory Group (NITAG) is to provide scientific and technical support to health authorities notably the Minister of Public Health in making informed decisions and implementing national immunization policies and strategies. The NITAG is responsible for issuing opinions or recommendations concerning vaccines and immunization based on a thorough analysis of factual data available at the national, regional, and international levels. These evidence-based recommendations serve as advisory guidance.

The Cameroon NITAG is a multidisciplinary body consisting of fifteen (15) statutory members, five (05) ex-officio members, liaison members, and a technical and scientific secretariat. The

statutory members are national experts recruited from various disciplines, including pediatrics, gynecology-obstetrics, epidemiology, infectious diseases, public health, bacteriology-virology, immunology, internal medicine, neurology, genetics, social sciences, university researchers, and lecturers. The ex-officio members are representatives from the Ministry of Health and other partner ministries involved in the implementation and monitoring of immunization activities. Liaison members represent national and international organizations and institutions that support immunization activities.

The core responsibilities of the Cameroon NITAG include:

1. Analyzing existing national immunization policies and strategies, encompassing routine immunization, non-EPI immunization, supplementary immunization activities, and epidemiological surveillance, as well as MAPI management.
2. Proposing necessary changes to vaccine policies and strategies based on local data.
3. Recommending optimal strategies for controlling vaccine-preventable diseases.
4. Providing advice to national authorities on relevant strategies for monitoring and evaluating the impact of immunization activities.
5. Keeping national authorities informed about the latest scientific advancements and innovations in the field of immunization and vaccines.
6. Establishing partnerships with other advisory committees focused on vaccinations.
7. Analyzing challenges related to the sustainability of immunization financing and proposing optimal strategies.

The NITAG plays a crucial role in ensuring that evidence-based recommendations are provided to health authorities, enabling them to make informed decisions regarding vaccines and immunization [20].

II.1.7 Cameroon health system organisation

The Cameroon health system is organised in the form of a pyramid composed of several levels, each with specific responsibilities in the delivery of healthcare services. Here is a general description of the healthcare pyramid in Cameroon:

Primary Level:

Community stage: This forms the basis of the healthcare pyramid and includes primary healthcare facilities such as health posts, integrated health centers, and health huts. These facilities are usually located in rural areas and are responsible for providing basic care, vaccinations, health counseling,

and maternal and child health services.

District stage: Health districts encompass multiple community health facilities. They are responsible for coordinating healthcare services within their respective geographical areas. District hospitals, district health centers, and health centers at the sub-divisional level are examples of healthcare facilities at this level. They provide more extensive services such as emergency care, preventive care, basic specialized consultations, and emergency obstetric care.

Secondary Level: Health regions bring together several health districts. They are responsible for the supervision and coordination of health activities at the regional level. Regional hospitals and regional health centers are located at this level, providing specialized care and referral services for more complex cases.

Tertiary level : The Ministry of Public Health is responsible for the overall coordination of the healthcare system at the national level. It defines health policies, develops strategic plans, and ensures coordination between the different levels of the healthcare pyramid. National hospitals and university teaching hospitals are located at this level, providing highly specialized healthcare services [21].

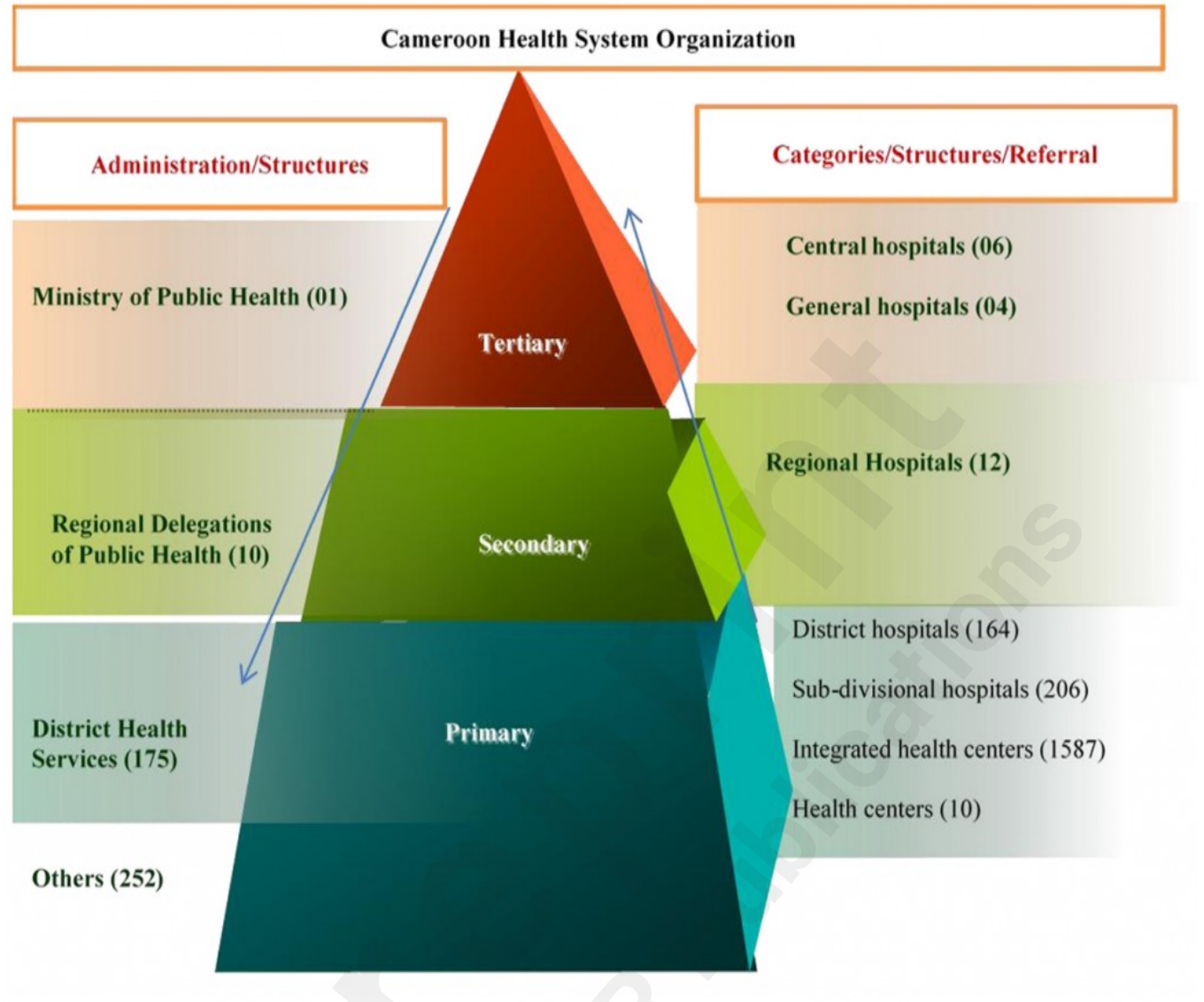

Figure 3: Cameroon health system organisation

The diagram illustrates the structure of the healthcare system. The primary, secondary, and tertiary levels are also referred to as the central, intermediate, and peripheral levels. The central level (primary) operates under the authority of the Ministry of Public Health and is responsible for defining strategies, coordinating, and regulating public health policies. The intermediate level (secondary) coordinates activities at the regional level and provides technical support to the 10 regional public health delegations. The peripheral level (tertiary) comprises operational health centers that are responsible for implementing health policies.

II.1.8 Data quality assessment

Ensuring good data quality is essential to maintain confidence in the decision-making process. Health data serves various purposes, such as health sector evaluations, planning, program monitoring, quality improvement, and reporting. Therefore, it is crucial to have reliable and accurate data on health sector performance readily available [14]. All data are susceptible to quality limitations, including missing values, bias, measurement errors, and human errors during data entry and computation. Conducting data quality assessments is essential to determine the reliability of health data used in assessing health sector performance and to understand the strengths and weaknesses of data sources. Specifically, it is crucial to assess the accuracy of national coverage estimates and other results derived from health facility data [14]. National authorities and partner organizations to assess the quality of health facility data use various mechanisms. Additionally, computer software applications used in health information systems can incorporate checks for data quality.

The purpose of the data quality assessment (DQA) is to evaluate the accuracy and reliability of data produced by health facility information systems. The DQA aims to achieve the following objectives:

1. Establish a systematic process for evaluating data quality, which includes regular monitoring of data, conducting annual discrete data quality reviews, and periodic comprehensive assessments of priority health programs.
2. Identify any deficiencies or shortcomings in the data management system and propose interventions to strengthen the system.
3. Monitor the progress of data quality over time and assess the capacity to consistently generate high-quality data

II.1.9 Immunization data quality self-assessment

The data quality self-assessment (DQS) consists of a flexible toolbox, designed for staff at the national, provincial or district levels to evaluate different aspects of the immunization monitoring system at district and health unit (HU) level in order to determine the accuracy of reported numbers of immunizations and the quality of the immunization monitoring system. Monitoring here refers to the measurement of the level of achievement in vaccination coverage and other system indicators (e.g. safety, vaccine management, etc). Monitoring is linked closely with reporting because it involves data collection and processing [18]. The DQS aims to diagnose problems and provide orientation to improve district monitoring and use of data for action, as highlighted in the Reaching Every District (RED) approach [19]. Basic knowledge of Excel is helpful when entering and

analysing collected data but the self-assessment can be conducted without computerized support. The following characteristics are useful measures for data quality assessment

II.1.9.1 Data Accuracy

Data accuracy refers to the degree to which the data stored in a database or system accurately reflects the true state of things in the real world. With the increasing dependence on data-driven decision-making in numerous sectors, ensuring the accuracy of data has become a critically important aspect [10].

- **Evaluating Reporting Accuracy**

The objective is to verify the accuracy of reported information regarding coverage data. This involves comparing the data available at one level (such as a form, report, or chart) with the same information compiled or reported at a more central level. The term "more central level" refers to a higher level in the data flow, which could be within the same facility (e.g, comparing tally sheets to registers within the same Health Unit) or between different facilities (e.g., comparing registers at the Health Unit to monthly reports found at the district level).

Description of a typical data flow.

Figure 4 illustrates a typical reporting flow for immunization coverage data. In some countries, there may be additional intermediate levels between the district and national levels, such as the province, region, zone, or state. Similarly, there may be intermediate levels between the Health Unit and district (e.g., subdistrict, etc.).

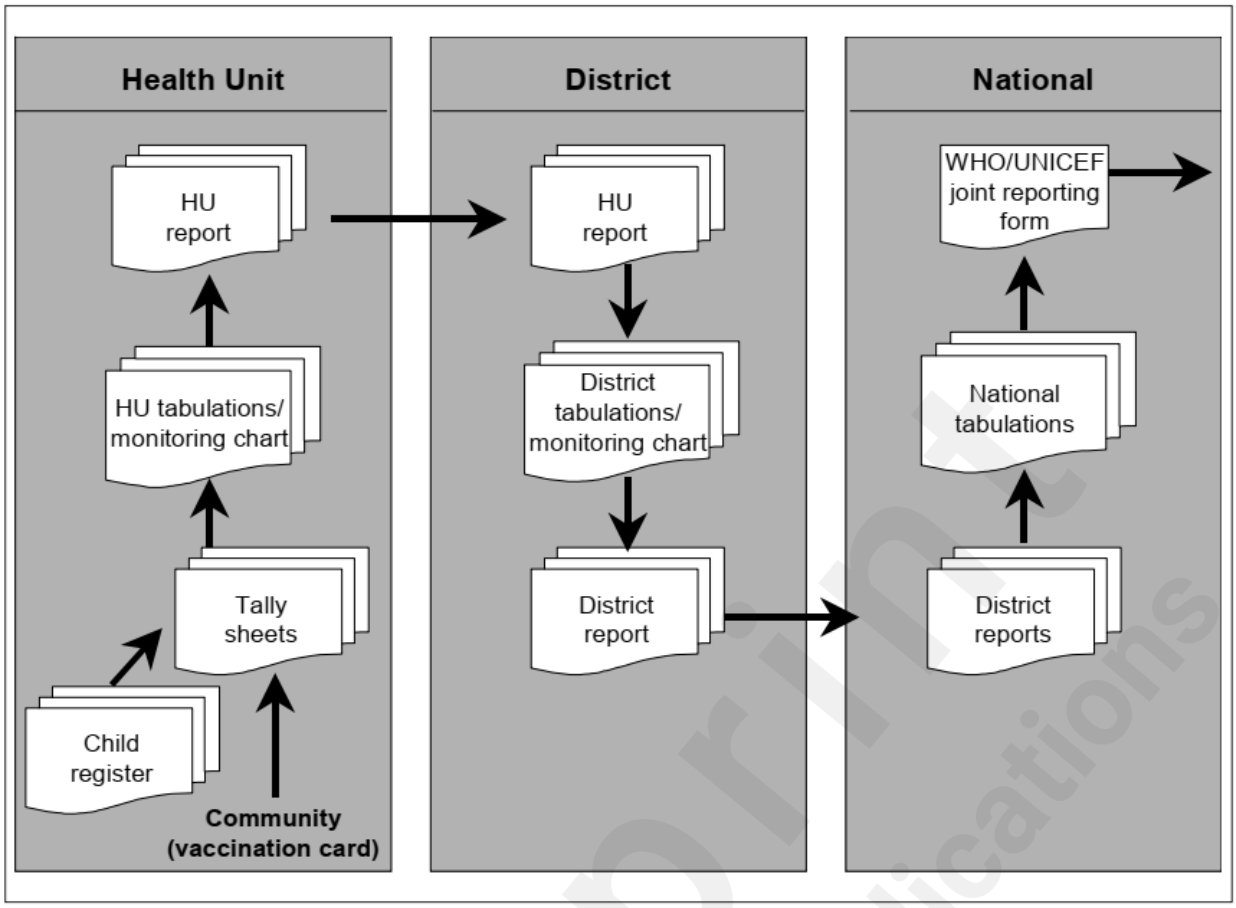

Figure 4: Reporting flow for immunization coverage data

The information flow begins at the Health Unit (HU) level, which is the administrative level where vaccinations are initially recorded. This can include private health facilities, NGO facilities, hospitals, or simple health posts. When a health worker administers a vaccine dose, the date of vaccination is immediately recorded on the child's individual vaccination card and the immunization register. The dose is also tallied on a sheet to facilitate easy recounting of all provided doses. The individual vaccination card is either kept at the HU or remains with the child's caretaker in the community, while the register and tally sheets are archived at the HU.

HUs regularly report to the district health office, typically on a monthly or quarterly basis. The HU report includes the number of doses administered for each antigen during the reporting period. To prepare the report, an HU officer retrieves the number of doses administered from the tally sheets. Alternatively, they may use the child registers to count the doses administered and include the total in the report. The HUs should retain copies of all reports sent to the district and display the cumulative number of doses administered on a graph for monitoring progress towards coverage targets [18].

At the district office level, administrative staff receive the reports, record the date of receipt, and follow up on any late reports. They then aggregate the information from all the HUs under their

oversight and send periodic district reports to the national level, or to the next intermediate level if applicable. Tabulations (either computerized or manual) are conducted to calculate the district totals based on the number of doses reported by each HU. Copies of the reports sent to the national level are retained at the district office [18].

At the national level, located at the national headquarters of the national immunization services/ programme, tabulations are made to consolidate the information from the district reports. Subsequently, the country sends the national data as an official report to WHO and UNICEF, made available through the immunization coverage link on each www.who.int country profile page. It is important to note that the availability of all the forms is subject to many factors, including the national policy in use. It is recommended that reports and registers should be kept for a minimal period of three years after the end of the calendar year they have been used

II.1.9.2 Data Completeness and timeliness

Data completeness is define as a percentage with the number of data report in the numerator and the number of data expected during a period as a denominator.

Data timeliness is define as a percentage with the number of data reported on time (by the deadline set by the EPI office) as the numerator and the number of data expected during a period as denominator.

Assessing the completeness and timeliness of data

- Reported completeness of HU reporting can be verified by re-counting the number of HU reports available at the district level for a given period. This is referred to as an indicator of the availability of data, defined as the proportion of reports physically available (retrievable) at the time of the assessment for a given time period divided by the total number of reports expected to be available. Note here that, the non-available reports are excluded from the denominator .
- Reported timeliness of HU reports can be verified by looking at the date of sending/reception written or stamped on the reports. According to the national policy, this date can be +5 days or 1 week, etc. after the end of the reporting period. This is defined as the proportion of reports physically available (retrievable) with a date stamped on time for a given time period divided by the total number of reports available. Again, the non-available reports are excluded from the denominator. The notion “on time” should also be defined, depending on whether the assessor wants to be strict on a given timeline, or whether he wants to allow for some flexibility (deadline + x days). This verification obviously depends on the local/national policy to write the reception and sending dates on the report itself. If the amount of time needed to verify each report of all

HUs for one year is too high, an alternative is to choose randomly a number of months for which the information will be collected.

II. 2. CUTTING-EDGE RESEARCH ON THE TOPIC

A recent systematic assessment study conducted in Australia highlighted the substantial workload associated with the large burden of data collection and routine reporting for immunization alone, especially in resource-constrained settings. The study emphasized gaps in measuring key areas of immunization, such as data use in decision-making, and equity and diversity, where efforts are needed to develop and validate indicators [22].

According to a review conducted by Harrison and colleagues in 2020, there is a limited amount of research available on the factors that hinder data quality in the expanded program on immunization in low and middle-income countries. The study found that the existing literature on immunization data quality in LMICs is limited and there is a lack of consensus on the definition of "data quality." The review also revealed that the quality of data in the articles examined was generally poor. Coverage numerators were seen to be inflated for official reports and denominators were inaccurate and infrequently adjusted. Numerous factors related to these deficiencies were reported, including health information system fragmentation, over-reliance on targets and poor data management processes. Factors associated with health workers were noted most frequently. Authors suggested that data quality could be improved by ensuring proper data collection tools, increasing workers' capacities and motivation through training and supervision, whilst also ensuring adequate and timely feedback on the data collected [12].

Saidu *et al.* in a systematic review assessment of immunization data management practices in Cameroon revealed potential barriers to immunization data quality. In the study the authors noted important gaps in data collection practices at the facility level that could adversely affect Cameroon's immunization data quality. The study highlights the urgent need for systematic capacity building of front-line immunization staff on data management capacity, standardizing data management processes, and building systems that ensure constant availability of data recording tools at the facility level [23].

III. METHODOLOGY

III.1 STUDY DESIGN

This will be a cross-sectional descriptive study (mixed-method approach, incorporating both

qualitative and quantitative methods) with an analytical component conducted in healthcare facilities in the health districts of Yaoundé Centre region of Cameroon.

III.2 STUDY SETTING

The study will be implemented in healthcare facilities in all the health districts of Yaoundé, Centre region.

III.3 STUDY PERIOD

The study will span a period of 12 months, and data collection will take place from August to October 2024.

III.4 STUDY POPULATION

III.4.1 Target population

The target population for this study comprises healthcare professionals working in health facilities providing Expanded Program on Immunization (EPI) services. A few policymakers, including NITAG members, Director of Vaccination, EPI manager, and NRA representative, will also be included.

III.4.2 Source population

The source population for this study includes healthcare professionals working in health facilities located in the health districts of Yaoundé, centre region of Cameroon who have been providing Expanded Program on Immunization (EPI) services. This includes healthcare workers, such as doctors, nurses, and other medical staff, who have been involved in the administration and management of vaccination programmes in these facilities for at least 2 years. Additionally, a selected group of influential policymakers directly involved in shaping vaccination policies and strategies, or providing essential input for recommendations, such as NITAG members, the Director of Vaccination, EPI manager, and NRA representative, will also be included.

III.4.3 Inclusion criteria

• Healthcare professionals that offer EPI vaccination services in health facilities .
• Healthcare professionals that have been operating for at least 2 years in the EPI services.
• Healthcare facilities in the aforementioned districts who will consent to participate in our study.
• Policymakers who are involved in vaccination policies and strategies and vaccine regulatory

authorities.

III.4.4 Exclusion criteria

• Healthcare professionals that agree to participate in the study but have been working in the EPI service for less than 2 years.

• New NITAG members with less than 1 year membership

III.4.5 Sampling methodology

The sample size (n) of the healthcare facilities to consider for this study will be computed using Cochran's Modified Formula for Finite Populations [24] :

$$n = Deff \frac{\frac{Z^2 \times P(1-P)}{d^2}}{1 + \frac{\frac{Z^2 \times P(1-P)}{d^2} - 1}{N}}$$

where Z is the approximate value of the 97.5 percentile point of the standard normal distribution =1.96, P is the proportion of healthcare facilities having good quality data for immunisation =50% (default due to non-availability), d is the precision= 0.1, N=666 (total number of healthcare facilities in Yaoundé), the design effect (DEFF) is 2, and 10% non-response rate. The numerical application of this formula gives the minimum sample size (n) of 194 healthcare facilities to be visited.

A two-stage sampling approach will be used for the selection of healthcare facilities in the Yaoundé health districts, Centre region. The number of healthcare facilities will be distributed proportionally across all healthcare facilities in the districts of Yaoundé.

Healthcare facilities will then be randomly selected within the health districts. This process will be carried out ensuring an equal number of facilities selected in each district of Yaoundé.

In addition, a total of 10 key stakeholders, comprising 7 NITAG members, the Director of Vaccination, the EPI manager, and an NRA representative will be included.

III.5 DATA COLLECTION

Training of enumerators

Training of enumerators will be conducted prior to deployment and will consist of theoretical presentations and practical sessions on data collection, entry, and transmission processes.

Data collection procedure

Data collection plans for the targeted districts and healthcare facilities will be developed by the baseline evaluation management team. To avoid unproductive visits during data collection, we will contact the healthcare facilities by phone to remind them of the scheduled visits. Upon arrival at the facilities, the evaluation objective will be explained again to the facility director or their representative, as well as the healthcare staff.

The staff responsible for EPI vaccination at the healthcare facility will be interviewed. A session of fixed-post vaccination will be observed, and the vaccination data collection tools will be physically inspected. Subsequently, a comparative assessment will be conducted with the data recorded in the DHIS2.

To ensure comprehensive insights, key stakeholders will be engaged/interviewed. This concerted effort will yield valuable perspectives on vaccination coverage, data quality challenges, and informed recommendations for optimizing data quality and utilization.

Study tools

The tool used for this study will be a modified version of the data quality self-assessment (DQS) tool developed by the WHO according to the immunization data quality audit procedure (WHO/V&B/03.19) and tested in a number of countries. The questionnaire will be designed to assess collected vaccination data and the availability of data collection tools and a vaccination service observation guide and checklist (comprising several questions to evaluate data management practices of the vaccination staff during vaccination sessions and data recorded in the main data collection tools). These study tools will be developed in French and pre-tested in a few healthcare facilities in the Centre health districts before being used to collect study data.

III.6 DATA ANALYSIS

• Analysis plan: Data management and analysis

A comprehensive database will be built, pretested, and validated by an expert data manager before data entry. Each enumerator will enter the data from the completed questionnaires and evaluation grids into the database and transmit the files to a secure server on a daily basis. The data will then be exported and cleaned in Microsoft Excel 2016 and analysed using SPSS 25 software. Frequencies and proportions will be used to summarize variables and healthcare facilities and healthcare personnel will be used as separate units of analysis. Chi-square test will be performed and a multivariate logistic regression model will be constructed. We will estimate our associations with a 95% confidence interval.

Variables to be measured

- **Sociodemographic characteristics of health care professionals and health facilities**

Age, gender, years of experience in EPI service, health districts

- **EPI Data** collected by health facilities, Availability and utilization of data collection tools
- **Data accuracy ratio**

This will be measured by dividing the number of EPI vaccines verified or re-counted from the registries during 2023 (numerator), compared to the number of EPI vaccines reported in DHIS2 in 2023 (denominator). This ratio will be expressed as a percentage.

Accuracy ratio < 100% will be considered as low verification

Accuracy ratio > 100% will be considered as very high verification

- **Data Completeness**

It will be measured by dividing the number of EPI data reported in 2023 as the numerator and the number of EPI data expected during 2023 as the denominator. The result will be expressed as a percentage.

- **Data Timeliness**

This will be the percentage of the number of EPI data that were received on time (by the deadline set by the EPI office) as the numerator and the number of EPI data expected during 2023 as denominator.

Qualitative data from stakeholders:

When evaluating vaccination data quality, it's important to ask comprehensive questions that provide insights into the effectiveness, coverage, and challenges of the vaccination program. Prototype questions will be formulated to form the interview guide, and will help understand stakeholders' perspectives on the vaccination program's quality, challenges, and areas for improvement:

1. Data Accuracy and Reliability
2. Coverage and Accessibility
3. Vaccine Supply and Logistics
4. Public Awareness and Education
5. Safety and Adverse Events Monitoring
6. Policy and Decision-Making
7. International Cooperation

Operational definitions

Data management practices: This refers to the collected data, availability and use of data collection tools, consistency of data across collection tools, and data recording practices during vaccination sessions.

Vaccination staff (used interchangeably with vaccination staff, vaccine providers, vaccinators): This refers to all healthcare personnel working in the vaccination unit.

Fully completed data collection tool: All columns of the vaccination tool have been filled in for a month up until the time of evaluation.

High-quality data: data that is accurate, consistent, complete and timely enough for EPI purposes.

Data utilisation

III.7 ADMINISTRATIVE CONSIDERATIONS

Before beginning the baseline assessment, we will seek approval from the relevant regional public health authorities. Once we have obtained their approval, we will proceed to obtain authorization from the administrators of the participating hospitals.

III.8 ETHICAL CONSIDERATIONS

This study is committed to upholding the principles set out in the 2013 Declaration of Helsinki and adhering to all pertinent national laws and regulations. We will obtain ethical clearance from the Institutional Review Board of the University of Yaoundé 1 and the Centre Regional Ethics Committee for Human Health Research before proceeding with the study. Prior to enrollment, participants will be asked to provide informed consent.

III.9. EXPECTED OUTCOMES

The study aims to evaluate the quality of vaccination data and is expected to yield the following outcomes:

1. Assessment of the current state of EPI data quality in Yaoundé Health districts, Centre region of Cameroon, including evaluating completeness, accuracy, and timeliness of data.
2. Identification of factors influencing the quality of EPI data in Yaoundé Health districts, such as lack of training, inadequate infrastructure, limited resources, and poor data management practices.
3. Formulation of recommendations to enhance the quality of vaccination data in the Centre region, which may include training healthcare workers and vaccination officials, improving infrastructure, providing adequate resources, and implementing better data management practices.
4. Preparation of a comprehensive report presenting the study's findings and recommendations, along with an analysis of the data and identified factors, to improve the quality of vaccination data in the Centre region.

5. Dissemination of the study's findings and recommendations to pertinent stakeholders, such as healthcare workers, vaccination officials, and government officials, to influence policies and practices related to vaccination data quality.
6. Contribution to existing literature on vaccination data quality, including identifying research gaps and providing recommendations for future studies.
7. Improved vaccination data quality in the Centre region resulting in better-informed decision-making and enhanced public health outcomes.
8. Increased capacity of healthcare workers and vaccination officials in the Centre region to collect, report, and manage vaccination data, leading to improved data quality and public health outcomes.
9. Heightened awareness and attention to the significance of vaccination data quality among stakeholders, including healthcare workers, vaccination officials, and government officials, leading to improved policies and practices related to vaccination data quality.

Overall, the study is expected to contribute to the enhancement of vaccination data quality in the Centre region of Cameroon and inform policies and practices related to vaccination data quality at both national and international levels.

III.10 TIMELINE

Activities (times in months)	M1-3(2023)	M4-7 (2024)	M8-9 (2024)	M10-12 (2024)
Development of the Protocol				
Obtaining Ethical clearance & Authorization from the centre regional delegation				
Obtaining Authorization from the Minister of Public Health				
Submitting protocol for publication in a peer-review journal				
Investigators training: theoretical presentations and practical sessions on data collection, entry, and transmission processes				
Participants' enrolment & Data analysis				
Final study report completion & Result dissemination				

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APPENDIX 1: INFORMED CONSENT FORM/INFORMATION NOTICE

TITLE: Assessment of the quality of vaccination data in Yaoundé Health districts, Centre

region of Cameroon

Investigator: DJUIDJE NGOUNOUE Marceline

Supervisor: Pr. NGUEFACK-TSAGUE Georges, Biostatistics, Faculty of Medicine and Biomedical Sciences, University of Yaoundé I.

Aim of study: Examine the quality and use of immunization data in Yaoundé Health dsitricts Centre region of Cameroon

Duration of study: June to October 2024

Procedure: We will have an interview with you and get basic information. If you are eligible for the study, you will answer the survey form.

Benefits: You will contribute in identifying the challenges and limitations of data collection and analysis, and propose recommendations for improving the quality and use of vaccination data in the country.

Risks and inconveniences: The process of questionnaire filling may be a little time-consuming.

Ethical consideration: Permission has been obtained from the appropriate persons in charge of the study sites and authorization gotten from the University and the ethics committee. An encryption code shall be used rather than your name on all documents containing data collected. The data will be handled with the greatest confidentiality. You can opt out of the study at any point and refusal to participate or opting out will involve no penalties nor alter the relationship between you and study investigators.

For more information or further clarification about the study you can contact the investigator through the following telephone number (699128874) and email address (djngmarceau@yahoo.fr)

Appendix 2: CONSENT FORM

Statement of person obtaining consent

“I confirm that I have fully explained this research, and provided complete and accurate information about it to…….……. and he/she has confirmed that he/she fully understands the information, as well as risks and benefits associated with

the study."

Name: …….. Mobile number:

Signature: ……..…….

Date/Time: ……

Statement of person giving informed consent

"I have read the information above, or it has been read to me. I have had the opportunity to ask questions about this study and all questions I have asked have been answered to my satisfaction. I consent voluntarily to participate in this study and understand that my consent means full participation in the study and access to information and data that will be used for present and future research purposes only. I also understand that I have the right to withdraw at any time without any prejudice. I have received a copy of the consent form to be kept for my records.''

Name: ……..

Signature: ……..…….

Date/Time: ……

Name of witness (where participant could not read the consent form and it had to be read and interpreted):

Name: ……..

Signature: ……..…….

Date/Time: ……

Appendix 3: Questionnaire for the assessment of the quality of vaccination data in Yaoundé Health districts, Centre region of Cameroon

Sheet number ..... **Participant code** .....

No	Question	Answer
	Characteristics of the Health facility	
1.	Name of the health district	
2.	Name of the health area	
3.	Name of the health facility	
4.	Category: 1 2 3 4 5 6	
5.	Status: 1-Private 2-Public 3-Confestional	☐
6.	Location of the health facility : 1-Urban 2-Rural	
	Characteristic of the healthcare professional	
7.	Age	
8.	Gender	
9.	What is your initial qualification? 1-GCE O level 2- GCE A level 3-Bachelor's degree 4- Professional degree/qualification	
10.	Do you have multiple responsibilities in the Health facilities? 1- Yes 2-No	
11.	How many years have you been in this position? (in years)	
12.	Have you received any training or support on vaccination data collection and reporting in the past 12 months? 1. Yes 2. No	
	Data quality evaluation	
13.	Do you have access to the DHIS2? 1- Yes 2- No	
14.	If yes, How do you ensure data entry into DHIS2?	
15.	Are you familiar with the DHIS2 quality control module? 1- Yes 2-No	
16.	Have you already used the DHIS2 quality control module? 1- Yes 2-No	
17.	Do you have guidelines for organizing data quality control at your level? 1- Yes 2-No	
18.	**What is your level of training and experience in vaccination data collection**	

	and reporting? 1. Novice (little or no experience) 2. Intermediate (some experience) 3. Advanced (extensive experience)	
19.	**How do you currently collect and report vaccination data in your health facility? (Select all that apply)** 1. Manually (on paper) 2. Electronically (using a computer or mobile device) 3. Through a combination of both	
20.	**How do you ensure that vaccination data is accurate and complete before submitting it to the DHIS2?** 1. I double-check the data for errors and inconsistencies 2. I use a data quality checklist 3. I validate the data with other sources (e.g. patient records) 4. Other (please specify)	
21.	**How do you handle missing or incomplete data in vaccination records?** 1. I follow up with the patient to obtain the missing information 2. I use a statistical method to impute the missing data 3. I leave the data blank and submit it as it is 4. Other (please specify)	
22.	**How do you ensure that vaccination data is kept confidential and secure?** 1. I use secure storage methods (e.g. encryption, passwords) 2. I only share data with authorized personnel 3. I follow established data sharing protocols 4. Other (please specify)	
23.	**What challenges do you face in collecting and reporting vaccination data? (Select all that apply)** 1. Lack of training or knowledge 2. Limited resources (e.g. computers, internet) 3. Difficulty in accurately tracking and recording data 4. Limited time and staff availability 5. Other (please specify)	
24.	How many EPI data entries have been submitted to the DHIS2 in the past year?	
25.	How many EPI data where expected from your health facility in 2023-2024?	

26.	What is the average time it takes to collect and report vaccination data?	
27.	How many EPI data entries have been missing or incomplete in the past year?	
28.	How many healthcare workers in this facility are involved in vaccination data collection and reporting?	
29.	How many EPI data entries have been rejected or not submitted due to data quality issues in the past year?	
30.	How many vaccination data entries have been stored securely in the past year?	
31.	What was the number of EPI data registered in the DHIS2 in 2023 (to be check in the DHIS2)	
32.	What was the number of EPI data that were received on time (by the deadline set by the EPI office)	
33.	**How do you think the quality of vaccination data in the Centre region could be improved? (Select all that apply)** 1. Provide more training and support for healthcare workers 2. Increase resources and funding for data collection and reporting 3. Implement a more robust data quality check process 4. Use technology (e.g. electronic data collection) 5. Other (please specify)	

Thank you for your cooperation!

Appendix 4: Interview guide for policymakers

Participant code .....

Name of the structure…….
Role/responsibility……

When evaluating the quality of vaccination data, it's important to ask comprehensive questions that can provide insights into the effectiveness, coverage, and challenges of the vaccination program. These interview questions will help us understand the perspectives of stakeholders and policymakers on the vaccination program's quality, challenges, and areas for improvement. The goal is to gather information that can lead to actionable insights for enhancing vaccination Policies and strategies.

1. Data Accuracy and Reliability:

1-How is vaccination data collected and reported?
2-What measures are in place to ensure the accuracy and reliability of the data?
3-How often is the data updated and verified?

2. Coverage and Accessibility:

4-What percentage of the target population has been vaccinated?
5-Are there any geographical or demographic disparities in vaccination coverage?
6-How is the government addressing barriers to vaccination access?

3. Vaccine Supply and Logistics:

7-Is there a sufficient supply of vaccines to meet the demand?
8-How are vaccines distributed across different regions?
9-What are the cold chain management practices for vaccine storage and transportation?

4. Public Awareness and Education:

10-What strategies are being used to educate the public about the importance of vaccination?
11-How is vaccine hesitancy being addressed?
12-What kind of feedback is received from the public regarding the vaccination program?

5. Safety and Adverse Events Monitoring:

13-How are adverse events following immunization monitored and reported?
14-What is the process for investigating and responding to vaccine safety concerns?
15-Are there any patterns or trends in the reported adverse events?

6. Policy and Decision-Making:

16-How is vaccination data used to inform policy decisions?
17-What are the key performance indicators for the vaccination program?
18-How is the success of the vaccination campaign measured?

7. International Cooperation:

19-How does the country's vaccination data compare internationally?
20-Is there any collaboration with international organizations for vaccine procurement or data sharing?
21-What lessons have been learned from other countries' vaccination efforts?

Thank you for your keen and kind collaboration