LIBERIA IMMUNIZATION COVERAGE AND EQUITY ANALYSIS

DECEMBER, 2023 Monrovia

MoH and UNICEF

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Acronyms

AEFI	Adverse Event Following Immunization
CER	Comprehensive EPI Review
CHA	Community Health Assistants
DTP-1	diphtheria-tetanus-pertussis
DHIS 2	District Health Information System
EPI	Expanded Program on Immunization
EPHS	Essential Package of Health Services
EVMA	Effective Vaccine Management assessment
FPP	Immunization Full Portfolio Planning
GAVI	Global Alliance for Vaccination and Immunization
HFs	Health Facilities
HHFA	Harmonized Health Facility Assessment
iSC	Immunization Supply Chain
IA	Immunization Agenda
KAP	Knowledge Attitude and Practice
LDHS	Liberia Demographic and Health Survey
MCV	Measles containing vaccine
MoH	Ministry of Health
PHC	Primary Health Care
RED/REC	Reaching Every District/Community
RI	Routine Immunization
SIA	Supplementary Immunization Activities
SPSS	Statistical Package for the Social Sciences
TT/Td	Tetanus Toxoid/Tetanus and diphtheria
UHC	Universal Health Coverage
UNICEF	United Nation Children Fund
VPDs	Vaccine-preventable diseases
WUENIC	WHO and UNICEF Estimate for National Immunization Coverage
WHO	World Health Organization

Foreword

The Liberia Immunization Coverage and Equity Analysis was a nationwide survey. This report is a critical step to strengthening the current implementation of Expanded Program on Immunization (EPI) in Liberia especially when new vaccines including COVID-19 virus is now being considered as part of the diseases covered under routine immunization of Liberia. Even more important is to update the existing EPI communication strategy capturing key socio-behavioral issues uncovered during this study.

It provides reliable information on barriers and drivers of immunization coverage and equity focusing on vaccines and other child health services availability, service delivery, demand, immunization supply chain, human resource, data management and social and gender related barriers and enablers associated with accessing immunization services in Liberia.

The report provides evidence to support planning for the immunization services as well as messaging to address current knowledge gaps, perception and attitudes towards immunization programs in Liberia. The need for publication of this report is timely and necessary for information dissemination and improved decision making at the country and global levels. Besides, the findings of this assessment will be input for development of the Liberia Immunization Full Portfolio Planning (FPP) 2024-2028.

The Ministry of Health in this regard appeals to all sectors to use the information in this document for planning, monitoring and evaluation of immunization programs. The figures shown here are expected to change with time. Improvement especially with immunization coverage and knowledge distribution by counties is expected; hence, continuous update of this information is key to tracking changes overtime in the EPI program.

Finally, on behalf of the Ministry of Health, I express our thanks and appreciation to UNICEF and other partners for providing much needed financial and technical support, and all that participated in one way or another to ensure that this was achieved. Your efforts cannot be quantified.

Wilhelmina S. Jallah, MD, MPH, CHES, FWACP

Minister of Health, Liberia

Acknowledgement

The Ministry of Health leadership and its staff could not have completed this assignment alone, henceforth, we would like to acknowledge and commend all those individuals, institutions and organizations that contributed to the successful implementation and crafting this report.

We wish to recognize experts within the Ministry of Health, Liberia Institute for Statistics and Geo-Information Service (LISGIS), health collaborative partners and private sectors and others who participated in this survey and made invaluable contributions, the technical and financial assistance that have resulted in the development of this report. To all those who contributed in this survey, kindly accept our sincere appreciation of the leadership of the Ministry for the job well done.

We would however, on behalf of all who contributed, like to acknowledge the hard work of the Technical Team from the design of this study up to finalization and report writing. At the Ministry of Health (the HMER) and LISGIS, we would like to recognize the efforts of the leadership, management and support from the rest of our team: Ministry of Health Team (Luke L. Bawo, Nelson K. Dunbar, Adolphus Clark, Nicholas Blidi, Dikena Jackson), Mr. Richard Russ, LISGIS and the field assessors who made this possible.

All of these could not have been possible without the technical leadership of the consultant Dr Zufan Abera Damtew appointed by UNICEF. We would also like to acknowledge partners particularly UNICEF (Financial and Technical Support) and the WHO (technical support) for their level of involvement in this assessment.

Again, on behalf of the Ministry of Health, we thank you all for your support.

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Executive Summary

Introduction: Childhood immunization is one of the priority interventions as outlined by the Immunization Agenda (IA) 2030 and Gavi 5.0 strategies. The immunization program must identify pro-equity strategies and interventions to reach every eligible groups. Liberia conducted this immunization coverage and equity analysis to provide timely information related to the EPI landscape, input for the immunization full portfolio planning (FPP) 2024-2028 and guide other strategies and interventions.

Background: In Liberia, 13 vaccines are provided targeting major vaccine preventable diseases (VPDs). Accessibility to vaccination within some counties is very difficult, especially when traveling from the county capitals to reach the remote districts.

The Liberia Ministry of Health (MoH), in-collaboration with UNICEF and other EPI partners has conducted this assessment from September to November, 2023, to identify major bottlenecks and disparities in coverage and equity of immunization. The assessment used multiple sources of information from primary and secondary data with extensive consultation and iterative engagement of various EPI stakeholders at the national and subnational levels.

Objective: the general objective of this immunization Coverage and Equity Analysis (CEA) is to assess the drivers, bottlenecks, and coverage and equity trends for immunization program in Liberia and propose corrective measures.

Specific objective

- To assess bottlenecks of the immunization program that help to develop apt strategies
- To analyze coverage status and trends of immunization of Liberia
- To describe the disparity in coverage of selected immunization indicators across different equity dimensions in Liberia
- To propose priority interventions for the gaps identified

Methods: A cross-sectional study design was used, employing mixed methods of quantitative and qualitative approaches, to assess relevant information for various study subjects. The assessment conducted among 12 of 15 counties and 24 Health Facilities (HFs). The findings for the three counties (Gbarpolu, Montserrado, and River Gee) were also incorporated in this assessment from a similar study that had recently been conducted in April, 2023. The selection of HFs and communities for the assessment was informed by the presence of a high number of zero-dose children. Desk review of strategic documents conducted to understand the immunization program performance and challenges and possible solutions. The primary data collected at county, HF and community levels were analyzed. The quantitative data analysis was done using SPSS and STATA latest versions, and the transcribed qualitative data analyzed to substantiate and triangulate findings from the quantitative data. Final report developed with extensive consultations of all EPI stakeholders.

Findings

Supply Side Related findings:

Cold Chain, Vaccines, and Supplies: out of 12 (100%) counties and 24 HFs assessed, all counties and 22 (91.7%) of the HFs reported the availability of refrigerators. Two HFs reported the unavailability of refrigerators for at least 150 days in the six months before this survey. At least two functional vaccine carriers were available in 11 out of 12 counties and 22 out of 24 assessed HFs. Out of the assessed 12 counties and 24 HFs, 11 (91.7%) counties and 16 (66.7%) HFs experienced one or more vaccine stock-outs during the six months prior to the survey. The three antigens with the longest average number of stock-out days at the county and HF level were BCG, OPV, and Td vaccines.

Human Resources and Trainings: The total number of health workers involved in the assessed counties is 294 ranging from 2 in Rivercess to 172 in Nimba. Among the 294 health workers involved in the immunization activities, 160 (54.4%) received training on immunization two years prior to the survey. Among 6208 community health workers involved in immunization activities, only 1141 (18.4%) received training during the period of two years prior to the survey. The distribution of health workers and community health workers was not proportional to HFs and population.

Geographic Accessibility: more than 97% of static sites and 75% to 98% of outreach sessions are conducted compared with planned.

Access of vaccination and other health services for people from some remote areas was challenging. The transport cost is high and they have to walk long distance to vaccinate their children. Most of them use public transport (37.5%) to reach to the HFs, about 20.8% each use walking and a combined means of motorbike, hammock and walking on foot, about 16.67% use motorbike/cycle and only 4% use ambulances.

Three counties (Lofa, Sinoe and Grand Kru) did not have reliable functional vehicles. The lack of road access and means of transportation is also the main barrier to immunization supply distribution. Similar challenge reported in the study conducted at the three counties in April 2023

Service Integration (Antenatal care, and child health interventions): The TT/Td coverage for mothers with fourth ANC visit vary by county ranged from 74% in Grand Cape Mount to 118% in Grand Kru, while the average for 12 counties is 85% which means more than eight women out of ten took TT/Td.

An average of 292 children per catchment population were screened for child health services by the Community Health Assistants from the visited sites in the six months prior to this survey. Service integration is acknowledged as a means to enhance the immunization service.

Demand Related Findings:

Demand-related factors were measured by the coverage of penta1 (initial contact) and penta3 (continuity). The average coverage for the 12 study counties was 91.4 and 69.2 % for penta1 and penta3 respectively. Counties such as Margibi, Sinoe, and Grand Bassa have relatively lowest penta1 and penta3 coverage.

Awareness on the vaccination services was high. However, this assessment showed that fake news and misconceptions may discourage vaccination. The findings from the study in the three counties in April 2023 also found beliefs, attitudes and behaviors of caregivers, migration and poor awareness of services as the three main factors for zero dose vaccination and proposed targeting these factors.

About 83.3 per cent and 87.5 per cent of counties and HFs reported that they have conducted community engagement stakeholders meeting prior to six months of the survey.

Enabling Environment:

Program Management and Coordination: The Liberia Interagency Coordination Committee (ICC) has been subsumed into the Health Sector Coordination Committee (HSCC) and the Health Coordination Committee (HCC) since 2015. The ICC revitalized in 2023. The Liberia National Immunization Technical Advisory Group (NITAG) was established in April 2022 with Terms of Reference (ToR). However, coordination with partner activities at the county level was limited.

Budgeting and Financing: the Liberia government put a line item for EPI in the health budget. Main funders of the immunization program included GAVI, USAID; WHO, US-CDC and UNICEF; NGOs and

other government partners provide supplementary funds. EPI has line item in the health budget, however, there is insufficient national financial resources and limited budgeting for immunization.

Planning: 75% of counties and HFs reported the availability of annual plan that integrated EPI activities.

Supervision, Monitoring and Surveillance: Supportive supervision, monitoring and follow-up were conducted at each level. Almost all 11 out of 12 counties and 21 (87.5%) of HFs stated to have supervision plan, 10 (90.9%) counties and 21 HFs received supervision visits from their higher levels.

Regarding to the Vaccine Preventable Diseases (VPD) outbreaks: 45.8% reported the occurrence of outbreaks in the past 6 months of the assessment. Measles and pertussis were mostly reported VPDs.

Program Review and HMIS: About 58.33% of HFs reported that they have conducted quarterly review meetings.

The admin data is higher and did not match with the WUENIC estimates. The analysis of DHIS 2018-2021 for zero-dose children showed 6 out of 15 districts with negative zero-dose (coverage >100%).

Quality Related Findings

Effective Vaccine Management Assessment (EVMA): The 2022 EVMA composite score (77%) is 11% higher than the 2015 EVMA composite score of 66% that signifies progress in the overall immunization supply chain system of Liberia. However, it is lower than the acceptable range of 80% and the score varies among counties, where Grand Gedeh and Maryland scored the least.

AEFI Monitoring: 11 out of the 12 counties had the AEFI reporting form, and 10 counties affirmed as they had reported the AEFI cases.

Continuous Coverage: According to the Liberia Demographic and Health Survey (LDHS) 2019-2020, the average coverage for measles containing first dose vaccination and fully vaccination of all basic vaccines was 70.3 and 50.8% per cent respectively, where counties Sinoe, Riverces, Margibi, and Grand Bassa, Nimba, Maryland, Grand Gedeh, Grand kru had coverage less than national average.

Gender Related Barriers for Immunization

Children vaccination is typically considered the responsibility of mothers, and consent from fathers may be required. Mothers computing responsibilities, such as the household chores, along with the distance to health facilities (HFs) and lack of money for transportation, can pose challenges when it comes to taking their children for vaccination. Vaccination interventions had always targeted women, overlooking the role of promoting inclusivity and sharing responsibilities with men. However, recent messages have targeted male involvement in immunization. Male involvement is being encouraged in the country and there are some progresses in males/fathers' involvement in immunization.

Coverage and Equity of Immunization Services

WUENIC data from 2013-2022 showed significant disparities on coverage and equity of immunization by counties in Liberia. The coverage suffered setback in 2014 and 2020/21 due to the Ebola epidemics, and COVID-19 pandemic respectively with recovery to the pre-pandemic period in 2022. The three recent LDHSs showed that Libera was successfully able to reduce the number of zero dose children and narrow the absolute disparity of vaccination among different population groups. However, still much work needs to be done to further narrow the disparity of immunization coverage within different counties and population groups, and identify and reach all zero-dose and under-immunized children.

1. Introduction

Immunization reaches more people than any other health service and is a vital component of primary health care (PHC). It benefits individuals, communities, countries, and the world at large. Immunization is an investment in the future in several ways: saving lives, protecting the health of the population, improving productivity, resilience, and enabling a safer, healthier, and prosperous world[1]. Vaccination is one of the most cost-effective interventions in public health, every dollar spent on vaccination delivers a return on investment of US$26[2]. In addition to saving lives, immunization contributes to the social and economic well-being of communities (ibid).

Childhood immunization is one of the priority interventions considered by the IA 2030 and Gavi 5.0 strategy. The immunization program must identify pro-equity strategies and interventions to reach every eligible groups. Accordingly, the Liberian Ministry of Health (MoH), in-collaboration with UNICEF and other EPI partners, has conducted this immunization coverage, and equity assessment in 12 of the 15 counties. This assessment was conducted from September to November 2023, using multiple sources of information from primary and secondary data with extensive consultation and iterative engagement of various EPI stakeholders. This assessment also incorporated the findings from a similar study that had recently been conducted in the three counties in April, 2023. The country has conducted an in-depth and comprehensive review of the immunization program Comprehensive EPI Review; (CER), 2022), which was used as a resource document for this assessment.

This report provides a comprehensive overview of the immunization program of Liberia and mainly focuses on analyzing barriers to immunization program performance, including gender-related barriers, coverage, equity trends, and possible solutions for the identification and reaching of zero-dose and under-immunized children. The findings will provide updated information on the coutry EPI, as well as, will be used as an input for the development of Liberia immunization Full Portfolio Planning (FPP) 2024-2028 and other strategic and planning documents.

The first chapter of the report describes background information about the country, including socio-economic status, health status, health systems, immunization situation, including literature review, barriers to immunization, and the GAVI 5.0 framework. The second chapter outlines the methods of assessment, including the study design, source of data, study areas and population, data collection, and analysis. The third chapter of the report illustrates the key descriptive findings from primary data both the quantitative and qualitative sources. This chapter of the report also describes immunization coverage and equity trends analysis from consecutive WUINEC and three recent LDHSs, as well as, the priority settings. The fourth chapter of the report provides conclusion and recommendation of the assessment.

1.1. Background Information

1.1.1. Geography, Population and Demography

Liberia, located in West Africa and spanning 43,000 square miles, borders Sierra Leone to the west, Guinea to the north, Côte d'Ivoire to the east, and the Atlantic Ocean to the south. It covers an area of 111,369 square kilometers, with an estimated population of **5,248,621[3].** The country is geographically divided into five regions and 15 counties (Figure 1). One-third of the country's population is residing

[1] Immunization Agenda, 2030; A Global Strategy to Leave No-one Behind
[2] UNICEF, 2023; The State of the World Children, 2023. For Every Child Vaccination, 2023.
[3] https://www.worldometers.info › world-population

in the capital city of Monrovia, and about 54.3% of the population lives in urban areas. As more than half of the population lives in urban areas, strengthening urban immunization is critical.

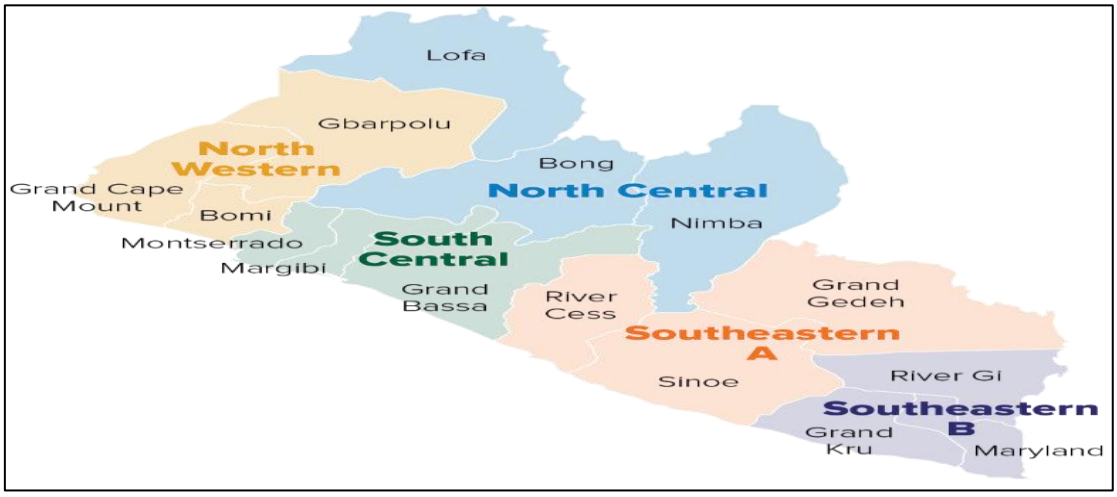

Figure 1: Map of Liberia with Regions and Counties: (Source CER, 2022)

1.1.2. Socio-Economic Context

Liberia is a low-income country with an estimated Gross Domestic Product (GDP) per capita of USD 622 in 2019, about 8.8% decline from 2018[4], with three-fourths of its population living below the poverty line on less than US$1.9 a day. According to the 2019 United Nations Development Program (UNDP) Human Development Index, Liberia ranked 176 out of 189 countries, which is among the lowest in the world. The average life expectancy in Liberia is estimated at 65 years (66.5 years for females and 63.5years for males) and the adult literacy rate is 52% for women and 75% for men[5] .

Progress is being made on some indicators, including the health outcomes as attested by assessments such as the Demographic and Health Survey[6]. Liberia's second national Health Financing Strategy (HFS) provides a mechanism for guiding the financing of health policy and strategy for both government and partners within the period of implementation (2021–2025) to achieve Liberia's universal health coverage (UHC) aspirations. The development of this strategy is guided by the goals set out in the Pro-Poor Agenda for Prosperity and Development (PAPD). The strategy is intended to strengthen the institutional and human capital development, including improving population health outcomes, to accelerate the country's transformation and address pervasive poverty and inequality[7].

1.1.3. Health Status

Liberia's investment in health care over the past two decades has resulted in significant improvements in the health outcomes of its population. According to the LDHS 2019-2020, the maternal mortality ratio is 742 deaths per 100,000 live births. The total fertility rate was 4.2, and the contraceptive prevalence rate was 25 percent. Infant and under-five mortality rates were 63 and 93 deaths per 1,000 live births, respectively. The neonatal mortality rate was 37 deaths per 1,000 live births. At these child mortality levels, about 1 in 11 children in Liberia does not survive until their fifth birthday. Childhood

[4] Liberia GDP Per Capita 2000-2020. www.macrotrends.net. Retrieved 2020-11-30.
[5] UNESCO Institute for Statistics (http://uis.unesco.org/)
[6] Liberia Demographic and Health Survey 2019-20. Monrovia, Liberia and Rockville, Maryland, USA: Liberia Institute of Statistics and Geo-Information Services
[7] Liberia National Health Financing Strategy 2022-2026, Republic of Liberia

immunization rates remain low, with only 51% of children receiving all basic vaccines in 2019 for children aged 12–23 months with large disparities within counties; for example, only 27% of children in Sinoe have received basic vaccinations compared with 66% in Lofa[8]. In addition, chronic malnutrition and stunting continue to be serious concern; 30% of children under-five are estimated to be stunted.

Despite the progress, many challenges remain to be addressed. Liberia is still struggling to cope with the effects of a long and devastating civil war. The 2014-2015 Ebola outbreak and the COVID-19 pandemic have had a devastating impact on the country's health system, reversing years of hard-won gains. The Ebola outbreak and the global COVID-19 pandemic further undermined the already fragile social and economic systems. In the aftermath of the Ebola outbreak, to address the health system's needs, the Liberia MoH prepared its roadmap for ongoing health system strengthening and in collaboration with partners, the country developed the Post Ebola Investment Plan. The plan aimed at building a resilient health system that endeavored to restore the gains lost due to the Ebola crisis (ibid).

The Government of Liberia is committed to achieving Universal Health Coverage (UHC) as a means of improving access to quality health care, including immunization for its citizens. The need to progress towards UHC has been acknowledged in national health and development policies. The country developed the Essential Package of Health Services (EPHS) for UHC in 2022, which is an important step towards achieving UHC.

1.1.4. The Health System

The health system is organized into three levels: the primary level is composed of community-based services and clinics; the secondary level is composed of health centers and hospitals serving 25,000-40,000people; and the tertiary level provides referral functions. The Essential Packages of Health Services (EPHS) define a set of interventions to be delivered at primary, secondary, and tertiary care levels, and it is expected to address a major burden of diseases affecting the Liberia population, particularly the most vulnerable[9]. The health services are free at the primary and secondary levels of care; however, these services do not have the corresponding budget to provide the EPHS which compromise the service quality[10]. The country has a line item for EPI in the health budget. The EPI budget is primarily funded by GAVI, US-CDC, WHO, and UNICEF; at the county levels, NGOs and other government partners provide supplementary funds and technical support for outreach and response to vaccine-preventable outbreaks. Regarding human resources, the Harmonized Health Facility Assessment (HHFA 2022) indicated that the national figure for the combined health cadres was 11 per 10,000 population (48%) of achieving the recommended target set by the WHO. The highest ratio was reported in Grand Gedeh and Montserrado (17 and 14 per 10,000 population, respectively), and the lowest (7 per 10,000 population) was reported in Sinoe, Grand Bassa, Bong, Maryland[11].

In 2022, the government reviewed and launched policies and strategies, such as the National Health Policy (2022-2031), the National Health Sector Strategic Plan (2022-2026), the National Health Financing Strategy (2022-2026), and the National Community Health Strategy (2023-2027). These policies and strategies all recognize and underscore the need to strengthen access to health services.

[8] Liberia Demographic and Health Survey 2019-20. Monrovia, Liberia and Rockville, Maryland, USA: Liberia Institute of Statistics and Geo-Information Services

[9] Liberia Ministry of Health, 2022; Essential Package of Health Services for Universal Health Coverage, Republic of Liberia

[10] Liberia Ministry of Health, 2022; National Health Financing Strategy 2022-2026, Republic of Liberia

[11] Liberia Ministry of Health, 2022; Liberia Harmonized Health Facility Assessment (HHFA) Report 2022, Republic of Liberia

Major health programs included in these national strategies are immunization, information, and communication with families and communities, for the most vulnerable groups: children, adolescents, families, and communities in order to ensure their survival and enable them to enjoy a healthy state of body and mind.

1.2. Immunization Status in Liberia

Equitable access to immunization is considered a fundamental right to everyone. IA 2030 positions immunization as a key contribution to people's fundamental right to the enjoyment of the highest attainable physical and mental health. The first priority of the framework for action of the IA 2030 is to ensure that the immunization program is an essential part of PHC and thereby, to vaccinate every child and contribute to UHC.

Gavi's, the Vaccine Alliance, 5.0 strategy and the IA 2030 focus on reaching marginalized groups and promoting equity in immunization (ibid). In line with the IA 2030, the overarching vision of the Gavi Alliance's 5.0 (2021-2025) strategy is "leave no one behind with immunization"[12]. The focus for Gavi investments is identifying zero-dose children and missed communities, reach these children and communities with sustainable context-specific approaches; monitor implementation; measure the effectiveness and efficiency of interventions; and advocate for these communities across the alliance.

Various studies and Liberia comprehensive EPI reviews, 2022 documented various challenges in providing vaccination for every child and in the process of introducing new vaccines, including insufficient cold chain capacity, limited human resources, and limited communication and social mobilization activities. For example, MCV2 coverage remains low, as reflected in the large drop-out rates in most countries. The reasons included that MCV2 has been introduced as the first childhood vaccine that is being delivered beyond the traditional target age for vaccination[13]. In Liberia, the coverage of MCV 1 and MCV 2 was 79% and 59%, respectively in 2022; a 20 percent points gap. However, vaccinating children with MCV2 is essential for measles elimination.

In Liberia, 13 vaccines are provided targeting major vaccine-preventable diseases (VPDs): Tuberculosis, diphtheria, pertussis, tetanus, poliomyelitis, measles, hepatitis B, Haemophilus influenza type B, yellow fever, rotavirus, pneumonia, human papillomavirus, and typhoid fever. Vaccination services are delivered at public, private, and faith-based health facilities. At the HF level, the vaccinator is responsible for the day-to-day EPI services under the supervision of the facility's officer in charge (OIC). Though the level of contributions differs from county to county, Community Health Assistants (CHAs) play a role in defaulter tracing, community mobilization, advocacy and disease surveillance[14].

According to the Immunization Root Cause Analysis Report, 2022[15], the administrative data from 2019 to 2021 showed a reduction in coverage of tracer antigens. For example, the coverage of pentavalent first dose (penta1) declined from 94% (n=166360) in 2019 to 89%% (162956) in 2021; pentavalent third dose (Penta3) declined from 87% (n =154163) in 2019 to 82% (n =146121) in 2020; and Measles-containing vaccine first dose (MCV1) declined from 85% (n =151040) in 2019 to 78% (n=139808) in 2020 and 75% (n = 136454) in 2021. The WHO and UNICEF Estimates of National Immunization

[12] Gavi.org, 2022; Program Funding Guideline; Gavi, the Vaccine Alliance
[13] Masresha BG, et al, 2018. Introduction of the Second Dose of Measles Containing Vaccine in the Childhood Vaccination Programs Within the WHO Africa Region - Lessons Learnt. J Immunol Sci. 2018 Jul 28; Suppl:113-121.
[14] Liberia Ministry of Health. Comprehensive Expanded Program Review, 2022. Republic of Liberia
[15] Liberia MoH, 2022; the Immunization Root Cause Analysis Report; MoH, EPI Division, Republic of Liberia

Coverage (WUENIC) data also revealed significant decline in Penta3 coverage from 80% in 2018 to 70% in 2019 and to 65% and 66%, respectively in 2020 and 2021 (WUENIC, 2018, 2021). WUENIC 2021 estimated 29,523 zero-dose infants (18% of surviving infants) in 2021. The analysis of the District Health Information Systems (DHIS) 2018-2021 for zero-dose children showed 6 districts with negative zero-dose (penta1 coverage >100%) out of 15 districts. Coverage over 100% can be a signal of poor data quality and/or inaccurate population data. However, the data can still point out the districts with the highest number of zero-dose children, which is Montserrado with 39,832 zero-dose children, followed by River Gee (4039) and Gbarpolu (3653).

The Institute for Health Metrics and Evaluation (IHME), 2020 indicated that almost 40% of zero-dose children live in 13% of districts in Liberia, and proportion of zero-dose children appear to be highest in Grand Bassa, Sineo, and Margibi[16]. It is also estimated that 14% of under-5 deaths are associated with households with a zero-dose child (ibid).

The CER, 2022 report indicated strong commitment and dedication by health workers to ensure the children in the community were vaccinated[17]. The report also identified good integration of health interventions with immunization services at all levels, for example, with growth monitoring and vitamin A supplementation.

The CER 2022 also identified barriers and weaknesses to an equitable and quality vaccination service delivery and missed opportunity for vaccination that included long distances and travel time to health facilities (HFs) or geographic inaccessibility, EPI staff shortages at the county, district, and HF, stockouts of vaccines, and health worker misunderstandings of the wastage policy. For the most part, the incomplete and/or delayed vaccination sessions were attributable to prolonged stock outs of vaccines and supplies, and insufficient transportation that may extend for several months (Ibid). The report showed that there was insufficient storage capacity and non-operational fridges in some counties, and there were no fridge tags in the counties visited by the CER team. These findings were affirmed by the Immunization Root Cause Analysis Report, 2022.

Accessibility within the country is very difficult, especially when traveling from the county capitals to reach some inaccessible districts. The rainy season extends almost nine months of the year, and the communications network is very limited that necessities to develop context-specific strategies to identify and reach zero-dose and under-immunized children.

The knowledge, attitude, and practice (KAP) surveys of 2017 and 2020 presented increasing positive attitudes and acceptance of vaccination services among caregivers and communities. The surveys recorded a significant increase from 76% to 99.7% of caregivers believing that vaccination is beneficial to children in 2017 and 2020, respectively[18]. The most trusted and effective sources of information on vaccination reported by interviewees were health workers, followed by community health volunteers[19], hence there is a need to build the capacity of health workers and community volunteers through trainings. The immunization root cause analysis, 2022 also found that town chief, vaccinators, and posters placed on the walls of public places were the main sources of information for care givers or mothers. Vaccine hesitancy from caregivers/parents mainly arises from limited access to

[16] Liberia zero-dose analysis by Gavi, 2022 from the Institute of Health Matrices Evaluation, 2020
[17] Liberia MoH, 2023; Comprehensive Immunization Review, Republic of Liberia
[18] Liberia MoH, 2017 and 2020, Immunization Knowledge, Attitude and Practice Survey Reports, Republic of Liberia
[19] Liberia MoH, 2019, Missed Opportunities for vaccination among children 0-11 months in Liberia, 2019

information about the use of vaccines and rumors about vaccine quality or adverse events following immunization that led to low uptake of immunization services (Ibid). This needs to be addressed by using appropriate and context-specific behavioral change communication approaches to overcome the demand-side barriers to childhood immunization.

1.3. Equity in Immunization through Strengthening the PHC

Vaccines must reach every child, no matter where they were born, who they are, or where they are living[20]. It means reaching children in the three areas identified as facing obstacles to immunization: remote rural villages, informal urban settlements, and conflict areas where half of the zero doses are believed to exist. It also means reaching zero-dose children living in places where barriers to vaccination may not be obvious, often no more than an hour from the nearest health centre (Ibid). For example, the State of the World's Children report, 2023 indicated that in the poorest households, 22.6% of children were zero-dose children compared to the wealthiest group of 4.9%. West and Central Africa presented the largest gap between rich and poor: 48.6% of children from the poorest households were zero-dose children, compared with 6.3% of children in the wealthiest[21]. In addition to poverty, location plays a significant role in whether a child is immunized. In the 74 low- and middle-income countries analyzed by UNICEF, 9.4% of children in urban areas were zero-doses whereas 15.1% of children in rural areas were zero-doses. In general, the gaps between rural and urban were widest in low-income countries and negligible in upper-middle income countries (Ibid). In Liberia, the coverage of DPT3 for children from the poorest and the richest households was 29.8% and 71.9% in LDHS 2007 and 59.8% and 75.7% in in LDHS 2019, narrowed from 42.1% per cent points in 2007 to 15.9 percent points in 2019 [22].

The IA 2030 emphasizes the importance of embedding national immunization services within PHC as the basis for achieving both high vaccination coverage and UHC[23]. For the most part, zero-dose and under-vaccinated children experience multiple other health deprivations[24]. Indeed, zero-dose children often have mothers who had no or few antenatal care visits and did not deliver the baby in a health-care facility.

Outreach services and campaigns are also used for reaching of zero-dose and under-immunized children and to address outbreaks of vaccine-preventable diseases (VPDs). Many campaigns have successfully immunized zero-dose children and have increased coverage above what was achieved by routine services (ibid).

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[20] Cesar Victora and Aluísio Barros of the International Center for Equity in Health at the Federal University of Pelotas, Brazil conducted an analysis for *the State of the World's Children 2023* report.
[21] UNICEF, 2023. The State of World Children, For Every Children
Vaccination Liberia MoH, 2017 and 2020, Immunization Knowledge, Attitude and Practice Survey Reports
[21] Liberia MoH, 2019, Missed Opportunities for vaccination among children 0-11 months in Liberia, 2019
[21] Cesar Victora and Aluísio Barros of the International Center for Equity in Health at the Federal University of Pelotas, Brazil conducted an analysis for *the State of the World's Children 2023* report.
[21] UNICEF, 2023. The State of World Children, For Every Children Vaccination

[22] Liberia Demographic and Health Survey 2019-20. Monrovia, Liberia and Rockville, Maryland, USA: Liberia Institute of Statistics and Geo-Information Services
23 Akwataghibe, Ngozi N., et al., 'Using Participatory Action Research to Improve Immunization Utilization in Areas with Pockets of Unimmunized Children in Nigeria', Health Research Policy and Systems, vol. 19, suppl. 2, art. 88, 2021
[24] Crocker-Buque, Tim, et al., 'Immunization, Urbanization and Slums: A systematic review of factors and interventions', *BMC Public Health*, vol. 17, art. 556, June 2017, p. 12,

Integrating vaccination into PHC and other services is part of the seven strategic priorities set out in the IA 2030[25]. This integration offers a cost-effective avenue to reach children and mothers who have missed out on immunization and other basic services (Ibid). Integration of services and strategies, such as (health, nutrition, WASH, etc.) strengthens not only routine immunization within the country but also the delivery of other PHC services[26].

Strengthening the PHC is an avenue for the UHC. By improving access to basic health services, particularly for the poor and vulnerable, UHC is also fundamental to achieving other Sustainable Development Goal (SDG) targets related to poverty alleviation, promoting quality education, achieving gender equality, and women's empowerment.

1.4. Left Behind: Zero-dose and Under-vaccinated Children

Vaccination coverage varies widely among and within countries. In some countries, progress has stalled or even reversed due to COVID-19, which has undermined the past achievements (ibid). The WUENIC, 2021[27] showed the health systems have been strained by COVID-19 in 2020 and 2021, resulting in 25 million missing out on vaccination six million more than in 2019, and the highest number since 2008. Essential immunization service coverage dropped in all WHO regions during the pandemic.

The number of children who are never reached by essential immunization increased sharply during the pandemic in each of two years. The number of zero-dose children missing out any vaccine increased by 5 million in 2021 compared with 2019, going from 13 million to 18 million. Zero-dose children lack DTP, which indicates that they are not served through routine services, although they may be reached through disease-specific Supplemental Immunization Activities (SIA). These are children who did not receive the first dose of the DPT-containing vaccine and are probably facing multiple deprivations. They are likely to miss out on other essential health services as well.

Significant efforts will be needed to recover from the strains experienced during the pandemic, catch up on missed children, and sustain immunization as an essential health service. As stipulated in IA 2030, to access immunization services, vaccines must be delivered to areas that are isolated geographically, culturally, socially, or otherwise, and to marginalized populations such as displaced people and migrants, as well as, those affected by conflict, political instability, and natural disasters. The causes of low vaccine use must be understood and addressed in order to increase people's demand for immunization services. Adequate, predictable supplies of appropriate, affordable vaccines of assured quality must be available at points of service delivery, and stock-outs must be avoided. Besides, tailored strategies are necessary for understanding and overcoming barriers to vaccination.

The IA 2030 and Gavi 5.0 strategy for 2021-25 aim to reduce the number of zero-dose children in Gavi-eligible countries by 25% by 2025 and 50% by the year 2030; both recognize the critical importance of addressing inequities across and within countries for the global immunization goals to be achieved. Use high-quality and fit-for-purpose data to identify zero-dose and under-vaccinated children and inform and guide action and invest in new technologies and approaches to make vaccines more granular. Develop an individual child health record system to monitor outcomes, including a community's vaccine status, and monitor progress and needs with publicly accessible dashboards in order to improve identification and reaching of zero-dose and under-immunized children (ibid).

[25] Oyo-Ita, A., et al., 'Effects of Engaging Communities in Decision- Making and Action Through Traditional and Religious Leaders on Vaccination Coverage in Cross River State, Nigeria: A cluster-randomised control trial', PLoS ONE, vol. 16, no. 4, 2021

[26] [26] IA, 2030, Strategic Plan4, Life Course and Integration

[27] WHO/UNICEF Estimates of National Immunization Coverage (WUENIC, 2021)

1.5. Gender Related Barriers and other Social Determinants of Immunization

Immunization is widely perceived as gender-neutral; however, in many countries, there are gender barriers and underlying power dynamics at the household and community levels. Gender barriers influence resource allocation, decision-making, women's mobility, their lack of access to health centers and time limitations outside of household chores[28].

Gender-related barriers operate at multiple levels, from the individual and household to the community and health systems, and are underpinned by power relations, leading to different obstacles, limitations, challenges, needs, and vulnerabilities, especially for women and girls, which in turn affect both the access to and provision of vaccines (ibid). The benefits of integrating gender into health can improve immunization and other health services coverage that improves overall health outcomes. Effective gender-responsive programming in the immunization and other health services can contribute to progress towards gender equality and positive health outcomes.

The desk review report on gender-barriers to immunization in Liberia indicated approval/consent from fathers, who are mostly considered the head of the home and final decision-maker was a key gender-related barrier to immunization[29]. The CER 2022 also showed that fathers make decision about child vaccination, especially as it relates to providing transport for the child and mother to go to the HF. Vaccination interventions have always targeted women, overlooking the role of promoting inclusivity and sharing responsibilities with men. However, recent messages have targeted male involvement in immunization. Male involvement is being encouraged in the country, and there are some progresses in males/fathers' involvement.

The CER 2022 report recommended that social mobilization, health promotion, and community-based interventions are critical to addressing gender-related barriers to immunization and healthcare access. To increase immunization coverage and equity, gender must be explicitly considered as an integral part of the initial design, implementation, monitoring and evaluation of immunization interventions and policies (ibid). The Gavi immunization Full Portfolio Planning (FPP) also emphasizes gender equity and tackling the gender-related barriers that limit immunization demand, coverage and impact as an essential component to address zero-dose and under immunized children [30].

In general, certain specific communities or population subgroups are continuously not served and fall outside the health system, even when the health system is functioning, and services are provided nearby. According to the UNICEF guidance note on Coverage and Equity Assessment (CEA) for the immunization program.[31] determinants that merit special attention include:

- Gender-related barriers to vaccination: These exist in all countries, but their relative importance can be very different between countries and across different communities.
- Nomadic and pastoralist populations: The CEA report should inform about the size of these populations and to what degree they are under-vaccinated.
- Remote rural and topographically or seasonally isolated populations:

[28] UNICEF Regional Office for South Asia (ROSA), 2019; A practical Guide to Integrate a Gender Lens into Immunization Programs
[29] Liberia MoH, Report on Desk Review of Gender-barriers to Immunization in Liberia
[30] Gavi.org, 2022; Program Funding Guideline; Gavi, the Vaccine Alliance
[31] UNICEF, 2019; Guidance Note on Coverage and Equity Assessments for Immunization Programs

- Refugees, people working and living in far-flung industrial zones, such as mining areas, internally displaced people and populations affected by insecurity and conflict represent a growing proportion of the under-vaccinated globally.
- Urban poor populations are growing in many countries and are at risk of under-vaccination despite physical access to services.

1.6. Gavi Immunization Full Portfolio Planning (FPP)

Since 2021, the Gavi Alliance has proposed a common framework for countries to design tailored programs to reach zero-dose children and missed communities through the FPP process. Countries are encouraged to plan an integrated request for support across all of the support types, such as the Health Systems Strengthening (HSS), Equity accelerating fund (EAF), Targeted Country Assistance (TCA), Cold Chain Equipment Optimization (CCEOP) and New Vaccine Support (NVS) that they will need during their 3–5-year grant period[32]. Whatever support is anticipated for the immunization program, it should be included in the FPP. This helps countries for better coordination and efficiencies across support, and less duplicated costs. The primary focus of the Liberia CEA is to inform the Gavi FPP process and the development of Gavi grant applications.

Gavi 5.0 has several key shifts to deliver on its mission, including a core focus on reaching "zero-dose" children and missed-communities, with equity as the organizing principle. It emphasizes more differentiated, tailored and targeted approaches for Gavi-eligible countries, including Liberia; an increased focus on programmatic sustainability; and providing limited and catalytic support. Equity and zero-dose are focus areas within Gavi's grant support across the portfolio. Gavi's strategy and funding have been highly targeted towards overcoming barriers to reach zero-dose and missed communities, which is increasingly reflected as a priority within Gavi's grant support (ibid).

The Gavi zero-dose analysis card is the tool to identify zero-dose and under-immunized children and missed communities; the framework included Identify, Reach, Measure, Monitor and Advocate (IRMMA)[33], as shown in Figure 2:

[32] Gavi.org, 2022. High-Level Introduction to Gavi's Application Materials and Guidelines

[33] Gavi, 2022. The Gavi Zero-dose Analysis Card, Gavi the Vaccine Allinance

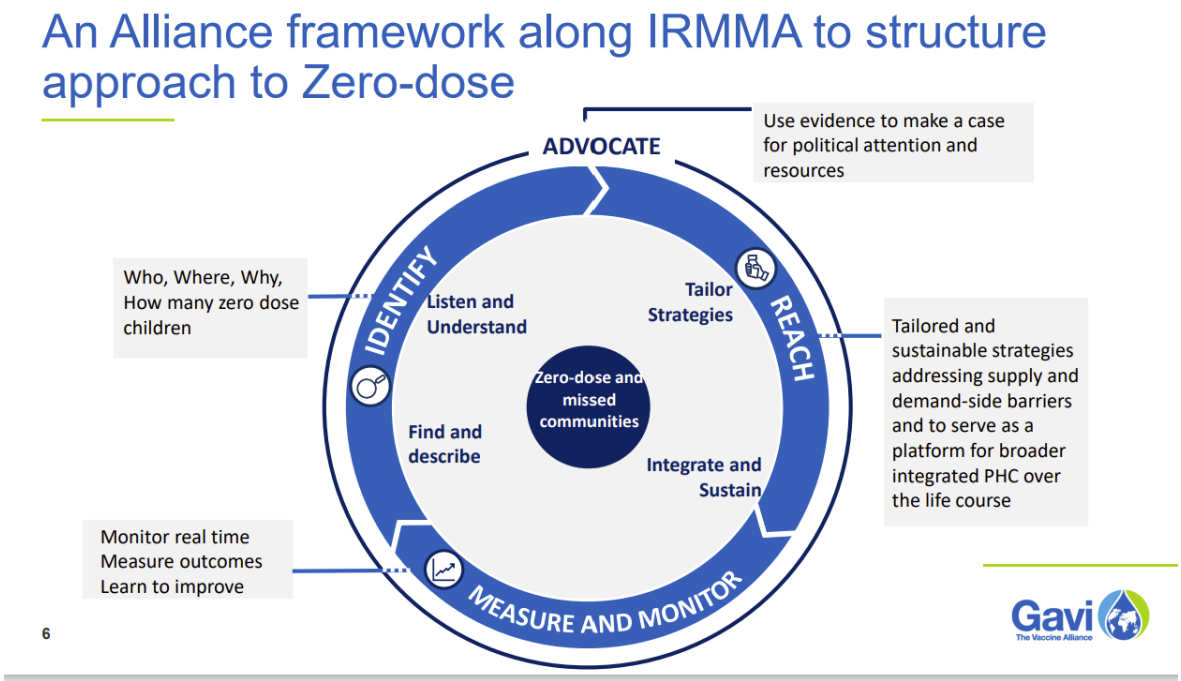

***Figure 2*: Gavi IRMMA framework**

Identify: find and describe who, where and how many: A clear understanding of how many zero-dose children and missed communities there are, who and where they are, and why they have not been reached.

Reach: tailor strategies, integrate and sustain: Develop and implement tailored and sustainable strategies to address supply and demand-side barriers from the identify step to ensure zero-dose children and missed communities are reached with immunization and other high impact child health interventions in different settings and to serve as a platform for broader integrated PHC.

Monitor: Ongoing monitoring to assess if immunization and programmatic strategies, as defined in the REACH step, are achieving the objectives and outcomes and which course correction measures need to be implemented.

Measure (And learn): Evaluation of effectiveness and efficiency of immunization programs in reaching zero-dose children and missed communities, as well as, enable to understand how high impact child health interventions are delivered through integrated services.

Advocate: Use evidence to make immunization a case for political attention and resources to secure commitment to prioritize reaching zero-dose children and missed communities with immunization.

The key target of FPP is Identifying and reaching zero-dose and under immunized children and missed communities with sustainable context-specific approaches; monitor implementation; measure effectiveness and efficiency of interventions; and advocate for these communities across the Alliance. The selected strategies and interventions should be evidence-based or appropriate for specific locality or community with a human centered design that is informed by local experience and knowledge[34].

[34] UNICEF, 2020. Embedding A Human Centered Design Approach in Sub-national Coverage and Equity Assessment

This immunization coverage and equity analysis of Liberia analyzed barriers for child vaccination, the immunization coverage trends, zero-dose and under vaccination status, and trends by equity indicators from the primary data collected through the quantitative and qualitative methods and secondary data, including the DHS and WUENIC. It is critical that the proposed strategies are informed by sound assessments of coverage and equity gaps within the country, and that the interventions are effective and target geographical areas and communities where the immunization coverage is lowest and inequities most pronounced[35]. This ultimately enables to identify and reach zero-dose and under-vaccinated children.

1.7. Objectives

The general objective of this immunization Coverage and Equity Analysis (CEA) is to assess the drivers, bottlenecks and coverage and equity trends for immunization program in Liberia and propose corrective measures.

Specific objectives, include the following:

- To assess drivers and bottlenecks of the immunization program that can help to develop context-specific strategies;
- To analyze coverage status and trends of immunization of Liberia;
- To describe the disparity in coverage of selected immunization indicators across different equity dimensions in Liberia; and
- To propose priority interventions for the gaps identified.

2. Methodology

2.1. Study setting

Liberia is a West African country with a total population of more than 5 million. It is divided into five health regions, with 3 counties each per region (Region1: Bomi, Gbarpolu, and Grand Cape Mount, Region 2: Montserrado, Grand Bassa, and Margibi; Region 3: Bong, Lofa, and Nimba; Region 4: Grand Gedeh, Rivercess, and Sinoe, and Region 5: Maryland, Grand Kru, and River Gee Counties). Each county is further sub-divided into districts, which are, in turn, split up into clans. The assessment was conducted in 12 of the 15 counties of the country. Three counties (Gbarpolu, Montserrado, and River Gee) were excluded since a similar study was already conducted in said counties in April 2023 and the findings from these three districts summarized and incorporated within this assessment.

2.2. Study Population

The study population was categorized at national, county, HF and community levels. The county-level study population included the County Health Officer (CHO)/Child Survival Focal Person (CSFP)/County Cold Chain Officer (CCO). At the HF level, the study participants included the vaccinator/Officer in Charge (OIC) and two (2) Community Health Assistants from two (2) zero-dose communities of the two selected facilities within the county. At the community level, the community leaders, parents/caregivers between the ages 15 and 49 years who had children under 59 months old, and other general community members participated in the study.

[35] UNICEF, 2019; Guidance-Note on Coverage and Equity Assessments for immunization Program

2.3. Study Design

A cross-sectional study design that employed mixed methods of quantitative and qualitative approaches was used to assess the relevant information for various study subjects. Secondary data analysis was also conducted from publicly available data to determine the coverage, trends and equity of immunization in Liberia. Desk review of strategic documents, such as the health sector policy and plan and national immunization design, surveys, annual reports, comprehensive EPI review report, and other documents (grey and published literature) conducted to understand the immunization program performance and challenges and possible solutions. Relevant documents, including the Comprehensive EPI Review report (2022), Root Cause Analysis (2022), and Harmonized Health Facility Assessment (2022), Liberia Demographic and Health Survey 2019, and other documents reviewed at the national level. The zero-dose analysis report conducted by Jhpiego, in-collaboration with MoH and other partners in April, 2023 reviewed and the findings incorporated with this assessment.

A review of trends in immunization coverage data disaggregated by HF, district, and county levels for the years (2018-2022). The primary data collected at county and HF levels were analyzed. In addition, observations were made on immunization service provision (immunization sessions), reporting, cold chain, logistic management, and national and sub-national level meetings to finalize the results of the assessment.

UNICEF engaged a consultant to support the MoH and all EPI stakeholders with the process of conducting the CEA design, data collection, analysis and report writing.

2.4. Sampling and Sample Size

The assessment conducted among 12 counties and 24 HFs among (15) counties, namely: Grand Cape Mount, Bomi, Margibi, Grand Bassa, Rivercess, Sinoe, Grand Kru, Maryland, Grand Gedeh, Nimba, Bong, and Lofa were selected purposively; a similar assessment was recently conducted in the remaining three counties that the summary findings merged with this study. The selection of HFs for the assessment is mainly informed by the high number of zero-dose children, and using the criteria below:

- High number of zero-dose children,
- High unmet need for immunization and other childhood services,
- Presence of communities that are hard to reach (missed communities); according to Gavi 5.0 missed communities are homes for a cluster of zero-dose and under immunized children
- Epidemiological characteristics or trends, and
- Geographical or physical terrain (urban vs rural)

2.4.1. Sample Size for Quantitative Component

In each of the 12 counties, 2 HFs (with a high number of zero-dose children) were purposively selected. The county health team members participated in the selection process of HFs included in the assessment. A total of 24 Officer in Charges/Vaccinators were assessed from the 24 selected HFs.

2.4.2. Sample Size for Qualitative Component

For qualitative assessment, the key informant interviews (KIIs) and focus group discussions (FGDs) were conducted in five counties purposefully selected with a high number of zero-dose. These five counties (Grand Cape Mount, Lofa, Grand Gedeh, River Cess and Grand Bassa) were identified based on the routine immunization data from the DHIS 2. The KIIs were conducted among Community Health

Assistants (CHAs) in 10 communities with a high zero-dose children in similar counties. Therefore, 10 KIIs were conducted with 10 CHAs in 10 communities (2 communities from 5 selected counties) with a high number of zero-dose children. Similarly, FDGs were conducted in two (2) communities with a high number of zero-dose children from the five counties. Therefore, a total of 10 FGDs were conducted (Table 1). The FGDs targeted community leaders, mothers/caregivers of under-five children and general community members in a HF catchment community. Every FGD consisted of 8-12 participants.

***Table 1*: Detail distribution of samples for the study.**

County	**KIIS (CHAs)**	**FGDs**	
		Parents of Children < 2 years	General Community
Lofa	2HF (High number of zero-dose children)	1	1
Grand Cape Mount	2HF (High number of zero-dose children)	1	1
Grand BassaGrand Bassa	2HF (High number of zero-dose children)	1	1
River Cess	2HF (High number of zero-dose children)	1	1
Grand Gedeh Gedeh	2HF (High number of zero-dose children)	1	1
Total	10 KIIs	5 FGDs	5 FGDs

2.5. Data Collection Tools and Sources

Both primary and secondary data sources were employed for the assessment. The primary data tools was developed through stakeholder engagement. The MoH staff from the Health Information Systems, Monitoring, Evaluation, and Research (HMER) and EPI division supported by UNICEF, WHO and other partners, reviewed and approved the generic quantitative questionnaire available to conduct the immunization assessment. This assessment used the Gavi zero-dose analysis card to design the questionnaire for the assessment, and the Gavi Identify, Reach, Measure, Monitor and Advocate (IRMMA) framework used for the preparation of proposed corrective actions or recommendations. The final quantitative questionnaire that was adapted to the country's context was used to collect data from the county, district, and HF. The real-time quantitative data collection was done using gadget tool.

The national CEA team also revised the draft questionnaire for the qualitative data collection tools of the assessment. The qualitative data was collected through interviews with a relevant person (key informant interview), document, and report review at the national, county, and HF, as well as, Focus group discussion (FGD) at the community level.

The recent three round LDHSs and ten years WUENIC (2013-2022) estimates were the two secondary data sources used in the present assessment, along with review of other relevant documents.

2.5.1. Questionnaire for Quantitative Method

The quantitative data collection tool, the questionnaire, was used to gather information from the county, and HF, which was adapted from Tanahashi framework to assess the health system bottlenecks, including supply, service delivery, demand, quality, and enabling environment for EPI in Liberia. The questionnaire was pre- tested before the actual data collection and refined to achieve the purpose of the assessment. The quantitative questionnaire was designed to include demographic data, cold chain, vaccines and supplies, human resources, estimated workload, geographic accessibility, vaccine safety, vaccination coverage, antenatal consultations, planning and financing, supervisions, monitoring and disease surveillance, community participation and key child and adolescent health interventions, among others. The final questionnaire was uploaded in the gadget tool to collect real-time data through the electronic device (gadget). The field team leads, or supervisors were responsible for overall supervision, including the electronic data collection and daily report submission to the central server.

2.5.2. Data Collection Tools for Qualitative Method

The KII and FGD guides were developed to explore barriers and drivers of immunization coverage and equity focusing on vaccines and other child health services availability, service delivery, demand, data management and social and gender related barriers and enablers. Information about inequalities associated with context-specific determinants are often best captured by the KII and FGD.

2.6. Training of data collectors

A 3-day training was provided to data collection team (supervisors and interviewers) from October 16-18, 2023. The MoH supported by partners recruited and trained 23 experienced enumerators, including supervisors who are experienced in supervision of the field data collection activities. The training was focused on equity in immunization, overview of the CEA, the Gavi framework and zero-dose analysis card, qualitative and quantitative data collection approaches, ethics and roles and responsibilities at the field/data collection sites. The national assessment team developed data collection template in excel sheet, trained and provided orientation of the data collection team on the use of the tool (gadget).

The trainees practiced with the KII and FGD guides and the survey tool/gadget was pre-tested at HF in Montserraodo, and feedbacks incorporate into the final version of the guides. For the field data collection, the data collectors were grouped into six teams and every team had four members and a supervisor. Additionally, 3 regional mentors, 1 national study lead and 1 information technology expert supported the gadget programming and the whole assessment process.

2.7. Data collection, management, and analysis

2.7.1. Data Collection and Management

The field data collection lasted for a period of 18 days from October 22, 2023. The gadget was used by field teams to collect and transfer real-time data to the national level server. The qualitative data was collected using voice recorders and by writing notes on the responses from participants.

The field team members collected data at assigned levels, consolidated the findings, presented findings to sub-national teams, and transmitted data to the national level. The field team lead/supervisor was responsible for data collection, entry, reporting, and writing a summary of field findings, sub-national debriefing; and preparing a synthesis of findings. The national CEA team also facilitated the generation of data from the designed questionnaires in ODK platform/gadget and monitored data quality and online submission.

2.7.2. Data Processing and Analysis

For the quantitative data, ODK software was used to collect and share data, and the data processing, cleaning and analysis were conducted using SPSS and STATA latest versions. Accordingly, descriptive and bottleneck analyses were conducted from primary data sources and coverage and equity analyses were also conducted using the secondary data, including WUENIC and the three round LDHS data.

The qualitative data was transcribed and organized into various themes. The transcription was done by listening to the audio and reading the field report from the data collection team. The transcribed data were analyzed to triangulate findings from the quantitative assessment. The qualitative data also enabled to gain deep insights into the coverage and equity of immunization services, as well as determinants of immunization equity, including social and gender-related barriers. This helped to propose and design appropriate interventions to identify and reach zero-dose and under-immunized children and missed communities.

The Tanahashi model was adapted to the local context and used to analyze the bottleneck for immunization services. The model organizes supply-side and demand-side barriers, quality and enabling environment in order to assess health system bottlenecks, coverage, equity, as well as, zero-dose analysis.

2.8. Report Writing and Feedback Sessions

The national assessment team cleaned and analyzed both the primary and secondary data and prepared the report. By collating all reference materials and relevant program documents, conducting the desk review, and analyzing data collected in the field, the team produced the first draft of the report and shared it with EPI partners for their input. The report provides detailed information on vaccination coverage and trends in inequalities, analyzed by equity markers and geographical settings. During the county level feedback sessions by the field team, all key EPI stakeholders at local level engaged and work together in the processes of: Identifying and validating system bottlenecks, identifying and validating hard-to-reach communities within the county, conducting causal analysis on system bottlenecks and hard-to-reach communities and proposing remedial actions and solutions.

MoH, in collaboration with partners, organized the national level dissemination and validation workshop in order to get further input. The objective of the one-day national level meeting was to validate the findings of the CEA and proposed actions that will improve the implementation and monitoring of selected high impact interventions. The report also shared and presented to UNICEF regional office and head quarter for their input and validation. The national CEA team accommodated the comments provided from all stakeholders through iterative approach and developed the final consolidated report on immunization coverage and equity analysis of the country, including concrete and actionable recommendations.

3. Findings

3.1. Descriptive analysis findings

3.1.1. Demographic Characteristics of Sample Counties

Out of 12 counties assessed, three counties Nimba (20%), Bong (15%) and Lofa (12%) comprise close to half (47.7%) of the population while Grand kru, Revercess and Bomi counties constitute only 9.5% of the population (Figure 3). Thus, the proportion of the zero dose and under vaccinated children is likely to follow the population distribution. However, those counties with sparse settlement have more challenging access to immunization.

In densely populated counties, strengthening the immunization system can be easier compared to thinly distributed counties.

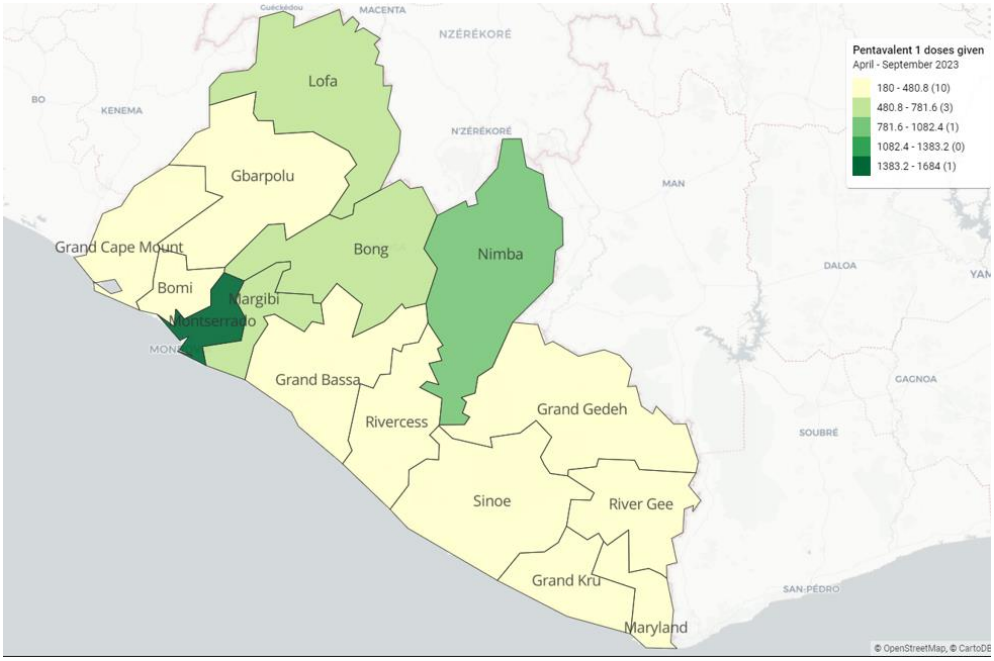

Figure 3: Population Distribution by Country (Source: HMER MOH)

3.1.2. Supply Side Related findings

The supply-side includes availability of commodities, including availability of cold chains, vaccines, and related supplies, trained human resources per HF and geographic accessibility and means of transportation.

3.1.2.1. Cold Chain, Vaccines, and Supplies

Table 2 below depicts the availability of functional refrigerators, whether the temperature is within an acceptable range, and availability of at least two functional vaccine carriers by county and HFs. Out of the 12 counties and 24 HFs assessed, all counties and 22 (91.7%) of HFs reported the availability of refrigerators and two HFs reported the unavailability of refrigerators. Among the 22 HFs that reported availability of refrigerator 21 (95.5%) of the HFs had functional refrigerators. The temperature reading during the assessment was within an acceptable range that is between 2°C and 8°C in all counties and 19 (90.5%) HFs while the temperature reading was not documented for more than six months in one HF. At least two functional vaccine carriers were available in 11 out of 12 counties and 22 out of 24 assessed HFs. The availability of cold chain equipment and proper temperature monitoring of cold chain equipment are critical to provide immunization services.

Table 2: Cold Chain Status of Sample HFs in the Past Six Months

Cold chain status (April-September 2023)		Counties		HFs	
		N	%	N	%
At least one refrigerator	Available	12	100	22	91.67
	Not available	0	0	2*	8.33

	Total	12	100	24	100
Functionality of available refrigerators	Functional	12	100	21	95.45
	Not functional	0	0	1	4.55
	Total	12	100	22	100
If functional is temperature reading at 2-8°C	Yes	12	100	19	90.48
	No	0	0	1	4.76
	Not working	0	0	1**	4.76
	Total	12	100	21	100
At least two functional vaccine carries	Yes	11	91.67	22	91.67
	Not always	1	8.33	2	8.33
	Total	12	100	24	100

Note: *Was not available for 150 days; ** was not working for 184 days

3.1.2.2. Vaccine Stockout Status

Vaccine stockout status was assessed at the county and HF levels. Table 3 shows the vaccine stock status for six months prior to the assessment at county and HF level. Out of the assessed 12 counties and 24 HFs, 11 (91.7%) and 16 (66.7%) counties and HFs respectively experienced one or more vaccine stock-outs during the six months prior to the survey. During the reporting period, stock out for almost all antigens reported at county and HF levels. The three antigens with the longest average number of stocks-out days at the county and HF level were BCG, OPV, and Td vaccines. This was due to supply chain challenges related to delay in accessing funding for timely procurement of traditional vaccines. However, the Pfizer vaccine experiences the longest stockout days for more than 60 days at county and HFs, which was due to increased stock volume of the alternative COVID-19 vaccine, J and J that has short shelf life.

Table 3: Vaccine Stock-out Experience within Sampled HFs in the Past Six Months

Vaccine stockout status (April-September 2023)		Counties		HFs		Average number of days stockout experienced in the past six months	
		N	%	N	%	Counties	HFs
Vaccine stock-out experienced	Yes	11	91.67	16	66.67		
	No	1	8.33	8	33.33		
	Total	12	100	24	100		
BCG	Yes	7	63.64	7	43.75	62	44
	No	4	36.36	9	56.25		
	Total	11	100	16	100		
Rota	Yes	2	18.18	3	90.48	3	28
	No	9	81,82	13	4.76		
	Total	11	100	16	100		
PCV	Yes	3	27.27	-	-	37	-
	No	8	72.73	-	-		
	Total	11	100	-	-		
IPV	Yes	4	36.36	1	6.25	24	30
	No	7	63.64	15	93.75		
	Total	11	100	16	100		
OPV	Yes	8	72.73	11	68.75	58	41
	No	3	27.27	5	31.25		
	Total	11	100	16	100		

Td	Yes	7	63.64	3	18.75	39	45
	No	4	36.36	13	81.25		
	Total	11	100	16	100		
HPV	Yes	6	54.55	9	56.25	40	31
	No	5	45.45	7	43.75		
	Total	11	100	16	100		
TCV	Yes	1	9.09	1	6.25	58	30
	No	10	90.91	15	93.75		
	Total	11	100	16	100		
J&J	Yes	1	9.09	2	12.50	15	175
	No	10	90.91	14	87.50		
	Total	11	100	16	100		
PFIZER	Yes	2	18.18	5	31.25	181	163
	No	9	81.82	11	68.75		
	Total	11	100	16	100		

The FGD and KII participants also mentioned that their children may not be vaccinated at their first HF visit because of sometimes stock out of vaccines at the HFs and health workers may reschedule them for not opening the vials for limited number of children for BCG and measles vaccines because of fear of vaccination wastage.

"*Sometime when we take our babies to HFs, they may say there is no vaccines available for that day. Therefore, we are required to return on another day. It is not enjoyable because the HF is far from our location. When we go to the HF carrying our babies and they (the health workers) inform us that there are no vaccines, we cannot be happy to return home without vaccination our children.*" FDG participant from Konoma community, Garwula district

"*Sometimes when we go to HFs for vaccination, they don't open the vaccine vial until they get five or more children; They will ask us to sit down, and we wait until other people come and join us. This approach may not be always successful, and there is a possibility that we may have to return home without vaccinating our children*" FDG participant from Balahun community, Kalahun district

The Liberia CER, 2022 and Immunization Root Cause Analysis, 2022 reports also indicated insufficient storage capacity, and non-operational fridges in some counties. The Liberia RI route cause analysis for low coverage, 2022 showed that out of the 20 HFs assessed, 42% had stock-out of measles and 37% had stock out of BCG vaccine as there were funding constraint to procure traditional vaccines which was later procured with funding from World Bank. IPV and Td vaccines were the only vaccines that had not been out of stock during the assessment period. However, the finding further reveals that there was stock out of other vaccines, such as Penta (11%), OPV (5%) and Rota (5%) by a few numbers of HFs. Vaccine stock out, regardless of the cause, can increase the missed opportunity for vaccination and lead to client dissatisfaction during repeated visits if vaccination service is not provided during the initial contact due to either lack of vaccine or not opening of the vaccine vial to minimize wastage.

3.1.3. Human Resources and Training Related Findings

3.1.3.1. Health Human Resource Availability

The availability of health workers and community health workers working and involved in immunization areas during the six months prior to the survey and whether they have received trainings within the past 2 years were assessed from study counties and HFs. Table 4 below depicts the number

of health workers and community health workers involved in immunization and received training related to EPI within two years prior to the survey that included Inter Personal Communication (IPC), Immunization in Practice (IIP) and immunization Mid-Level-Manager (MLM) trainings. The number of health workers and community health workers involved in immunization significantly varies by county. The total number of health workers involved in the assessed counties is 294 ranging from 2 in Rivercess to 172 in Nimba. Among the 294 health workers involved in the immunization activities, 160 (54.4%) received training on immunization two years prior to the survey. Similarly, it was reported that a total of 6,208 community health workers involved in immunization activities ranged from 4,202 reported from Nimba to only one from Grand Cape Mount and Lofa counties.

Among the community health workers involved in the immunization, only 1141 (18.4%) received training during the period of two years prior to the survey. The distribution of health workers and community health workers should be proportional to HFs and population. In many instances, the maldistribution of health workers and community health workers is common. Some counties with better infrastructure and socioeconomic development often have high concentration of health workers, while the remote rural areas and counties with less socio-economic, development and low infrastructure have a lower number of health workers.

Table 4: Average Number of Health Workers Participated in Immunization training the past six months of the Assessment

Name of the County	#Health worker involved in immunization during the past six months	#Health worker involved in immunization and trained in the past 2 years	# Community health worker involved in immunization during the past six months	#Community health worker involved in immunization and trained in the past 2 years
Bomi	9	0	177	177
Bong	10	2	3	0
Grand Bassa	9	4	400	-
Grand Cape Mount	3	1	1	0
Grand Gedeh	10	2	288	0
Grand Kru	5	2	122	122
Lofa	4	3	1	1
Margibi	12	12	260	260
Maryland	4	0	263	263
Nimba	172	131	4202	22
Rivercess	2	3	296	296
Sinoe	54	0	195	0
County level total	294	160 (54.4%)	6208	1141 (18.4%)
HFs level total	80	27 (33.8%)	340	118 (34.7%)

The CER, 2022 also analyzed the performance of human resources component across different levels of the health system that showed the highest performance at the national level (57.6%), followed by the county level (56.2%), and (48.8%) at the HF level.

Availability of human resources is an essential pillar to improve immunization services and to maximize access the immunization service to zero-dose and under-immunized children.

3.1.3.2 Health Workers Training Status

Health workers technical and communication skill is critical to providing quality immunization services. The immunization mid-level managers training for immunization managers at county and above levels, and immunization in practice and interpersonal communication/counseling trainings for immunization service providers are essential to provide quality and equitable immunization services. Table 5 below shows the number and proportion of health workers at county and HF levels who received immunization-related trainings preceding two years of this assessment. Only two health workers who are at the county level received EPI mid-level managers training two years prior to this survey, while none of health workers working at HF level received the mid-level EPI managers training. Six out of nine (66.67%) and eight out of 15 (53.3%) of health workers who are working at county and HF levels received immunization in practice (IIP) training within two years preceding the survey. However, only one health worker from the visited counties and none from the staff at the HF took Inter-personal communication training. This training is essential to develop communication skill to provide quality immunization services with good clients and service providers interaction.

Table 5: Type of Training Provided by County and HF for health workers last two years

Type of training		Counties		HFs	
		N	%	N	%
Inter-personal communication training	Yes	1	11.11	0	0
	No	8	88.89	15	100
	Total	9	100	15	100
Immunization in Practice training	Yes	6	66.67	8	53.33
	No	3	33.33	7	46.67
	Total	9	100	15	100
Middle-level manager training	Yes	2	22.22	0	0
	No	7	77.78	15	100
	Total	9	100	15	100

3.1.4. Geographic Accessibility and Catchment Population

3.1.4.1. Geographic Accessibility

There are two approaches for a community to access and use immunization services: community needs to go to a HF, or health workers with services and supplies go to the community. Geographic accessibility measures communities' access to immunization services through fixed (static) immunization or outreach sessions and the availability of means of transport per county. Table 6 indicates the number of planned and conducted immunization sessions by county and availability of means of transport. Data on immunization sessions was not available for four counties (Bong, Grand Bassa, Lofa, and Nimba). In the eight counties, more than 97% of static sites and 75% to 98% of outreach sessions are conducted compared with planned. Data for Grand Gedeh county showsessions conducted beyond the planned (154%). Out of 12 assessed counties, three counties (Lofa, Sinoe and Grand Kru) did not have reliable functional vehicles (Table 5). The lack of road access and means of transportation is the main barrier to immunization supply distribution and to conducting supportive supervision.

Table 6: Geographic Accessibility Related Issues

COUNTY	# Planned immunization sessions		Completed immunization sessions		Means of Transportation	
	Fixed strategy	Outreach service	Fixed strategy	Outreach service	Functional or not functional	# days not working
Bomi	3356	672	3346(99.7%)	662 (98.5%)	Functional	-
Bong	No data	No data	-	-	Functional	-
-Grand Bassa	No data	No data	-	-	Functional	-
Grand Cape Mount	4200	840	4200(100%)	630(75%)	Functional	-
Grand Gedeh	No data	No data	-	-	Functional	-
Grand Kru	600	630	No data	No data	Not always	8
Lofa	No data	No data	-	-	Unfunctional	180
Margibi	5184	1296	5024 (96.9%)	1256(96.9%)	Functional	-
Maryland	3120	624	No data	No data	Functional	-
Nimba	No data	No data	-	-	Functional	0
Rivercess	2520	504	2520(100%)	378(75%)	Functional	0
Sinoe	3744	936	3664(97.9%)	744 (79.5%)	Not always	20

Access of vaccination and other health services for people from some remote areas is challenging. The transport cost is high and they have to walk long distance carrying their children. It is required to design a context specific strategy to provide health services for these communities.

"*We are in Burma, James town, and walking from Burma to Gbroso can take six or seven hours. Consequently, it is important for us to receive the necessary services on the initial visit. Returning for the second and subsequent visits to Gbroso can be challenging because of the distance and condition of the road. As a result, our children may not be able to complete their vaccines. The road is too far for us to transverse repeatedly*". FDG Participant, Rivercess.

Figure 4: Pictures taken by the data collection team traveling to……..counties, October, 2023

Please put the name of this county…

Means of Transportation

Lack of transportation or transport cost is one of the main constraining factors for the uptake of immunization services. Figure 4 below depicts means of transportation used by HFs. Community members use different means to go to the nearest HFs. Most of the population use public transport (37.5%) to reach to the HFs, about 20.8% each use walking on foot, and motorbike, hammock and walking on foot, about 16.67% use motorbike/cycle and only 4.17% use ambulances.

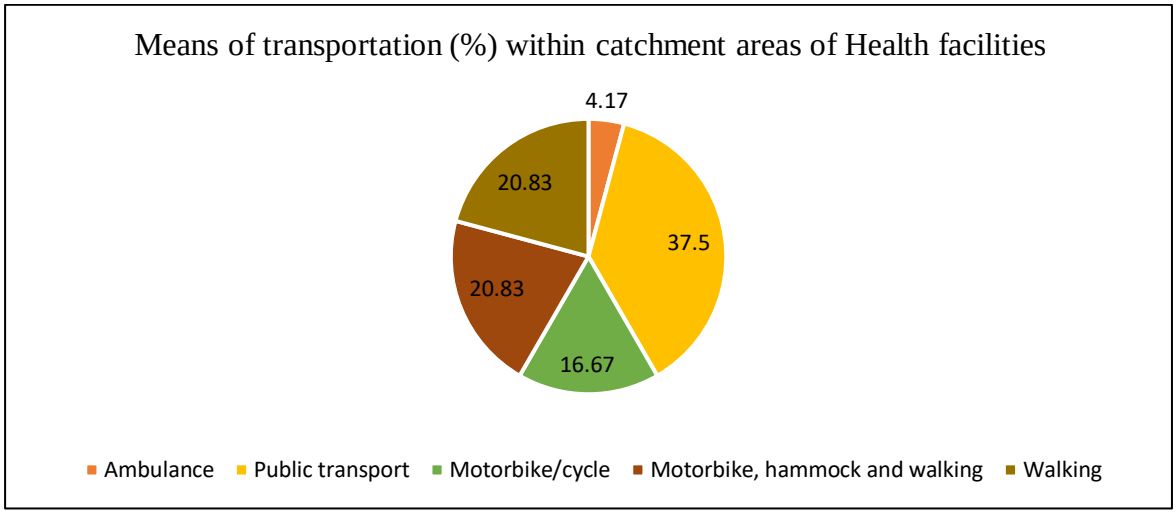

Figure 4: Means of transportation for sick people, including children to the HF in the community

This was also confirmed by the FGD participants from Tolokor community, Jundu Clinics*, who mentioned that riding a motor bike is a bit costly for them due to the distance. They would pay $250 to 300 Liberian Dollars to ride.* FGD participant.

The CER, 2022 also identified long distances and travel time to HFs as a major barrier and weaknesses to an equitable and quality vaccination service delivery and missed opportunity for vaccination.

3.1.4.2. Health Facilities Catchment Population

As the distance of the HF increases for the community, the chance of uptake of immunization decreases. People living within radius of 5Km from HFs or walking distance of one hour is considered as catchment population for the HF. The average catchment population for the surveyed HFs was 6120, ranging from 1560 (Fassavolu Clinic in Lofa County) to 20767 (Karnplay Health Center in Nimba County).

3.1.5. Service Integration (Antenatal Consultations, and Child Health interventions)

In general, service integration in health service delivery includes planning, managing and delivering of essential health services together. Immunization is often provided at the PHC level, which provides an opportunity for contact between clients and health care providers. Health services are provided across the continuum of care and life course according to their needs, over time. In most studies, there is a high correlation between ANC follow-up and the completion of immunization. The number and proportion of pregnant women who made the first and fourth ANC visit and received the second dose of TT/Td vaccine is depicted by county in Table 7 below. The TT/Td coverage which is ANC fourth visit varies by county ranging from 74% in Grand Cape Mount to 118% in Grand Kru, while the average for the 12 counties is 85% which means more than eight women out of ten took TT/Td. The TT/Td coverage of greater than 100% in Grand Cape Mount country (118%) may be due to data quality issues and/or inaccurate denominator. Improving ANC visit is a prerequisite for skilled delivery and completion of

immunization services. Literatures depicted that zero-dose children often have mothers who had no or few ANC visits and did not deliver the baby in a health-care facility.

Table 7: Antenatal Visits and uptake of TT/Td

COUNTY	Total Expected Pregnant women	#Pregnant women attended 1st ANC visit	#Pregnant women attended 4th ANC visit	Pregnant women attended four ANC visit and received TT2/Td (Fixed)	
				Number	%
Bomi	2872	2676	1620	1248	77%
Bong	11387	10119	5999	4134	69%
Grand Bassa	7570	7569	3517	2692	77%
Grand Cape Mount	4339	3869	2342	1727	74%
Grand Gedeh	4277	3796	3108	2376	76%
Grand Kru	1977	1558	723	854	118%
Lofa	9453	7199	5146	4732	92%
Margibi	7168	6839	3187	3061	96%
Maryland	4642	3235	1963	1741	89%
Nimba	15776	13940	8412	7887	94%
Rivercess	2442	1661	722	688	95%
Sinoe	3496	2627	1275	1253	98%
Total	118,709	65,088	38,014	32,393	85%

By integrating essential child health services, including nutrition screening, we can ensure that children who missed vaccination can be screened for nutritional status, counseled, and provided with other health services. Nutritional screening also gives an opportunity to assess a child's nutrition status and connect them with immunization services. Community health workers conduct nutritional screenings of children aged 6 to 59 months. While the data on nutritional screening was not collected from eight HFs, community health workers screened an average of 292 children for child health services per catchment population in the six months before this survey (Table 8).

Table 8: Child health related responses

Monitoring and surveillance indicators		HF (N=24)
Average number of 6-59 months children screened by community health workers in the catchment areas (mean)		292*
Is there anyone in the community who provides free medicines and care for sick children? (%)	Yes	83.33
	No	16.67
	Total	100

*8 HFs had no information

The FGD participants acknowledged the service given by the community Health Assistants (CHAs), and they mentioned that absence of medications is a challenge;

"*When our children fail ill and we take them to the health facility, it can sometimes be challenging. They may inform us that there is no medicine available and instead prescribe medication, providing us with a lengthy prescription to purchase the necessary drugs elsewhere. At the hospital, only the bed is provided, and we are expected to purchase everything else required for treatment. As a result, we appeal to the MoH to ensure that medicines are made available in HFs*……." FDG Participants, Folley Town, Dewein District

"*The distance from here to the HF is approximately 5 kilometers. However, when there is excessive flooding, we are unable to cross the flooded bridge to reach the HF."* A CHA, Bogbeh community, Dewoin District

"*We have 6-7 communities around here. If government helps us build a HF here and then makes sure that vaccine are available all the time, and our children will take all the vaccines*" A CHA, Cape Mount

Service integration is also acknowledged as a means to enhance the immunization service. For instance, one of the FDG participants from Konoma community, Garwula district mentioned, "*Yes, if they (HFs) offer other childhood services alongside vaccination, it can motivate the parents to bring their children for vaccination*."

Vaccination services can be an entry-point for the delivery of more essential services and contribute to improvements in access. Integrating vaccination into PHC and other services is part of the seven strategic priorities set out in the IA 2030[36]. This integration offers a cost-effective avenue to reach the children and mothers who have missed out on immunization and other basic services[37].

3.1.6. Demand Related Findings

3.1.6.1. Initial and continuous coverage

Demand-related factors are measured by the coverage of penta1 (initial contact) and penta3 (continuity). The data collected during the assessment regarding the number and proportion of children received Penta1 and Penta 3 didn't provide an optimal estimate as it is collected for children 0 to 23 months old and did not capture full-year data which may lead to inaccurate denominator for the target population. Instead, the coverage for access (first dose) and utilization (third dose) is taken from 2019 LDHS data by county. Figure 5 below indicated the coverage of penta1 and penta3 by county from 2019 LDHS result. The average coverage for 12 study counties is 91.4 and 69.2 per cent for penta1 and penta3 respectively. The average absolute proportion of dropout from penta1 to penta3 was 22.2 per cent which is more than four folds from WHO recommended standard. Counties such as Margibi, Sinoe, and Grand Bassa have relatively lowest penta1 and penta3 coverage. While Lofa, Grand Cape Mount, and Rivercess had relatively better coverage of initial contact and utilization. Counties with high proportion of dropout from penta1 to penta3 are Sinoe (34.8), Grand Gedeh (30.4), Maryland (26.4), Nimba (25.9), and Bomi (22.1).

[36] Oyo-Ita, A., et al., 'Effects of Engaging Communities in Decision- Making and Action Through Traditional and Religious Leaders on Vaccination Coverage in Cross River State, Nigeria: A cluster-randomised control trial', PLoS ONE, vol. 16, no. 4, 2021

[37] IA, 2030, Strategic Plan4, Life Course and Integration

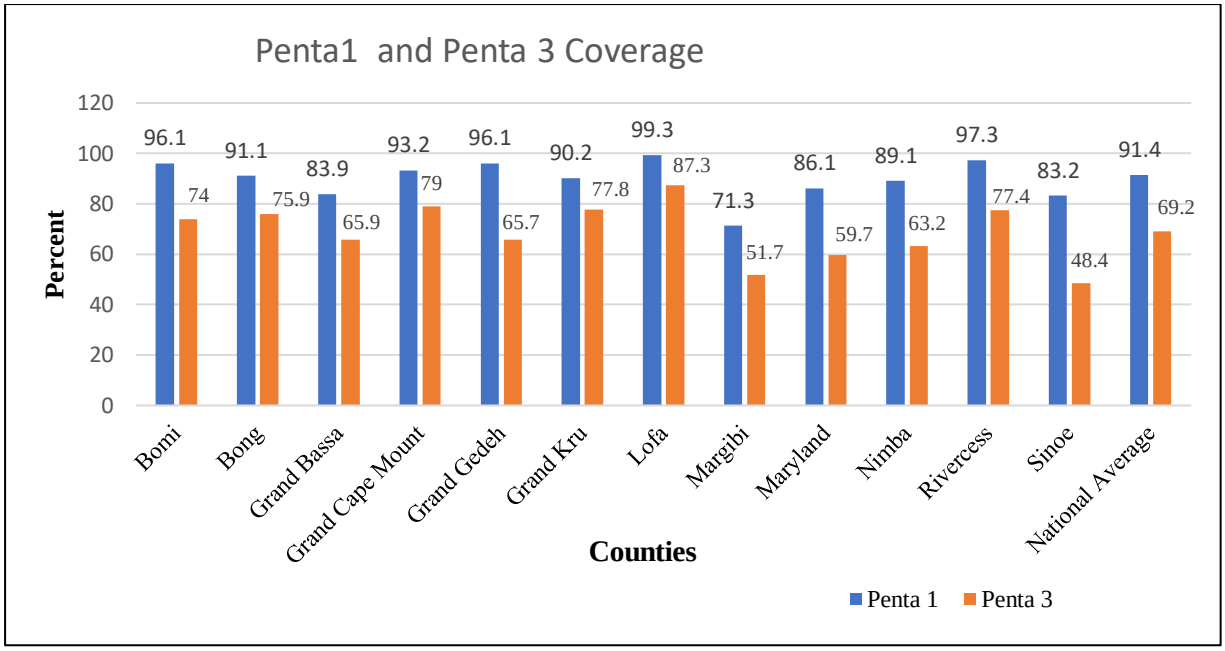

Figure 5: Penta 1 and 3 coverage of 12-23 months of age children using 2019 LDHS

The findings from the FGD and KII also are revealed that participants in this assessment were aware of the vaccination services. They have mentioned vaccination as one way of prevention measure against diseases. One participant said *"Yes, vaccines are beneficial for children. They can promote their health and strengthen their immune system"* FGD participant, Tolokor community, Jundu Clinics

"*The vaccine is important for children because it can prevent children from failing ill"* FGD participant, Balahun Community, Kalahun District

"*We feel good when the children receive vaccine because it makes them look healthy"* FDG participant, Mowulahun, Kolahun District

The Liberia immunization knowledge, attitude, and practice (KAP) surveys of 2017 and 2020 also presented increasing positive attitudes and acceptance of vaccination services among caregivers and communities[38]. The surveys recorded a significant increase from 76% to 99.7% of caregivers believing that vaccination is beneficial to children in 2017 and 2020 respectively.

Existing literatures indicate that certain traditions and socio-cultural factors can affect immunization uptake. Most of participants of the assessment affirmed that there are no traditional reasons that stop children from receiving vaccines. However, some assessment participants mentioned that fake news and misconceptions may discourage vaccination. They highlighted some rumors, such as the belief that vaccine is harmful and can make the child sick. Some community members believe that the vaccine is not good for their children because they themselves and their great-grandmothers didn't take the vaccine, and therefore, their children do not need to take the vaccine. The Liberia Knowledge, Attitude and Practice (KAP), 2017 and 2020, also showed that vaccine hesitancy from caregivers/parents mainly arises from limited access to information about the use of vaccines and rumors about vaccine quality or adverse events that lead to low uptake of immunization services (Ibid).

[38] Liberia MoH, 2017 and 2020, Immunization Knowledge, Attitude and Practice Survey Reports, Republic of Liberia

It is necessary to disseminate accurate information about vaccines, address misconceptions and promote positive health-seeking behaviors using context-specific channels to ensure that information reaches all communities, including the most marginalized (zero-dose) communities. In addition, implementing context specific solutions and using the community asset can be one solution as indicated by the following examples provided by the study participants:

"*Wednesday is market day, which is when people come to the market. During their visit, they use the opportunity to bring their children or babies to the facility because the distances are far. As for the outreaches, they occur once a week for a month.*" CHP, Mowulahun community, Kolahun District

The assessment also identified that some wise or model community members share their experiences and offer advice to parents on saving money for transporting their children to the immunization services as outlined below;

"*Yes, sometimes we volunteer, or we task each household to put money together for emergency and to take some of the children for vaccine at least every month. But we can also use that money in case of any emergency.*" FDG Participant, Konoma community, Garwula district

3.1.6.2. Community Engagement

Community engagement practice is part of demand promotion activity, and it was measured by stakeholders meeting with community volunteers at county and HF level. From assessed counties and HFs about 83.3 per cent and 87.5 per cent of counties and HFs reported that they have conducted community engagement stakeholders meeting prior to the six months survey (Figure 6).

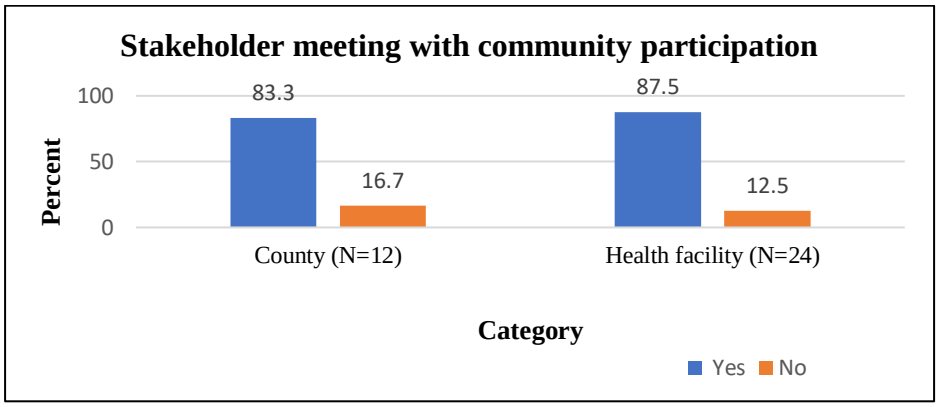

Figure 6: Proportion of counties and HFs organized stakeholder meetings

The main stakeholders of vaccination at the community level include the CHA, Community Health Committee, Health Facility Development Committee, town chief, religious and woman leaders and relevant others. The CHAs get involved also in providing health services:

"*When medications are available, I can provide services for some childhood illnesses. I can treat the three common childhood diseases; malaria, pneumonia and diarrhea. However, shortage of medications is a challenge*" A CHA, Jollos town, Timbo district.

"*We were trained to give treatment in the community. They used to give us medicine to treat the community when they get sick. But it has been almost one year since we have not received supply from the central government. We can still refer to the HF if anybody is sick*". The CHA, Konoma community, Garwula district.

The CHAs also requested for incentives or salaries from the government;

We have been working in providing services to our community for a long time, but we are not in payroll, then let it be done. If it is necessary some of us have considered going back to school. It would be beneficial if the MoH could provide scholarship for those are interested in furthering their education while continuing their work" A CHA Folley Twon, Dewoin District,

3.1.7. Enabling Environment

3.1.7.1. Program Management and Coordination

The vital role of a strong leadership, management, and coordination of immunization programs at all levels is recognized. The Liberia Interagency Coordination Committee (ICC) has been subsumed into the Health Sector Coordination Committee (HSCC) and the Health Coordination Committee (HCC) since 2015. These Committees are chaired by the Minister of Health and the Chief Medical Officer respectively. The HSCC and the HCC committees address all health issues, and the EPI does not include detailed input from other ministries, parliamentarian chairs of the health committees, donor partners, and the private sector. While engagement of other sector ministries on the EPI is beneficial for the program, as to the CER, 2022, these groups are not actively engaged in the planning of EPI activities. The ICC, which gives more focus to the immunization program, is being revitalized and had two meetings held in 2023.

The Liberia National Immunization Technical Advisory Group (NITAG) was established in April 2022 with Terms of Reference. However, appears to be limited coordination with partner activities at the county level and below. The EPI has been operating with little strategic oversight and suboptimal coordination among partners. There is a need to strengthen coordination between government and its partners of the immunization program, both at the national and lower levels. This can be achieved through joint planning, regular meetings and improvements in the monitoring and evaluation of EPI activities.

3.1.7.2. Budgeting and Financing

There is a line item for EPI in the health budget. The budget is primarily funded by GAVI, USAID, US CDC, WHO, and UNICEF; at the county levels, NGOs and other government partners provide supplementary funds for outreach and response to vaccine-preventable diseases (VPDs) outbreaks. Donor partners have provided support through performance-based financing.

The CER, 2022 indicated that the performance of program management and financing in different counties is low (<50%). At the HF level, the performance of program management and financing ranges from 60% to 10%. Althoiugh there is a line item for immunization in health budget in Liberia, there are insufficient national financial resources allocated to immunization, as evidenced by the delay in co-financing by the Government. Insufficient sub-national budgeting for immunization was also identified due to limited time allocated for the budgetary process and delays in accessing government allotment. The sustainability of funding for new vaccines is also uncertain. Additionally, availability and disbursement of funds from the central level are slow and do not adequately address to sub-national and local needs. As the result, planned immunization activities can be delayed (ibid), which in turn affects the immunization service delivery to reach zero-dose and under-vaccinated children. It is encouraging that the Liberia government put a line item for EPI in the health budget. To optimize the resource for the immunization program, it is also necessary to strengthen the national and subnational microplanning and budgeting as well as mobilize domestic resources.

Advocacy is required to enhance immunization financing and make a case for political attention, securing commitment and allocating resources to prioritize reaching zero-dose children and missed communities with immunization.

3.1.7.3. Planning

Counties and HFs were assessed whether they have prepared annual plans. About 75% of counties and HFs reported the availability of annual plan that integrated with the EPI activities (Figure 7).

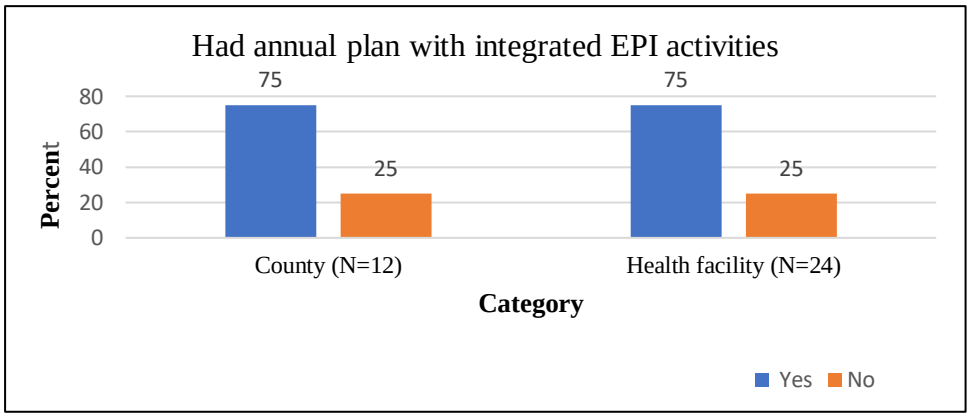

Figure 7: Annual plan with integration EPI activities

Evidence based planning through integrating bottleneck analysis and the Reaching Every District/Community (RED/REC) approach is crucial. The CER, 2022 recommends ensure transparency and robust engagement with local governments, the parliament, and partners with clear roles and responsibilities all throughout the process of planning, implementation, monitoring, and evaluation.

3.1.7.4. Supervision, Monitoring and Surveillance

The assessment findings showed that supportive supervision, monitoring and follow-up were conducted at each level. Counties and HFs were assessed for the presence of supervision plan, whether they received supervision visits from their higher level, received feedback and whether follow-up conducted after last visit. Almost all 11 (91.7%) out of 12 counties and 21 (87.5%) of HFs claimed to have supervision plan, 10 (83.3%) counties and 21 (87.5%) HFs received supervision visits from their higher levels. Additionally, 8 (66.7%) counties and 21 (87.5%) HFs received written feedbacks and the majority of those who received written feedbacks claim that they were following-up recommendations after the last visit (Table 9).

Table 9: Supervision plan, visits and follow-up during Sep 2022 to Sept. 2023

	Had supervision plan		Received supervision visit from higher level		Received written feedback with findings and recommendation from last visit		Follow-up conducted on recommendation after the last visit	
Category	Yes	No	Yes	No	Yes	No	Yes	No
County	11(91.7%)	1(8.3%)	10(90.9%)	1(9.1%)	8(80%)	2(20%)	9 (90%)	1(10%)
HF	21(87.5)	3(12.5%)	21(100%)	0	21(100%)	0	18 (85.7%)	3(14.3%)

Immunization activities in Liberia are monitored as part of the regular monitoring and evaluation process for the entire health sector. Supportive supervision is also conducted towards lower levels to acknowledge and support their performances and discuss corrective measures. Review meetings are organized to discuss the progress of the implementation of EPI plans. At the national level, a Joint Reporting Format is conducted annually and shared with partners (CER, 2023).

3.1.7.5. Program review

HFs were requested whether they have organized quarterly review meetings prior to the survey about 58.33%, 33.33% and 8.33% reported organized review meeting, not organized and don't know whether it is organized or not respectively.

Regarding to the VPD outbreaks, 45.8% reported the occurrence of outbreaks in the past 6 months of the assessment. Measles and pertussis were mostly reported VPDs (Table 10)

Table 10: Monitoring and Surveillance

Monitoring and surveillance indicators		HF (N=24)
Organize quarterly monitoring meeting (%)	Yes	58.33
	No	33.33
	Don't Know	8.33
Average number of quarterly meetings conducted from April to Sep. 2023		2
Average number of monthly reports (HMIS) submitted in the past 6 months		6
Average number of timely submitted monthly reports		5.9
Average number of disease surveillance reports submitted		12
VPD outbreaks in the past 6 months (%)	Yes	45.8
	No	54.2
	Total	100

The CER, 2022 findings showed that data on service utilization and equity are not optimally used for service delivery planning. There is poor data quality and an inefficiency in the use of data for decision-making (ibid). The data quality issue is also identified by the Liberia zero-dose analysis, 2022 where the coverage of some tracer antigens was greater than 100% (ibid). The administrative data is higher and did not match with the WUENIC estimates. The analysis of DHIS 2018-2021 for zero-dose children showed 6 districts with negative zero-dose (coverage >100%) out of 15 districts. Coverage over 100% can be the signal of date quality and/or inaccurate population data. This can mask the under-served communities and the efforts of identifying and reaching zero-dose and under-immunized children. Therefore, effective strategies are required to address the gap, such as providing on-the-job trainings to health workers, conduct regular monitoring, supportive supervision and review meetings, especially to priority communities and geographies with high number of zero-dose and under-immunized children.

Strengthening surveillance system and VPD responses and data driven actions is necessary to address measles, pertussis, and other outbreaks. Timely monitoring and surveillance are essential for tracking progress and identifying areas that require further attention.

3.1.8. Quality Related Findings

3.1.8.1. Effective Vaccine Management assessment (EVMA)

The overall EVMA composite score for Liberia was 77% which is slightly below the acceptable benchmark of 80%. The overall score indicates that E1 (Vaccine arrival), E2 (Temperature management) E5 (Maintenance and Repair) E8 (Vaccine Management) M1 (Annual needs forecasting) and M3 (Supportive supervision) performed optimally scoring 80%, and above. The EVM Version 2.0 was modified to include four new criteria that look at Annual Needs Forecasting, Annual Work Planning, Supportive Supervision, and immunization Supply Chains (iSC) Performance Monitoring.

The EVMA, 2022 score shows variations among counties, where Grand Gedeh and Maryland scored the least on all the indicators. The findings also indicated that information system and supportive management, and building, cold chain, and vehicle maintenance are critical areas that need improvement in all counties across the country.

The 2022 EVMA composite score (77%) is 11% higher than the 2015 EVMA composite score of 66% that signifies progress in the overall immunization supply chain system of Liberia. However, the country needs to put further efforts to reach the standard EVMA score of 80% for all countries.

3.1.8.2. Safety

Vaccine safety was assessed by the availability of Adverse Effects Following Immunization (AEFI) reporting form and number of AEFI reported. The findings showed that 11 out of the 12 counties had the AEFI reporting form, and 10 counties affirmed as they had reported the AEFI cases (Table 11).

Table 11: Safety related issues during the past six months

Name of the County	Have AEFI reporting form	# Vaccines dosage administered from April-Sept. 2023	Number of AEFI cases reported from administered vaccine dosage	Proportion (%) of AEFI cases reported from expected
Bomi	Yes	67253	28	0
Bong	Yes	11035	31	0.28
Grand Bassa	Yes	87850	61	0.07
Grand Cape Mount	Yes	15	8	0.53
Grand Kru	Yes	39634	0	0
Lofa	Yes	8541	68	0.80
Maryland	Yes	79263	10	0.01
Nimba	Yes	21742	4	0.02
Rivercess	Yes	6087	18	0.30
Sinoe	Yes	No data	No data	.-

The CER 2022 showed that too few AEFI were reported; vaccinators have a lack of awareness about AEFI or the need to report AEFI, and inadequate plans with media to counteract rumors or false reports about AEFI that need to be corrected.

Monitoring and evaluation of AEFI allows for the continuous improvement of immunization programs and the identification of rare or unexpected safety concerns. It helps ensure that vaccines are safe and effective, and that any potential risks are minimized through proper surveillance and communication.

Immunization safety is a vital component of public health, as it helps maintain confidence in vaccination programs and ensures the ongoing protection of individuals and communities against (VPDs). It is important to monitor and report AEFIs to ensure safety and effectiveness of the vaccination program.

3.1.8.3. Effective Coverage

Effective coverage of vaccination is measured by the coverage of MCV1 and fully immunized. According to the 2019 LDHS results, the average coverage for measles containing first dose vaccination and fully immunized of all basic vaccines was 70.3% and 50.8% respectively at the national level. Like access and continuity which was measured by penta1 and penta3, most counties Sinoe, Riverces, Margibi, Grand Bassa, Nimba, Maryland, Grand Gedeh, and Grand kru had coverage less than national average (Figure 8).

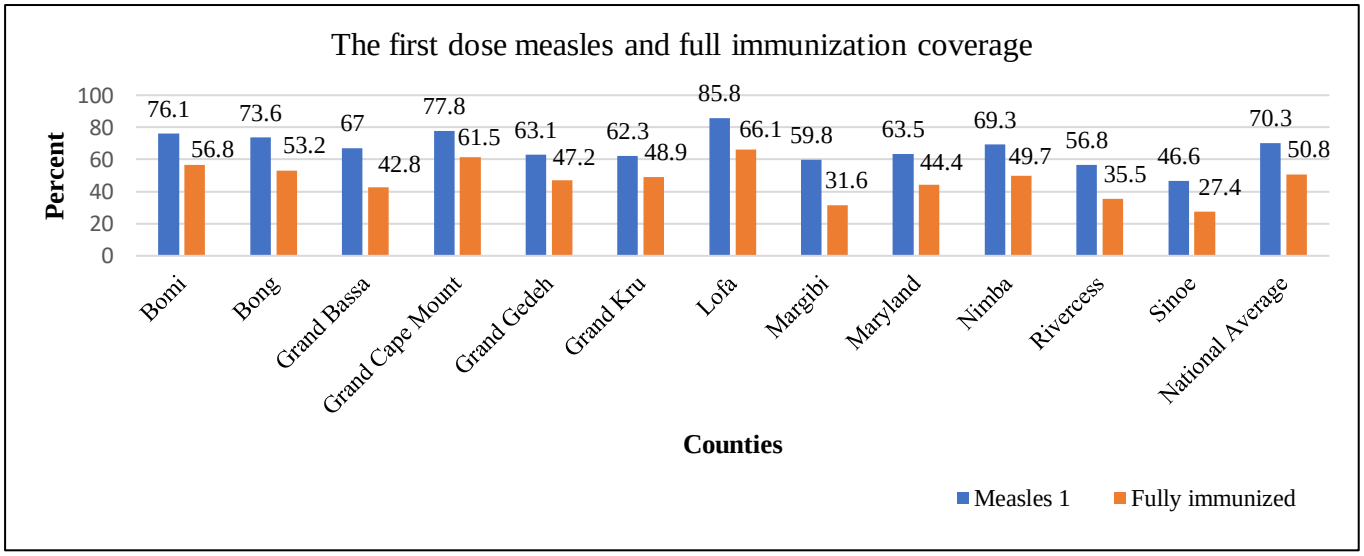

Figure 8: Coverage of measles and fully immunization for 12-23 months children using 2019 LDHS

Parents have relatively sufficient information on vaccines given for under one children, but some FGD participants mentioned that they had no clear information about the MCV2 and HPV. For instance, the FGD Participant, from the Rivercess stated *"The information on MCV2 and HPV has not properly reached here, so we do not take our children to HFs to receive these vaccines. Sometimes, some parents do not take their children for the MCV 2 because they lack information."*

Furthermore, MCV2 has been introduced as the first childhood vaccine that is being delivered beyond the traditional target age for vaccination.[39] In Liberia, the coverage of MCV 1 and MCV 2 was 79% and 59% respectively in 2022. However, vaccinating children with MCV2 is essential for measles elimination and there is a need to design a strategy that increases community awareness on MCV2 and during the introduction of new vaccines.

[39] Masresha BG, et al, 2018. Introduction of the Second Dose of Measles Containing Vaccine in the Childhood Vaccination Programs Within the WHO Africa Region - Lessons Learnt. J Immunol Sci. 2018 Jul 28; Suppl:113-121.

3.1.9. Gender Related Barriers for Immunization

Immunization is widely perceived as gender-neutral, however in many countries, gender barriers and underlying power dynamics are evident at household and community level.[40] The Liberia desk review report on gender-barriers to immunization indicated approval/consent from fathers, who are mostly considered the head of the home and final decision maker, which is a key gender related barrier to immunization[41]. The CER 2022 also showed that fathers make decision on the child vaccination especially as it relates to providing transport for the child and mother to go to the HF. The finding of this assessment also indicated that children vaccination is taken as the role of mothers in most cases as confirmed by the participants of the assessment as follow:

"*Fathers don't take children for vaccine. Sometimes they can only escort us because of the distance. They may be waiting around until the mother finishes or fathers may only accompany us half-way because of the distance and return back…"* FGD participant, in Konoma community, Garwula district

"*The father may provide support; however, it is the mother's responsibility to take children to the HF for the vaccination service"* CHA from Kanoma community, Garwula District

"*Most of children activities are done by the mothers; they carry their children to HFs for vaccination and other health services. Since I am educated, I always help my wife to take my child to HF for vaccines. Others can see me and my family (children) take the vaccines, in that way they can follow*" FGD participant Garwola District. Tolokar Town

Literatures show gender barriers influence resource allocation, decision making, women's mobility, their lack of access to health centers and time limitations outside of household chores. The Liberia gender desk review on immunization identified women are disproportionately and often unfairly represented in leadership and decision-making bodies in Liberia. This leads to a variety of socio-political problems of gender inequality and imbalance. Violence against women and girls has long been recognized as a socio-cultural problem entrenched in traditional social norms and behaviors. This leads to a variety of socio-political problems of gender inequality and imbalance that can limit access to health services, the burden to family care, and a higher economic and health vulnerability (ibid).

The Liberia CER 2022 also showed that fathers make decision on the child vaccination especially as it relates to providing transport for the child and mother to go to the HF. Imbalance of power at the household level also described by the Liberia Desk Review on gender Barrier to immunization, 2023.

A clear strategy is required to identify and reach zero-dose children by addressing gender barriers and other equity concerns including identifying context appropriate indicators to track gender related barriers in Liberia. The Liberia CER, 2022 indicated that vaccination interventions had always targeted women, overlooking the role of promoting inclusivity and sharing responsibilities with men. However, recent messages have targeted male involvement in immunization. Male involvement is being encouraged in the country and there are some progresses in males/fathers' involvement. The report recommended that social mobilization, health promotion, and community-based interventions are critical to addressing gender-related barriers to immunization and other healthcare access. To increase immunization coverage and equity; gender must be explicitly considered as an integral part of the

[40] UNICEF Regional Office for South Asia (ROSA), 2019; A practical Guide to Integrate a Gender Lens into Immunization Programs

[41] Liberia MoH, Report on Desk Review of Gender-barriers to Immunization in Liberia

initial design, implementation, monitoring and evaluation of immunization interventions and policies (ibid).

Male involvement is very important for immunization. Other computing responsibilities, such as the household chores, as well as, the distance to HFs and lack of money for transport can pose challenge on mothers in prioritizing vaccination. Encouraging male role models can be one strategy. The CER, 2022 also recommended, social mobilization, health promotion, and community-based interventions are critical to addressing gender-related barriers to immunization and healthcare access. Effective gender-responsive programming in immunization and health sector can contribute to progress towards gender equality and positive health outcomes (ibid).

3.2. Bottleneck Analysis (BNA) Findings

Bottleneck analysis was conducted using the adapted Tanahashi framework. This analysis was conducted using tracer indicators from supply, demand, community engagement, quality, and enablers. Figure 7 below depicts the key findings from the assessment. The findings of the assessment revealed gaps within the immunization system. While there are some progresses due to the efforts made by the MoH and partners; there are critical gaps and causes for gaps to be addressed to improve immunization system and PHC in Liberia.

3.2.1. Supply side bottlenecks

Supply side bottlenecks assessed availability of cold chain equipment, vaccine and related supplies, and human resources involved in immunization. Vaccine stockout is a gap both at county and HF level. Only one county and one third of HFs did not experience any type of vaccine stockout six months prior to this assessment, and almost all antigens were stockout within the six months period. This indicates, critical gap on vaccine distribution system. Effective vaccine management assessment (EVMA, 2022) also indicated low vaccine distribution (E7) score which was lower (72) compared with overall composite score of 77.

The assessment findings showed availability of health workers and community health workers involved in immunization activities at county and HF level. However, the distribution of health workers and community health workers was not evenly. Thus, attention should be given to the even distribution of health human resources across counties and HFs giving due attention for remote counties with high number of zero-dose and under immunized children.

Training of health workers and community health workers known to improve knowledge, skill and motivation of health workers. Availability of trained community health workers is key to link communities and HFs and to mobilize eligible targets to receive vaccination. In addition, training can be one incentive mechanism to them. However, about half of health workers at HF level and only one third of community health workers reported that they had training in the last two years.

3.2.2. Demand side bottlenecks

The data from 2019 LDHS indicated that the national average for penta1 is above 90 per cent which showed good access or initial contact. However, the coverage of penta3 which is the proxy indicator for continuous utilization is 69 per cent which showed that almost one out of five children who started immunization dropped before taking the third dose. The coverage has disparity among counties. Although the majority of HFs and counties reported that they conducted stakeholders meeting, these meetings contribute very little to reduce the dropout. Therefore, appropriate mechanisms should be

in place for defaulter tracing and improve awareness among caregivers and ensure continuous utilization of subsequent doses of vaccination.

3.2.3. Effective coverage

The proxy indicator for effective coverage is MCV1 vaccination coverage and fully vaccination which the national average was 70 and 50.8 per cent respectively and there was disparity within counties according to the LDHS 2019.

3.2.4. Quality

Effective vaccine management assessment score was considered as a quality indicator. The EVMA, 2022 result revealed that composite score of 77% with variation in counties, which is slightly lower benchmark of 80%.

3.2.5. Monitoring and surveillance

A little less than half (46%) of the assessed HFs and 58 % of counties reported the experience of the VPDs in their respective catchment areas which is an indicator of sub-optimal immunization coverage.

3.2.6. Enabling environment

Availability of annual plan that incorporate EPI activities was considered as tracer indicator for program management (enablers). One fourth or quarter of the HFs and counties reported that they don't have annual plan that include EPI activities (Figure, 9). Preparation of RED/REC micro-planning for county and HF level is crucial to design appropriate service delivery approach.

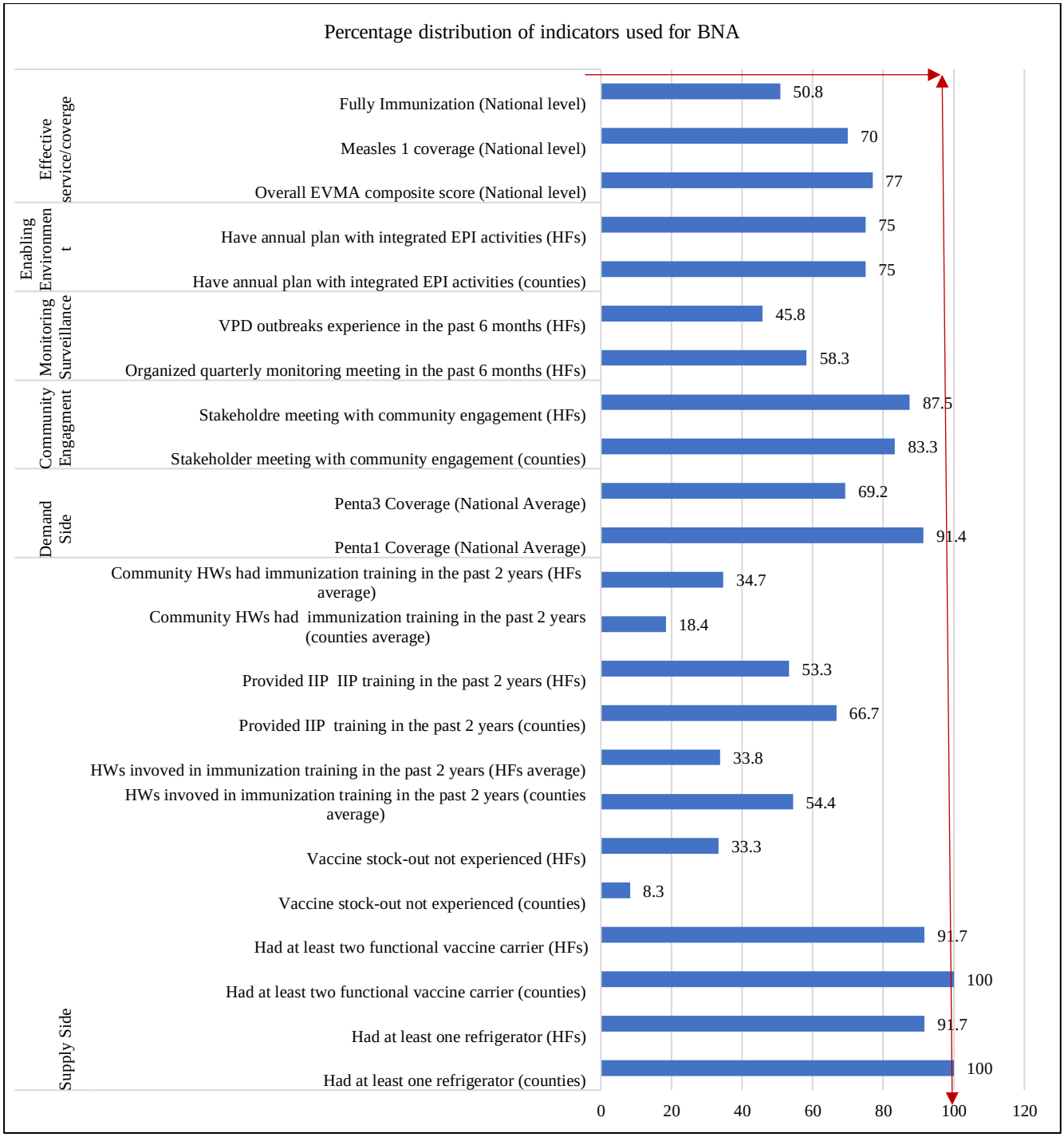

Figure 9: Percentage distribution of indicators used for BNA

3.3. Key Findings from the Three Counties: Gbarpolu, Montserrado, and River Gee

3.3.1. Determining Zero-dose Children from the Three Counties

The overall number of targeted children between the ages of 0-23 months in the three selected counties was 67,871 and the zero-dose of 12,221. This analysis utilized 2019 to 2022 routine immunization data from the DHIS2 to determine the number of zero-dose and unvaccinated children. Table 12 provides a summary statistic on the number of zero-dose children and other key statistics using 2022 routine immunization data from the DHIS2.

Table 12: Summary statistics of zero-dose children in three counties (Gbarpolu, Montserrado, River Gee), 2022

Parameters	*Zero dose*	*% Zero dose*
Maximum (Montserrado)	10934	19.4
Minimum (Gbarpolu)	593	13.3
Mean (All)	4074	17.0

Note: the percentage of zero dose is calculated on the number of zero-dose children divided by the number of surviving infants multiple by hundred

3.3.2. Geographic characteristics of zero dose children

The geographical distribution of the number of zero-dose, under-immunized children, and missed communities is proportionate to the size of the population and number of children being immunized. For instance, Montserrado County accounts for the highest number of zero-dose children (n = 10934) with the second highest percent zero-dose (18.3%), while River Gee County accounts for the second highest number of zero-dose children (n = 694) and highest percent zero-dose children (19.4%) and Gbarpolu county accounts for the lowest number of zero-dose children (n = 593).

The number of zero-dose and under-immunized children, and missed communities can be seen in areas that are challenged by range of factors, including cultural and gender-related barriers, poverty, geographical accessibility, limited infrastructure, concessions and mining environments, and weak health system. Mixed drivers were identified that were unique to certain counties and cross-cutting to all counties. River Gee and Gbarpolu mining areas were identified as a key driver for zero-dose and under-immunized children including missed communities while cultural belief (Sande and Poro Society) was unique to Gbarpolu. In Montserrado, slum communities, ghettos, and other hostile environments were considered key drivers of zero-dose, under-immunized children and missed communities. Bad road conditions, river overflowing, and hard-to-reach/ difficult terrains were identified as cross-cutting drivers in the three counties.

In sum, the three main factors for zero dose vaccination in these three counties were beliefs, attitudes and behaviors of caregivers, migration and poor awareness of services. The study proposed that targeting these factors in the Liberian setting will greatly improve zero dose vaccination rate.

3.4. Coverage and inequality trend Analyses Findings

Trends in coverage and inequalities in prevalence of zero-dose and under-immunization by equity identifiers at national level;

3.4.1. The coverage trends of tracer antigens

The Reach Every District (RED) strategy categorizes immunization coverage into three, (i) less than 80% (categorized as low), (ii) between 81% to 90% (categorized as medium), and (iii) greater than 90% high coverage. According to WUENIC data, Liberia was able to maintain high DPT1 containing vaccine coverage of over 90 percent in 2013, however, the progress has been reversed in 2014 that might be due to the Ebola epidemics, which grossly affected the social and economic status of the people of Liberia. The following graph (Figure 10) shows the immunization coverage of tracer antigens in Liberia for 10 years (from 2013-2022):

The DPT1 coverage was 91% in 2013 and declined sharply to 74% in 2014. It increased steadily over the years from 2014 and reached to 91% in 2018. However, the coverage dropped again from 91% in

2018 to 81% 2021; this may be attributed to the impact of global COVID-19 pandemic. Then the coverage raised to 93% in 2022[42].

The DPT3 coverage also dropped, from 80% in 2013 to 63% and 65% in 2014 and 2015 respectively. The drop from 2014 to 2015 might be attributed to Ebola epidemic. The coverage is reversed back after Ebola and raised to 80% in 2018, then dropped again to 70% in 2019, and to 65% and 66% in 2020 and 2021 respectively. The coverage increased to 78% in 2022. This increment in 2022 indicated that the country is restoring the immunization service after the effects of COVID-19.

MCV1 was 74% in 2013 then sharply decreased to 58 and 64 during the following two years. The coverage improved to 70% in 2016 after the era of Ebola. The coverage further increased to 75% and 74% in 2017 and 2018 respectively. However, the gain declined to 68% in 2019, 61% in 2020 and 58% in 2021 that may be due to the COVID-19 pandemic. Like other antigens, MCV1 also raised to 79% in 2022.

The country introduced MCV2 in 2019 and the coverage was 13%, which was low during its first year of introduction. Meanwhile, the coverage constantly increased in the following three years. The coverage of MCV1 raised more than a double (30%) in 2020 compared to the preceding year. Furthermore, it has increased to 59% in 2022, which is a commendable progress over time. While the progress is encouraging, much remains to reach the global and national targets.

The dropout rates from DPT1 to DPT3 increased from 11% in 2013 to 15% in 2022, and the dropout rates from DPT1 to MCV1 was 17 and 14 in 2013 and 2022 respectively. In line with the dipping coverage, the dropout rate from DPT1 to DPT3 and from DPT1 to MCV1 was not improved over the ten years. The dropout rate from DPT1 to DPT3 increased from 11 to 15 in ten years and the reduction of dropout rate from DPT1 to MCV1 was not significant in the same time period. This can be attributed for the challenges the country faced due to Ebola and COVID-19 pandemic. The proportion of zero-dose children declined from 9% in 2013 to 7% in 2022. According to WUENIC report out of the 57 Gavi-supported countries Liberia (along with Myanmar and Rwanda) saw double digit increases in basic vaccine coverage in 2022. For Liberia DTP3 coverage increased form 66% in 2021 to 78% in 2022, a total of 12 % increase. The country needs to strengthen the health system capacity and PHC service delivery performance to maintain the gains made and identify and reach zero-dose and under immunized children, enhance the immunization service utilization and attain the global and national targets.

[42] WHO-UNICEF estimate for national immunization coverage, WUENIC, 2022

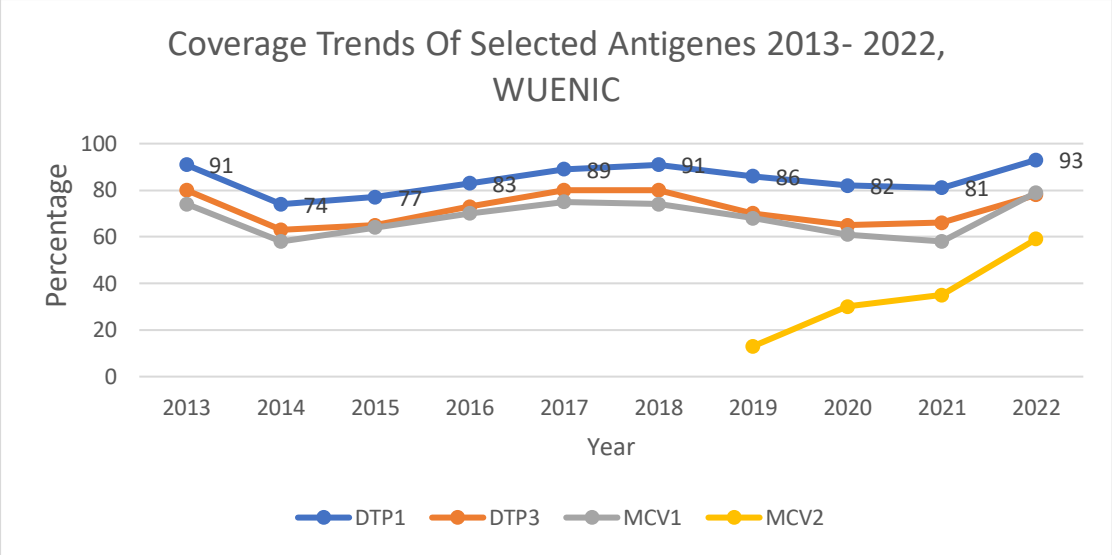

Figure 10: Coverage Trends of Selected Antigens 2013- 2022, WUENIC

3.4.2. Trends in inequalities in prevalence of zero-dose children by socioeconomic status

The following graph (Figure 11) shows the coverage of tracer antigens based on the socio-economic dimensions. The household's asset-based wealth status is measured by five categories of wealth quantiles: poorest, poorer, medium, richer, and richest. Liberia successfully reduced the absolute inequality gap for zero-dose children by household wealth status from 2007 to 2019. The educational status of mothers/caregivers is classified into three categories: (1) no education, (ii) completion of primary education and (iii) completion of secondary school and above. The proportion of zero-dose children from the three consecutive LDHS 2007, 2013 and 2019 analyzed based on the above-mentioned criteria as follow:

- The proportion of zero-dose children from the poorest households reduced from 38.3% in 2007 to 11.4% in 2019, a 26.9% drop.
- The proportion of zero-dose children from the richest households reduced from 11.2% in 2007 to 0.2% in 2019, a significant reduction of zero-dose children within the highest wealth quantile groups in these 12 years.
- In 2019, the disparity of vaccination coverage by economic status significantly decreased between the richest and poorest households. In 2019, the proportion of zero-dose children was nearly zero in rich households and dropped to 11.4% in poor households.
- The absolute inequality gap on the prevalence of zero-dose between children from caregivers with no education and those children of mothers/care givers who completed secondary school and above has narrowed from 16.9% in 2007 to 7.4% in 2019.
- The drop in zero-dose prevalence within the twelve years was significant (17.2% points) among children born from mothers or care givers with no education.
- The disparity on the prevalence of zero-dose children between mothers/caregivers with no education and those children of mothers/care givers who completed secondary school and above were 16.9% and 7.4% points in 2007 and 2019 respectively. This indicated that the country is working to narrow the equity gap in immunization among various groups that needs to be harnessed to attain the universal immunization goal of leaving no-one behind.

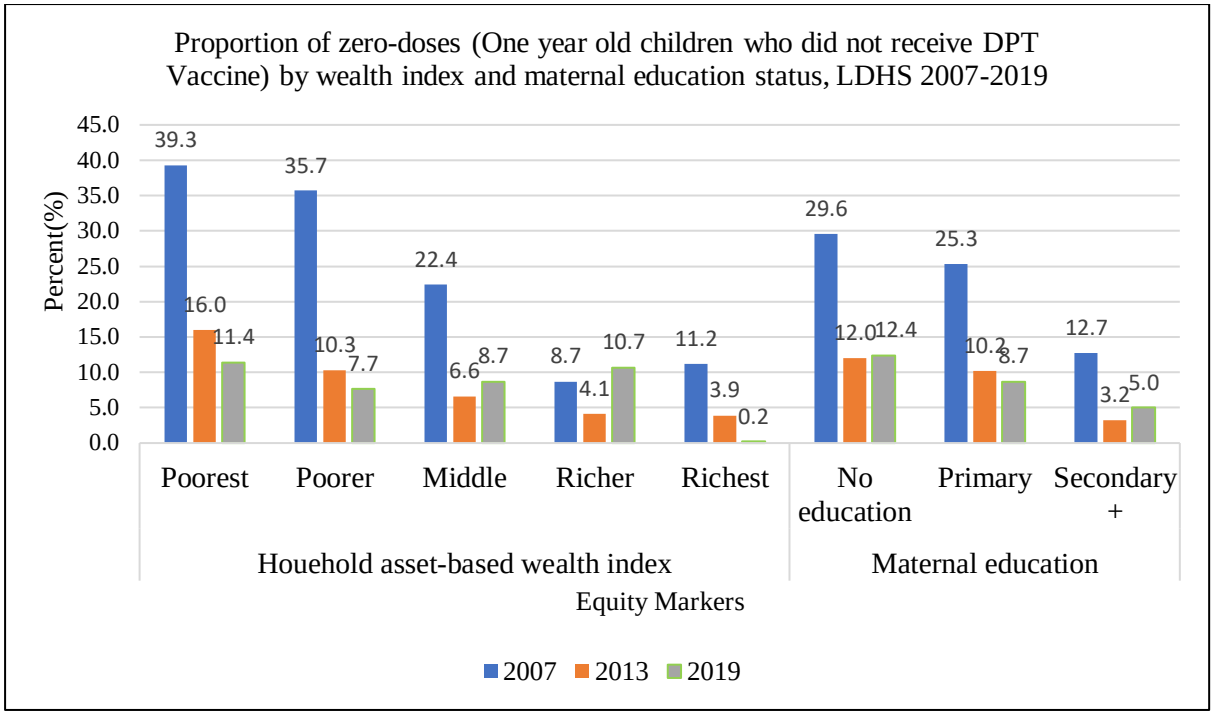

Figure 11: Liberia zero-dose children by socio-economic status and education level 2007, 2013 & 2019

3.4.3. Trends of zero-dose children by place of residence and sex

The place of residence is categorized as urban or rural. Place of residence is one of the vaccination inequality drivers in almost all countries. Liberia significantly reduced the absolute vaccination inequality gap for zero-dose children between urban and rural areas from 19.7% points in 2007 to 6.8 percent points in 2019 (Figure 12):

- The prevalence of zero-dose children in rural communities reduced from 31.1% in 2007 to 10.4 % in 2019, a 20.7% drop within twelve years. Whereas the proportion of zero-dose children reduced from 11.4% in 2007 to 6.8% in 2019 in urban areas, a 4.6%-point decline. The continuous narrowing of the gap in immunization coverage, especially for the rural population, might be attributed to the expansion of primary health care (PHC) services in rural communities.
- In 2019, the significant reduction of zero-dose children in rural communities indicated the country is on the right track to achieve the goal of immunization agenda and Gavi 5.0 strategy of minimizing the disparity in immunization and reaching everyone with immunization services.
- The three DHS of Liberia showed no significant difference in zero-dose status of children by sex. This finding coincides with many other countries that pointed out mothers or care givers seek health services for both male and female children indifferently.

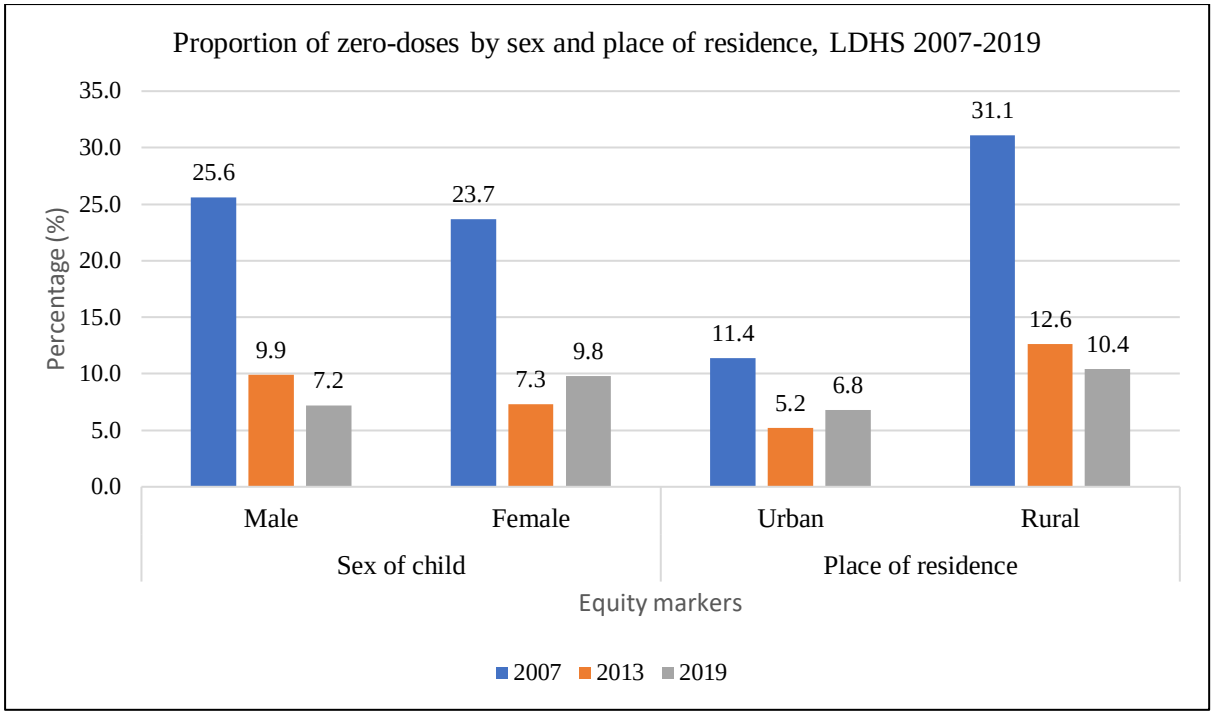

*Figure 12: **Zero dose children by place of residence and sex, 2007, 2013 & 2019***

3.4.4. Trend of Under-vaccinated Children- DPT3 Coverage by Equity Identifiers

- Under-immunized children are defined as those missing the third dose of the DPT- containing vaccine, DPT3. The under immunized children is estimated as the difference between those children vaccinated DPT1 and DPT3. This is an indicator of service utilization. The following graph shows the DPT3 coverage by the economic status, education and place of residents of households in Liberia (Figure 13).
- The coverage of DPT3 for Children from poorest and richest households was 29.8% and 71.9% in DHS 2007. In DHS 2019, the coverage of DPT3 for the poorest quantile improved significantly (59.8%) and richest groups of the population increased to 75.7%. The household wealth quantile is a driver for dropout in Liberia. Nevertheless, the disparity in immunization coverage by wealth quantile has significantly declined for children from the poorest and richest households from 42.1% in 2007 and 15.9% in 2019.
- Over time, the inequality gap between caregivers who had no education and those who completed secondary and above has narrowed.
- The coverage of DPT3 among children of mothers/caregivers with no education and children of mothers/caregivers who completed secondary and above increased from 46.3% to 66.6%, and from 70.3% to 71.1% respectively between 2007and 2019.
- The absolute inequality gap for DPT3 coverage between children of mothers/caregivers with no education and children of mothers/caregivers' who completed secondary and above was 24% points in 2007 and 4.5% points in 2019, respectively.
- The Proportion of children from mothers/care givers with no education who received the DPT3 vaccine increased by 23.3 points, while the proportion of children from mothers/care givers who completed secondary school and above increased by only 0.8% points. Thus, the proportion of under-vaccinated children of children from mothers with no education was highly improved

between 2007 and 2019. This indicated that the country is working to narrowing the gap on immunization among the population sub-groups improve the equity in immunization services.

- Liberia significantly reduced the absolute vaccination inequality gap for under-vaccinated children between urban and rural areas from 28.9 percent points in 2007 to 1.5 percent points in 2019.
- The coverage of DPT 3 in rural areas was 41.2% in 2007 and 68.5% in 2019. While the coverage of DPT 3 in urban areas was 69.8% and 70.0% in 2007 and in 2019 respectively. The improvement of DPT 3 coverage was encouraging in rural settings within twelve years, whereas the progress in urban areas was not significant. The continuous increment of coverage of DPT 3 in rural settings might be attributed to the expansion of PHC services for rural communities.

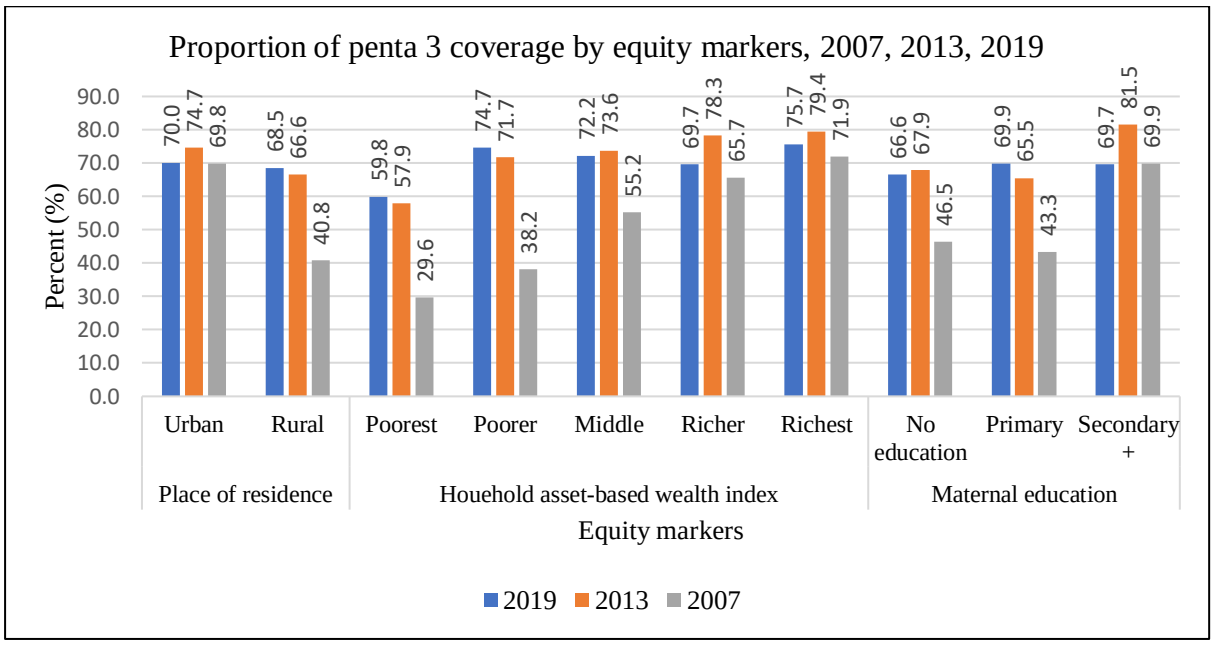

***Figure 13*: Percentage of DPT/Penta 3 coverage among one-year-old by economic status, education and place of birth**

Liberia's immunization program has improved substantially. The coverage has increased progressively, and the country has been able to reduce substantially the inequality of immunization among different population groups, as indicated by subsequent demographic and health survey results. The State of the World's Children Report 2023, indicated that in the poorest households, 22.6% of children were zero-dose children. In contrast, in the wealthiest group, just 4.9% were zero-dose children. West and Central Africa presented the largest gap between rich and poor: 48.6% of children from the poorest households were zero-dose children compared with 6.3% of children in the wealthiest[43].

Further effort is required to address the equity gaps and increase access and immunization service utilization of the Liberia population residing in all counties. There is a need to develop strategies to address zero-doses and the disparities in immunization services to effectively identify factors affecting the equitable delivery of immunization services, measure inequities in immunization and design strategies to reach the unreached children. Gavi's, the Vaccine Alliance, 5.0 strategy and IA 2030 focus

[43] UNICEF, 2023. The State of World Children, For Every Children Vaccination Liberia MoH, 2017 and 2020, Immunization Knowledge, Attitude and Practice Survey Reports
[43] Liberia MoH, 2019, Missed Opportunities for vaccination among children 0-11 months in Liberia, 2019
[43] Cesar Victora and Aluísio Barros of the International Center for Equity in Health at the Federal University of Pelotas, Brazil conducted an analysis for *the State of the World's Children 2023* report.
[43] UNICEF, 2023. The State of World Children, For Every Children Vaccination

on reaching marginalized groups and promoting equity in immunization with the overarching vision of "leave no one behind with immunization"[44].

3.5. Prioritizing of Zero-dose and Under-Immunized Children: IRMMA Framework for Identification and reaching Zero Dose Children

The strategic approaches to identify, prioritize and reach zero dose children are guided by the IA 2030, the national health sector strategic plan, EPI comprehensive plan, and the GAVI 5.0 framework of Identify-Reach-Monitor-Measure-Advocate (IRMMA). The IRMMA framework involves deep analysis at national, sub-national, HF and community levels to identify where zero doses are and why they are not reached. The communities with high number of zero-dose children are identified per HF catchment areas and counties in Liberia.

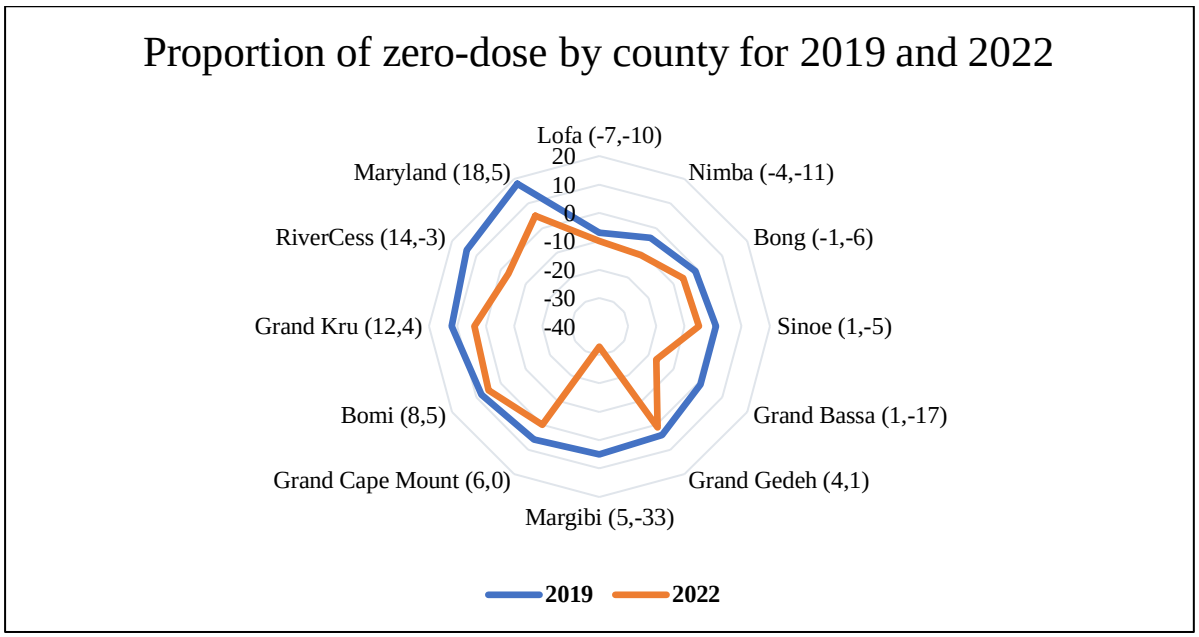

Figure 14: Proportion of zero-dose by county for the year 2019 and 2022 (Source, ZD Analysis of Liberia data for the year 2019 and 2022)

In this regard, the MoH of Liberia with support from UNICEF and other partners conducted this extensive analysis of existing data from various sources on where the majority of zero-dose children and missed communities are concentrated using different sources of data. The analysis estimated number of zero-dose children by location and context. Apparently, the majority of zero-dose children are found where most of the population is concentrated, such as people living in remote rural areas and urban slums. Zero-dose children were not reached due to health system, supply and demand constraints, and gender and other social characteristics. Thus, prioritization of counties is made using various data, including, DHIS2 and survey data mainly previous LDHSs, remoteness, VPD incidence, infrastructure and other population characteristics such as mining population.

Immunization is both an indicator and tracer of PHC coverage which is a marker for equitable access of health service, including immunization to all communities. Thus zero-dose children and communities are a pragmatic indicator for those who do not have equitable access to essential PHC

[44] Gavi.org, 2022; Program Funding Guideline; Gavi, the Vaccine Alliance

and other social services; the equity indicator. As to stipulated in IA 2030, to access immunization services, vaccines must be delivered to areas that are isolated geographically, culturally, socially or otherwise and to marginalized populations such as displaced people and migrants and those affected by conflict, political instability and natural disasters. The causes of low vaccine use must be understood and addressed in order to increase people's demand for immunization services. Adequate, and predictable supplies of appropriate and affordable vaccines of assured quality must be available at points of service delivery, and stock-outs must be avoided. Besides, tailored strategies are necessary for understanding and overcoming barriers to vaccination.

The Government of Liberia with support from its partners can reach the majority of zero-dose and under immunized children through implementing different approaches such as strengthening service delivery, and supply and demand side interventions and providing access to immunization services through designing appropriate strategies, including functional PHC and outreaches. Addressing gender and other social barriers to immunization is also vital to improve immunization service delivery and identification of zero-dose and under-immunized children.

4. Conclusion and Recommendation

4.1. Conclusion

Analyzing coverage and equity trends is important to identify the priority areas and population groups. Assessment of bottlenecks that affect immunization services is also critical to develop sound strategies and plans that fit to the country context. This assessment assessed the immunization bottlenecks and analyzed coverage and equity trends by the equity stratifies.

The bottlenecks assessment included, immunization supply availability, service delivery, demand to access and use of services, quality and enabling environment. The coverage and equity trend analysis presents the immunization coverage trends from yearly WUENIC 2013-2022 and the three recent consecutive LDHSs.

The Liberia MoH is striving to improve access and ensure use of immunization service to Liberian regardless of where they are and who they are. Counties vary in terms of population density where Nimba, Bong and Lofa had large population, whereas Grand kru, Revercess and Bomi relatively lower population that necessities to design apt strategies to reach zero-dose and under-immunized children based on the context. Availability of refrigerators, vaccine carriers, vaccines, supplies and trained health workers at HF and county levels are essential to offer immunization services. The assessment showed the availability of functional refrigerator and vaccine carriers almost in all counties and HFs. Temperature reading is within acceptable range in 9 out of 10 HFS. Two-thirds of the HFs experienced one or more vaccine stockout in six months prior to the study.
The assessment indicated uneven distribution of health workers and community health workers involved in the immunization. The majority of health workers and community health workers did not receive immunization related trainings within two years prior to this survey.

Geographic access is also identified as a key challenge to access immunization services particularly in remote rural areas where there is lack of all-weather road and limited transport access. About

41% of the population walk long distance or use hammock or motorbike to reach to HFs. The HFs and counties can identify and estimate the catchment population which can be essential to prepare REC micro-plan. Missed opportunity for vaccine was also evident due to misunderstanding of opening multi-dose vaccine vials policy that necessities corrections. Maternal and child health services such as antenatal care, nutritional screening and sick child treatment are provided at HFs integrated with immunization but need further strengthening the service integration and by availing essential drugs at the HFs.

Demand to immunization service (initial contact between child and health worker) which is measured by children who received penta1 was relatively high in Liberia. Nine out of ten children received penta1 in Liberia. However, there is high disparity in access by counties. Whereas continuity means those children who received penta3 are about 21 per cent points lower than those who started vaccination which indicates high dropout rate. Effective coverage measured by the coverage of MCV1 and fully vaccination of all basic vaccines was 70.3 and 50.8% per cent respectively with wide variation across counties. While community engagement initiation exists in most counties and HFs, it had less impact on improving immunization continuity that needs to design apt strategy, including incentives to CHAs to maximize the community contributions for the EPI.

Effective program management and coordination, budget allocation and development of proper planning for immunization are enabling factors for strengthening immunization service and quality. However, stakeholders' engagement and coordination on planning, implementation and monitoring at county and HF level was limited. The budget for immunization is mainly from oversee development partners. Although there is a budget line item for EPI in health budgte, domestic financing for immunization is limited. While there is annual plan for most counties and HFs (four out of five), the data quality and micro plan was limited to reach all underserved communities in their respective catchment areas. The assessment revealed adequate supportive supervision, monitoring and program review that is commendable to enhance the immunization Program.

Regarding quality, the recent EVMA, 2022 showed composite score of 77 which is a little bit lower than the WHO recommended level (80). Immunization service providers and community health workers training is inadequate which may contribute to deterioration of vaccination service quality. Designing a motivation mechanism to CHAs also found to be useful to improve immunization service for the underserved communities. While the AEFI reporting was practiced, reporting rate was limited to some HFs that has to be improved.

As elsewhere in the Low- and Middle-Income Countries, gender related barriers are among key barriers in Liberia too. The key informants and FGD participants cited vaccinating the child is mothers' responsibility, while women had triple burden activities including, family care household activities and engagement on income generating activities. There is a need to strengthen the already initiated male engagement approach for the immunization services.

This assessment also identified significant disparities on coverage and equity of immunization in Liberia. According to WUENIC data from 2013-2022, Liberia was able to maintain high DPT1 containing vaccine coverage. However, the coverage setback in 2014 and 2020/21 due to the Ebola epidemics, and COVID-19 pandemic respectively and recovered in 2022. In terms of equity, Libera was successfully able to lower zero dose children and narrow the absolute disparity of vaccination among different population groups. Although there is a commendable progress to enhance immunization services in Liberia, much remains to do to reach all zero-dose and under immunized children and further narrow the disparity of immunization coverage across counties and population groups.

4.2. Recommendation

- Improve supply chain system; particularly vaccine distribution, frequent and close monitoring of vaccine stock, use of digital application for real time stock management to the level of HFs, capacity development on stock management, requesting and reporting of vaccines and supplies, and strengthening partnership at lower level.
- Improve availability of human resource- consider evenly distribution and assignment of health human resource mainly in remote areas, as this assessment identified maldistribution of immunization service providers varies from two in Rivercess to 172 in Nimba. Increase the density of CHAs, and provide continuous and focused capacity development trainings and design incentive or compensation mechanism as proposed by the CHAs from Jollos town, Timbo district, Konoma community, Garwula district, and Folley Twon, Dewoin District during the KII.
- Provide interpersonal communication and counseling training for health workers and use human centered design (HCD) approach for demand promotion particularly in communities with high number of zero-dose and under-immunized children (missed communities).Use context-specific service delivery- such as, periodic intensification of routine immunization (PIRI) in remote rural areas where rain fall is long, and flooding may interrupt immunization services, such as Bogbeh community, Dewoin District. Increase the number of integrated outreaches for the underserved communities. Support HFs to map their catchment population and ensure the reach to vaccination service to every target group;
- Ensure regular profiling of vulnerable populations and communities with high number of zero-dose and under-vaccinated children (Missed communities), by the number of unvaccinated children, the reasons for non-vaccination, and size of such population per catchment of HFs and adapt appropriate microplanning for immunization service provision.
- Design strategies to address missed opportunities for vaccination, such as provide clear guidance on opening of multi-dose vaccine vials and consider switching of measles vaccines to 5-doses vial to reduce vaccine wastage and missed opportunities for vaccination.
- Strengthen integration of immunization program with other health services that enables to comprehensively address the health needs of populations over time, make efficient use of resources and improve collaboration between programs;
- Provide client oriented and demand responsive vaccination service delivery through sustained engagement of community members and caregivers, especially during the introduction of new vaccines; get regular feedback from the community and provide apt responses for their inquiries to increase demand for immunization and ensure ownership and accountability

- Build trust to address vaccine hesitancy, through designing context-specific messaging and channels, and meaningful community engagement and education;
- Strengthen coordination, management and planning capacity at HF and county level to be able to develop tailored strategies/ plan, monitor implementation, targeting counties and HFs with high number of zero-dose, missed communities, unvaccinated children and with wide disparities compared with national average that included. This should be through coordination of stakeholders and enhancing community engagement.
- Avail functional vehicles for the three counties (Lofa, Sinoe and Grand Kru) to facilitate immunization supply distribution, service delivery and supportive supervision. The lack of road access and high transportation cost also identified from the assessment conducted at the three counties and FGDs in this assessment, for example, with Burma, Bogbeh and Tolokor communities. This requires expanding the number and location of HFs and/or outreaches providing immunization services in remote rural areas where there is lack of all-weather road and limited transport access.
- Strengthening immunization safety and surveillance system and VPD responses and data driven actions to address outbreaks. Timely monitoring and surveillance are essential for tracking progress and identifying areas that require further attention.
- Use evidence to make immunization a case for political attention and resources. It is encouraging that the Liberia government put a line item for EPI in the health budget. To optimize the resource to immunization, advocate for domestic budget allocation and secure commitment to prioritize reaching zero-dose children and missed communities with immunization.
- Enhancing use of the available evidence and generate periodic evidence, including the national immunization equity assessment, bottleneck analysis, immunization commodity assessment and document lessons learned and scale up best practices;
- Over-coverage (penta1 >100%) for immunization service, as identified in six counties from the DHIS 2018-2021, can mask identification and reaching of zero-dose children. It is required to improve data quality and the accuracy of population projections/estimates to produce realistic immunization coverage rates and minimize the chance of under-budgeting for the identification and reaching of zero-dose or under-vaccinated children;
- Consider gender during planning, data collection, analysis and prepare plans that incorporate gender transformative activities for immunization. Design strategies with involvement of the community to improve decision making power of women that enable them to decide on their children immunization and train and engage male community models on immunization program to address such challenges.
- Enhance the community involvement through robust awareness and sensitization on the importance of immunization services, and use of context-specific approaches and the community assets, such as depositing money for emergency and to cover transport cost for children immunization carried out by Konoma community, Garwula district. This promotes community ownership and sustainability towards immunization service delivery to meet the national and global target of addressing zero-dose and under immunized children.

Annex I: Assessment Tools (Questionnaire for Quantitative Data Collection and KII and FGD Guides for the Qualitative data


KII Guide


FGD Guide


Quantitative Questionnaire

Annex II: Table A1-A3: Proportion of Zero-dose Children by counties (Sources DHIS2, 2020-2023, and CEA Assessment, 2023, Liberia)

Table A1: Zero dose and Under-Immunized children at National level

Year	Target pop	# vaccinated Pentan1	#Vaccinated Penta 3	#Zero dose children	# Under Immunized children
2020	178453	161119	146766	17334	14353
2021	182201	164575	150702	17626	13873
2022	186027	188992	176667	-2965	12325
2023	216308	208442	193176	7866	15266

Source: DHIS2 (2020-2023) compiled by EPI team

Table A3: Proportion of zero dose children by county and district

County	Number of Districts	District	District Under 1 Population	Average # Vaccinated, Penta 1 2020-2023	# Zero Dose	Proportion (%) of Zero Dose	Proportion of zero dose district
Gbarpolu	5	Belleh	816	624	192	24%	60%
		Bokomu	1124	861	263	23%	
		Gbarma	860	691	169	20%	
Grand Gedeh	6	Konobo	1583	1157	426	27%	33%
		Putu	1011	967	44	4%	
Grand Kru	5	Barclayville	1029	995	34	3%	80%
		Buah	582	429	153	26%	
		Dorbor	274	252	22	8%	
		Lower Jloh	478	368	110	23%	
Montserrado	7	Bushrod	12544	6503	6040	48%	29%
		Central Monrovia	13537	11046	2491	18%	
River Gee	6	Chedepo	557	537	20	4%	50%
		Gbeapo	1144	748	396	35%	
		Sarbo	622	427	195	31%	
Rivercess	6	Central Rivercess	450	356	94	21%	33%
		Yarnee	333	264	69	21%	

Source: DHIS2 (2020-2023) compiled by EPI team

Table A4: Six months target children and proportion of zero dose by county, 2023 Assessment

	Six months target	Received Penta1 in the past 6 months of the Assessment		
County	#0-11 months*	Average #0-11	Proportion (%)	% of ZD
Bomi	1352	1157	85.6	14.4
Bong	2537	3094	122.0	-22.0
Grand Bassa	2003	2631	131.4	-31.4
Grand Cape Mount	1118	1457	130.3	-30.3
Grand Gedeh	1076	1326	123.3	-23.3
Grand Kru	515	687	133.4	-33.4
Lofa	2291	2588	113.0	-13.0
Margibi	2176	2606	119.8	-19.8
Maryland	4740	1331	28.1	71.9
Nimba	3595	4894	136.2	-36.2
Rivercess**	718	789	110.0	-10.0
Sinoe	1728	1295	75.0	25.0
Average total	23847	23855	100.0	0.0

*assuming average #0-11 months to be half of #0-23 months of age children

** One HF has no information at the time of field assessment