REACHING ZERO-DOSE AND UNDER-IMMUNIZED CHILDREN IN REMOTE AND UNDERSERVED SETTINGS OF ETHIOPIA: EVALUATION

ZERO TOLERANCE FOR ZERO DOSE CHILDREN

NOVEMBER
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FOREWORD

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According to the WHO/UNICEF 2021 global estimate, more than 18 million children are zero-dose. Almost all zero-dose children live in low- and middle-income countries, especially in the African and South-East Asian regions of the world.

Despite significant progresses made in increasing the number of infants immunized, Ethiopia, is still the fourth leading contributor to the global total of zero-dose children. In Ethiopia there are substantial regional variations in zero dose and under immunized children. For example, a subgroup meta-analysis indicated that the lowest proportion of immunized children are in Somali and Afar regions, 21% and the highest in the Amhara region, 89%. Ethiopia as one of Gavi support recipient countries is now giving focus to bring an end to this inequity, making reaching zero-dose and under immunized children with immunisation as a key priority for the next five years.

The MoH was part of this evaluation study and recognizes the importance of identifying program gaps in immunization coverage to work in remote and hard to reach, conflict and special setting. It will also require a focus on gender as one key barrier stopping children from receiving vaccines. The findings of this evaluation were used as inputs to inform immunization program planning and implementation targeting zero-dose and under-immunized children in 2022 and beyond. More importantly, the evaluation answered critical questions that will ultimately help to reach zero-dose and under-immunized children in line with IA2030 and GAVI 5.0 strategy.

The recommendations made in this evaluation study will play significant role in the national efforts of improving immunization coverage in hard to reach and underserved setting in Ethiopia. The research document will serve as a quick reference in line with understanding the magnitude of zero dose and under immunized children, reasons why vaccination coverage was so low in those underserved settings. The document also highlights potential strategies and policy recommendations to address the gaps related to zero dose and under immunized children in remote and underserved settings of Ethiopia.

The Federal MOH urges all program managers, care providers and implementing partners to make the best use of this this evaluation document in the implementation of immunization activities within remote and underserved populations in the country.

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ABBREVIATIONS

AACA	Addis Ababa City Administration
ANC	Antenatal Care
ARRA	Administration for Refugees and Returnees Affairs
B&E	Barrier and Enabler
BCG	Bacille Calmette-Guérin vaccine
BG	Benishangul Gumuz Region
CBHI	Community Based Health Insurance
CHIS	Community Health Information System
CHW	Community Health Worker
CSA	Central Statistical Authority
DICAC	Development and Inter-Church Aid Commission
DHIS	District Health Information System
DHS	Demographic Health Survey
DPT	Diphtheria, Pertussis and Tetanus
EA	Enumeration Area
EOC	Ethiopian Orthodox Church
EPI	Expanded Program on Immunization
EPHI	Ethiopian Public Health Institute
EPSA	Ethiopian Pharmaceutical Supply Agency
EFY	Ethiopian Fiscal Year
EVM	Effective Vaccine Management
FGD	Focus Group Discussion
FHT	Family Health Team
FP	Family Planning
FPP	Full Portfolio Planning
Gavi	The Vaccine Alliance
GMP	Growth Monitoring and Promotion
GoE	Government of Ethiopia
HC	Health Center
HDA	Health Development Army
HEP	Health Extension Program

HEW	Health Extension Worker
HF	Health Facility
HIT	Health Information Technologist
HPV	Human Papillomavirus
HSTP	Health Sector Transformation Plan
IA	Immunization Agenda
IDP	Internally Displaced People
IGAs	Income Generating Activities
IMNCI	Integrated Management of Newborn and Childhood Illnesses
IOM	International Organization for Migration
IPOS	Integrated Periodic Outreach services
IPV	Inactivated Poliovirus Vaccine
IRB	Institutional Review Board
IRMMA	Identify, Reach, Monitor, Measure and Advocacy
IRT	Integrated Refresher Training
KDE	Kernel Density Estimation
KII	Key Informant Interview
M&E	Monitoring and Evaluation
MCH	Maternal Child Health
MCHN	Maternal Child Health and Nutrition
MCV	Measles-containing Vaccine
MDVP	Multidose Vial Policy
MEL	Monitoring, Evaluation and Learning
MICS	Multiple Indicator Cluster Surveys
MoH	Ministry of Health
NGO	Non-governmental Organization
OPV	Oral Poliovirus Vaccine
PCA	Principal Component Analysis
PCV	Pneumococcal Conjugate Vaccine
Penta	Pentavalent vaccine
PHC	Primary Health Care
PIRI	Periodic Intensification of Routine Immunization
PNC	Postnatal Care
PMT	Performance Monitoring Team

QGIS	**Quantum GIS**
RCS	**Random Convenience Sampling**
RDQA	**Routine Data Quality Assessment**
RED/REC	**Reach Every District/Reach Every Child**
RHB	**Regional Health Bureau**
RRS	**Refugees and Returnees Service**
SBA	**Skilled Birth Attendants**
SBCC	**Social Behavioral Change Communication**
SD	**Standard Deviation**
SDD	**Solar Direct Drive Refrigerator**
SMS	**Short Message Service**
SNNPR	**Southern Nations Nationalities People Region**
SW	**South West Ethiopia Peoples' Region**
TB	**Tuberculosis**
T/SFP	**Therapeutic or Supplementary Feeding Program**
TT	**Tetanus Toxoid**
TWG	**Technical Working Groups**
UNHCR	**United Nations High Commissioner for Refugees**
UNICEF	**United Nation Children's Fund**
VPDs	**Vaccine Preventable Diseases**
VVM	**Vaccine Vial Monitor**
WDA	**Women Development Army**
WHO	**World Health Organization**
WoHO	**Woreda Health Office**
ZHD	**Zonal Health Department**

EXECUTIVE SUMMARY

BACKGROUND

Ethiopia has recently made substantial gains in increasing coverage of childhood vaccination. Between 2000 and 2019, proportion of children who received all the routine antigens increased from 15 to 44%, and that of measles-containing vaccine 1 (MCV-1) doubled from 32 to 59%. Proportions of zero-dose (missing DPT-1 containing vaccine) and under-immunized (missing DPT-3 containing vaccine) have been also reduced by 32 and 40 percentage points, respectively. Yet, important challenges remain unaddressed. In 2019, 23% of children 12-23 months of age were zero-dose and 39% under-immunized. Among GAVI-supported countries, Ethiopia is ranked fifth based on burden of zero-dose immunization. Other outstanding challenges include high dropout, and geographic and social inequality. The recent political unrest and Covid-19 pandemic have also threatened to revert the hard-fought gains.

PURPOSE:

With the financial support from Bill and Melinda Gates Foundation, Project HOPE in partnership with AMREF Health Africa and three local implementing partners, conducted an evaluation project – *Reaching zero-dose and under-immunized children in remote and underserved settings of Ethiopia*. The objectives of the research were to identify and map clusters of missed communities and zero-dose children in Ethiopia, to explore demand and supply barriers, including gender and socio-cultural constraints, and; to generate evidence to inform policy and practice towards reaching zero-dose and under-immunized children in Ethiopia. This document summarizes the overarching findings of the four main sub-components of the study: situational assessment, vaccination coverage survey, barrier and enabler (B&E) analysis and formative assessment for developing key strategies.

METHODS

The situational analysis included a qualitative study and a geospatial analysis based on secondary data. The purposes of the qualitative situational analysis were to identify underserved population/areas for the following vaccination coverage survey and B&E analysis; and evaluate the strengths, weaknesses, opportunities and threats (SWOT) and looks at internal and external factors affecting the Ethiopian immunization program. This situational analysis was conducted in March 2022. The study was designed in such a way that the perspectives of top-level officials of the health sector – Ministry of Health (MoH) and Regional Health Bureaus (RHBs) – and other core partners of the Ethiopian immunization program were reflected. Data were primarily collected through key informants' interview (KII). The study has captured the perspectives of key-informants from all regional states of Ethiopia excluding Tigray due to security reasons.

Geo-spatial analysis was used to map spatial distribution of zero-dose and under-immunized children in Ethiopia based on diverse data sources including: (i) Vaccination data of Ethiopian Demographic and Health Survey (EDHS) 2005, 2011, 2016 and Mini DHS 2019; (ii) Number of zero-dose and under-immunized infants as estimated based on the District Health Information System (DHIS) II data for the year 2015, 2019 and 2021; (iii) case-based surveillance data of measles compiled by the EPHI for the year 2021. We also conducted secondary analysis of Mini DHS 2019 dataset to estimate regional distribution of zero-dose and under-immunized children in Ethiopia. Number of zero-dose and under-immunized children was estimated based on vaccination coverage reported in Mini DHS 2019 report and population projections based on the 2007 national census.

The objectives of the coverage survey were to estimate number and rates of zero-dose and under-immunized children in underserved settings in Ethiopia and to identify health facilities readiness to provide vaccination service in the same setting. The vaccination coverage survey comprised community-based and health facility surveys. The study was designed in such a way that the findings would be generalizable to the following eight partly overlapping population groups: (i) Pastoralist regions and populations, (ii) Developing regions (Afar, Somali, Gambella and Benishangul Gumuz (BG)), (iii) Newly established regions of Sidama and South West Ethiopia Peoples' Region (SW) regions, (iv) Conflict-affected areas, (v) Underserved urban population including slum areas, (vi) Hard-to-reach areas in major regions (Amhara, Oromia, and SNNP regions), (vii) Internally displaced peoples (IDPs), and (viii) Refugees. The community-based survey enrolled 3,646 children 12-35 months from 304 enumeration areas (EAs). Study subjects were selected using multi-stage sampling procedure. Vaccination status was determined based on three different sources of information including caregiver's report, home-based (vaccination cards) and facility-based reports. Data was collected using CommCare digital data capture method and vaccination coverages estimated using weighted analysis approach. The health facility survey included 282 primary health care facilities that provide vaccination service to the EAs selected for the community-based survey. The survey primary included the nearest health posts or health centers to the EAs. At times when health centers or health posts were not available, primary hospitals were included.

The purpose of the B&E study was to identify service-delivery and demand-side barriers for reaching zero-dose and under-immunized children in Ethiopia. The study also explored how gender norms, roles and relations affects vaccination service provision and utilization. This qualitative B&E analysis was implemented over two phases. The first phase was completed in March 2022 along with the situational analysis, and explored the perspectives of top-level officials of the health system – Ministry of Health (MoH) and Regional Health Bureaus (RHBs) – and other core partners of the Ethiopian immunization program, through key informants' interviews (KII). The second phase was done in June 2022 in selected underserved settings, as identified by the first phase of the study. The second phase captured the viewpoints of managers of zonal and woreda health offices, implementing partners, and health workers deployed at all levels of the primary health care unit. We also assessed the opinions of end-users (communities, refuges, IDPs) through KIIs with formal

and informal community leaders and Focus Group Discussions (FGDs) with caregivers. During the first phase 98 KIIs, and in the second phase 270 KIIs and 33 FGDs, were completed. The KII and FGDs were facilitated by semi-structured guidelines validated with relevant stakeholders including MoH and RHBs. All interviews and discussions were tape recorded, and verbatim translation and transcription were done. The investigators independently went through the transcripts and field notes, did manual coding, and analyzed the data thematically on the basis of a priori framework.

The purpose of the formative phase was to assess the feasibility and acceptability of selected potential intervention for reaching zero-dose and under-immunized children in remote areas of Ethiopia. The formative assessment was informed by the qualitative and quantitative data collected in the earlier phases of the project and review of relevant literature. The research team identified and prioritized the potential interventions and assessed their feasibility through qualitative study integrated with the B&E analysis. Internal and external validation workshops were also organized to finetune the proposed interventions.

KEY FINDINGS OF THE SITUATIONAL ANALYSIS

The situational analysis identified the SWOT of the Ethiopian immunization program in various sub-domains including service delivery, human resources for health, supply chain management, Social Behavioral Change Communication (SBCC) and community mobilization, program planning, monitoring and evaluation (M&E), health information system and data quality, surveillance of vaccine preventable diseases (VPDs), governance and leadership, and partnership. The study has also mapped missed and underserved settings and provided region-specific data.

The geospatial analysis indicated significant clustering of missed communities in Ethiopia. Interpolation based on the 2019 data suggested almost all areas of Afar and Somali regions had higher rates of under-immunization. Hotspots areas were also identified in western Gambella and pocket areas of Oromia, SNNP (including Sidama and SW regions), Amhara, and BG. Analysis of the DHIS-2 data indicated considerable proportion of districts (more than half for Penta 1 and one-third for Penta-3) reported coverages exceeding 100%, suggesting data quality concerns. High burden districts (based on number of zero-dose and under-immunize children), especially in Tigray, Amhara, Somali, have been identified. Geospatial analysis based on reported measles cases also identified hotspot districts of measles outbreak in many regions, specially including SNNP, Oromia, Amhara and Somali regions. In 2021, Selamgo and South Ari woredas reported more than 100 measles cases.

Secondary analysis of the Ethiopian Mini DHS 2019 dataset was used to estimate regional distribution of zero-dose and under-immunized children. The analysis indicated, developing regions of Somali (58% zero-dose and 74% under-immunized) and Afar (55% zero-dose, and 74% under-immunized) had the highest zero-dose and under-immunization rates. However, in terms of actual numbers, 87% of the total zero-dose and under-immunized

children in Ethiopia were from Oromia, Amhara and SNNP regions. Oromia region alone contributed to nearly 50% of the national total.

KEY FINDINGS OF THE VACCINATION COVERAGE SURVEY

VACCINATION COVERAGE

3,646 children 12-35 months (45.6% girls) represented in the study. 60.8% of the children have had vaccination card. In total, 69% of children received BCG. While 66.3% of children received Penta-1, only 37.2% of them got the last Penta dose. Children who received MCV 1 and 2 were 65.7% and 33.9%, respectively. The coverages of OPV 3 (49.1%), IPV (38.0%), Rota 2 (51.7%) and PCV 3 (35.2%) were also low. Among the population domains that we studied, Penta-1 and Penta-3 coverage rates (93.8% and 85.3%, respectively) were higher in urban slums. Conversely, Penta-1 and Penta-3 rates in developing regions (46.1% and 19.8%, respectively) and newly formed regions (62.2% and 36.8%, respectively) were disappointingly low.

PREVALENCE OF ZERO-DOSE AND UNDER-IMMUNIZED CHILDREN:

Aggregated prevalence of zero-dose and under-immunized children in hard-to-reach and underserved settings of Ethiopia were 33.7% and 62.8%, respectively. The lowest prevalence of zero-dose (6.2%) and under-immunization (14.7%) were found in urban slums. Conversely, developing regions had the highest prevalence of zero-dose (53.9%). Prevalence of zero-dose children was unexpectedly lower in refugees (29.9%). Hard-to-reach areas in major regions had the second lowest rates of zero-dose (25.5%) and under-immunization (54.8%).

ESTIMATED NUMBER OF ZERO-DOSE AND UNDER-IMMUNIZED CHILDREN

Conflict-affected areas have the highest contribution of zero-dose (221,458) and under-immunized children (394,434). Pastoralist populations (181,515 zero-dose and 300,015 under-immunized), developing regions (174,429 zero-dose and 259,539 under-immunized) and newly formed regions (100,188 zero-dose and 167,511 under-immunized) also harbor 100,000 plus zero-dose children. Hard-to-reach areas of the major three regions harbor 92,337 zero-dose and 198,433 under-immunized children. Conversely, the contributions of IDPs (37,860 zero-dose and 68,326 under-immunized), refugees (7,653 zero-dose and 15,792 under-immunized) and urban slums (8,659 zero-dose and 20,530 under-immunized) were relatively lower.

VACCINATION DROPOUT

The overall Penta-1 to Penta-3 and Penta-1 to MCV-1vaccination dropout rate were 43.5% and 23.4%, respectively. Region-wise, dropout rates were lowest in Amhara and BG regions (about 30%) and highest in Somali, Afar and Gambella (> 60%). Among the population domains, IDPs had the highest (70.2%) dropout rate.

SOCIO-ECONOMIC INEQUALITY IN VACCINATION COVERAGE AND DROPOUT RATE

In terms of household wealth index near to 30 PP difference were observed between the poorest and richest wealth quintiles in the prevalence of zero-dose and under-immunized children. Similar pattern was also seen in Penta-1 to Penta- 3 dropout rate. Children from parents with no formal education were largely under-immunized and missed routine vaccines compared to children from parents with tertiary education. Living in rural settings had largely contributed to the prevalence of zero-dose, under-immunization and dropout rates.

MISSED OPPORTUNITY AND HORIZONTAL INTEGRATION

68.9 and 92.8% of women received vaccination-related information during antenatal (ANC) and postnatal (PNC) care. Access to vaccination information during PNC is universally high (> 90%) in all the sub-populations studied. Provision of vaccination-related information during ANC was highest among refugees (88.6%) and lowest in newly formed regions (56.8%) and IDPs (62.2%). About half of the respondents visited health facility at least once while the index child was younger than 12 months of age for seeking various Maternal and Child Health (MCH) related services. Missed opportunities were relatively low during ANC or PNC (6.1%) and growth monitoring and promotion (9.8%) services. Conversely, missed opportunities were higher during family planning (25.0%), distribution of bed nets (24.7) and during sick child care (21.4%).

KNOWLEDGE AND ATTITUDE TOWARDS CHILDHOOD VACCINATION

Most of the respondents have heard of routine childhood vaccines (90.3%) and knew vaccines prevent diseases (VPDs) (88.0%). Yet, the awareness on specific VPDs appears to be low. The most popular diseases that the respondents identified as vaccine preventable were measles (46.2%) and poliomyelitis (45.3%). Less than 10% identified Diphtheria, Meningitis and Hepatitis B as VPDs. Only one-fifth (19.1%), were aware that childhood vaccination has to be started at birth. About one-third (68.9%) thought that it would be very likely that the child be susceptible to VPDs if not unvaccinated. Similarly, 65.8% assumed that VPDs can get very sever if the child gets infected. The attitude of the caregivers towards routine childhood vaccination appears to be positive and small proportion reported vaccine hesitancy.

BARRIERS AND ENABLERS TO UTILIZATION OF VACCINATION SERVICE

Among 1,854 caregivers whose children received Penta-3 vaccine, barrier for not utilizing the vaccination service were assessed. The leading reported reasons were absence of vaccination service in the locality (47.0%), and failure of health workers to visit the village (44.6%). Closure of vaccination cite (21.8%), absence of vaccine (20.5%) and domestic workload were also cited by considerable proportion of the respondents. Conversely among 1,665 caregivers whose children received Penta-3, enablers for utilizing the service

were explored. The leading reasons were knowledge on the importance of vaccination (75.9%), proximity of health facility/outreach site (57.2%) and door-to-door campaigns (48.3%).

GENDER AND VACCINATION

In terms of zero-dose, under-immunization and drop-out rates, no meaningful differences were observed between boys and girls. Female-headed households had higher rates of under-immunized children (72.0%) and dropout rates (56.0%). The prevalence of zero-dose and under-immunized children and dropout rates declined with women's increasing power in household decision making. Vaccination rates did not show consistent difference across types of women's occupation; however, women engaged in professional jobs had substantially better outcomes. Women's land and house ownership, husbands support in household chores, engagement of both partners in household resource allocation, and women's better access to information about what is happening in the community were all associated with lower rates of zero-dose, under-immunization and drop-out.

KEY FINDINGS OF THE HEALTH FACILITY SURVEY

A total of 282 health facilities were enrolled. Of them 23 (8.1%) were not functional at the time of the survey. Hence the actual analysis was made in the remaining 259 health facilities. The studied health facilities included 137 health posts, 111 health centers and 11 primary hospitals. In a typical week more than two-third (69.3%) of the health facilities provide vaccination service twice per week or less frequently. The frequency of providing multidose vials (BCG and measles) is even lower. Nearly a tenth (9.8%) of the health facilities don't provide outreach vaccination service and 21.3% organize outreach activities less than once per month. One-tenth of the health facilities did not organize any vaccination campaign in the previous 12 months. Nearly two-third of the health facilities reported interruption of vaccination service in the last 3 months of the survey. The leading reasons for service interruptions were related to hiccups in the vaccine logistic system. Vaccine refrigerators were available in 80% of the health facilities and of the available refrigerators, 87% of them were working at the time of the survey.

KEY FINDINGS OF THE B&E ANALYSIS

FUNCTIONALITY OF HEALTH FACILITIES

Major supply-side barriers that hinder provision of vaccination services in remote areas of Ethiopia are unsatisfactory health service coverage, topographic barriers, and poor functionality of health posts secondary unavailability of Health Extension Workers (HEWs) or absence of refrigerators. Furthermore, shortage of vehicles to implement vaccination programs, unmanageably large catchment population size, weak linkage between health centers and health posts, and overcrowding in urban settings, were identified as important blockades.

CHALLENGES OF STATIC VACCINATION SERVICE DELIVERY

The regular availability of the static service is limited due to closure of health posts, shortage of refrigerators, frequent campaign-based activities, and scheduled provision of EPI service. Providing statistic vaccination service only once a month or a week were frequently reported. Shortage of manpower, low client flow and fear of wasting multidose vaccines are common reasons for not providing vaccination service on daily basis. In selected underperforming settings, Periodic Intensification of Routine Immunization (PIRI) is being implemented to support the routine service, but many hard-to-reach areas remain uncovered.

CHALLENGES OF OUTREACH VACCINATION SERVICE DELIVERY

Similarly, the outreach strategy is not being implemented regularly due to shortages of manpower, vehicles and budget to cover fuel and per diems for health workers. Demotivation of HEWs and disintegration of HDA/WDA network are also key blockades. In many cases, outreach sessions are organized irregularity due to demotivation and conflicting commitments of HEWs. Outreach programs are also frequently cancelled because of lack of transportation, leading to service dissatisfaction.

CHALLENGES OF THE MOBILE OUTREACH STRATEGY

The mobile outreach strategy is not being implemented in remote settings due to shortage of resources, scarcity of partners to support the initiative, limited number of mobile teams, sporadic field deployment, and unmanageably large catchment area. In Somali and Afar regions, mobile teams give priority to nutrition and emergency response than immunization. In the same regions, the mobile teams are directly deployed by RHBs, so sense of ownership at lower level is low. The strategy is also costly to regions and districts, so it is only being activity implemented in district supported by partners.

HEALTH WORKFORCE RELATED BLOCKADES

Across all the regions, increasing number of health workers are being deployed. Yet, with the exception of predominately urban regions, scarcity of health workers remains a major bottleneck. Other challenges are shortage of EPI focal person at regional level, demotivation HEWs, lack of system for recognizing good performing health workers, unavailability on duty due to weak control mechanism, high staff turnover (especially in developing and conflict-affected areas), skill gaps of HEWs (especially fresh graduates and those working in pastoralist areas), and unjustified demand for incentive. HEWs are also extremely overloaded with increasing service packages, repeated campaigns and other engagements. Trainings on EPI are provided rarely and skill transfer mechanism within the health system is weak.

ENGAGEMENT OF PUBLIC HOSPITALS IN EPI

Primary hospitals are expected to support the vaccination program in their locale through providing static outreach services. However, most hospitals assume EPI is rather the duty of health posts and health centers. Hospitals are usually overstretched with curative serve and the consider vaccination as a fringe activity. Further they have weak linkage with district health offices. In some settings, the role of hospitals in EPI is limited to linking hospital-born infants with nearby health centers or health posts. Even some hospitals discharge newborns without providing vaccines due to weak link between delivery and EPI units, and fear of wasting multidose BCG vaccine.

ENGAGEMENT OF PRIVATE SECTOR IN EPI

So far, the health system has done little to engage the private sector in EPI. However, some health facilities in Addis Ababa, Dire Dawa, Harari and urban areas of Oromia have been supported to provide the service. In this regard, the major blockade is incapability of the facilities to purchase prequalified refrigerators. Private health facilities providing vaccination service in Harar and Dire Dawa have also been criticized for not closely monitoring defaulters and failing to establish linkage with the public sector. However, caregivers in urban areas usually assume that the service quality is better-off in private facilities.

DEFAULTER TRACING

Most of the key informants considered dropout from vaccination program as a major problem. Specially MCV-1 to MCV-2 dropout is very high as the latter has not been adequately promoted. The problem is more pressing in pastoralist and conflict-affected communities. Frontline heath workers sometimes fail to provide basic information including appointment dates to caregivers, leading to the dropouts. Irregularity in the schedule of outreach sessions is also another contributor to dropout. Across the settings, systematic approach has not been instated to trace defaulters. Earlier the HDA network was supporting the effort, but the network is largely passive now.

MISSED OPPORTUNITY AND SERVICE INTEGRATION

Though national guidelines promote horizonal integration of EPI with other MCH services, in practice the link with services like sick childcare, nutritional screening, vitamin A supplementation and family planning is modest and missed opportunities are common. Major blockade is unavailability of static vaccination service on daily basis. Sometimes babies born at hospitals may not even get birth doses due to lack of coordination between delivery and EPI rooms. With the intension of reducing vaccine wastage, health workers, usually give appointment for BCG vaccination, but caregivers many not return back. Carelessness, demotivation and overload of health workers also led to missed opportunities. The potential of multi-sectorial integration, for instance with food aid

programs, is rudimentary. Conversely, in urban areas, schools or childcare centers have vaccination requirements and this has increased the utilization of the service.

CHALLENGES OF THE HEALTH EXTENSION PROGRAM (HEP)

Respondents both from the government and partners sides have concurred that the HEP is becoming weak to support EPI and other routine programs. Across the board, HEP is not functioning as it used to do ten years back due to lack of attention, demotivation of HEWs, and disintegration of HDA/WDA network. The respondents hopped that the new HEP Roadmap may resolve the problem. In many hard-to-reach areas absence of male HEWs has limited the implementation of the HEP.

SOCIAL BEHAVIORAL CHANGE COMMUNICATION (SBCC) AND COMMUNITY MOBILIZATION

Regular and diverse SBCC for promote vaccination is generally rare. SBCC activities are commonly incorporated in the annual plan of the woreda health offices; yet they are not frequently translated into practice. Interpersonal communications through WDA/HDA network, house-to-house visit by HEWs, Community Conversation and Pregnant Women's Forum are also losing momentum. Frequently reported challenges were the weaking of the HDA network, decline in the motivation of HEWs, and failure to engage influential community members. Reports on SBCC activities by frontline workers is also difficult to validate. Though health workers frequently blamed lack of audiovisual aids for weak SBCC efforts, the widely available Family Health Card has been underutilized. Health workers sometimes fail to provide comprehensive information on vaccination, including side effects management, when vaccinating children, and this has contributed to dropouts.

IMMUNIZATION FINANCING

The Ethiopian government is modestly co-financing the national vaccination program. In Ethiopia EPI remains largely donor-dependent and this has posed threat to the sustainability of the program. In many settings, even operational costs are being covered by partners. Decisionmakers frequently complained budget shortages as a major barrier for implementing EPI. Shortage of finance to cover per dimes, purchase kerosene and organize review meetings and trainings have been reported.

PLANNING FOR VACCINATION

The information that we received about vaccination planning from different levels of respondents was divergent. Higher level informants reported that bottom-up microplanning is being largely practiced. However, information from partner organizations, lower-level managers and health workers suggested otherwise. According to them, microplanning is not being done in many settings due to lack of attention, workload and lack of resources. Some lower-level managers also considered microplanning as costly and donor driven initiative that cannot be sustained. Micro plans are not commonly translated into practice

due to lack of resources and follow up. Lack of reliable denominator remains the major challenge for planning across all settings. The expansion of the Community Health Information System (CHIS) may in the long run resolve this problem.

MONITORING AND EVALUATION

The information that we get from top and low-level mangers regarding monitoring, evaluation and learning practices was also divergent. According to top level managers, in most regions and at all levels, EPI is regularly monitored through annual or semi-annual review meetings, Performance Monitoring Teams (PMT) and integrated supportive supervisions. Feedback is also given to districts and PHCU on the basis of their performance. However, the information that we received from health workers suggested, such efforts are weak and irregular due to scarcity of resources, lack of commitment and conflicting engagements of managers.

DATA QUALITY FOR DECISION MAKING

All groups of respondents (decisionmakers, managers, health professionals and partners) concurred that, despite recent improvements, poor data quality remains a major concern. Causes of poor data quality in the vaccination program include use of faulty population conversion factors, lack of value for data, weak data accountability system, demotivation of HEWs, carelessness, miscommunication between HEWs working in a same facility, skill gaps and data fabrication. Improper data documentation and shortage of recording formats also contribute to this end.

DEMAND SIDE BARRIERS

Resistance to routine childhood vaccination in general is rare and such challenges are limited to few remote areas. Yet self-initiated demand has not been established in most settings (except in urban areas and major regions) because of poor access to vaccination service, service dissatisfaction and absence of sustained SBCC interventions. The most common demand-side barrier identified in FGDs was fear of vaccination side effects. Small-scale misconceptions due to religious beliefs (like delaying vaccination until the baby gets baptized, fear of evil eye, and asserting that the baby is already protected by God), cultural norms (limiting the movement of women in the postpartum period) and misconceptions (like fear of injections and concerns about multiple injections at a time), have been reported. Domestic workload, forgetfulness and negative influence of others family members (e.g., husbands, parents and mother-in-law) have also been reported.

GENDER-RELATED BARRIERS

Boys and girls appear to have equal access to vaccination service. Though son preference is common in many communities, it has limited implication to vaccination. Caregivers also do not have a strong gender preference for health workers. However, the study has identified other relevant gender-related blockages. Culturally, child care including taking

children to vaccination service is considered as mothers' duty. Even health workers show a similar stereotyping and this may discourage fathers from caring for their children. The health system rarely engages fathers in vaccination. Usually, vaccinators interact only with mothers; despite women have limited decision making power and control over resources. Women's domestic workload is a major cause for vaccination dropout. Specially, female-headed households have poor care seeking practice. The health system does not take gender into consideration while planning, implementing and evaluating vaccination programs. Gender-disaggregated data collection and analysis are not practiced in EPI.

CHALLENGES OF THE VACCINE LOGISTIC SYSTEM

Since 2016 Ethiopian Pharmaceutical Supply Agency (EPSA) has taken the responsibility of distributing vaccines directly to hospitals, health centers and districts. The transition has substantially improved the national vaccine logistic system. Yet many districts and health facilities remain inaccessible to EPSA. Mass distribution of solar refrigerators, refrigerator maintenance campaigns, and rollout of the Effective Vaccine Management (EVM) system including the Fridge-tag system, are bold constructive initiatives. Outstanding challenges are frequent refrigerator failures secondary to improper handling or lack of preventive care, inability to timely maintain them due to shortage of spare parts and skill gap of biomedical technicians, lack of resource to transport vaccines from districts to health facilities and limited cold storage capacity at lower level. Failure of districts to submit vaccine requests on regular basis frequently causes artificial vaccine shortage. Vaccine wastage (both open and close vial wastage) has not been satisfactorily reduced. Distribution of vaccines is being seriously affected by the ongoing political instability in the country.

PECULIAR CHALLENGES IN HARD-TO-REACH AREAS

The health system in remote areas is fragile and has limited options to provide vaccination service in equitable manner. Some remote areas (e.g., Akobo in Gambella region and Surma in South West region) are only being accessible through campaigns. Though PIRI is a promising initiative, many remote districts have not been covered by the program. Hard-to-reach areas frequently have inadequate human and material (e.g., refrigerators, motorbikes) resources to implement vaccination programs. Despite the improving vaccine logistic system at national level, remote areas frequently face supply interruptions. Female HEWs usually avoid traveling to hard-to-reach communities due to physical challenge and fear of sexual violence. The increasing demotivation of frontline health workers means they are increasingly reluctant to serve remote areas. Specially areas near to inter-national and -regional boundaries are frequently underserved.

PECULIAR CHALLENGES IN PASTORALIST AREAS

Pastoralist regions (Somali, Afar), districts (those in Oromia, Gambella, SW and SNNP regions), and isolated communities in Sidama are largely underserved. Apart from mobility and dispersed settlement pattern, pastoralists have limited access to health service due to poor road and health infrastructure, movement across political boundaries and

political instability. Health facilities are also not strategically located. The existing HEP in most pastoralist areas is fragile due to shortage and skill gaps of HEWs, scarcity of refrigerators, and absence of the HDA/WDA network. Climatic conditions also discourage HEWs from organizing campaigns and outreach sessions. In most pastoralist areas there is no meaningful service delivery strategy that takes the nomadic nature of the population into consideration. Demand-side barriers are relatively more frequent and include low awareness about vaccines, giving more value too food aid rather than health services, and reduced care seeking due to recurrent drought and adverse climatic conditions. High fertility, polygamy and women's excessive domestic workload also limited ability of parents to give optimal care to their children.

PECULIAR CHALLENGES IN CONFLICT-AFFECTED AREAS

Political instability has seriously affected the delivery of vaccination service not only in north and western Ethiopia, but also in pocket areas in SNNP, SW and Gambella regions. Even prior to the recent political instability, most of these areas have been physical inaccessibility. Though small-scale mop-up campaigns have been organized, the areas have not been adequately reached so far. Despite the relative stability over few months preceding the study, many areas remain unsafe to health workers. The recent conflict in north Ethiopia has caused widespread destruction of health facilities, and looting of refrigerators and other equipment. Some health facilities have been restored to provide emergency service. Yet, EPI is not considered as part of the emergency service package. Despite, repeated field visits and pledges by many NGOs, conflict-affected areas have not been meaningful supported so far. The political instability has diverted the attention and resources to the war and social services are receiving little attention.

PECULIAR CHALLENGES OF IDPS

In general, among IDPs vaccination coverage is low and dropout is high. From supply perspective, the health system in the host community is usually weak and inadequately supported, so it easily gets overwhelmed with the IDPs. Lack of refrigerators at camp clinics and shortage of vaccine supply are common challenges. On the other hand, few IDP centers are too small or remote to get attention. Humanitarian services provided to IDPs are not well integrated with health services, consequently missed opportunities are common. Assimilation into the host community make IDPs difficult to target. From the demand perspective, vaccination is usually a secondary issue for IDPs as most have not met the basic needs.

PECULIAR CHALLENGES OF REFUGEES

The vaccination service situation in refugees appears to be better than that of IDPs. Vaccination service is usually provided by linking in-camp clinics with the existing health system in the host community. Vaccination service is also provided through a mix of modalities: static, outreach sessions and mop-up campaigns. Alike IDPs, linkage between vaccination and humanitarian service is weak. Other peculiar challenges for the refugee

population are physical inaccessibility of camps, staff turnover, unregulated mix-up between host and refugee population, vaccine supply interruption, and vaccine hesitancy. FGDs that we had with refugees indicated that knowledge gaps on vaccination are more common among refugee population than the general population.

PECULIAR CHALLENGES IN URBAN AREAS

Vaccination service coverage is satisfactory in most urban settings like Addis Ababa, Harar, Dire Dawa and other towns. Urban slums, impoverished and street families, daily laborers and urban communities bordering other regions and rural areas are relatively underserved. In Addis Ababa vaccination service delivery is mainly limited to static approach. Other service delivery barriers in urban areas are: overcrowding at health facilities leading to service dissatisfaction, geographical maldistribution of health centers, poor engagement of hospitals in EPI, and provision of vaccination service only in morning hours. Demand-side barriers including unavailability of caregivers during working hours, reluctance to accept booster doses, refusing to open doors due to security concerns and rejecting vaccines based on unfounded claims.

CONCLUSION

According to the vaccination coverage survey, with the exception of urban slums, coverages are unsatisfactory in all the remote, hard-to-reach and special populations that we studied. Specially the coverage of newly introduced vaccines (IPV and MCV) is disappointingly low. The pooled prevalence of zero-dose and under-immunized children in hard-to-reach and underserved settings of Ethiopia were 33.7% and 62.8%, respectively. The highest prevalence was in the developing regions, IDPs and pastoralist populations. In terms of actual numbers, conflict-affected areas have the highest burden of missed children. Penta-1 to -3 and Penta-1 to MCV-1vaccination dropout rates are unacceptably high. The study witnessed considerable socio-economic inequality in vaccination coverage and dropout rates. Missed opportunities are also common during family planning and sick child care services provision. Though vaccination service coverage is balanced between boys and girls, multiple gender-related factors seem to affect utilization of the service. The health facility survey suggested considerable number of health facilities are non-functional in terms of vaccination service provision. Further regular provision static and outreach service is largely sub-optimal and interruption of service due to hiccups in the vaccine logistic system are frequent.

Secondary data analysis DHS data suggested, in terms of improving vaccine coverage, the biggest opportunity for impact would be intervening in the three major regions. Yet, investing in the other regions would also give sense from vaccine equity perspective.

The B&E study has identified several service delivery and demand side blockades for provision and utilization vaccination service in various underserved settings. In conflict-affected areas, FMOA and RHBs should introduce a strategy and established an emergency

fund for rehabilitating the damaged health infrastructure. In the case of ongoing conflicts, vaccination should be provided through a mix of makeshift strategies like coordinated hit-and-run approach and negotiating access to conflict areas. Integration of vaccination service with humanitarian aid programs likely increase uptake of vaccination service specially in conflict- affected settings. Standardized mop-up strategy for regularly reaching remote areas has to be designed. PIRI should be expanded to cover more remote districts. Pockets of local inequities should be reduced through implementing "Reaching Every Community" strategy. The pastoralist population have to be reached through expansion of integrated mobile outreach strategy. The increasing demotivation of HEWs should be addressed through providing meaningful carrier development opportunities and other financial and non-financial incentives. Hardship benefits should be considered for HEWs deployed in remote areas in all regions. FMOA should consider to deploy male HEWs in remote settings of all regions. The disintegrating HDA/WDA network should be revitalized by introducing an efficient incentive system. Defaulting from the vaccination program should be reduced through strengthening the "tickler box" system. MoH, RHBs and WoHOs have to ensure that static service is provided routinely at all hospitals, health centers and health posts. A standard to guide the role and responsibilities of public hospitals in vaccination program should be introduced. Public-private partnership should receive attention. At community level, SBCC and community mobilization efforts should be diversified and intensified. Improving the counseling skills of health workers and making job aids accessible would enable health workers to provide comprehensive and persuasive information to caregivers. Ensuring SDD refrigerators are available in all health posts, improving access to long range cold boxes, introducing mobile-based vaccine logistics management information system, piloting the use of small drones for distributing vaccine supply to remote areas, and reducing multidose vials to smaller vial sizes may help to improve the vaccine logistic system.

BACKGROUND

Immunization is one of the most cost-effective public health interventions that averts 3-5 million deaths every year (WHO, 2019; UNICEF, 2019). However, since 2020 childhood vaccination coverage has either stagnated or even declined globally (WHO and UNICEF 2021). In 2021, 25 million children had missed at least one life-saving vaccine (GAVI, 2022). Among Vaccine Alliance (GAVI)-supported countries, in 2020, 12.4 million of 72.9 million eligible children were zero-dose (missing DPT-1 containing vaccine) and 16 million were under-immunized (missing DPT-3 containing vaccine) (GAVI, 2021a). A recent estimate by WHO and UNICEF concluded that worldwide 18 million children are zero-dose and 25 million under-vaccinated (WHO & UNICEF, 2021).

Since the new millennium Ethiopia has substantially increased the coverage of childhood vaccination. Proportion of children who received all the routine antigens triplicated to 44% and the coverage of measles-containing vaccine 1 (MCV-1) doubled to 59% (CSA & ORC Macro, 2001; EPHI & The DHS Program, 2021). Likewise, percentages of zero-dose and under-immunized children have been reduced by 32 and 40 percentage points, respectively. However, important challenges remain unaddressed. In Ethiopia 23% and 39% of children 12-23 months of age are zero-dose and under-immunized, respectively (EPHI & The DHS Program, 2021). Among GAVI-supported countries, Ethiopia is the fifth country with the highest number of zero-dose children (GAVI, 2021b).

Globally increasing attention is being given to Gavi 5.0 "Leaving no one behind" Strategy that envisions to reduce the number of zero-dose children by 50% by 2030. The strategy has a mission to increase equitable and sustainable vaccination service in all settings including underserved urban areas, hard-to-reach communities, and conflict-affected populations (GAVI, 2021b). The Ethiopian Health Sector Transformation Plan (HSTP) II (2021-25) has also incorporated a strategic direction for controlling vaccine-preventable diseases (VPDs) and set an ambitious target to increase full vaccination coverage from 44% to 75% (MoH, 2021a). The National Expanded Program on Immunization (EPI) Comprehensive Multi-year Plan (2021-2025) included several important programmatic objectives like reaching 90% full vaccination coverage at national level and 85% in every district (MoH, 2021b).

With the financial support from Bill & Melinda Gates Foundation, Project HOPE in collaboration with Federal Ministry of Health (FMoH) and AMREF Health Africa has conducted evaluation research "Reaching zero-dose and under-immunized children in remote areas of Ethiopia". The purpose of the evaluation was to generate evidence that informs the steps along the Identify, Reach, Monitor, Measure and Advocacy (IRMMA) Framework towards reaching under-immunized and zero-dose children in underserved settings in Ethiopia.

The report summarizes the key findings of the four components of the evaluation: situational assessment, vaccination coverage survey, Barrier & Enabler (B&E) analysis

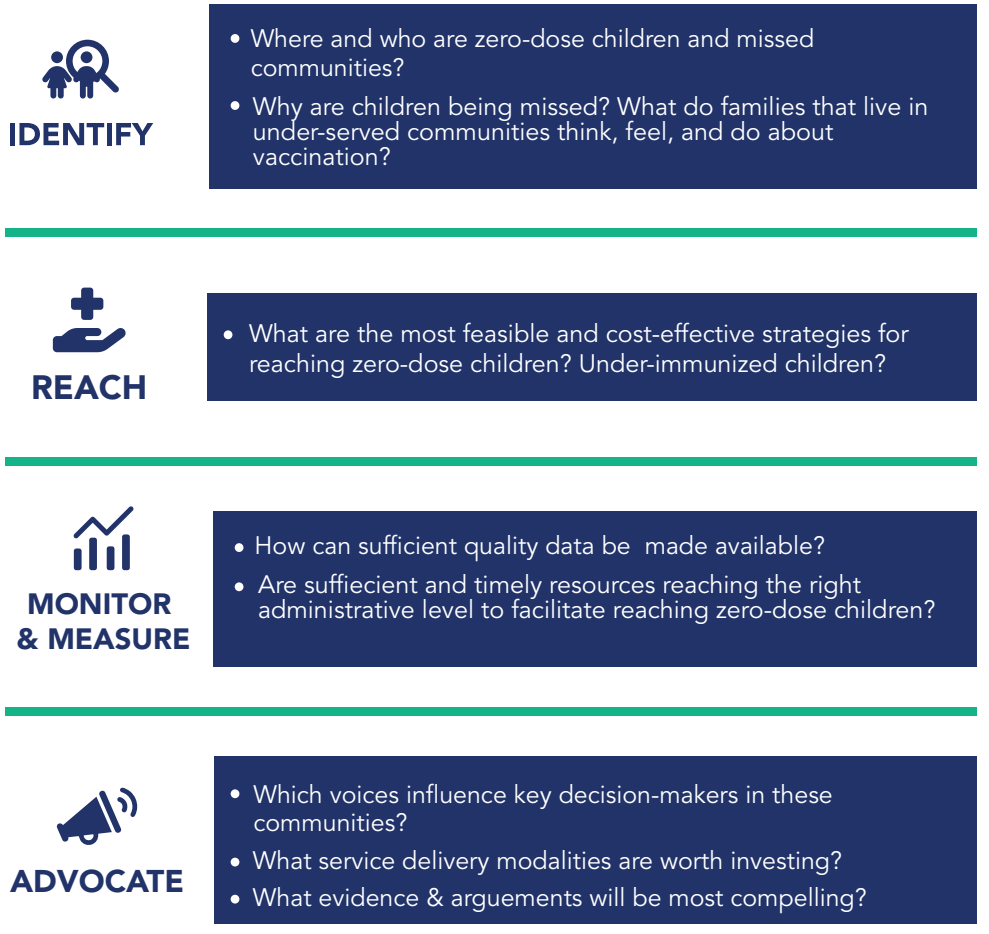
and formative assessment, implemented from February to July, 2022. The evaluation was primarily focused on underserved settings of the country including hard-to-reach areas, pastoralist populations, conflict-affected settings, socially disadvantaged urban communities, refugees and internally displaced populations (IDP).

Project HOPE and its partners believe that the findings of the study are imperative for informing vaccination programming in Ethiopia. The study also helps to develop context-specific Social and Behavior Change Communication (SBCC) strategies for promoting uptake of childhood vaccination. Without comprehensive understanding the context specific supply and demand-side barriers, effective immunization program cannot be implemented. The evaluation will help the Government of Ethiopia (GoE) and its stakeholders to design strategies to reach missed communities in Ethiopia. The evaluation is also aligned with Immunization Agenda (IA) 2030 as well as the GAVI 5.0 strategy (WHO, 2022). The preliminary findings of the evaluation have already been used as an input to inform the Full Portfolio Planning (FPP) process of the Federal Ministry of Health (FMoH) and its stakeholders on immunization program planning for GAVI support.

PURPOSE AND OBJECTIVES

The purpose of this evaluation was to generate evidence to inform the steps along the Identify, Reach, Monitor, Measure and Advocacy (IRMMA) Framework towards reaching under-immunized and zero-dose children in underserved settings in Ethiopia. The evaluation has identified and mapped clusters of missed communities and zero-dose children in a systematic manner, and explored demand and service delivery related barriers, including gender and socio-cultural constraints. The evaluation also included a formative assessment for designing strategies to reach missed communities in Ethiopia. The study was designed to answer the critical questions along the IRMMA Framework (Figure 1).

Figure 1: The IRMMA framework and key evaluation questions



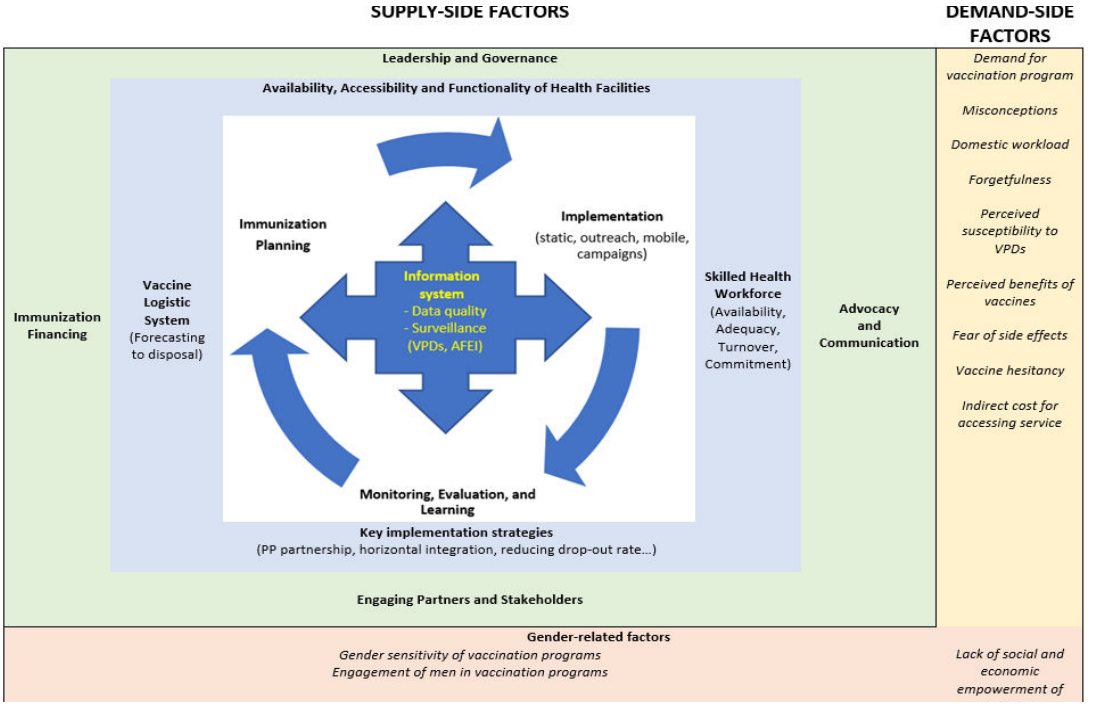
The objectives of the research were to identify and map clusters of missed communities and zero-dose children in Ethiopia, to explore demand and supply barriers, including

gender and socio-cultural constraints, and; to generate evidence to inform policy and practice towards reaching zero-dose and under-immunized children in Ethiopia.

ANALYTICAL FRAMEWORK

Figure 2 presents the analytical framework of the study. The framework integrates supply- and demand-side barriers affecting immunization service delivery and utilization. Further, it assumes gender-related factors function on both sides. The framework conceptualizes supply-side factors in three domains: the core domain includes the vaccination planning –implementation – monitoring and evaluation (M&E) cycle, and health information system for informing the cycle. The intermediate domain represents immediate inputs for delivering the service including availability and functionality of health facilities, health workforce, presence of efficiency vaccine logistic system and strategic approaches for delivering the service. The external domain included cross-cutting elements including leadership, advocacy and communication, and immunization financing (Figure 2).

Figure 2: Analytical framework for the study



METHODS

Evaluation Setting

In line with the understanding that nearly half of zero-dose children in lower-income countries are from hard-to-reach communities, conflict-affected settings or disadvantaged urban areas, the evaluation study was conducted in the following eight partly overlapping settings.

1. Pastoralist regions and populations: Afar and Somali regions, and specific pastoralist or semi-pastoralist settings in Oromia, Southern Nations, Nationalities, and Peoples (SNNP), South West Peoples' (SW) and Gambella regions.
2. Developing regions: Afar, Somali, Gambella and Benishangul Gumuz (BG) regions
3. Newly established regions: Sidama and South West Ethiopia Peoples' (SW) regions
4. Conflict-affected areas: Selected settings in Afar, Amhara, Oromia, and BG regions
5. Underserved urban population: Urban slums in five selected cities and rural areas under Dire Dawa City Administration and Harari region
6. Hard-to-reach areas in major regions: Selected remote districts in Amhara, Oromia, and SNNP regions.
7. Internally displaced peoples (IDPs): Selected IDP centers in Afar, Amhara, Oromia, and BG regions
8. Refugees: Refugees from selected camps found in Somali, Afar and Gambella regions

Evaluation Design

The evaluation employed a mixed design (qualitative and quantitative study) and was implemented over four stages that comprised six distinct but interlinked activities (Figure 3).

Figure 3: Stage-wise implementation of the study

Stage I	Stage III
• Situational analysis for identifying SWOT of the national vaccination program • Geospatial analysis for mapping under-immunized areas	• Mixed method research for identifying service delivery and demand- side barriers • Mixed methods study for identifying gender-related barriers
Stage II	**Stage IV**
• Sample quantitative survey to determine vaccination coverage and estimate number zero-dose children in selected undeserved population groups	• Formative assessment for reaching zero-dose and under-immunized children in a better manner

Situational Analysis

Purpose

The purposes of the qualitative situational analysis were to identify underserved population/areas for the following vaccination coverage survey and B&E analysis; and evaluate the strengths, weaknesses, opportunities and threats (SWOT) and looks at internal and external factors affecting the Ethiopian immunization program. The situational analysis also included stakeholder mapping to better understand the landscape of partners engaged in the Ethiopian vaccination program.

Design

This qualitative situational analysis was conducted in March 2022. The study was designed in such a way that the perspectives of top-level officials of the health sector (Ministry of Health and Regional Health Bureaus) and other core partners of the Ethiopian immunization program were reflected. Data were primarily collected through key informants' interview (KII). The study has captured the perspectives of key-informants from all regional states of Ethiopia excluding Tigray due to security reasons.

Study participants and sampling procedure

The key informants were selected using criterion purposive sampling (selecting respondents who are more likely to give rich information). The interviewees from MoH included the Deputy

Director of MCH Directorate, EPI team leader, and Directors of Health Extension Program (HEP)/Primary Health Care (PHC) and Health Systems Special Support Directorates. Their respective counterparts at regional level were also represented. Furthermore, key partners including multilateral agencies and NGOs at national and regional level were included. We also interviewed the EPI focal persons at the Ethiopian Pharmaceutical Supply Agency (EPSA) placed at central and regional hubs. In total 98 in-depth interviews: 14 at federal level and 84 at regional level were successfully completed (Table 1).

Table 1: Summary of the key informants for the situational analysis

Federal-level respondents (# 14 KII)
• MoH, MCH Directorate Deputy Director • MoH, EPI Team Leader • MoH, Primary Health Care (PHC) Technical Advisor • MoH, Policy and Planning, Monitoring and Evaluation Directorate Director • MoH, Health System and Special System Team Leader • MoH, Disease Surveillance and Response Directorate Director • EPHI, Disease Surveillance and Response Directorate • Federal EPSA, Vaccine Supply Manager • EPI Focal persons at core partner organizations (UNICEF, WHO, CHAI, PATH)
Regional-level respondents (# 84 KII)
• RHBs, MCH Director • RHBs, EPI Team Leader or equivalent • RHBs, HEP Director • Regional EPSA Hubs, EPI Focal Person • Regional EPHI, PHEM Director • Local partners (2/region): UNICEF, WHO, CDC, JSI, CHAI, Save the Children, Transform PHCU

Data collection procedures

The KIIs were facilitated using semi-structured guidelines (Annex II: tools 1.1-1.5) developed based on 12-15 open ended and exploratory questions. Interviews were facilitated by trained and experienced personnel holding PhD (facilitators) or MPH (note takers) qualification. The interviewers were recruited from local universities from the respective regions based on their merits. A 2-day training of interviewers was organized in Addis Ababa and based on the discussion and pretesting the tools were further modified accordingly. Data were gathered until information saturation is achieved. All in-depth interviews were tape recorded unless and otherwise the interviewees have not provided consent for doing so. Translation and transcription were done verbatim and sent to the

researchers for feedback and analysis along with field notes.

Data collection procedures and quality assurance

The KIIs were facilitated using semi-structured guides (Annex I: tools 1.1-1.5) developed based on 12-15 open ended and exploratory questions. Interviews were facilitated by trained and experienced personnel. The interviewers were recruited from local universities from the respective regions based on their merits. A 2-day training of interviewers was organized in Addis Ababa and based on the discussion and pretesting the tools were modified further. All in-depth interviews were tape recorded unless and otherwise the interviewees have not provided consent for doing so. Translation and transcription were done verbatim and sent to the researchers for feedback and analysis along with field notes.

Geospatial Mapping and Secondary Analysis of DHS Data

Geo-spatial analysis was employed to show the spatial distribution of zero-dose and under-immunized children in Ethiopia. We specifically used the following data sources.: (i) Vaccination data of Ethiopian Demographic and Health Survey (EDHS) 2005, 2011, 2016 and Mini DHS 2019; (ii) Number of zero-dose and under-immunized infants as estimated based on the report of the national District Health Information System (DHIS) II data for the year 2015, 2019 and 2021; (iii) case-based surveillance data of measles compiled by the EPHI for the year 2021. The DHS datasets were accessed from the repository of the DHS Program. DHIS reports and case-based surveillance data were extracted from MoH and EPHI databases.

We also conducted secondary analysis of Mini DHS 2019 dataset to estimate regional distribution of zero-dose and under-immunized children in Ethiopia. Number of zero-dose and under-immunized children was estimated based on vaccination coverage reported in Mini DHS 2019 report and population projections based on the 2007 national census (Population Census Commission, 2008).

Vaccine Coverage Survey

Purpose and design

The objectives of the coverage survey were to estimate number and rates of zero-dose and under-immunized children in underserved settings in Ethiopia, to identify health facilities readiness to provide vaccination service in the same setting, to identify barriers and enablers for utilizing childhood vaccination and assess the association between vaccination coverage and gender-related factors. Prior to the survey, we identified under-immunized areas through the qualitatively situational analysis and the geospatial analyses. This cross-sectional study incorporated both community-based and health facility surveys.

Sample size

Adequate sample size for each of the population listed above (Section 4.1) was calculated using Cochran's Single Proportion Sample Size Formula assuming 95% confidence level, 4% margin of error, 16% prevalence of zero-dose children (CSA & The DHS Program, 2017) and 10% compensation for possible non-response. Accordingly, for each of the aforementioned population domains, a sample size of 360 was required. Based on our analysis of DHS 2016 and Mini DHS 2019 data, in Ethiopia on average 12 children 12-35 months of age are available per enumeration area (EA). Accordingly, for each of the population domains listed above a minimum of 30 EAs were required to recruit 360 children 12-35 months, assuming all children in the EA would be included into the study.

As presented in Table 2, we initially planned to include 4,080 children from 340 EAs (a minimum of 360 sample per population domain) in the survey (Table 2). However, in the actual survey due to conflict in some of the districts, we enrolled 3,646 children 12-35 months from 304 EAs. The total sample size was large enough to allow subgroup analysis based on sex and age groups.

Table 2: Total sample size and EAs required for the vaccination coverage survey.

Types of study population	**Number of EAs**	**Sample size**
Afar	30	360
Somali	30	360
Benishangul Gumuz	30	360
Gambella	30	360
Newly formed regions Sidama and South west regions	30	360
Urban slums	40	480
Pastoralist areas in Oromia, SNNP and SW regions	30	360
Hard-to-reach areas	30	360
Conflict affected areas	30	360
Refugees	30	360
IDPs	30	360
Total	**340**	**4,080**

Sampling procedure

The sample survey was representative of the selected target populations listed above and it was be implemented according to the recommendation of the WHO for conducting vaccination coverage cluster surveys (WHO, 2015). This assured the comparability of the survey data with large scale standardized surveys including the DHS and Multiple Indicator Cluster Surveys (MICS).

Children aged 12-35 months were selected using cluster sampling approach. Initially, Enumeration Areas (EAs) were randomly selected from the total EAs available in each population domain. In this case, the EAs delineated by the Central Statistical Agency (CSA) of Ethiopia for the recent census was used as a sampling frame. In the case of urban slums, hotspot urban slums in Addis Ababa, Adama, Bahir Dar, Hawassa, Harar and Dire Dawa were located, delineated and EA maps were drawn by experienced cartographers. In the case of IDP and refugee camps, villages or clusters were considered as EAs. Then all eligible children in each EA were listed and 12 were ultimately selected using smartphone-based random number generator.

Data collection procedures

Data was collected using pretested tools prepared in local (Amharic, Afan Oromo, Somali, Afar, Sidama) languages. The English version questionnaire is annexed (Annex II). Survey data was collected using the CommCare (Dimagi, 2022) digital App, an open source and user-friendly application system on which Project HOPE has extensive in-house capability and resources to leverage. This platform is interoperable with major data analytics and visualization software and helps to ensure close to real-time quality data collection, cleaning, and monitoring. Data were uploaded by the supervisors on daily basis to the CommCare cloud server. Vaccination status was determined based on three different sources of information including caregiver's report, home-based (vaccination cards) and facility-based reports.

Survey data was collected by 48 experienced enumerators and 24 supervisors. Recruitment of the personnel was made based multiple criteria including: educational status (at least diploma holders in health-related disciplines), experience of work in similar surveys, previous experience of collecting data using CommCare digital App and successful completion of the data collectors' training. Prior to deployment, the enumerators and supervisors received 5-day training guided by a structured training manual. The training included: explanation on the sampling approach; basic principles of data collection, line-by-line discussion on the questionnaire, practicing the CommCare digital app, mock interviews, field practice and a review of basic ethical practices of research involving human subjects.

Health facility survey

The health facility survey included 259 primary health care facilities that provide vaccination service to the EAs selected for the community-based survey. The survey primary included the nearest health posts or health centers to the EAs. At times when health centers or health posts were not available, primary hospitals were included. Health facility data was primarily collected from HEWs in the case of health posts and EPI coordinators in the case of health centers and district hospitals. The health facility survey explored readiness of the health system for providing vaccination service.

Quality assurance plan

In order to assure the quality of the survey extensively experienced da
ta collectors and supervisors were employed and the survey team received an intensive 5-day training using a structured training manual. Data was collected using pretested tools. Furthermore, data collectors were be allowed to collect data from more than 6 individuals per person per day. In order to validate the quality of the data, one third of all the study participants were re-interviewed by the supervisors. The uploaded data was closely monitored by the research team throughout the survey implementation period.

Barrier and Enabler Analysis

Purpose of the Study

The objectives of the barrier-enabler study were to: (i) identify service-delivery related barriers that hinder effective implementation of routine childhood vaccination service in underserved settings in Ethiopia (including hard-to-reach, pastoralist, conflict affected areas, socially disadvantaged urban, refugees and internally displaced populations) from multiple perspectives and at different levels of the health system; (ii) identify demand side B&E for utilizing vaccination program in underserved settings and; (iii) understand how gender norms, roles and relations affects vaccination service utilization.

Study design and setting

This qualitative B&E analysis was implemented over two phases. The first phase was completed in March 2022 integrated with the situational analysis phase, and explored the perspectives of top-level officials of the health sector (MoH and RHBs) and other core partners of the national immunization program. Data were primarily collected through KIIs. This phase captured the perspectives of key-informants from all regional states of Ethiopia excluding Tigray. The second phase was completed in June 2022 and captured the perspective of the decisionmakers. This phase captured the viewpoints of managers of zonal and woreda health offices, implementing partners, and health workers deployed at all levels of the primary health care unit. The second phase also assessed the viewpoint of the community through conducting in-depth interviews with formal and informal community

leaders and FGDs with caregivers of children in underserved settings. The second phase was conducted in all regions except Tigray and BG regions (Table 3).

Table 3: Scope of the first and second phases of the B&E study

Phase of the study	First Phase	Second Phase
Purpose	• To capture the perspective of top-level policy and decisionmakers of the health system and core partners engaged at higher level of the system • To identify underserved settings, populations, and districts for the second phase study	• To gain deeper understanding into the perspective of middle and lower-level managers, health providers and partners working at lower level • To explore the viewpoint of the community on both supply and demand side barriers for routine childhood vaccination program
Time	• February – March 2022	• May – June 2022
Participants	• Key informants from MoH, RHBs, PFSA hubs • Immunization focal persons from core partner organizations	• Key informants from ZHDs, WoHOs, public health facilities and implementing partners • Caregivers and influential community members
Settings	• FMoH, all RHBs (except Tigray), PFSA hubs	• Selected underserved zones and districts from all regions (except Tigray and BG regions) • Selected IDP and refugee populations
Data collection approach	• In-depth interviews	• In-depth interviews and FGDs
Number of KII and FGDs	• 98 in-depth interviews	• 270 in-depth interviews • 33 FGDs

Study participants and sampling procedure

The key informants were selected using criterion purposive sampling (selecting respondents who are more likely to give rich information). The interviewees From MoH included the Deputy Director of Maternal Child Health and Nutrition (MCHN) Directorate, EPI team leader, Directors of HEP/PHC Directorate and Health Systems Special Support Directorate.

Their respective counterparts at regional, zonal, woreda levels were also interviewed. Furthermore, key partners including multilateral agencies, international and local NGOs working at national, regional and lower levels were represented. We also interviewed the EPI focal persons of the Ethiopian Pharmaceutical Supply Agency (EPSA) placed at central and regional hubs. In total 368 in-depth interviews and 33FGDs were completed.

Community-level respondents including formal and informal community leaders, Women/ Health Development Army (WDA/HDA) members and caregivers, were selected in consultation with local Health Extension Workers (HEWs). In the FGDs, heterogenous sampling that included caregivers with optimal and sub-optimal vaccination service utilization was employed so that active discuss and dialogue can be fostered (Table 4).

Table 4: Summary of the study participants for the B&E analysis

Federal-level respondents (# 14 KII)
• MoH, MCH Directorate Deputy Director • MoH, EPI Team Leader • MoH, Primary Health Care (PHC) Technical Advisor • MoH, Policy and Planning, Monitoring and Evaluation Directorate Director • MoH, Health System and Special System Team Leader • MoH, Disease Surveillance and Response Directorate Director • EPHI, Disease Surveillance and Response Directorate • Federal EPSA, Vaccine Supply Manager • EPI Focal persons at core partner organizations (UNICEF, WHO, CHAI, PATH)
Regional-level respondents (# 84 KII)
• RHBs, MCH Director • RHBs, EPI Team Leader or equivalent • RHBs, HEP Director • Regional EPSA Hubs, EPI Focal Person • Regional EPHI, PHEM Director • Local partners (2/region): UNICEF, WHO, CDC, JSI, CHAI, Save the Children, Transform PHCU
Zonal or sub-city level respondents (# 36 KII)
• MCHN Directorate Director • EPI Team leader
Woreda-level respondents (# 66 KII)
• MCHN Directorate Director • EPI Team Leader • HEP Directorate Director • Local implementing partners/ NGOs
Primary Health Care Unit (PHCU) (# 88 KII)

- MCH/EPI head (Primary hospital)
- HEW supervisors (health centres)
- MCH/EPI head (health centres)
- HEWs

Community-level respondents (# 39 KII, 22 FGDs)

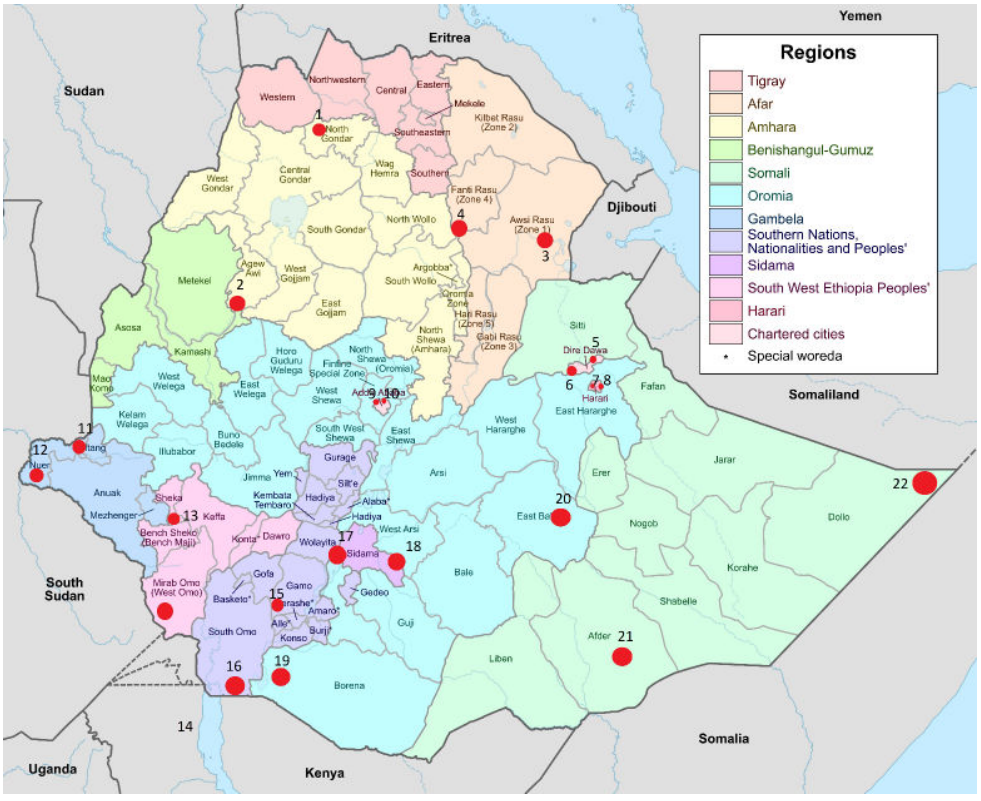
- Kebele administrators
- Influential community members
- Women Development Army/Health Development Army (WDA/HDA)
- Local women/caregivers

Refugees and IDPs (# 25 KII, 10 FGDs)

- Humanitarian agencies working in conflict areas/IDPs or refugees
- Health workers at refugee/IDP camps
- Community Health Agents (CHAs) at refugee/IDP camps

For the second phase, underserved study woredas (2 per region) were identified based on qualitative information provided by regional-level respondents in the earlier phase of the study. Spatial analysis of the Mini DHS Survey (2019) was also used to identify hotspot districts with low vaccination coverage. Once the underserved districts were identified, then their respective ZHDs and WoHOs were included in the study. Within each district, one kebele with the lowest vaccination service coverage (based on the qualitative information provided by EPI Focal Person of the WoHO) was identified, and health facilities that provide service to the area were enrolled in the study. In total, the study included 22 districts from nine regions and two city administration of Ethiopia (Figure 4).

Figure 4: Geographic locations (red dots) of the 22 woredas included in the B&E analysis



AMHARA REGION	AACA	SIDAMA REGION
(1) Debarq Zuria woreda (N Gondar zone) (2) Guangua woreda (Agew Awi zone)	(9) Woreda13, Addis Ketema Sub-city (10) Woreda 01, Gulele sub-city	(17) Loka Abaya woreda (18) Chire woreda
AFAR REGION	**GAMBELLA REGION**	**OROMIA REGION**
(3) Kori woreda (Zone 1) (4) Ewa woreda (Zone 4)	(11) Akobo woreda, Nuer zone (12) Jikawo woreda, Nuer zone	(19) Teltele woreda, (Borena zone) (20) Sewena woreda, (East Bale zone)
DDCA	**SW REGION**	**SOMALI REGION**
(5) Jeldessa woreda (6) Wahil woreda	(13) Surma woreda, West Omo zone (14) Yeki woreda, Sheka Zone	(21) Bokh woreda (Bokh woreda) (22) God-god woreda (Afder zone)
HARARI REGION	**SNNP REGION**	

(7) Hakim woreda (8) Erer woreda	(15) Garda Marta woreda (Gamo zone) (16) Hamer woreda (South Omo zone)	

Data collection procedures and quality assurance

The KIIs were facilitated using semi-structured guidelines (Annex III) that were developed based on 12-15 open ended and exploratory questions. Interviews were facilitated by trained and experienced personnel holding PhD (facilitators) or MPH (note takers) degrees in relevant field. A 2-day training of interviewers was organized in Addis Ababa, and based on the discussion and pretesting, the tools were refined further. The data collection tools were also validated by stakeholders including MoH and RHBs. All in-depth interviews and FGDs were tape recorded. Translation and transcription were done verbatim and sent to the researchers for feedback along with field notes.

Formative Assessment

The purpose of the formative phase was to assess the feasibility and acceptability of selected potential intervention for reaching zero-dose and under-immunized children in remote areas of Ethiopia. The formative assessment was informed by the qualitative and quantitative data collected in the earlier phases of the project and review of relevant literature. The research team identified and prioritized the potential interventions and assessed their feasibility through qualitative study integrated with the B&E analysis. We have also reflected the opinions and recommendations given by Donors, the GAVI, Core and Implementing partners, Expert opinions, and national and regional EPI program leads (EPI mangers, vaccinators, etc.). In addition, it also included desk review of documents available like policy documents, guidelines and other literatures undertaken in Ethiopia and other similar settings to Ethiopia. Internal and external validation workshops were also organized to finetune the proposed interventions.

Data Management and Analysis

Vaccination coverage survey

Data was collected using CommCare digital data capture method and uploaded to the server on daily basis. Data were analyzed using SPSS for windows. Vaccination coverages were estimated using weighted analysis approach. Separate coverage estimates were provided for all antigen and population domains. In order to balance weighted and unweighted sample size, linearization of post-stratification weights was made.

We estimated the Penta-1 to Penta-3 and Penta-1 to MCV-1 vaccination dropout rates. The earlier was calculated as proportion of children who did not get Penta-3 antigen

among those who received Penta-1. Similarly, the latter was determined as proportion of children who did not get MCV-1 antigen among those who received Penta-1. Socio-economic inequality in vaccination service was assessed by comparing the prevalence of zero-dose and under-immunized children and dropout rates across wealth index quintiles, paternal and maternal educational status and place of residence (urban vs rural).

Wealth index was computed as a composite index of living standard as recommended by the DHS Program, (The DHS Program, 2016). Wealth index was developed based on ownership of valuable assets and livestock, size of land for agriculture and housing purposes, materials used for house construction and access to basic social services including electricity, banking, improved water sources and body waste disposal methods. A total of 41 variables were reduced into nine factors using Principal Component Analysis (PCA). The components were further totaled into a score and ultimately divided into five quintiles (poorest, poorer, middle, richer, richest).

Qualitative data analysis

During the situational assessment and barrier-enabler analysis, two investigators independently went through the transcripts and field notes, did manual coding, and analyzed the data using Thematic Analysis Approach. Developing themes were identified, and the report is organized in logical order according to the themes and sub-themes of the analysis. Key quotations are provided to support the interpretation and demonstrate how the finding evolved from the actual data. The validity of the qualitative research was ascertained by making sure that the data collection and analysis approaches are compatible with the five-dimension criteria (credibility, transferability, dependability, confirmability and reflexivity) set for assuring rigor of qualitative research (Korstjens & Moser, 2018).

To ensure the credibility, we triangulated the data coming from different levels (high, middle and low managers) and types (government bodes vs partners, health workers vs community representative) of respondents. We have also validated the findings with selected key informants who provided the data. Two-staged validation workshop – first with the core research team members and then with those who generated the data – was done. The information was also used to assess the transferability and confirmability of the data. We attempted to improve the transferability of the findings by presenting findings also with along pertinent contextual data including setting and type of population.

Gender analysis

Gender is among the powerful determinants of health-seeking behavior. Gender-related barriers occur on both demand and supply sides and function at multiple levels: household, community, or health facility. Gender-related barriers lead to different vulnerabilities to children in utilizing vaccination services as mediated by caregiver or others. Project HOPE understands that integrating gender and addressing socio-cultural determinants in immunization programs is important to increase vaccination coverage, reduce inequality, and ensure social responsibility. In the B&E study, we explored gender-related barriers, conducted gender analysis and presented the findings in a separate sub-section.

In the vaccination coverage survey, we used variety of approach to understand the relationships between gender and access to and utilization of vaccination service. We compared dropout rates and proportion of zero-dose and under-immunized children between boys and girls, female- and male-headed households, and across levels of women's household decision-making power, ownership of resources and access to information. Women's domestic workload and the support they received from their partners in domestic chores were also analyzed and linked with vaccination service utilization.

Women's autonomy in domestic decision making was measured using a composite scale (min=0 and max=6). The scale was developed based on women's reported power on the following six issues: major household purchases, expending own income, expending partner's income, visiting families/relatives, and deciding on health care for herself and the index child. Each component was coded as "0" when decision is made solely by the partner and "1" when decision is made by the woman or in joint with her partner. Ultimately a score out of 6 was computed and categorized into low (0-2), medium (3or 4) or high (5 or 6) ordinal categories.

Geospatial analysis

Data management was carried out using STATA version 14.1 Quantum GIS (QGIS) version 3.16 and GeoDa version 1.20 were used for Spatial visualization and autocorrelation analysis, respectively. A spatial weight matrix, conceptualizing the spatial relationship between clusters, was generated using Kernel Density Estimation (KDE). The spatial autocorrelation (Global Moran's I) statistic was used for assessing the pattern of zero-dose and under vaccination. Getis-Ord Gi* statistics was conducted to measure how spatial autocorrelation differs through the study location by computing Gi* statistics for each area. Statistical output with high Gi* indicates "hot spot" area, whereas low Gi* means a "cold spot" area. We have also conducted Local Moran's I analysis to detect outlier clusters. Local Moran's I measures positively correlated high-high (hotpot) and low-low (cold spot) clusters. It also measures negatively correlated high-low and low-high outliers. The spatial interpolation technique was also applied to estimate unknown values that fall between known values. Inverse distance weighting interpolation method was used to predict the risk of zero-dose and under vaccination using EDHS data.

Ethical Considerations

The evaluation was implemented in compliance with national and international ethical guidelines. The protocol was ethically cleared by the Institutional Review Board of EPHI. Administrative clearances were secured from various levels of the health system. Data was collected after taking informed consent from the study participants. To prevent the risk Covid-19 transmission, precautionary measures including use of hand sanitizers, physical distancing, and ventilation of interview settings were practiced. To maximize beneficence, all under-immunized children were referred to the nearest health facility by filling a referral form.

Underserved Settings

According to informants from MoH and partners working at federal level, Afar and Somali region have the lowest achievement in terms of implementing vaccination program. The coverages in Gambella and BG are also very low secondary to many reasons including the ongoing political and social instability. Though the Oromia, Amhara and SNNP region have better coverage, their large population size means they have numerical large number of zero-dose children.

Addis Ababa City Administration

In AACA, the vaccination coverage is always reported above 100% for all antigens; however, measles cases are being reported. In campaigns unvaccinated children are being identified in slums and in areas bordering Oromia region. Poor neighborhoods in Addis Ketema (Atobis Tera and Mercato areas) and in Lideta sub-cities are generally considered underserved. Unvaccinated children are also identified in peripheral parts of Nifas Silk Lafto, Akaki Kaliti (Woreda 10 and 11), Lemi Kura, Bole (around Bole Bulbula), Yeka, Kolfe and Gulele sub-cities bordering Oromia region. Impoverished people living on the streets and around religious institutions have not been adequately reached through the routine vaccination program. People residing in peripheral condominium buildings have not been adequately reached because of limited physical accessibility to health facilities.

> *"Within ten days, we identified 83 children who have not been vaccinated for polio in Addis Ababa city"* Key informant from AACA Health Bureau

Afar region

In Afa,r the coverage of health service and access to road infrastructure are limited so that majority of its districts, excluding town administrations, can be considered as a hard-to-reach areas. However, the most underserved settings are the districts in Kilbet Rasu (Zone 2) including Dalol and Koneba districts. The pastoralist nature of the population, dispersed population settlement pattern, frequent drought, adverse climatic condition, topographic and geographic barriers (Kilbet Rasu zone), and weak infrastructure have undermined the provision of vaccination service in the region. Over the last year, the political instability has directedly affected many of the districts (especially those in Zone 4 and 2, and partly zone 5) of Afar including Yalo, Gulina, Ewa, Berhale and Chifera districts and caused a massive internal displacement including that of health workers.

Amhara region

The recent political instability in northern Ethiopia has caused massive internal displacement and destruction of health infrastructure in Amhara region. In North and South Wollo, Wag

Hemera, and South and North Gondar, vaccination programs have been disrupted for more than six months due to the conflict and in many settings, it had not been restarted at the time of the study. Currently IDPs and areas affected by the conflict are the most underserved settings. The RHB has been trying to reach the IDPs through monthly outreach activities and static service provided by the existing health centers found in the host communities. However, the IDPs cannot be adequately reached due to unmanageable large numbers, shortage of resources and assimilation to the host community. With the improving security situation, the IDPs are now returning home but the existing health system is nearly non-functional.

The region also has pockets of hard-to-reach areas in almost all the zones due to topographic challenges. This includes Wag Humera (Dahna woreda), North Gondar (Janamora, Beyeda, Telemt), West Gondar (Gendawuha, Metema, Mirab Armacho, Quara), North Shoa (Hagere Mariam) and Central Gondar (Tach Armacho, Takusa), and West Gojam (Dega Damot, Debub Achefer). Key informants from the region also reported, in some major urban areas, households with low social economic status and street families, are also not adequately covered. Measles outbreak have recently been reported in some towns like Dima and Kemise.

Dire Dawa City Administration

In DDCA access to health service is not a major problem as compared to the other regions of Ethiopia. However, it is important to note that DDCA also comprises rural districts that contribute to one third of its population. The rural districts surrounding the city (like Jeldesa, Biyawale, Wahil) have a relatively lower vaccination coverage. The rural areas adjacent to Somali and Oromia regions also harbor nomadic communities with limited access to health services. Dire Dawa city proper is also rapidly expanding, and the new settlements have limited access to health infrastructure.

Benishangul Gumuz region

In BG region, as compared to other developing regions, the vaccination service coverage was relatively good until the occurrence recent political instability. The instability has totally reverted the achievements attained over the last decade. Currently, Kemashi zone, Metekel zone (specially Guba, Wombera, Dibate and Bullen districts) and Mao Komo Special district are heavily affected by the conflict and vaccination programs are not being optimally implemented. The region also harbors several IDP centers in Assosa and Metekel areas. In BG region, the scattered settlement of the population has made service delivery challenging. Though, accessibility is not a major challenge in the region, some remote areas have been reported in Metekel and Kemashi Zones.

Gambella region

In Gambella region, excluding major urban areas, vaccination coverage is disappointingly low. Districts like Akobo, Jor and Dima are hard-to-reach and lack access to basic services including vaccination. Another underlying reason is seasonal inaccessibility of few districts

due to flooding, and interethnic and cross-boundary conflicts. Conflict with Moralie groups in areas bordering South Sudan has caused major displacements over the last five years and disrupted provision of health services. In Neur zone, the vaccination coverage is also low due to the pastoralist nature of the population. Recently, major outbreaks of measles in refugee camps in Gambella region had been reported. As the refugees live intermingled with the host community, outbreaks easily spread to the general population. The refuge communities frequently come in and out of the region making them difficult to target.

Harari region

As predominantly urban and smaller region, Harari region does not have health access problems. However, villages bordering Oromia region are relatively underserved. Among the three rural districts, Errer and Dire Xeiyara (Jibralo) have lower coverage and that of Sofi is improving. The region is also trying to reach street families through vaccination campaigns. According to the key informants, there is no IDP centre or major slum area in Harari region.

Oromia region

In general, vaccination coverage in Oromia region is considered optimal but sporadic outbreaks of VPDs occur in different settings. In addition, specific districts and zones exhibit low coverages due to political instability, pastoral nature of the population and inaccessibility. Pastoral and semi-pastoral districts, especially those in Borena and Guji zones have limited access to service due to the mobile nature of the population. The political instability over the last three years in West and East Wollega, Horro Guduru, Kelem Wollega and Guji zones has made large numbers inaccessible. At the time of the study vaccination service has been interrupted for more than six months in four zones of Wollega. Illu Ababor and Bale zones have low vaccination coverages possibility due to inaccessibility. East and West Hararge and West Arsi zones are also more frequently affected by outbreak of VPDs like measles. According to a key informant, surveys during recent campaigns also detected considerable number of unvaccinated children in urban centers like Bishoftu, Sebeta, Shashemene, Jimma, Nekemte and Bisha Guracha. The region (especially western Oromia) also harbors many IDP centers.

> *"In our region topographic challenge is not a major concern. Rather, the problem is frequent closure of streets [due to the ongoing political conflict]." Key informant from Oromia RHB*

Sidama region

In Sidama region, zero-dose and under-immunized children are relatively more common in boarder districts like Lok Abaya, Aroresa and Chire districts where access to road and other social services are relatively limited. Isolated communities in Lok Abaya are also semi-pastoral making them difficult to serve. The immunization service is sub-optimal in slum urban areas including Hawassa due to illegal settlements, uncontrolled rural-urban

migration, and presence of large number of street families. During recent polio campaign in Hawassa city, the number of children vaccinated was much higher anticipated due to lack of data on size of eligible children in the informal settlements of the city. Since the region is new, it has limited vehicles and budget to reach to the remote areas.

SNNP region

In SNNP region, many districts in Gamo zone (Martagarda, Garamalo, Uba Debretsehay), South Omo zone (Salamago, Male, North Ari, Nyangatom), Konso zone, and Derashe special woreda are not satisfactorily covered. These districts are not only hard-to-reach but also heavily affected by inter-ethnic conflicts. Consequently, IDPs are common. Measles outbreak frequently occur in these districts as well. Populations in the southwestern part of the region are pastoralists and have limited access to infrastructure and health services. Though mobile health team strategy has been introduced, ground level implementation has not been effective due to lack of resources.

> *"One major problem is security. For instance, Selamago is a district where vaccination has not been given for the last several months due to political unrest. There are many similar places in South Omo" key informant from SNNP RHB*

South West region

The vaccination coverage in this newly formed region appears to be relatively low. According to key informants, except for Keffa and Benchi Sheko zones, the coverage is unsatisfactory in the entire region. Especially West Omo and Sheka zones have the lowest coverages due to multiple reasons including topographic problems, pastoralist nature of the population (West Omo and partly Kaffa), dispersed population settlement patterns, poor road network, and rudimentary health infrastructure. The region has also limited health facilities (health centers and posts) to serve the population. In West Omo (specially Surma district), Bench Sheko (Guraferda, Bero and Sheko districts), and Sheka (Tepi Town and Yeki district), conflicts have affected the service delivery and health infrastructures have been vandalized. As the region is new, it has limited resources to rehabilitate the system.

Somali region

Somali region has enjoyed a relative political stability over recent years. However, the vaccination coverage in many districts remain suboptimal due to the mobile nature of the population (including cross-border nomads), low health service coverage and limited road infrastructure. The recent widespread drought has worsened the health service delivery in the region. According to the key respondents from the region, the most underserved areas in the region are six of the rural districts of Nogob/Fik zone, Godgod and Afder districts of Afder zone, Dolo Ado and Kersa Dula of Liben zone, Kelafo district of Gode (Shebele) zone, Qooraan (Mulla) and Goljano of Fafan zone, and Degehmadow of Jarar zone. Furthermore, most districts in Sitti, Erer and Warder zones have limited vaccination

coverage. The region also harbors IDPs and refugees from Somalia. Reportedly, the situation of the refugees is better than the host communities as they earlier have received better attention from partners.

Summary of the SWOT Analysis

Based on the data obtained from key informants from FMoH, RHBs, partner organizations and EPSA, we identified the SWOT of the Ethiopian vaccination program. Table 5 summarizes the internal weakness and strength of the program subdivided according to the analytical framework of the study. Table 6 provided the external opportunities and threats to the national vaccination program (Table 5 and 6).

Table 5: Strength and weakness of the immunization program in Ethiopia

Please find the table on the next page →

EPI Components	Strengths	Weakness
Immunization service delivery	• Existence of multiple vaccination service delivery strategies (static, mobile and outreach services) • Reaching hard-to-reach areas through PIRI- and other campaign-based activities • Introduction of new antigens into the EPI program • Making vaccination service accessible to refugees through statistic, outreach and campaign-based (child health days, supplementary vaccination) activities	• Frequent campaigns compromise delivery of routine vaccination program • Weak Integrated Mobile Outreach program (Afar, Somali, pastoralist areas in Oromia, SNNP and SW regions) • Lack of adequate support and resources for implementing mobile outreach program in pastoralist and semi-pastoralist areas • Weak integration of vaccination into mobile outreach program • Weak horizontal integration of immunization program with other MCH services, weak intersectoral integration of EPI with PSNP and other food aid programs • Static vaccination programs are not regularly available on daily basis and in all working hours • Irregular schedule of outreach activities • Weak private-public partnership for immunization program (except few urban areas) • Weak engagement of hospitals and some health centers in EPI • Weak default tracing mechanism and high dropout • Absence of national guideline for catch-up vaccination program • Unavailability or lack of functionality of health posts in remote areas of Gambella, BG, Afar and Somali regions • Absence of established system to reach to disadvantaged urban populations including street families and urban slums • Absence of established system to serve missed children in IDP centers • High population to health facility ratio in urban settings leading to long waiting time and client dissatisfaction • Large catchment area or population per health post (SW, Amhara region) • Weak outreach and campaign-based activities in predominately urban areas • Weak health centre and health post linkage • Failure to engage men in vaccination programs • Shortage of vehicles and fuel for implementing outreach and mobile activities • Spatial maldistribution of health centres in AA

EPI Components	Strengths	Weakness
Human resources	• Provision of IRT to HEWs • Engagement of male HEWs in challenging and hard-to-reach areas	• Demotivation HEWs and lack of incentive system • Shortage of HEWs in many regions (except urban areas) • Increasing negligence and lack of commitment of frontline health workers and weak staff accountability system • Unjustified payment demands of health workers for implementing outreach, community mobilization and other routine activities • Frequent closure of health facilities due to demotivated HEWs • Skill gaps (fresh HEWs, HEWs in developing regions) • High staff turnover in developing regions and lack of effective staff retention mechanism • Irregularity of IRTs in many regions • Staff turnover and demotivation of health professionals and community health agents working in refugee camps
Supply chain management	• The "last mile/direct delivery" to health facilities has improved the vaccine logistic system • Mass distribution of SDD refrigerators • Organizing mass campaigns to maintain refrigerators • Large scale training for implementing EVM system • Temperature monitoring using the Fridge Tag system • Increasing availability of biomedical technicians	• Many health facilities are not receiving supplies directly from EPSA due to inaccessibility • Shortage of refrigerators spare parts like that of solar panel from SDD refrigerators • Failure to maintain refrigerators on time due to multiple problems including bureaucracy, and skill gaps of technicians • Unavailability of refrigerators in many health posts • Failure of districts and health facilities to submit VRF timely on monthly basis • National level interruption of vaccine supply • Some districts have limited technical capacity on vaccine stock management • Failure of health workers to handle refrigerators with care and lack of skill in preventive maintenance of refrigerators

EPI Components	Strengths	Weakness
	• EPSA has provided better attention to the EPI logistic system • Regional EPSA hubs have large cold storage capacity • Daily temperature monitoring and monthly reporting has been introduced	• High "open vial wastage" due to health workers negligence, failure to implement the open vial policy of the country • High "close vial wastage" due to poor forecasting during campaigns, distribution of nearly expired and heat exposed vaccines • Lack of monitoring system and accountability for vaccine wastage • Lack of refrigerated tracks for distributing vaccines
Advocacy, communication and social mobilization and risk communication	• HEWs receive SBCC training through IRTs • The use of local FM radios as a platform to promote immunization in multiple regions • Translation of SBCC materials to local language • Engagement of formal and informal community leaders in vaccination advocacy in BG, Sidama and Afar regions	• Lack of intense and diverse SBCC interventions for promoting vaccination • Lack of budget and resources to support SBCC and community mobilization activities • HEWs have poor interpersonal communication skills • HEWs and other frontline health workers frequently fail to give basic information to caregivers • Inadequate promotion of newly introduced vaccines, specially MCV-2 • Demotivation and workload reduced engagement of HEWs in community mobilization activities • Community mobilization and health communication activities are usually inaccessible to men • The engagement of HDA members community mobilization activities is declining • Pregnant women's forum is getting weaker

EPI Components	Strengths	Weakness
Vaccination planning, evaluation, monitoring, feedback	• Presence of PMT, and technical working group for supporting planning, monitoring and evaluation activities	• Weak implementation of micro plans due to budget shortage and reluctance of health workers (SW, Sidama Regions) • Inadequate attention given to bottom-up planning • Lack of dependable denominator and conversion factors for planning, M&E • Irregularity of PMT and review meetings • Weak and irregular supportive supervision (both integrated or program-specific) • Weak inbuilt feedback system
Health information system and quality data for decision making	• Digitalization of the health information system (DHIS-2)	• Failure to adequately address data fabrication problems and lack of data accountability system • Lack of value for data and sub-optimal use of data for decision making • Absence of carrier structures for HITs • Absence of gender-disaggregated data collection and analysis • Lack of commitment and scarcity of resources to triangulate data • Failure to effectively implement data quality initiatives
Surveillance for monitoring VPDs	• Presence of strong PHEM structure in many regions • Presence of guidelines to monitor VPD and to take outbreak responses • Availability of good lab facility at central level and in the major regions	• Weak AFEI monitoring system • Failure to implement active case search due to budget shortage • Weak PHEM system in developing regions • Small health work force at district and health facilities levels • Weak SBCC and community mobilization activities • Giving more attention to outbreak control, than disease prevention • Poor data quality and low value for data • Lack of timeliness in taking outbreak responses • Weak capacity to conduct operational research

EPI Components	Strengths	Weakness
Leadership and governance	• Commitment of the top-level management (federal and regional) for making vaccination program accessible to hard-to-reach communities • Increasing openness of the top-level management to admit data quality problems and implementation gaps	• Negligence of district-level managers to assure available of health workers at health posts and health centers • Competing priority of district-level government officials • Lack of commitment to sustain programs initiated by partner organizations • Externalizing of service provision and implementation problems to budget shortage • Shifting attention of decisionmakers from one to another program
Partnership	• Government commitment to work with partners • Presence of EPI Task Forces or TWGs for fostering engagement of partners in immunization program • Increasing attention of partners to the cold chain system	• Shortage of budget for operational activities and dependency on partners • Lack of commitment of the health system to sustain initiative of partners • Inequitable distribution of partners across-regions and between districts

Table 6: External opportunities and threats to the national vaccination program

Opportunity	Threats
• Increasing willingness of the government to invest in immunization program • Partners involvement and support in wide range of activities including financial and technical support, vaccine logistic system, capacity building etc.… • GAVI 5.0 Strategy increased attention to vaccine equity • Increasing availability of digital technologies (e.g., fridge tag system, mBrana program) to support the vaccine logistic system • Absence of active community resistance to routine childhood vaccines • The community gives equal vaccination access to boys and girls • Commitment of RRS/ARRA and UNHCR to provide vaccination service to refugee population • Expansion of CHIS	• Ongoing political instability causing widespread displacements (including health workers), destruction of health facilities and interruption of vaccine logistic system • COVID-19 pandemic diverted the attention of the health system, overstretched the vaccine logistic system and reduced the care-seeking behavior of the community • Donor dependence • Weakening of the health extension program • Disintegration of the HDA network • Poor access to electricity and mobile network services in remote areas is making mplementation of digital technologies challenging • Power interruption and shortage of fuel for maintaining the cold chain system • Lack of accurate denominator for district-based and microplanning planning • Frequent drought (Afar, Somali, other pastoralist areas) making service delivery in the astoralist even more difficult • Overwhelming number of IDPs • Assimilation of IDPs with the population is making them difficult to be targeted • Unable to access hard-to-reach areas due to poor road condition, topographic issues or flooding • Mobility of pastoralist population • Scattered settlements, topographic and geographic barriers (hard-to-reach areas)

Opportunity	Threats
	• Low active public demand for vaccination program due to lack of awareness, workload, forgetfulness • Women are not adequately empowered in social and economic terms and vaccinating children considered as the primary duty of mothers • Limited access of women to mass media • Cultural norms that limit the movement of women in the postpartum period (SNNP, SW regions) • Small-scale misconception such as vaccinations may harm children (Gambella, South Omo of SW region, Amhara region), cause infertility (BG region), aggravates or causes febrile illness (SW and Afar regions) and infants should not be injected unless sick (SW region) • Dissatisfaction of communities due to the existing open vial policy for BCG or measles. • Cross-border transmission, and influx of unvaccinated children from neighboring countries • Migratory or seasonal workers that are difficult to target (Gambella) • Cross-border mobility of refugees • Inaccessibility of refugee camps

GEOSPATIAL AND SECONDARY DATA ANALYSES

Spatial Analysis Based on EDHS

Spatial autocorrelation

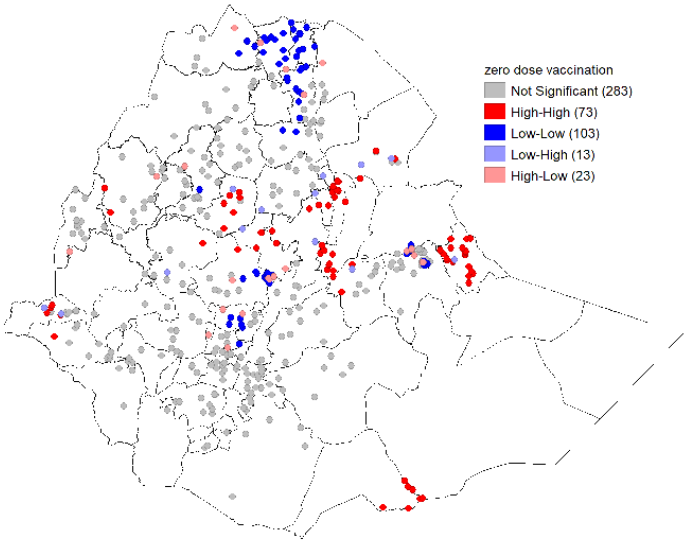
The spatial distribution of zero-dose and under-immunization was clustered in all the data points (2005, 2016 and 2019). Clustering higher in 2005 (for zero-dose) and 2016 (under-immunization). The spatial auto correlation the Global Moran's I index of the surveys is summarized (Table 7).

Table 7: Spatial autocorrelation of zero-dose and under-immunization in Ethiopia (2005-2019)

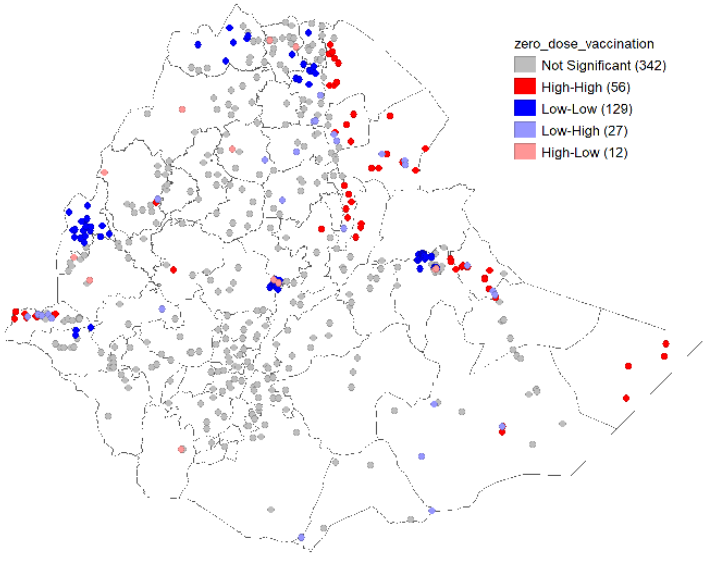
EDHS year	Moran's I		Z-score	p-value
	Observed	Expected		
Zero-dose				
2005	0.326	-0.002	15.544	<0.001
2016	0.220	-0.002	12.004	<0.001
2019	0.281	-0.003	9.870	<0.001
Under-immunization				
2005	0.307	-0.002	15.309	<0.001
2016	0.336	-0.002	18.422	<0.001
2019	0.287	-0.003	10.229	<0.001

Clustering and outliers of zero-dose and under-immunization are shown in Figure 5 and 6 using local Moran's I analyses. Regarding zero-dose High-High clustering was found in Afar and Somali regions in all the study periods. High-High clustering was also found in Amhara in 2005, Gambela in 2016 and SNNPR in 2019. Low-Low clustering was found in Addis Ababa and Dire Dawa in all the study periods. Zero-dose clustering decreased across the period except in the eastern Ethiopia (Afar and Somali) and Sidama region. Regarding, under-immunization, we identified High-High clustering in Afar and Somali regions and Low-Low clustering in Addis Ababa, Dire dawa and Tigray during all the study periods. Areas around Sidama region shows unusual worsening trend in clustering of under-immunization (figures 5 and 6).

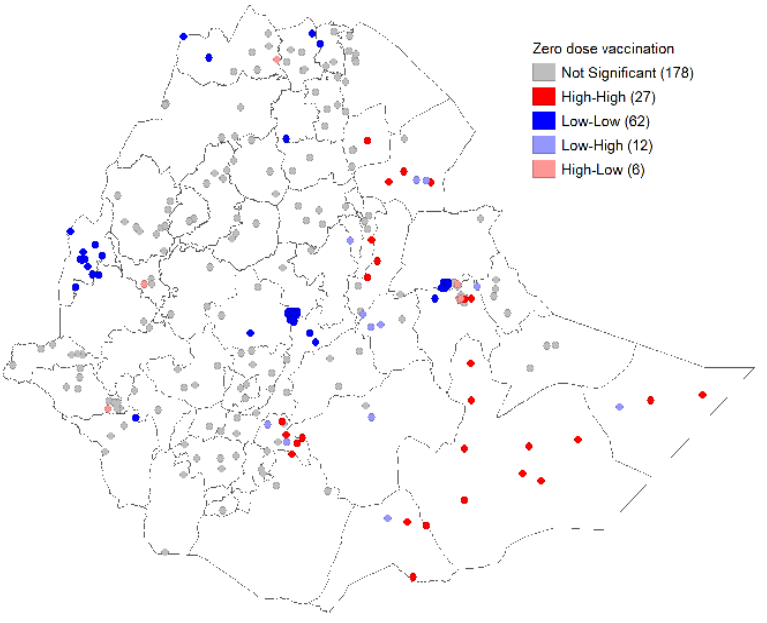
Figure 5: Clustering of zero-dose immunization in Ethiopia (2005-2019).



2005 (zero-dose)

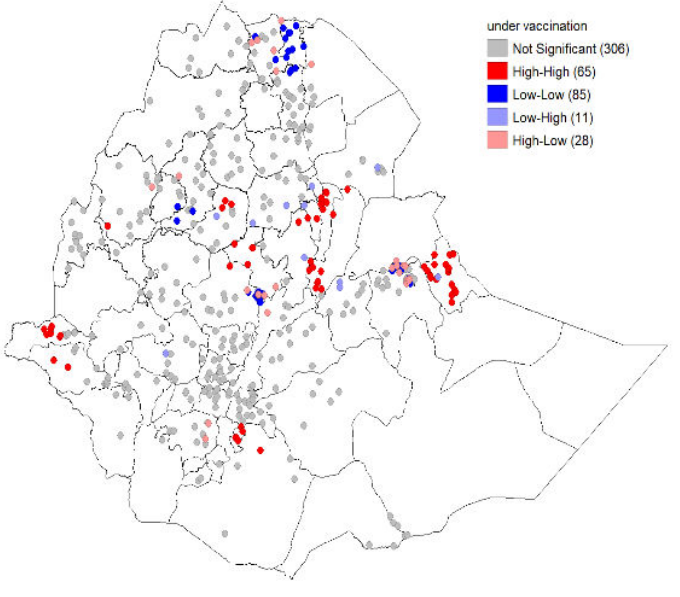


2015 (zero-dose)

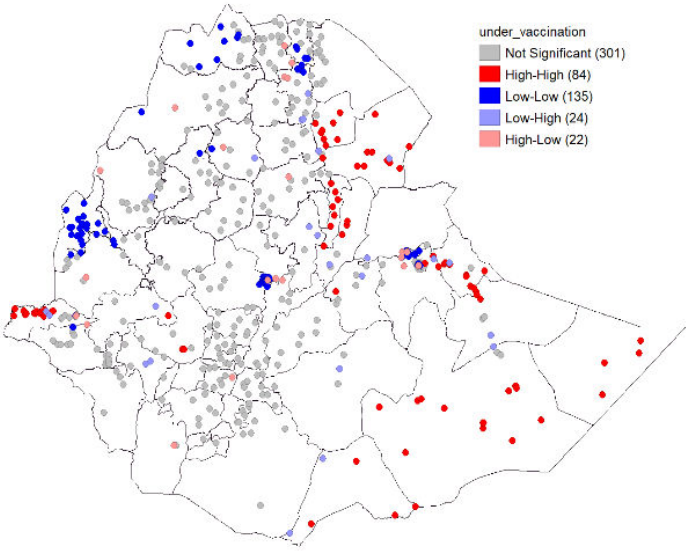


2019 (zero-dose)

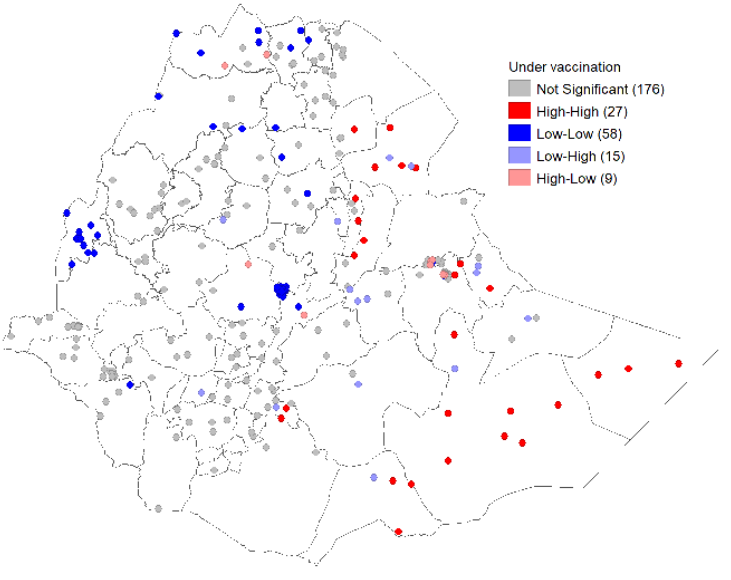
Figure 6: Clustering of under-immunization in Ethiopia (2005-2019).



2005 (under-immunized)



2015 (under-immunized)



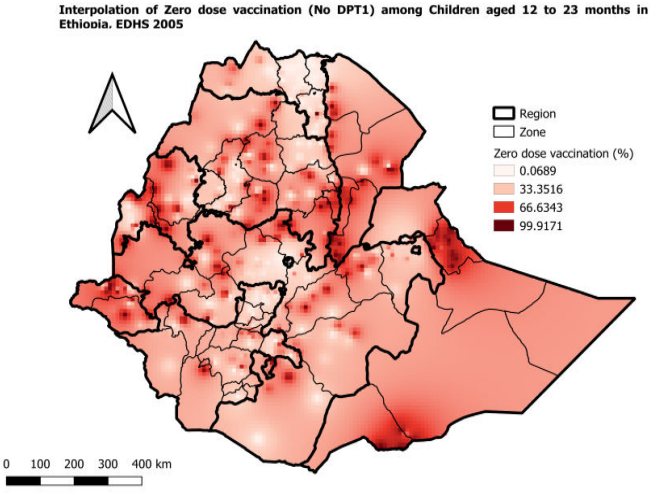
2019 (under-immunized)

Spatial interpolation

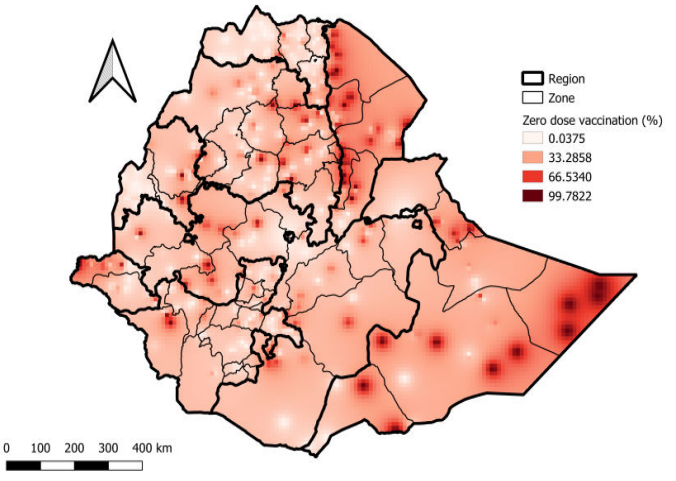
The spatial interpolation analysis predicted high-risk areas for zero-dose and under-immunization. Hotspot areas were relatively fewer in the recent survey suggesting improvements. Regarding zero-dose, Afar, Somali, Oromia, SNNPR and Gambela were identified as high-risk areas. Interpolation based on the 2019 data indicated, almost all woredas of Afar and Somali regions had higher zero-dose rates. Gololcha Arsi, Gasero, Nensebo, Degem and Tiro Afeta districts of Oromia, Gibe, Boloso Sore and Malga districts of SNNPR also had higher zero-dose rates. In addition, Ankasha woreda of Amhara, Jikawo and Akobo woreda of Gambella were identified as hotspot areas (Figure 7).

The spatial interpolation analysis also predicted high-risk areas for under-immunization. Most part of Ethiopia was at risk of under-immunization in 2005. Interpolation based on the 2019 data suggested all areas of Afar and Somali (except Jijiga area) had higher rates of under-immunization. Hotspots areas were also identified in Oromia (Gasera, Gursum, Golocha Arsi, Adama, Degem, Tro Afeta and Nensebo districts); SNNPR (Gesha, Denibu Gofa, Gibe, East Badawacho, Boloso Sore, Kindo Dida, Malga, Arbrgona and Kochere districts), Amhara (Ankasha district), BG (Guba district) and Gambella (Jikawo and Akobo districts) regions (Figure 8).

Figure 7: Interpolation of zero-dose distribution in Ethiopia based on DHS Data (2005, 2016 and 2019).



Interpolation of zero dose vaccination (No DPT1) among Children aged 12 to 23 months in Ethiopia, EDHS 2016



Interpolation of zero dose vaccination (No DPT1) among Children aged 12 to 23 months in Ethiopia, miniEDHS 2019

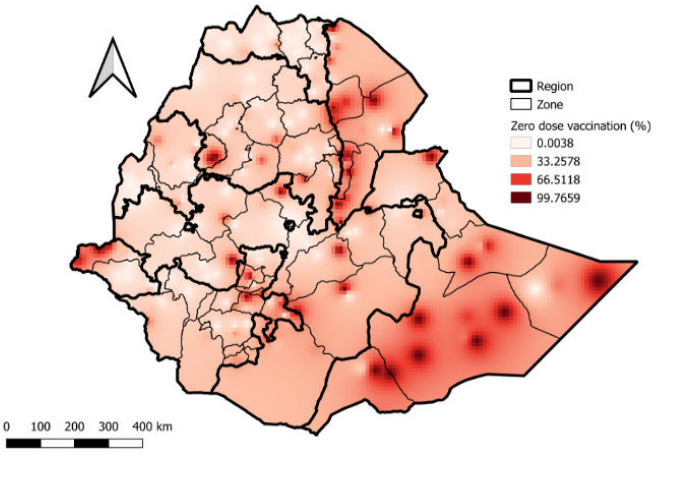
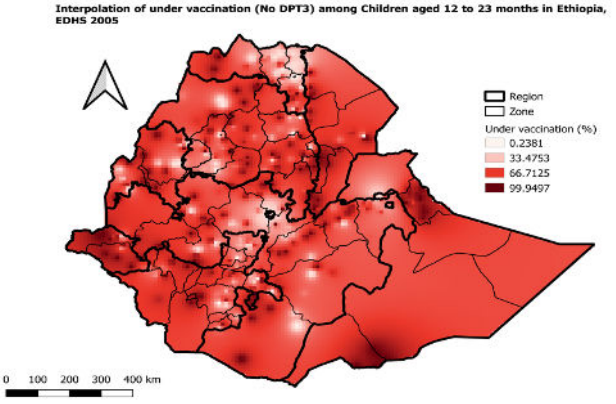
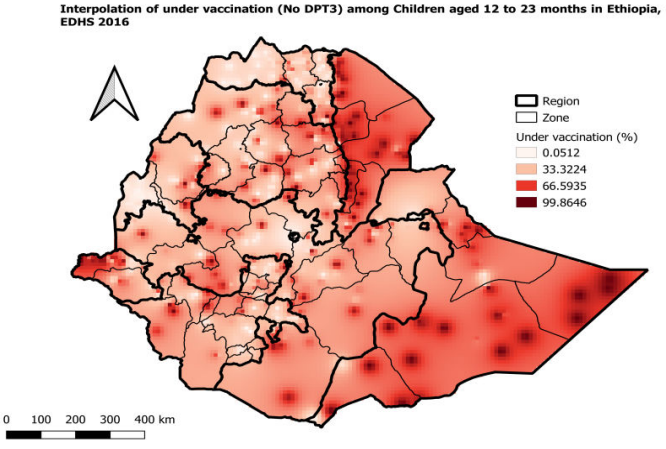
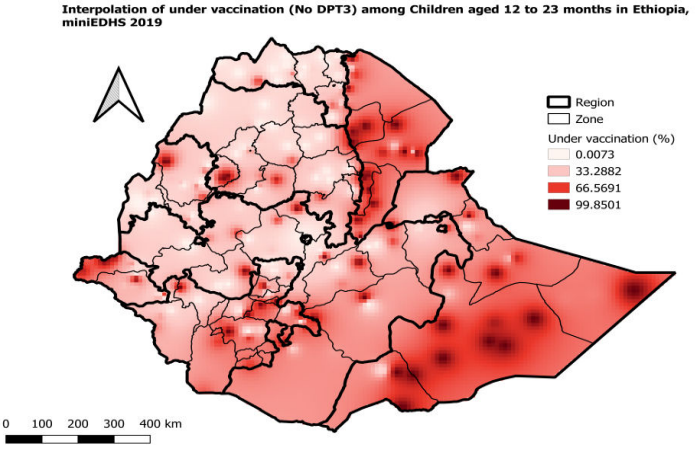


Figure 8: Interpolation of under-immunization distribution in Ethiopia based on DHS data (2005, 2016 and 2019)







Geospatial Analysis Based on DHIS-II Data

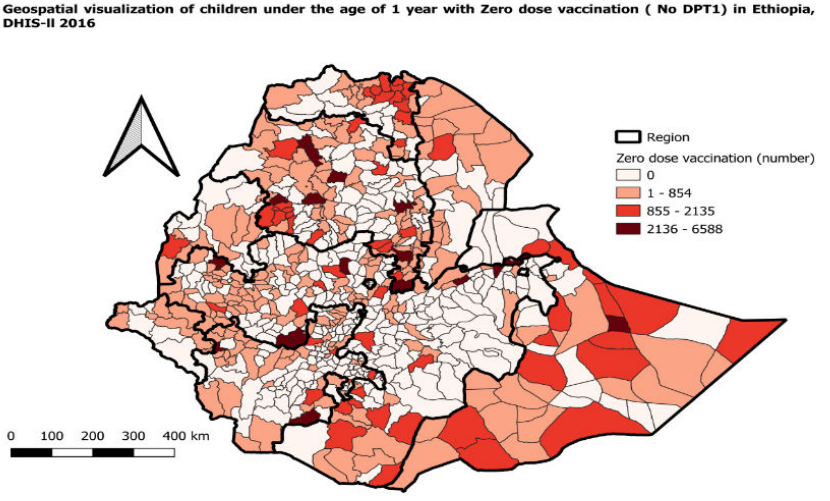
Table 8 presents summary of district level vaccination (Penta 1 and Penta 3) coverage as reported to the DHIS II in 2016, 2019 and 2021. Considerable proportion of districts (more than half for Penta 1 and one-third for Penta-3) reported coverages above 100% suggesting data quality concerns (Table 8).

Table 8: Number of districts classified based on reported (DHIS II) coverage of Penta 1 and Penta 3 coverage (2016, 2019 and 2021)

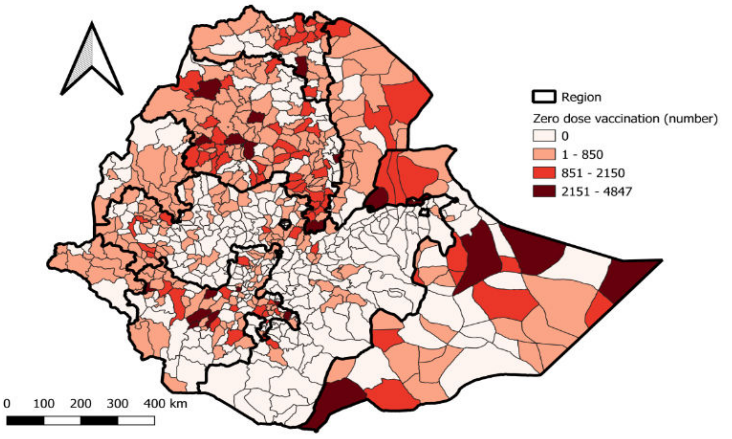
Coverage (%)	Penta-1 Coverage (n=690)						Penta-3 Coverage (n=690)					
	2016		2019		2021		2016		2019		2021	
	n	%	n	%	n	%	n	%	n	%	n	%
>100	359	52.0	325	47.1	374	54.2	248	35.9	236	34.2	293	42.5
80-100	234	33.9	223	32.3	191	27.7	308	44.6	263	38.1	239	34.6
50-79.9	85	12.3	123	17.8	77	11.2	115	16.7	156	22.6	104	15.1
<50	12	1.7	19	2.7	48	6.9	19	2.7	35	5.1	54	7.8

Figure 9 and 10 shows geospatial distribution of zero-dose and under-immunization by actual numbers in 2016, 2019 and 2021 based on DHIS-II data. The visualization indicated some hotspot areas harboring large numbers of under-vaccinated children. However, it did not show a meaningful trend overtime possibly due to data quality problems. In 2021, the entire Tigray region had large number of zero-dose and under-immunized children likely due to the ongoing political instability there (Figure 9 and 10).

Figure 9: Geospatial visualization of number of zero-dose under-1 children (DHIS II data: 2016, 20



Geospatial visualization of children under the age of 1 year with Zero dose vaccination (No DPT1) in Ethiopia, DHIS-II 2019



Geospatial visualization of children under the age of 1 year with Zero dose vaccination (No DPT1) in Ethiopia, DHIS-II 2021

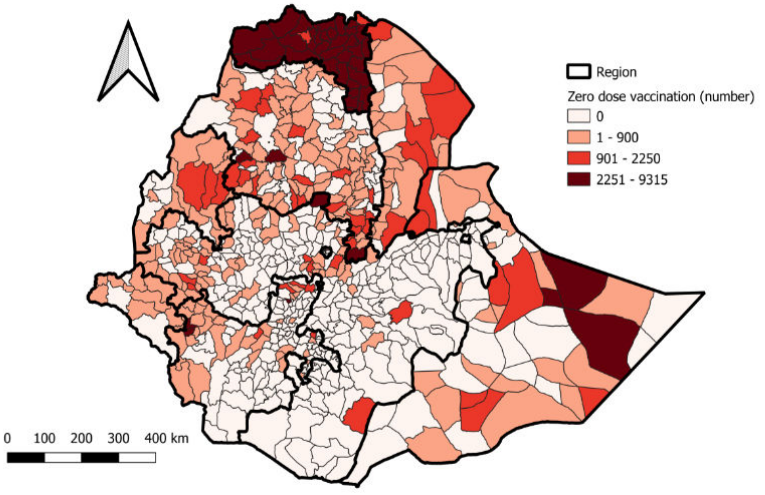
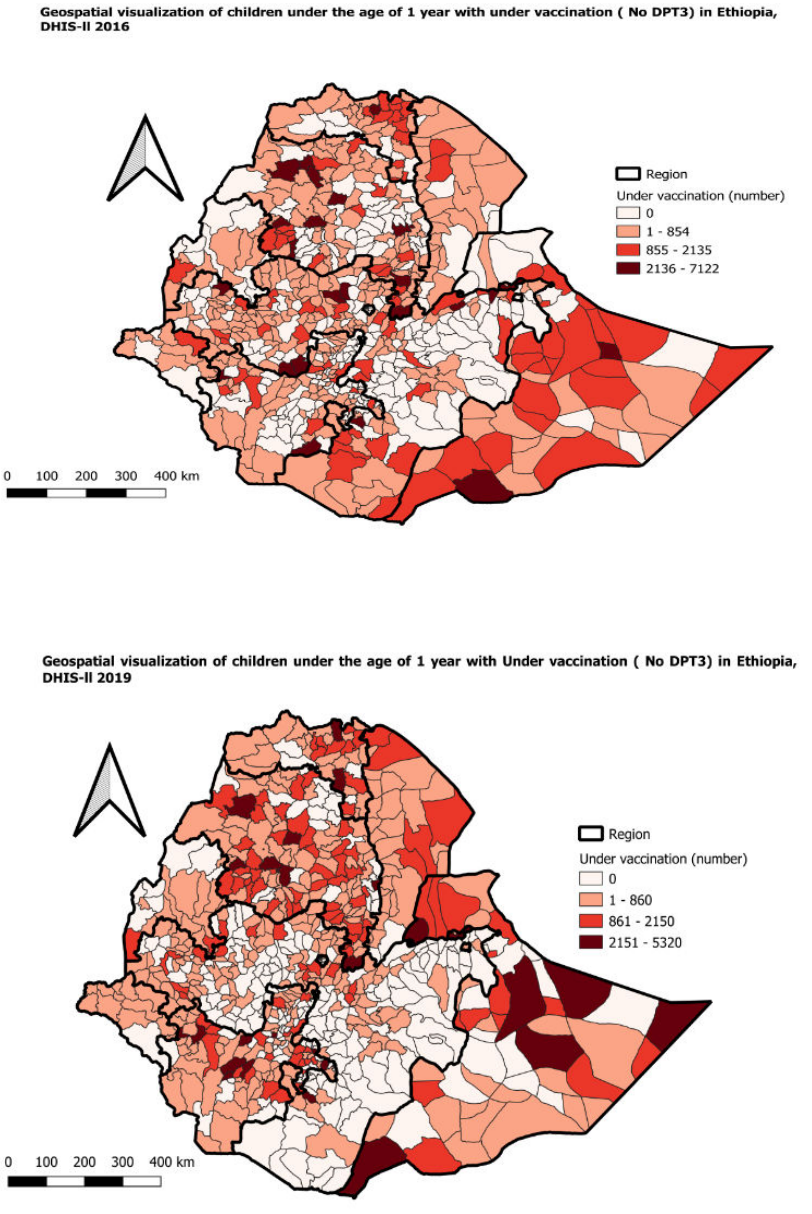
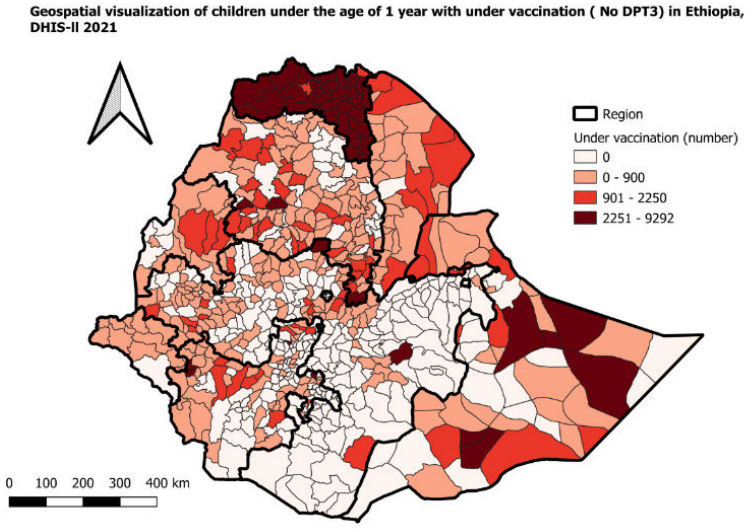


Figure 10: Geospatial visualization of number of zero-dose under-1 children (DHIS II data: 2016, 2019, 202)

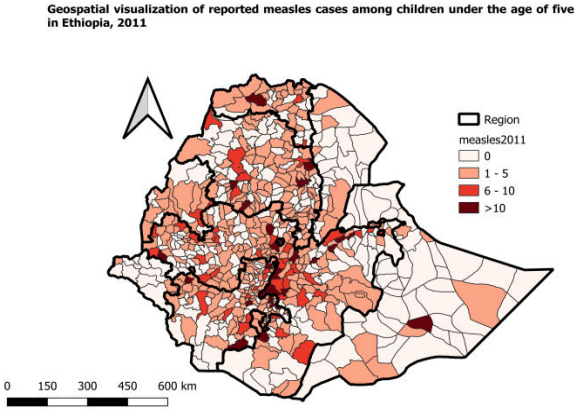




Geospatial Analysis of Reported Measles Cases

Geospatial analysis based on reported measles cases in 2011, 2016 and 2021 was also made. In the three years, a total of 7,466 cases had been reported among under-five children. Almost half (3,672) of the cases were reported in the year 2016. The rest, 1,990 was reported in 2011 and 1,804 in 2021.The analysis identified hotspot districts of measles outbreak in many regions including SNNP, Oromia, Amhara and Somali regions. In 2021, Selamgo and South Ari woredas of SNNPR reported more than 100 cases (Figure 11).

Figure 11: Geospatial visualization of reported measles cases among under-five in 2021.



Secondary Analysis of DHS Dataset

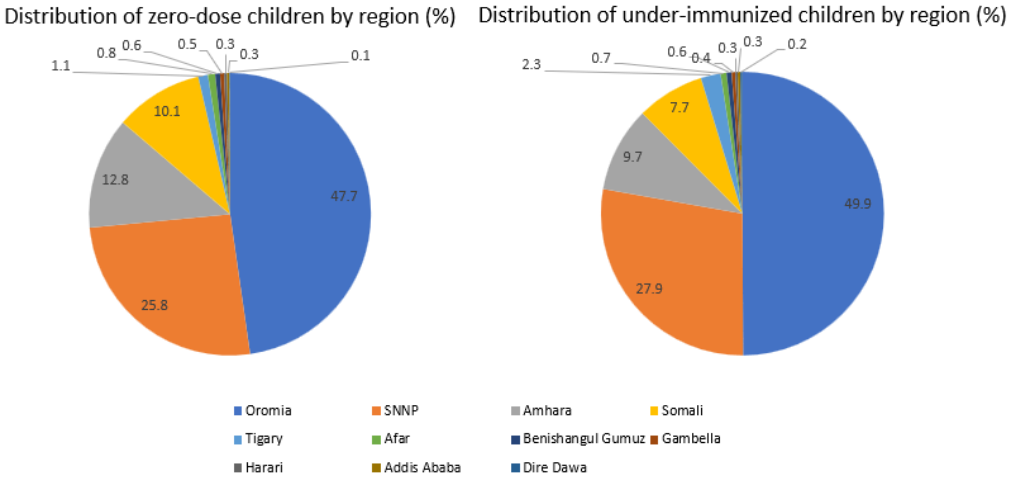
We conducted secondary analysis of Mini DHS 2019 dataset to estimate regional distribution of zero-dose and under-immunized children in Ethiopia. Number of zero-dose and under-immunized children was estimated based on projections of 2007 national census. According to the estimate, in Ethiopia there were more than 700,000 zero-dose and about one million under-immunized children in 2019 (Table 9).

Table 9: Estimated regional distribution of zero-dose and underimmunized children in Ethiopia (2019).

Regions	Coverage (%)		%		Project population (2019)		Numbers (2019)	
	Penta-1	Penta-3	Zero-dose	Under-immunized	Total population	Children 12-23 mos	Zero-dose	Under-immunized
Tigray	95.4	84.4	4.6	15.6	5,802,463	169,326	7,789	26,415
Afar	45.5	25.9	54.5	74.1	1,805,139	36,856	20,087	27,310
Amhara	84.4	80.2	15.6	19.8	21,083,097	572,416	89,297	113,338
Oromia	73.4	53.6	26.6	46.4	38,040,889	1,254,593	333,722	582,131
Somali	42.2	26.2	57.8	73.8	6,048,692	122,383	70,737	90,318
BG	89.2	81.2	10.8	18.8	1,118,288	36,052	3,894	6,778
SNNP	72.7	50.8	27.3	49.2	21,039,293	659,877	180,146	324,660
Gambella	76.3	65	23.7	35	497,373	13,619	3,228	4,767
Harari	65.3	52.8	34.7	47.2	249,576	6,460	2,241	3,049
AACA	96.3	93.1	3.7	6.9	3,515,509	50,810	1,880	3,506
DDCA	95.2	74.2	4.8	25.8	459,728	11,234	539	2,898
Total	**76.3**	**60.9**	**23.7**	**39.1**	**99,660,047**	**2,933,625**	**713,560**	**1,185,170**

The Mini DHS 2019 survey indicated, developing regions of Somali (58% zero-dose and 74% under-immunized) and Afar (55% zero-dose, and 74% under-immunized) had the highest zero-dose and under-immunization rates. However, in terms of numbers, 87% of the total zero-dose and under-immunized children in Ethiopia are found in Oromia, Amhara and SNNP (including the newly formed Sidama and SW) regions. Oromia region alone contributed to nearly 50% of the national total. Accordingly, in terms of improving vaccine coverage, the biggest opportunity for impact would be intervening in the three major regions. Yet, investing in the other regions would also give sense from vaccine equity perspective (Figure 12).

Figure 12: Geographic distribution of zero-dose and under-immunized children (2019)



VACCINATION COVERAGE SURVEY: KEY FINDINGS

Geographic Distribution

Table – 10 presents the geographic distribution (unweighted sample size) of the children 12-35 months old (n=3,646) represented in the vaccination coverage survey. Among the federal regions and city administrations, Afar (14.2%) and Gambella (9.9%) regions had the highest representation; conversely, Harari Region and Dire Dawa City Administration (DDCA) had the lowest. The study represented different domains of remote, underserved and special populations and settings including pastoralists, urban slums, IDPs, refugees and those from developing and newly formed regions (Table 10).

Table 10: Regional distribution (unweighted sample size) of the children 12-35 months included in the survey, remote, underserved and special settings in Ethiopia, June 2022

Study setting (n=3,646)	Frequency	Percent
Regions and city administrations		
Afar	516	14.2
Gambella	360	9.9
Somali	336	9.2
Oromia	300	8.2
SNNPR	300	8.2
Amhara	240	6.6
SWEPR	181	5.0
Sidama	179	4.9
Benishangul Gumuz	168	4.6
Addis Ababa	192	5.3
Harari	60	1.6
Dire Dawa	60	1.6
Other urban settings (Adama, Bahir Dar and Hawassa)	179	4.8
Special populations		
Refugees in Afar, Somali, Gambella regions	311	8.5
IDPs in Amhara, Afar, BG, Oromia regions	264	7.2

Type of population/study setting†		
Developing regions (Somali, Afar, BG, Gambella)	1380	37.8
Pastoralist in Somali, Afar, Oromia, SNNPR, SWEPR	1344	36.9
Hard-to-reach areas from Amhara, Oromia, SNNPR	786	21.6
Newly formed regions (Sidama and SWEPR)	418	11.5
Underserved settings in urban regions	491	13.5
Urban slums	443	12.2
Refugees	311	8.5
Conflict affected areas in Amhara, Afar, BG, Oromia	276	7.6
IDPs	264	7.2

† Total exceeds the total sample size (3,336) as some populations contributed to more than one domain

Socio-demographic Characteristics

The vast majority (97.7%) of the respondents were primary selections. The remaining were replacements for various reasons. In 93.4% of the cases mothers of the children provided the data. More than four-fifth (81.4%) of the respondents were drawn from rural areas. The mean (± SD) of the respondents was 28.7 (± 6.7) years and more than half were between 25–34 years of age. More than half had no formal education (59.2%) and were unemployed (56.2%) during the survey. The vast majority (90.8%) of the respondents were married and about half (50.5%) of their partners had no formal education. About one-in-ten of the households were female-headed. Regarding the profile the children, boys (54.4%) were slightly represented than girls (45.6%) and nearly half (50.7%) were between 12–23 months of age. The remaining (49.3%) were older than 2 years of age (24-35 months) (Table 11).

Table 11: Socio-demographic characteristics of the study participants in remote, underserved and special settings in Ethiopia, June 2022.

Socio-demographic characteristics (n=3,646)	Frequency	Percent
Respondent		
Mother	3,407	93.4
Father	147	4.0
Another primary caregiver	92	2.5
Type of respondent		

Primary selection	3,562	97.7
Replacement	84	2.3
Place of residence		
Urban	677	18.6
Rural	2,969	81.4
Age of the respondent (year)		
15–24	875	24.0
25–34	1,969	54.0
35–44	572	15.7
45 or above	105	2.9
Not sure	126	3.5
Sex of the respondent		
Female	3,488	95.7
Male	158	4.3
Educational status of the respondent		
No formal education or preschool education	2,158	59.2
Primary education	788	21.6
Secondary education	616	16.9
Tertiary education	84	2.3
Marital status		
Married/Living together	3,312	90.8
Separated or divorced	193	5.3
Widowed	98	2.7
Not ever married	43	1.2
Educational status of the partner (n=3,312)		
No formal education or preschool education	1,674	50.5
Primary education	716	21.6
Secondary education	697	21.0
Tertiary education	215	6.5
Not sure	11	0.3
Respondent's occupation		
Unemployed/house wife	2,048	56.2
Agriculture	1,052	28.9
Manual (unskilled or skilled)	129	3.5

Trade, including petty trade	272	7.5
Professional	83	2.3
Others	62	1.7
Household head		
Male	3,318	91.0
Female	328	9.0

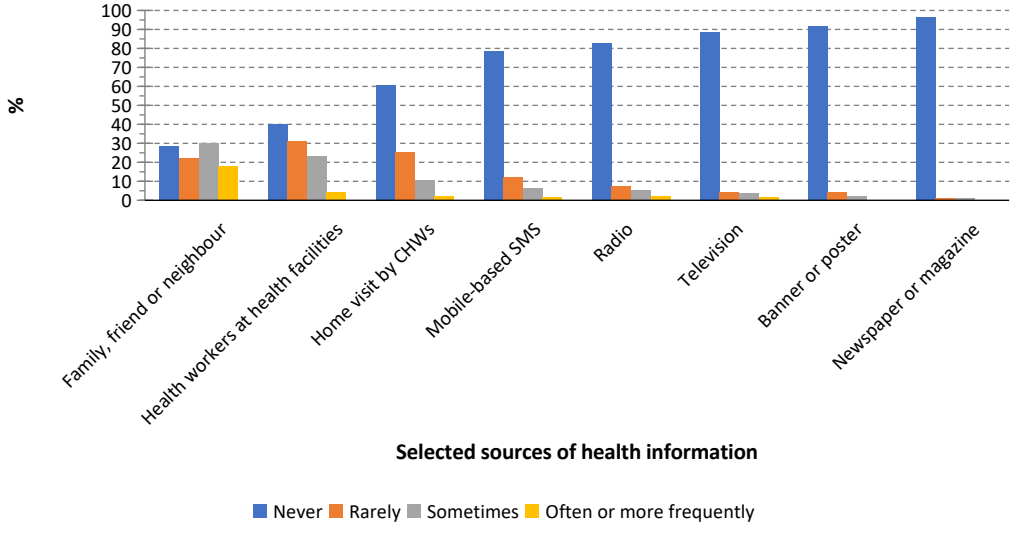
Access to Health Services

Nearly one-tenth of the participants reported that there was no health facility in their kebele and in 53.2% of the cases the nearest health facilities were not within 30 minutes walking distance. Less than half (47.8%) have been visited at home by HEWs in the past 3 months of the survey and smaller proportions (13.5%) have been visited by HDAs (Table 12).

Table 12: Access to health service in remote, underserved and special settings in Ethiopia, June 2022.

Access to health services (n=3,646)	Frequency	Percent
Availability of health facility in the kebele		
Yes	3,307	90.7
No	339	9.3
Nearest health facility		
Health post	2,295	63.0
Health centre	1,233	33.8
Public Hospital	50	1.4
Others	66	1.9
Time to walk to the nearest health facility		
30 minutes or less	1,708	46.8
30-60 minutes	742	20.3
More than an hour	1,196	32.8
Home visit by frontline health workers		
% of households visited by HEWs at least once in the last 3 mos	1742	47.8
% of households visited by HDA members at least once in the last 3 mos	490	13.5

Figure–13 presents access of the survey participants to health information from different sources. Families, neighbors and friends appear to be the popular source of health information. Conversely, newspapers and magazines, banners and posters, television, radio and mobile-based SMS were less frequently mentioned sources (Figure 13).



We also disaggregated accessibility of health facilities and frequency of home visits by frontline health workers by the types of populations studied. Availability of health facilities within 30 minutes walking distance was relatively better in conflict affected areas, IDP centers and urban settings. The opposite was true in hard-to-reach areas, pastoralists and newly formed regions. Regarding home visit by HEWs, the practice was better in urban settings and slums and low in pastoralist population and developing regions (Table 13).

Please find the table on the next page →

Table 13: Access to health service across different study settings in remote, underserved and special settings in Ethiopia, June 2022.

Population domain	Access to health service (%)			
	Availability of health facility in the kebele	Availability of health facility within 30 mins walking distance	Households visited by HEWs in the past 3 mos	Households visited by HDAs in the past 3 mos
Developing regions (n=1,380)	86.0	55.7	30.4	3.1
Pastoralist population (n=1344)	89.5	47.2	39.2	4.2
Hard-to-reach areas in Amhara, Oromia, SNNPR (n=738)	93.9	43.9	56.0	15.6
Newly formed regions (n=418)	99.8	50.7	44.5	13.2
Underserved settings in urban regions (n=491)	84.5	60.4	60.7	9.0
Urban slums (n=433)	84.5	61.0	61.3	9.0
Refugees (n=311)	96.5	56.3	42.1	14.1
Conflict affected areas (n=276)	94.6	68.1	45.3	8.3
IDPs (n=264)	84.5	62.9	43.9	25.0

Access to Vaccination-related Information

The vast majority of the caregivers (85.2%) reported that they received vaccination-related information when the child was younger than 12 months of age. The major sources of vaccination-related information were HEWs (67.5%). Other sources including print and mass media, HDA members, religious and community leaders and husband/partner were less frequently cited. The most frequently disseminated information was about importance of vaccination. More than two thirds were informed about possible adverse events after vaccination and what to do when adverse effects occur (Table 14).

Table 14: Access to vaccination-related information in remote, underserved and special settings in Ethiopia, June 2022.

Access to vaccination-related information (n=3,292)	Frequency	Percent
% of respondents who received information about vaccination when the child was younger than 12 months	2805	85.2
Source of information		
Health extension workers	2,224	67.5
Health professionals	950	28.8
Family/friend/neighbor	889	27.0
Husband/partner	372	11.3
Religious/community leaders	303	9.2
Volunteer community health workers	279	8.5
Television	107	3.2
Radio	103	3.1
Printed materials (Newspaper, magazine, poster, banner)	39	1.3
Messages received		
Importance of vaccination	2,357	71.6
Where to get routine vaccination	1,227	37.3
About vaccination campaigns	1,101	33.4
Timing for vaccination	1,077	32.7
Return to next doses of vaccination	680	20.7
% of respondents informed about possible adverse events of vaccination	2,296	69.8
% of respondents informed about what to do if adverse effects happen	2,089	63.4

Missed Opportunity and Integration of Immunization with MCH Services

Among mothers who participated in the study, 81.0% attended antenatal (ANC) and 55.6% were assisted by skilled birth attendants (SBA) while they were pregnant with the index child. Likewise, 43.1% had at least one postnatal care (PNC) after giving birth to the child. Among those who had ANC and PNC, 68.9% and 92.8% got vaccination-related information at least once while receiving the maternity care. Access to vaccination information during PNC was universally high (> 90%) in all the sub-populations we studied. Access to vaccination-related information during ANC was highest among refugees (88.6%) and, lowest in newly formed regions (56.8%) and among IDPs (62.2%) (Table 15).

Table 15: Provision of vaccination information during maternity care, remote in underserved and special settings in Ethiopia, June 2022.

Population domain	%					
	At least one ANC	4 or more ANC	SBA	At least one PNC	Received vaccination info during:	
					ANC	PNC
All (n=4,407)	81.0	38.2	55.6	43.1	68.9	92.8
Developing regions (n=1,246)	49.9	15.8	31.7	30.3	65.4	91.3
Pastoralist population (n=1,232)	60.9	24.0	40.4	32.7	72.1	93.8
Hard-to-reach areas in Amhara, Oromia, SNNPR (n=736)	86.6	44.5	59.8	45.0	71.3	92.1
Newly formed regions (n=397)	85.1	39.0	56.7	37.0	56.8	89.8
Underserved settings in urban regions (n=462)	97.5	80.0	95.7	79.4	65.2	91.2
Urban slums (n=416)	97.6	81.5	95.9	79.3	65.1	91.5
Refugees (n=311)	87.1	24.4	86.8	71.3	88.6	96.9
Conflict affected areas (n=264)	85.9	43.7	45.8	35.6	67.3	88.3
IDPs (n=256)	86.7	34.0	75.0	50.4	62.2	94.6

While the index child was younger than 12 months of age, about half of the respondents visited health facility at least once for seeking various MCH-related services. The most

popular reason was to get the child treated for medical conditions. With the aim of assessing the extent of missed opportunity for vaccination, the respondents were asked whether they have been encouraged to get their child vaccinated while they visited the health facility for these MCH services. Missed opportunities were very low during ANC or PNC (6.1%) and growth monitoring and promotion (9.8%) services. Conversely, missed opportunities were higher during family planning service provision (25.0%), distribution of bed nets (24.7%) and during sick childcare (21.4%) (Table 16).

Table 16: Missed opportunity and integration of vaccination with MCH care in remote, underserved and special settings in Ethiopia, June 2022.

Missed opportunity during MCH care (n=3,646)	Frequency	Percent
% of respondents who visited health facility while the index child was younger than 12 months of age	1,887	51.8
Reasons for health facility visit:		
Sick childcare	1,340	36.7
Family planning service	514	14.1
ANC or PNC	436	12.0
Growth monitoring and promotion	285	7.8
Therapeutic od supplementary feeding program	177	4.9
To collect bed net	145	4.0
Others	45	1.2
% of respondents who were encouraged to vaccinate their child while seeking the following care:		
ANC/PNC	409	93.9
Growth Monitoring and Promotion (GMP)	258	90.2
To collect bed net	142	80.0
Sick childcare	1,053	78.6
Therapeutic or supplementary feeding program (T/SFP)	110	75.3
Family planning service (FP)	386	75.0

Knowledge and Attitude towards Childhood Vaccination

Most of the respondents have heard of routine childhood vaccines (90.3%) and knew at least one VPD (88.0%). Yet, the awareness on specific VPDs appears to be low. The most popular diseases that the respondents identified as vaccine preventable were Measles (46.2%) and Poliomyelitis (45.3%). Less than 10% identified Diphtheria, Meningitis and Hepatitis B as VPDs. Only one-fifth (19.1%), were aware that childhood vaccination has to

be started at birth. The most popular places for receiving childhood vaccines were health posts (59.0%), health centers (46.2%) and outreach cites (28.0%).

We have also assessed caregivers' attitude on perceived susceptibility of their children to VPDs if not vaccinated and severity when get infected. About one-third (68.9%) thought that it would be very likely that the child be susceptible to VPDs if not unvaccinated. Similarly, 65.8% assumed that VPDs can get very sever if the child gets infected. In general, the attitude of the caregivers towards routine childhood vaccination appears to be positive as very small proportion reported vaccine hesitancy. The vast majority reported that they would recommend children in their community to get vaccinated and nearly four fifth (78.6%) were satisfied with the vaccination service provided in their area (Table 17).

Table 17: Knowledge and attitude towards childhood vaccination in remote, underserved and special settings in Ethiopia, June 2022.

Knowledge and attitude towards vaccination	Frequency	Percent
% of respondents who have heard of routine childhood vaccination (n=3,646)	3,292	90.3
% of respondents who were aware that vaccination prevents disease (n=3,646)	3,208	88.0
% of respondents who identified the following as VPDs (n=3,646)		
Measles	1,683	46.2
Poliomyelitis	1,650	45.3
Diarrheal diseases	1,488	40.8
Tuberculosis	1,121	30.7
Pertussis	918	25.2
Tetanus	766	21.0
Pneumonia	744	20.4
Diphtheria	346	9.5
Meningitis	230	6.3
Hepatitis B	146	4.0
When do you think a child should start on immunization? (n=3,646)		
At birth	697	19.1
First few weeks	1,105	30.3
First few months	1,356	37.2
Later	34	0.9
Don't know	100	2.7

Have not heard about vaccines	354	9.7
Where can you take a child for vaccination? (n=3,646)		
Health post	2,150	59.0
Health centre	1,684	46.2
Outreach cites	1,020	28.0
Hospital	354	9.7
Perceived susceptibility to VPD if the child is not vaccinated (n=3292)		
Very likely	2,268	68.9
Somewhat likely	887	26.9
Not likely at all	64	1.9
Not sure/Don't know	73	2.2
Perceived perceptibility to severe illness if the child is not vaccinated (n=3292)		
Very likely	2,166	65.8
Somewhat likely	793	24.1
Not likely at all	243	7.4
Not sure/Don't know	90	2.7
Other attitude related issues: (n=3292)		
% of respondents who opted out vaccination after being offer by a health worker	15	0.4
% of respondents who had any doubts or suspicions about having their child vaccinated	59	1.8
% of respondents who would recommend children in their community to get vaccinated	3216	97.7
% of respondents satisfied with the vaccination service provided in their area	2586	78.6

Ownership of Vaccination Card

Vaccination card ownership can be considered as a proxy indicator for access to vaccination service. In the current study more than half (60.8%) of children 12-35 months have had vaccination card. Card ownership was lower in the developing regions (37.8%) and pastoralist settings (50.5%) specially in Somali region (26.5%). Conversely, nearly all (97.1%) children from urban settings owned vaccination card (Table 18).

Table 18: Vaccination card ownership among children 12-35 months in remote, underserved and special settings in Ethiopia, June 2022.

Setting	Ownership of vaccination card
Developing regions (n = 1,380)	37.8
Afar (n=516)	62.4
Benishangul Gumuz (n=168)	41.7
Gambella (n=360)	79.7
Somali (n=336)	26.5
Newly formed regions (n= 418)	60.5
Sidama (n=179)	44.7
South west (n=181)	67.1
Hard to reach areas in major regions (n=786)	68.2
Amhara (n=240)	81.7
Oromia (n=300)	67.0
SNNP (n=300)	61.3
Conflict affected settings[1] (n=276)	68.1
Pastoralist populations[2] (n=1,344)	50.5
Underserved settings in predominately urban regions and city administrations (n=491)	97.1
Urban slums (n=443)	97.0
Special populations	
IDPs (n=264)	68.2
Refugees (n=311)	67.5
Total (n=3,646)	60.8

1 Conflict affected settings in Afar, Amhara, BG, and Oromia regions
2 Afar, Somali, Selected districts in Gambella, Oromia, SW and SNNP

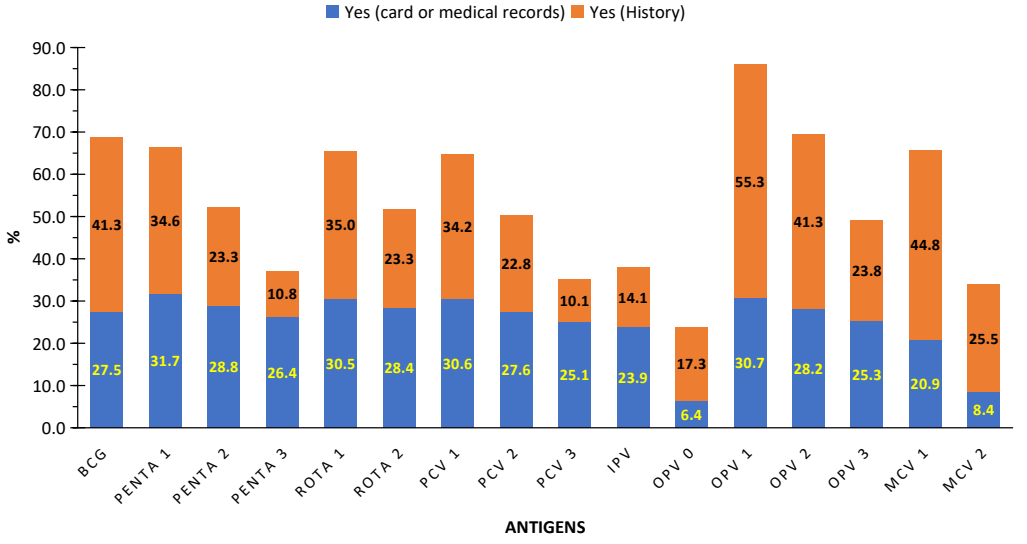
Vaccination Coverage

Aggregated vaccination coverage

Figure – 14 presents the aggregated vaccination coverage among children aged 12-35 months in remote, underserved and special settings in Ethiopia. The vaccination coverage was estimated based on two types of sources: vaccination card or medical records, and history. More than two-third (68.8%) of children received BCG of which 27.5% of the caregivers showed the children's vaccination card or their data was recorded in the respective health facilities. While 66.3% of children received Penta-1, only 37.2% of them got the third Penta dose. Children who received MCV-1 and -2 were 65.7% and 33.9%, respectively.

MCV-1 coverage was unusually higher than Penta-3 coverage. This might be due to the reasons that measles vaccination is had been frequently provided through campaign based-modality. The high vaccination coverage of measles based on mothers' or caregivers' report, which is almost twice the coverage found from card or medical records, also suggest that much of the measles coverage had been attained by campaign-based approach (Figure 14).

Figure 14: Aggregated vaccination coverage in remote, underserved and special settings in Ethiopia, June 2022



Vaccination coverage disaggregated by different target populations

Aggregated vaccination coverage rates were calculated for special populations of interest that included developing regions, newly formed regions, hard-to-reach areas in major regions, conflict-affected settings, pastoralist populations, urban slums and IDPs and

refugees. Among these population groups, Penta-1 and Penta-3 coverage rates (93.8% and 85.3%, respectively) were found to be higher in urban slums than the rest of the groups. On the other hand, developing regions' performance in Penta-1 and Penta-3 coverage rates were unsatisfactory (46.1% and 19.8%, respectively) which is attribute to the very poor coverage rates in Somali region (36.3% and 13.7%, respectively). Among the developing regions, the highest coverage rates for the two separate doses were reported from BG region (73.8% and 38.1%, respectively). Penta-1 and Penta-3 rates in newly formed regions were also low (62.2% and 36.8%, respectively). Among hard-to-reach areas in major regions, coverage rates of the two Penta doses were found to be higher in Amhara (74.5% & 45.2%) than in SNNP and Oromia regions. In general, MCV-2 and IPV coverages were low in almost all population groups studied (Table 19).

Table 19: Vaccination coverage by selected antigens among children 12-35 months in remote, underserved and special settings in Ethiopia, June 2022.

Please find the table on the next page →

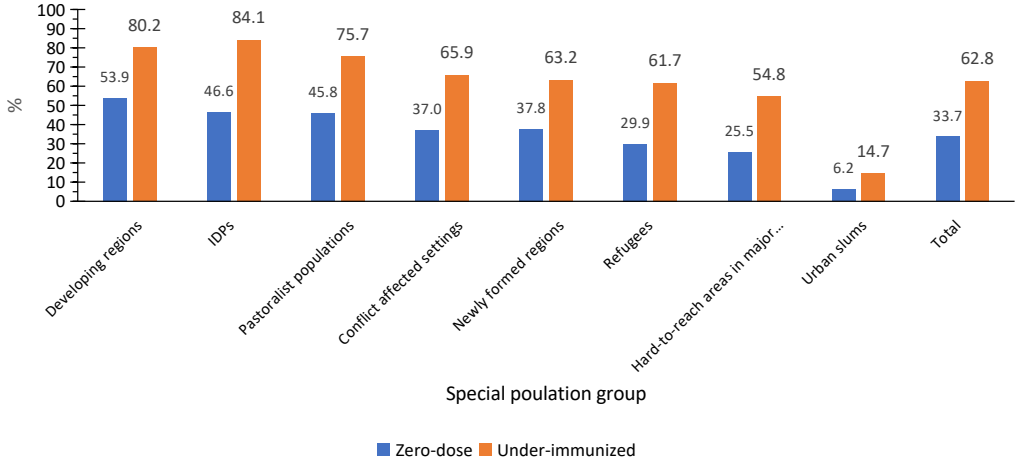
Setting	BCG		Penta 1		Penta 3		IPV		OPV 3		Rota 2		PCV 3		MCV 1		MCV 2	
	C/R	T	C/R	T	C/R	T	C/R	T	C/R	T	C/R	T	C/R	T	C/R	T	C/R	T
Developing regions (n=1,180)	17.1	50.1	23.7	46.1	13.8	19.8	15.9	30.4	14.2	29.0	15.7	31.8	13.5	17.2	13.4	51.4	4.3	23.9
Afar (n=516)	7.4	51.2	9.9	57.9	6.4	22.1	6.4	26.9	6.8	36.0	7.6	41.9	6.6	16.9	5.0	64.3	1.7	30.0
Benishangul Gumuz (n=168)	38.7	72.6	48.2	73.8	44.0	51.8	38.1	54.2	44.0	57.7	45.8	59.5	44.6	52.4	37.5	71.4	14.3	35.7
Gambella (n=360)	25.0	80.3	31.9	72.8	21.4	27.5	17.5	36.9	20.8	31.4	20.8	39.7	17.8	18.3	17.2	72.2	4.2	40.0
Somali (n=336)	16.4	44.3	23.8	36.3	11.0	13.7	15.5	27.4	11.6	22.3	13.4	23.8	10.7	11.9	12.2	42.9	3.6	19.0
Newly formed regions (n= 418)	27.8	66.0	30.9	62.2	26.8	36.8	24.4	36.6	26.1	55.3	29.2	52.9	25.1	35.4	19.9	56.7	11.2	29.9
Sidama (n=179)	17.3	53.1	18.4	45.3	15.6	21.2	15.6	21.2	16.2	37.4	17.9	34.6	16.2	21.8	8.9	46.4	1.1	22.3
Southwest (n=181)	24.9	71.3	27.6	66.9	23.8	42.0	20.4	39.2	22.1	66.9	25.4	58.6	22.1	40.9	14.9	56.9	9.9	24.9
Hard to reach areas in major regions (n=786)	31.8	72.1	35.6	74.5	30.8	45.2	26.8	44.1	29.3	54.0	33.0	60.6	29.4	43.0	24.2	70.8	9.7	37.2
Amhara (n=240)	44.2	86.7	48.3	83.3	42.5	58.8	41.7	59.6	43.3	61.7	45.4	72.9	42.1	53.8	35.8	81.3	16.7	49.2
Oromia (n=300)	24.3	65.7	28.7	69.3	24.7	38.7	18.3	35.0	23.0	51.0	27.3	55.0	22.0	36.0	18.3	66.3	5.7	32.3
SNNP (n=300)	38.3	75.7	42.0	79.7	34.7	48.7	32.3	49.7	32.3	54.7	36.7	63.0	34.7	48.7	28.0	72.0	13.3	40.0
Conflict affected settings[1] (n=276)	23.2	61.2	30.1	63.0	23.2	34.1	22.1	34.8	23.2	47.1	26.1	44.9	22.1	29.7	18.8	71.0	11.2	39.1
Pastoralist populations[2] (n=1344)	16.7	52.7	22.7	54.2	14.1	24.3	14.4	30.7	13.7	35.4	16.5	39.2	12.8	21.4	12.3	56.1	4.1	25.5
Underserved settings in predominately urban regions and city administrations (n=491)	84.0	92.0	87.2	93.6	82.5	84.8	76.6	80.0	81.9	86.1	85.8	90.6	82.7	85.1	78.9	86.2	48.5	54.5
Urban slums (n=443)	84.4	92.0	87.8	93.8	83.1	85.3	76.7	79.8	82.6	86.5	86.2	90.7	83.3	85.5	79.5	86.6	49.2	55.2
Special populations																		
IDPs (n=264)	11.4	79.2	13.3	53.4	12.1	15.9	11.4	26.9	11.7	51.1	12.1	31.8	12.1	15.9	9.5	75.8	4.5	34.1
Refugees (n=311)	43.4	80.7	43.1	70.1	33.4	38.3	27.7	37.3	31.5	39.5	29.9	44.7	29.9	32.5	22.2	58.2	6.4	25.4
Total (n=3,646)	27.5	68.8	31.7	66.3	26.4	37.2	23.9	38.0	25.3	49.1	28.4	51.8	25.1	35.2	20.9	65.7	8.4	34.0

C/R = vaccination coverage based on vaccination card or medical records
T= vaccination coverage based on vaccination card or medical records or caregiver's report
1 Conflict affected settings in Afar, Amhara, BG, and Oromia regions
2 Afar, Somali, Selected districts in Gambella, Oromia, SW and SNNP

Prevalence of zero-dose and under-immunized children

The overall prevalence of zero-dose and under-immunized children in hard-to-reach and underserved settings of Ethiopia were 33.7% and 62.8%, respectively. The lowest prevalence of zero-dose (6.2%) and under-immunized children (14.7%) were found in urban slums. On the other hand, developing regions had the highest prevalence of zero-dose (53.9%). Prevalence of zero-dose children was unexpectedly lower in refugees (29.9%). Hard-to-reach areas in major regions had the second lowest prevalence of zero-dose (25.5%) and under-immunized children (54.8%) (Figure 15).

Figure 15: Prevalence of zero-dose and under-immunized children in remote, underserved and special settings in Ethiopia, June 2022.



Estimated Number of Zero-dose and Under-immunized Children

Based zero-dose and under-immunization rates coming from the current survey, and size of the target population estimated from different literature, we computed the number of zero-dose and under-immunized children in remote, underserved and special settings in Ethiopia. According to our estimate, conflict-affected areas have the highest contribution of zero-dose (221,458) and under-immunized children (394,434). Pastoralist populations (181,515 zero-dose and 300,015 under-immunized), developing regions (174,429 zero-dose and 259,539 under-immunized) and newly formed regions (100,188 zero-dose and 167,511 under-immunized) also harbor more than 100,000 zero-dose children. Hard-to-reach areas of the major three regions harbor 92,337 zero-dose and 198,433 under-immunized children. This figure was estimated based on the assumption that 15% of the population of the regions live in relatively hard-to-reach areas and the estimate is sensitive to this assumption. Conversely, the contributions of IDPs (37,860 zero-dose and 68,326 under-immunized), refugees (7,653 zero-dose and 15,792 under-immunized) and urban slums (8,659 zero-dose and 20,530 under-immunized) were relatively lower. The estimated

numbers related to conflict-affected settings and IDPs are unlikely to be stable due to the changing situation at the ground. It is important to note that population domains presented in Table 12 are overlapping hence figures cannot be totaled (Table 20).

Table 20: Number of zero-dose and under-immunized children in remote, underserved and special settings in Ethiopia, June 2022.

Settings	Zero-dose (%)	Under-immunized (%)	Projected population (2022)	Estimated # of children 12-23 mos	Estimated #	
					zero-dose	Under-immunized
Developing regions	53.9	80.2	10,405,630[a]	323,615	174,429	259,539
IDPs	46.6	84.1	2,612,353[b]	81,244	37,860	68,326
Pastoralist populations	45.8	75.7	12,743,457[c]	396,322	181,515	300,015
Newly formed regions	37.8	63.2	8,522,465[d]	265,049	100,188	167,511
Conflict-affected settings	37.0	65.9	19,245,493[e]	598,535	221,458	394,434
Refugees	29.9	61.7	823,000[f]	25,595	7,653	15,792
Hard-to-reach areas in major regions	25.5	54.8	11,643,215[g]	362,104	92,337	198,433
Urban slums	6.2	14.7	8,883,675[h]	139,662	8,659	20,530

[a] Projected population size of Afar, Somali, Benishangul Gumuz and Gambella regions based on the population size and weighted population growth rate reported in the most recent national census (2007).
[b] [f] UNHCR March 2022 estimate
[c] Projected population size of Afar, Somali, and selected pastoralist districts of Oromia (Borena, Guji and West Guji), Gambella (Neuer and Aguwak) SNNP and SW Regions based on the population size and weighted population growth rate reported in the most recent national census (2007).
d Projected population size of Sidama and SW regions based on population size and weighted population growth rate reported in the most recent national census (2007).
e total of pulation living in conflict affected districts of Amhara, Tigray, Afar, BG and Oromia
g We assumed 15% of the population of Amhara, SNNP and Oromia live in relatively hard-to-reach areas.
h urban population size projected based on the 2007 census. 64% of urban dwellers reside in slum areas (UN-Habitat estimate).

Vaccination Dropout Rate

The overall Penta-1 to Penta-3 and Penta-1 to MCV-1vaccination dropout rate among children aged 12-35 months in remote, underserved and special settings in Ethiopia were 43.5% and 23.4%, respectively. Region-wise, Penta-1 to Penta-3 dropout rates were lowest in Amhara and BG regions (about 30%) and highest in Somali, Afar and Gambella regions (> 60%). Among the population domains that we studied, IDPs have the highest (70.2%) Penta-1 to Penta-3 dropout rate (Table 21).

Table 21:Vaccination dropout rate among children 12-35 months in remote, underserved and special settings in Ethiopia, June 2022.

Settings	Dropout rate (%)	
	Penta-1 to - 3	Penta-1 to MCV-1
Developing regions (n =636)	57.1	25.6
Afar (n=299)	61.9	19.1
Benishangul Gumuz (n=124)	29.8	23.4
Gambella (n=262)	62.2	21.0
Somali (n=122)	62.3	30.3
Newly formed regions (n=260)	40.8	30.4
Sidama (n=81)	59.3	40.7
South west (n=121)	39.7	32.2
Hard to reach areas in major regions (n=586)	39.3	21.1
Amhara (n=200)	29.5	17.5
Oromia (n=208)	44.2	24.0
SNNP (n=239)	38.9	20.5
Conflict affected settings (n=174)	46.0	20.7
Pastoralist populations (n=729)	55.2	24.4
Underserved settings in predominately urban regions (n=460)	9.4	9.2
Urban slums (n=415)	9.0	9.2
Special populations		
IDPs (n=141)	70.2	12.8
Refugees (n=218)	45.5	33.5
Total (n=2,418)	43.5	23.4

Socio-economic Inequality in Vaccination Coverage and Dropout Rate

Zero-dose, under-immunization and vaccination dropout rates were compared across levels of wealth index, parents' educational status and place of residence (urban/rural). In terms of household wealth index, near to 30 percentage points (PP) difference were observed between the poorest and richest quintiles in the prevalence of zero-dose and under-immunized children. Similar pattern was also seen in Penta-1 to Penta- 3 dropout rate. Children from parents with no formal education and those residing in rural area were largely unvaccinated and had higher dropout rates (Table 22).

Table 22: Socio-economic inequality in vaccination coverage and dropout rates in hard-to-reach, underserved and special settings in Ethiopia, June 2022.

Socio-demographic characterstics	Zero-dose (%)	Under-immunized (%)	Dropout (%)
			Penta-1 to Penta- 3
Wealth index			
Poorest (n=787)	48.8	79.0	59.1
Poorer (n=855)	39.2	68.1	47.5
Middle (n=749)	30.0	60.9	44.1
Richer (n=741)	23.8	51.3	36.1
Richest (n=513)	21.1	48.7	35.1
Maternal educational status			
No formal education (n=2,158)	36.4	68.2	50.0
Primary education (n=788)	32.5	58.9	39.1
Secondary education (n=615)	28.5	53.2	34.5
Tertiary education (n=84)	13.1	33.0	23.3
Paternal educational status			
No formal education (n=1,674)	36.9	68.4	50.0
Primary education (n=716)	34.2	61.0	40.8
Secondary education (n=697)	26.7	54.7	38.2
Tertiary education (n=215)	18.6	39.1	25.1
Place of residence			
Urban (n=678)	25.6	55.2	42.6
Rural (n=2,968)	35.5	64.1	44.4

Access to Health Service and Vaccination Service Utilization

The association between accessibility to health facilities and prevalence of zero-dose and under-immunization was also analyzed. The rates of zero-dose, under-immunization and dropout tend to be higher in kebeles having no health facility. Further, the rates rise as physical access to health facilities decrease. Children who lived in areas close to health facilities had received better vaccination services and had low dropout rates (Table 23).

Table 23: Relationship between vaccination coverage and accessibility of health facilities in hard-to-reach, underserved and special settings in Ethiopia, June 2022.

Accessabilty of health facilities	%		Dropout (%)
	Zero-dose	Under-immunized	Penta-1 to - 3
Availability of health facility in the kebele			
Yes (n=3,306)	30.2	60.3	43.2
No (n=339)	67.8	87.9	62.0
Distance from the nearest health facility			
30 minutes or less (n=1,708)	29.6	57.3	39.3
30-60 minutes (n=743)	32.4	62.4	42.9
More than 60 minutes (n=1,196)	39.1	71.0	52.3

Barriers and Enablers to Utilization of Vaccination Service

Among 1,854 caregivers whose children received Penta-3 vaccine, barrier for not utilizing the vaccination service were assessed. The leading reasons reported by nearly half of the respondents were absence of vaccination service in the locality (47.0%), and failure of health workers to visit the village (44.6%). Closure of vaccination cite (21.8%), absence of vaccine (20.5%) and domestic workload were also cited by considerable proportion of the respondents. Conversely among 1,665 caregivers whose children received Penta-3, enablers for utilizing the service were explored. The leading reasons were knowledge of the importance of vaccination (75.9%), proximity of health facility/outreach site (57.2%) and presence of outreach activities (48.3%) (Table 16).

Table 24: Barriers and enablers for utilizing vaccination service in hard-to-reach, underserved and special settings in Ethiopia, June 2022.

Barriers and enablers	Frequency	Percent
Reported barriers for not completing vaccination (n=1,874)		
Absence of health facility/or vaccination service	881	47.0
Health workers did not come to the village	837	44.6
Vaccination site closed/vaccinator absent	408	21.8
No vaccine at the vaccination site	384	20.5
Domestic workload	346	18.5
Long waiting time	108	5.8
War or displacement	86	4.6
Vaccinator not friendly/poor relationship with the vaccinator	51	2.7
Vaccination is of no use	14	0.8
Vaccination hurts children/make them sick	23	1.2
My husband discouraged me	28	1.5
Fear of cost associated with vaccination	27	1.4
Lack of information or carelessness	20	1.1
Others	102	5.5
Reported enablers for utilizing the vaccination service (n=1,665)		
Vaccinations are important for children	1264	75.9
Proximity of health facility/outreach site	951	57.2
Presence of outreach activities	804	48.3
My husband supported/encouraged me	353	21.2
Community health workers' follow up	285	17.1
It is normal to vaccinate children	137	8.2
Others supported/encouraged me	110	6.6
Others	7	0.4

Gender-related Factors and Vaccination Service Utilization

The study detected no meaningful difference between boys and girls in terms of zero-dose, under-immunization and drop-out rates. However, female headed households had higher rates of under-immunized children (72.0%) and dropout rates (56.0%) than their counterparts.

The prevalence of zero-dose and under-immunized children and dropout rates declined with women's increasing power in household decision making. In most of the cases (87.8%) mothers alone or in joint with their partners make decisions about the health care of their children. Such engagement of women in household decision making was associated with reduced rates of zero-dose, under-immunized and dropout rates as compared to households in which decisions are made solely by husbands.

More than half of the women (56.2%) were unemployed or housewife and about one-third (36.3%) were engaged in IGAs. Very small fractions (2.3%) had professional jobs. Zero-dose, under-immunization and drop-out rates did not show meaningful and consistent differences across types of occupation. Yet, women engaged in professional jobs had substantially better vaccination outcomes.

More than half (51.8%) of the women spent nine or more hours working. The finding indicated the excess women's workload both in domestic chores and IGA activities. Paradoxically, increasing number of working hours was associated with better vaccination outcomes. This can be due to the reason that women with better educational and economical status are busier than their counterparts. Only 15.8% of women reported that their husbands assist them in household chores in most days of a week. Such kind of support was also associated with lower zero-dose and under-immunization rates.

Considerable proportion of women reported that they own house (65.3%) and agricultural/non-agricultural land (58.7%), alone or in joint. Women's land or house ownership was associated with lower rates of zero-dose, under-immunization and drop-out. We also examined who allocates money for household expenditures (including health care and consumption), and how this is associated vaccination outcomes. Households that allocate resources by engaging both partners have had better vaccination outcomes. Conversely, women's saving and access to credit schemes did not show any meaningful association with the outcomes of interest.

In households where women have better access to information about what is happening in the community, zero-dose, under-immunization and drop-out rates were lower. Similarly, in households in which dialogue among family members on health issues including immunization had been reported, vaccination outcomes were better (Table 25).

Table 25: Vaccination and gender-related factors in hard-to-reach, underserved and special settings in Ethiopia, June 2022.

Gender-related factors	Freq distribution (%)	Zero-dose (%)	Under-immunized (%)	Penta-1 to - 3 Dropout (%)
Sex of the baby				
Boy	54.4	33.3	63.3	45.0
Girl	45.6	34.2	62.3	42.7
Head of the household				
Male	91.0	33.4	61.9	42.8
Female	9.0	36.3	72.0	56.0
Women's household decision making power				
Low (0-2)	13.4	41.2	76.6	60.2
Medium (3-4)	13.9	41.1	66.5	43.2
High (5-6)	72.7	29.8	55.5	40.9
Who makes decision about child's health care				
Mother of the child or in joint	87.8	31.9	60.2	42.2
Father of the child or someone else	12.2	38.2	72.4	53.8
Women's occupation				
Unemployed or housewife	56.2	33.8	60.6	40.5
Manual including agriculture	3.5	37.2	53.1	25.9
Trade (including petty trade)	36.3	35.1	69.9	53.6
Professional	2.3	20.5	40.2	24.6
Others	1.7	11.3	38.7	30.9
Number of hours women work in a typical day				
0-4	12.4	34.2	83.4	74.8
5-8	35.9	34.7	63.1	43.6
9 or more	51.8	31.4	56.2	36.2
Husbands supports to wife in household chores				

Yes	15.8	25.6	58.7	44.5
No	84.2	34.3	62.7	43.2
Women's house ownership				
Yes	65.3	31.5	57.0	37.2
No	34.7	35.5	71.6	55.9
Women's agricultural/non-agricultural land ownership				
Yes	58.7	31.8	58.2	38.7
No	41.3	34.4	67.5	50.4
Who allocates money for health expenses?				
Mother of the child	14.5	40.6	75.6	58.9
Father of the child	46.0	34.2	63.7	44.8
In joint	37.2	29.4	56.0	37.7
Others	2.2	47.6	75.6	53.5
Who saves money from household income				
Mother of the child	23.1	32.9	62.1	43.5
Father of the child	40.8	34.3	63.6	44.6
Both	31.7	35.4	65.7	46.8
Mothers' access to credit scheme				
Yes	12.5	29.8	62.6	49.4
No	87.5	34.2	64.6	43.1
Who has more access to information about what is happening in the community?				
Mother of the child	56.1	28.8	56.1	38.4
Father of the child	25.0	44.1	67.7	42.3
Presence of dialogue on health among family members				
Yes	62.5	27.0	59.9	41.9
No	36.7	44.9	68.0	45.0

Key Findings of the Health Facility Survey

Background characteristics

A total of 282 health facilities located nearest the EAs represented in the community-based survey were enrolled. Of them 23 (8.1%) were not functional at the time of the survey hence the actual analysis was made in the remaining 259 facilities. The surveyed health facilities included 137 health posts, 111 health centers and 11 primary hospitals. Region-wise, Afar and Somali contributed more than a quarter of the health facilities. More than two-third of the facilities were located in rural areas (Table 26).

Table 26: Profile of health institutions enrolled in the health facility survey, hard-to-reach, under-served and special settings in Ethiopia, June 2022.

Characterstics	Frequency	Percentage
Functionality (n=282)		
Functional	259	91.9
Non-functional	23	8.1
Region (n=259)		
Afar	37	14.3
Somali	34	13.1
Amhara	29	11.2
Oromia	30	11.6
Gambella	26	10.1
SNNPR	25	9.6
Sidama	19	7.3
BG	17	6.6
SW	16	6.2
Addis Ababa City Administration	16	6.2
Dire Dawa City Administration	6	2.3
Harari	4	1.5
Type of health facility (n=259)		
Health post	137	52.9
Health centre	111	42.9
Primary hospital	11	4.2
Location (n=259)		
Urban	85	32.8
Rural	174	67.2

Vaccination service provision

Table–27 summarizes the typical frequency of vaccination service provision through static, outreach and campaign-based approaches. In a typical week more than two-third (69.3%) of the health facilities provide static vaccination service twice per week or less frequently. The frequency of providing multidose vials (BCG and measles) is even lower. Nearly a tenth (9.8%) of the health facilities did not provide outreach vaccination service and 21.3% organized outreach activities less than once per month. One-tenth of the health facilities did not organize any vaccination campaign in the previous 12 months of the survey. Nearly two-third reported interruption of vaccination service in the last 3 months. The leading reason for service interruption was interruption in the vaccine logistic system (Table 19).

Table 27: Vaccination service delivery in remote, underserved and special population in Ethiopia, June 2022.

Variable	Frequency	Percentage
Number of days vaccination service is provided in a typical week through static strategy		
Does not provide such service	15	6.2
Less than once per week	69	28.3
1-2 days	85	34.8
3-5 days	75	30.7
Number of days vaccination service is provided for multidose vaccines in a typical week through static strategy		
Does not provide such service	18	7.4
Less than once per week	87	35.7
1-2 days	113	46.3
3-5 days	26	10.6
Number of days vaccination service is provided in a typical month through outreach strategy		
Does not provide such service	24	9.8
Less than once per month	76	21.3
1-10 days	137	56.1
11-30 days	7	2.9
Number of vaccination campaigns organized in the past year		
No campaign	25	10.2
1-10 campaigns	202	82.8
10+campaigns	5	2.1
Do not know	12	4.9

Interruption of vaccination service in the last 3 months		
Yes	168	68.9
No	76	31.1
Reasons for interruption		
Vaccines not available from higher store	26	35.1
Vaccines not collected timely	16	21.6
Lack of transportation	12	16.2
Security situation/conflict	4	5.4

Vaccine logistics and functionality of refrigerators

The analysis indicated 80% of the health facilities, vaccines were supplied on monthly basis as per the standard. Vaccine refrigerators were available in 80% of the health facilities and of the available refrigerators, 87% of them were working at the time of the survey (Table 28).

Table 28: Vaccine logistic system related issues in health facilities found in remote, underserved and special settings in Ethiopia, June 2022.

Variables	Frequency	Percentage
Vaccines delivered /collected to facilities from EPSA/WoHO/HF (n= 259)		
At least once in a month	207	79.9
At least once in 2 months	23	8.9
At least once in the previous three months	21	8.1
No visit during the last three months	8	3.1
How are routine vaccines delivered/ collected to health facilities (n=257)		
Car (Government and NGO)	132	51.4
Foot/walking	51	19.8
Motorcycle	40	15.6
Public transport (taxi, buses, Bajaj)	28	10.9
Bicycle	6	2.3
Availability of vaccine refrigerators (n= 259)		
Yes	206	79.5
No	53	20.5
Functionality of available refrigerators (n= 206)		

Functional	180	87.4
Not functional	26	12.6
Reasons why refrigerator/s not being used (n= 26)		
Unknown technical problems	10	38.5
Not installed	4	15.4
Kerosene not available	3	11.5
Others	9	34.6

In 86% of the health facilities, stockout of vaccine related commodities has occurred in the last 3 quarters of 2014 EFY which included mainly syringes and safety boxes. Discarding few hours after reconstitution (43.5), expiry (19.3%) and VVM indications (18.7%) were the major reasons for vaccine wastage. Nearly half of the health facilities dispose their vaccine wastes using their own incinerators. In the surveyed health facilities; 75%, 87% and 92% of the respondents had basic knowledge of VVM, shake test and MDVP (Table 29).

Table 29: Vaccine management techniques, stockout, wastage in health facilities found in remote, underserved and special settings in Ethiopia, June 2022.

Variables	Frequency	Percentage
Presence of vials with VVM in stages II and III (n=256)		
Yes	153	59.8
No	103	40.2
Vaccine stockout in the last 3 quarter of 2014 EFY (n= 257)		
Yes	96	37.4
No	161	62.6
Stockout of antigens in the last 3 quarter of 2014 EFY (n=230)		
OPV	56	24.3
BCG	48	20.9
PCV	41	17.8
Penta-3	33	14.3
Measles	30	13.1
Tetanus Toxoid	22	9.6
Stockout of vaccine-related commodities in the last 3 quarters of 2014 EFY (n= 257)		
Yes	37	85.6
No	220	14.4
Stockout by types of commodities (n= 69)		

Syringes	26	37.7
Safety box	17	24.6
Diluent	14	20.3
Icebox	12	17.4
Reasons for vaccine wastage in health facilities		
Discarding few hours after reconstitution	163	43.5
Expiry	72	19.3
VVM indication	70	18.7
Cold chain failure	41	11.0
Exposure to freezing	28	7.5
Practice on vaccine management techniques in health facilities		
VVM	234	39.8
Fridge-tag	154	26.2
Shake test	135	22.9
Effective vaccine management (EVM)	65	11.1
Knows the purpose of VVM (n= 215)		
Yes	161	74.9
No	54	25.1
Knows the purpose of shake test (n= 183)		
Yes	159	86.9
No	24	13.1
Knowledge on MDVP (n= 224)		
Yes	206	91.9
No	18	8.1
Vaccine waste disposal (n= 259)		
Using their own incinerator in the health facility	132	51.0
Using another health facility's incinerator	43	16.6
Bury at the health facility	33	12.7
Bury at another health facility	14	5.4
Dispose in the field	9	3.5
Send back to health centre/woreda	18	6.9
Do not know	10	3.9

BARRIER-ENABLER ANALYSIS: KEY FINDINGS

Service-delivery Related Barriers

Accessibility, and functionality of health facilities

Availability and accessibility of health facilities

Major supply-side barrier that hinders provision of vaccination services is unsatisfactory health service coverage and physical inaccessibility of health facilities. Absence of health posts in remote kebeles or inaccessibility due to distance or topographic barriers is a major challenge to reach to unvaccinated children in all regions except in urban area. The problem is even more serious in the four developing regions, pastoralist communities and the newly established SW region. Inaccessibility of health facilities due lack of road infrastructure or topographic barriers was also reported in SW, Gambella, BG, SNNP, Somali, Afar, and Amhara regions.

> *"In Hamer woreda, there are about 38 kebeles. But about 30 kebeles don't do not have functional health posts" Immunization Coordinator of a partner organization working in Hamer woreda*

> *"For example, in Jor woreda, there are 15 kebeles. However, no more than seven provide vaccination services because they do not have functional health posts" Key informant from Gambella RHB*

In Gambella, vaccination supplies are not regularly distributed to remote districts (e.g., Akobo) due to seasonal flooding. In SW region, few remote kebeles are even inaccessible for campaign-based activities. In Borena zone of Oromia region households located 30 km away from nearby health posts, and in North Gondar zone of Amhara region, communities located two walking days away from the nearest health post have been reported. In these settings, HEWs are expected to travel for hours to collect vaccine supplies and this may have implication on the potency of the vaccine. FGDs with local women in Somali region revealed that the major barrier for vaccinating their children is inaccessibility of health centers in their area.

Functionality of health facilities

Lack of functionality of health posts due to unavailability of HEWs and shortage of essential equipment has also been identified as a major barrier. In many settings the available health posts are not adequately engaged in vaccination service due to lack of functional refrigerators. Non-functionality of health posts due to shortage of HEWs was also reported in all regions except Harari, DDCA and AACA.

"There are kebeles which do not have health posts at all. There are also kebeles with health posts that don't have refrigerators" Key informant from God-God Health Center, Somali region

"There are around 300 health posts in our zone. So, we were expected to have a minimum of 600 HEWs. But currently, we only have 350 active HEWs" Key informant from Gamo ZHD, SNNP region

In Sidama region, some health posts that have been constructed in campaigns under substandard condition 10 or 15 years back are deteriorating and becoming non-functional. The same has been reported in Sewena woreda of Oromia region. As reported from Chire woreda of Sidama, some health posts have been closed because the WoHO has failed to pay rents to private owners on time. In Gambella region (Gikawo woreda), many health posts are too small to provide service.

In health centers and hospitals, lack of standalone rooms for EPI was reported as a challenge in SW and Amhara regions. In Erer District of Harari, due to shortage of rooms, some health centers provide MCH and EPI services together causing overcrowding and client dissatisfaction. conversely, an initiative to make EPI rooms user-friendly is being implemented in several health centers in Agew Awi zone. However, in the same zone, health centers that provide EPI service in the corridors have been reported.

Overcrowding and large catchment population size

Unmanageably large catchment population to health post ratio was reported as a challenge in SNNP, Amhara, Sidama, SW regions. The same was also reported as a challenge in Borena zone of Oromia regions. In these settings some health posts serve as large as 10,000 or 15,000 population.

"In the current context, population to HEWs ratio is not optimal. (….) This can be one reason for low coverage" Key informant from Amhara RHB

In AACA, even if access to health facilities is not a problem, the health facility to population ratio is low and this has caused overcrowding at vaccination centers. The same has also been reported in DDCA and Harari region. Currently there are only 100 health centers that provide vaccination service in AACA. Frequently health centers provide vaccination in the morning hours, so it is common for the mothers to return home without receiving the service. Caregivers usually wait hours to receive the service and this has led to service dissatisfaction. Most of the existing health centers are also found in the city center so people leaving in the periphery have limited access to service. Over the last few years, the AACA Health Bureau has attempted to make health centers accessible to newly constructed condominium complexes.

Weak health post to health center linkage

In South Omo of SNNPR, health posts are located far away from health centers making distribution of vaccine difficult. In SW region, limited number of health centers are available to support and supervise health posts. Reportedly, a health center controls as many as 20 health posts in the region. In some localities, health centers and health posts located in the same compound don't function in harmony as one pushes the vaccination service to the other. In line with the direction of the MoH, such arrangements are being discouraged. Conversely, in Amhara region, strong health center – health post linkage was reported. In North Gondar and Agew Awi zones, health professionals working at health centers would be temporarily deployed to health posts when HEWs are absent from their duty for various reasons. Health professionals also provide special support to HEWs working in hard-to-reach areas.

Unavailability of motorbikes and vehicles

In Afar, Gambella, Somali, BG, SNNP, SW and Sidama regions EPI officers and health workers do not have adequate motor bikes for implementing outreach services. The same was reported in Harrai region. Limited efforts have also been made to maintain the available non-functional motorbikes. In Afar region sometimes health workers have to use camels instead. Many regions also have no dedicated vehicle for supporting the EPI program. In BG region, the available vehicles have been burnout during the recent instability. In SW region, reportedly vehicles are not being properly used for the intended purpose. In almost all regions, shortage of fuel also affects use of motorbikes and vehicles.

> *"About 20-30 percent of health facilities [in SW region] have motorcycles, but they do not have budget for fuel" Key informant from a partner organization working in SW region.*

Vaccination service delivery platforms

Static vaccination service provision

Despite the recent direction by the MoH to provide static vaccination service on daily basis, regular availability of the service remains limited. In many settings static service is not being provided on regular basis due to closure of health facilities, unavailability of health workers, shortage of refrigerators, frequent campaign-based activities, lack of active demand for vaccination, shortage of vaccines and schedule-based EPI service provision. Limited case flow and fear of vaccine wastage also limited routine availability of the static service.

> *"We have recently identified that there are health centers and health posts which do not give static immunization service" Key informant from Amhara RHB*

Providing statistic vaccination service only once in a month or once a week are frequently reported as targets or success stories by health facilities. In BG, Gambella and SW regions, some health posts irregularly provide static service, and the community assumes the routine service is no more available. In Sidama, health posts may only provide static service during market days. In Afar and Somali regions, due to "climatic factors" vaccination service is not provided in the afternoon. In some health centers of Agew Awi zone, health professionals are not permanently assigned to the EPI unit because vaccination service is not provided on daily basis. In predominately urban regions vaccination service is usually provided in the morning hours.

"Our target is to provide static vaccination service at least once per week at health centers and health posts that have refrigerators" Key informant from Agew Awi ZHD, Amhara region

"We [health professionals at the health center] provide static vaccination service on the 15th and 16th day of the month; whereas they [HEWs] provide outreach service from 17 to 20 day of the month". Key informant from a health center in DDCA

The single most important barrier to provide static vaccination service is shortage of refrigerators at health posts. Across all the regions (excluding urban settings), many health posts don't have their own refrigerators, and vaccines are stored in the nearby health centers. Consequently, regular availability of static service is impractical. Health posts that don't have their own refrigerators provide vaccination service rarely, because collecting vaccines from nearby health centers in the morning and returning the remaining in the evening is a demanding task. In many remote settings (e.g., North Gondar zone), health posts that don't have refrigerator only provide outreach vaccination service.

"In those health posts having no refrigerator, it is not possible to deliver the static services on regular basis" Key informant from Loko Abaya WoHO, Sidama region

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Conversely, in Afar and Somali the static approach is more active than other modalities due to the weak HEP. In these regions static service provided at health centers level is the only functional approach to deliver service. Accordingly, vaccination coverage is low in areas located far away from health centers. Static service at health posts level has not been very effective due to unavailability and demotivation of HEWs, absence of refrigerators and interruption of vaccine supplies.

"In our district there are two health centers. The vaccination coverage is better in areas located near to the health centers. Elsewhere, the coverage is low [b/c the health posts are not functional]" Key informant from Kori WoHO, Afar region

"In the zone, we have 57 health centers; among these only 36 health centers provide child vaccination services." Key informant from Gamo ZHD, SNNP region

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In the static approach, multi-dose vaccines (BCG and measles) are usually provided in selected days depending on the number of children coming for vaccination. This also applies to babies born at health facilities. Even mothers coming to outreach sites are sometimes appointed for another day when the available number of children is below the required threshold. During the FGDs, this was frequently cited as a major cause of service dissatisfaction. Due to poor coordination between delivery and EPI departments, babies born at health facilities are discharged without receiving birth doses of BCG and OPV 0.

> *"For example, BCG vaccine vial is opened when at least 8 eligible children come. You cannot open it for 5 or 6 children. Instead, you have to reappoint them. As a result, people are getting dissatisfied" Key informant from Borena zone, Oromia region*

Outreach vaccination service provision

In general, the outreach strategy is not being implemented as expected due to multiple constrains including shortage of manpower, motor bikes, and vehicles. There is also no established mechanism to cover the expenses, including fuel and per diems for health workers. Previously, HDA members used to play an active community mobilization role ahead of outreach activities, but recently the network is weak and some volunteers are even demanding payments. Outreach programs are frequently cancelled in all settings (including predominately urban settings like DDCA and Harari region) because of lack of transportation service. Sometimes ambulances are used to implement outreach programs. Shortage of vehicles also affects distribution of vaccines to health facilities.

> *"At district level there is no budget to implement outreach program. In some districts an NGO was covering the expense. Now the program has phased out" Key informant Gikawo WoHO, Gambella*
>
> *"The overtime 'duty' payment of the health workers has not been paid due to budget shortage. So, it is difficult to ask them to conduct outreach activities now" Key informant from Kori WoHO, Afar*

Outreach service also lacks regularity due to lack of commitment and demotivation of HEWs. In Sidama region, outreach activities are not being scheduled regularly because of negligence of HEWs. In North Gondar zone, outreach sessions are usually organized once per month aligned with monthly Orthodox Christian holidays. In Remote districts of Gambella, outreach sessions are organized on quarterly basis. In many settings, HEWs are reluctant to schedule outreach service in remote villages due to demotivation. HEWs sometimes assume that health centers are the one responsible to implement outreach activities in their locality. HEWs frequently fail to appear at the outreach sites despite appointing mothers and this has contributed to service dissatisfaction and high dropout rates. Sometimes the outreach sites themselves are described as inaccessible by the community.

"We sit here [at the outreach site] and wait for the HEWs. They may or may not come" FGD discussant, Yeki woreda, SW region

"In the outreach site, HEWs tell mothers to wait until the required number of children to open the vial are available. At the end of the day, if adequate number of children are not available, they will be reappointed" WDA member, Guangua woreda, Amhara region

In Somali region, reportedly, active outreach program is only being implemented in districts supported by partners. In the same region, engagement of health posts in outreach service is low; however, health centers might sporadically implement outreach activities. Weak engagement of hospitals in outreach activities has also affected the service provision in hospital catchment areas.

"When we talk about why outreach and mobile programs aren't available, the answer is simple. There is no budget and the biggest challenge in any district is the same" Key informant from Afder ZHD, Somali region

According to data coming from EPI focal persons from health centers, in AACA outreach vaccination program has not been provided for more than two years due to shortage of budget to cover per diems. Commonly health professionals demand special payments to provide community-based services. Though Family Health Teams (FHTs) – a field team that comprise health professionals and urban HEWs – have the potential to provide outreach vaccination service, their engagement is usually limited to linking unvaccinated children with health centers. As reported by high level officials of AACA, vaccine delivery through outreach strategy is not being frequently conducted because it is cost ineffective.

"Our responsibility is to provide service at the health center. For any fieldwork we have to be paid (…) Due to lack of budget, we have not provided outreach service for more than two years" Key informant from a health center in AACA

"AACA Health Bureau provides vaccination service primarily through static approach. That is why we have not been able to reach the informal settlements and slum areas." Key informant from AA Health Bureau

Mobile vaccination service provision

In pastoralist settings like Somali and Afar regions and specific districts in Oromia, SNNP, SW and Sidama region no meaningful service delivery modality is available to reach pastoralist and semi pastoralist communities. Consequently, low vaccination coverage and high dropout are commonly observed. Integrated Mobile Outreach Strategy (IMOS) is not being largely implemented due shortage of vehicles, fuel and budget. In Afar and Somali, mobile health and nutrition teams have been organized and are covering 20 and 29 districts, respectively. In Oromia (Borena and Guji) and Gambella (Neur and Anuak zones), the mobile approach is implemented irregularly. SNNP, SW and Amhara regions

also have limited experience of implementing the mobile strategy. In Oromia IDPs are being reached through this approach.

> *"The communities are semi-pastoralist. But we only provide static and outreach service. We don't have mobile vaccination service" Key informant from Loka Abaya District Health Office, Sidama region*

As stated above, the mobile strategy has not been effective due to multiple barriers including shortage of resources, scarcity of partners to support the initiative, limited number of mobile teams, irregularity in field deployment, and unmanageably large catchment area. In Somali and Afar regions, As the mobile teams are under PHEM system, the approach is rather focused on nutrition and emergency response. In the same regions, the mobile teams are directly deployed by RHBs, so the service provision has not been decentralized and coordination with WoHO is weak. As reported from Afar and Somali regions, mobile service provision has not been adequately accompanied by community mobilization. One possible threat to the engagement of the team in vaccination program is, challenge of maintaining the cold chain system during prolonged field engagement in desert areas.

> *"Mobile teams have been established for serving hard-to-reach areas. However, as Oromia is wide, we could not be able secure adequate resources for the strategy. Consequently, we were forced prioritized extremely inaccessible areas. Even there is no resource to support this too" Key informant from a partner organization working in Oromia Region*
>
> *"Unless there are partners that can support the mobile service, it is not possible to provide service through the approach. We don't have any resource to support it" Key informant from Somali region*

In Hard-to-reach areas of Amhara region (e.g., north Gondar and Agew Awi zones) mobile teams comprising multiple focal persons from health centers (nutrition, TB, EPI and MCH focal persons) and HEWs are deployed to a hard-to-reach area for few days and provide integrated service including vaccination, family planning, bed net distribution and nutritional screening. The mobile teams are well accepted by the community because they provide integrated service and are usually the only options to provide the services. Regarding vaccination, the intervention has been very useful for tracing defaulters. However, due to the recent conflict and shortage of budget, the frequency of deployment is declining. Integrated mobile teams in Amhara region are being primarily managed by ZHDs and woreda health offices are inadequately engaged. The motivation of health workers to be engaged in mobile activities is low due to hardship and lack of basic services in target areas.

A local NGO (Semen Mountain Mobile Medical Services) supporting an integrated mobile outreach program in north Gondar zone reported that lack of support from HEWs and

difficulty to assure the vaccine potency during long travels are major challenges while implementing mobile vaccination programs. They also encountered interruptions in vaccine supply during the rainy season. In Borena zone of Oromia, with the support of a partners, Integrated Periodic Outreach Services (IPOS) is being implemented in selected hard-to-reach districts and kebeles. Mobile team composed of people form district health office and health posts are deployed to remote kebeles on quarterly basis for 3-5 days and provide integrated service. The service package of IPOS (vaccination, vitamin A supplementation and screening for malnutrition and deworming) are provide at accessible sites known to the community.

> *"The mobile team needs a lot of budget, logistics, vehicles, and human resources. We are supporting the program by providing technical and financial assistance. (…) As it is not affordable to deploy a mobile team monthly, we have to do it quarterly" An NGO working in Borena zone, Oromia region*

Surma WoHO of SW region, with the support of an NGO had been implementing IPOS. The IPOS comprised twelve service packages including screening for malnutrition, deworming, family planning and vaccination. However, the program was interrupted because the implementing partner left the area due to security concerns. The district health office could not sustain the initiative because of budget shortage. Absence of cold chain system that maintain vaccine efficacy beyond 2-3 days also limits implementation of IPOS.

Vaccination campaigns

House-to-house campaign-based activities are usually limited to polio and measles vaccinations. Campaigns are usually organized centrally on semi-annual basis or during special events (e.g., African vaccination week). Campaigns are usually organized in such a way that the routine service is not compromised. However, incidents of closure of health facilities during campaigns have been reported. HEWs reportedly use campaigns to identify defaulters. Some remote areas (e.g., Akobo in Gambella region and Surma in SW region) are only accessible through campaign-based approach.

> *"Due to the security problem, we only provide vaccination in campaigns, there is no static or outreach vaccination program" EPI Focal Person, Kibish Health Center, Surma woreda*

As reported from different regions including Somali and Sidama, campaigns are frequently organized as an outbreak response mechanism without addressing the root cause of the outbreaks. In many settings HEWs usually implement campaign-like activities, rather than strengthening their routine static and outreach activities. As reported from Harari region, HEWs sometimes organized house-to-house campaigns as a corrective measure for low vaccination performance.

Challenges for implementing campaign-based vaccination activities are allocation of inadequate budget and time, failure to release budget on time, lack of motivation of health workers to provide door-to-door vaccination and shortage of supplies. Until recently, the modest per diems paid during campaigns used to be considered as incentive by health workers. But recently, with the increasing cost of living, many health workers are resistant to take part in such activities. Many remote districts also have limited vehicles to implement campaign-based activities. In urban settings common challenges encountered by vaccinators during campaigns are unavailability of caregivers during working hour, complacency regarding the need for booster vaccination, and refusing to let vaccinators in due to security concerns.

> *"For instance, we establish a team comprising three professionals. But the budget we receive can only cover the per diem for one of them and it has to be divided into three" Key informant from Hamer WoHO, SNNP region.*
>
> *"Polio campaign should be completed within 4 days. But this is unrealistic in pastoralist settings like Hamer" Key informant from South Omo ZHD, SNNP region*

Human resources for health

Shortage of skilled health workforce

Across the regions, increasing number of health professionals and HEWs are being deployed at health center and health posts levels. Yet, with the exception of the predominately urban regions (AACA, Harari and DDCA) shortage of health workers has been consistently reported as a major bottleneck for providing vaccination service. More critical shortage was reported in Afar, Somali, SW, and Gambella regions. In Afar and Somali, some health posts have been closed due to paucity of HEWs. In North Gondar zone of Amhara region, shortage of health professionals was identified as the most critical boatneck for providing health service.

> *"Among the ten kebeles in Gardamarta district, only four have HEWs. In the remaining kebeles we don't have HEWs." Key informant from Gamo ZHD, SNNP region*

In health centers, standalone EPI focal persons are not available and health professionals provide vaccination service on rotation basis. Shortage of EPI focal person at regional level was also reported in Amhara region. In AACA, availability of limited number of focal persons at regional and sub-city levels has constrained the implementation of the vaccination program. In SNNP RHB level, the child health case team is responsible for EPI and absence of standalone unit has negatively affected provision of vaccination service.

Skill gap and training

Fresh HEWs reportedly lack skill to administrate vaccines. Some HEWs also lack the knowledge on how to store different types of vaccines. In pastoralist settings, many HEWs have weak academic background and have major skill gap in providing health services including EPI. Integrated Refresher Training (IRT) have not been provided at the expected frequency in many regions including SNNP, SW and Harari regions. In most of the hospitals and health centers that we studied, only one or two health professionals have been trained on EPI. Even smaller numbers received refresher trainings. This has made the program sensitive to staff turnover.

> *"Out of the 17 HEWs we have, only four are diploma holders. The rest are 6th grade complete HEWs who have major skill gaps." Key informant from Surma WoHO, SW region*

According to many key informants, the prototype pre-service service curricula for training health professionals is deficient on EPI and do not go beyond describing the national vaccination schedule. Contemporary issues like Effective Vaccine Management (EVM), strategies to prevent vaccine wastage and proper storage of vaccines are not adequately address in the curricula. Upon graduation, health professionals are not ready to function as EPI focal person unless they get in-service training.

Usually when an experience health worker leaves the system, the quality of the service declines because of absence of skill transfer mechanism. It is uncommon for a trained professional to share the training experience with another coworkers. As reported from SNNP region, experts at zonal and district health offices provided training opportunities by their respective offices leave their position immediately after completing their trainings because there is no formal commitment agreement between the two parties.

Staff turnover

Turnover and lack of staff retention mechanism are major concerns specially in the developing regions and other remote areas. In regions like Afar, Somali, Gambella, BG, and SW, health worker turnover is extremally high, and has hampered delivery of all basic health services including the EPI. The recent widespread political instability has even made the problem worse. In Bokh and God God districts of Somali region, multiple health posts were not functional during the study due to staff turnover. In SW region, getting new recruits for health extension training was challenging due shortage of qualified applicants. In Afar region, most of the health works are originally from the neighboring regions, and they tend to serve short due to lack of staff retention mechanism. Usually, skilled manpower drains to the NGO sector for better working conditions. Even health professionals leave their jobs to work at lower level (e.g., data collectors) in NGOs.

"There is a high staff turnover. A health post which was functioning before 2 months could not be functioning now. The facility may stay closed until new health workers are hired" Key informant from Afar RHB

Demotivation and lack of system to recognize health workers

In all the regions HEWs are becoming increasingly demotivated in delivering HEP service packages due to workload, lack of incentives, partiality in career development opportunities, and working for several years in the same setting without change. Demotivation has been rated as the leading service-related barrier. They also do not get close support by health centers and district health offices.

Due to demotivation, HEWs are becoming reluctant and resistant to implement health programs with the expected quality. Specially, in relation to the vaccination program, HEWs engagements in demanding activities like door-to-door campaigns, tracing of defaulters, provision of vaccination service per schedule and identification of pregnant women in the community is declining. Conversely, there are committed HEWS that do their best to serve remote communities by covering transportation costs by themselves.

"There are areas where the motivation of health professionals is very low. Sometimes vaccines are not given despite the availability of supplies" Key informant from Gambella RHB

"In the past, health workers used to travel by camels to provide vaccination service in remote areas. But now there is no health workers motivation to provide the service in areas not accessible by cars" kebele leader, Ewa woreda, Afar

Payment delay, lack of hardship benefits (E.g., SW region), lack staff retention scheme (Afar region) and inequitable education opportunity among health workers (developing regions) were among the key demotivating factors. In Sidama, Gambella, SNNP, Amhara and Afar regions salary or overtime (duty) payments to health professionals have not been made on time and this has caused demotivation. Reportedly, the commitment of HEWs substantially declines after establishing their own families. In SW region male HEWs are doing relatively good in implementing HEP in remote areas.

"More should be done to encouraged men to work as HEW, because it is impossible for females to work in such challenging terrain" Key informant from SW RHB

"Many HEWs have worked at the same health post for about 7-9 years. Initially they were very motivated. But now most of them have established families and are not committed as before" Key informant from Oromia RHB

Reportedly, the existing HEP has limited mechanism to recognize and motivate good performing HEWs. Most key informants pointed out that the HEP is getting weaker but

they hoped the new health extension roadmap will resolve the problem soon. In Sidama region, health professionals at health centers are not interested to work in the EPI units because they are not entitled to overtime payments. In AACA, health professionals do not want to work in EPI rooms for more than one year because the work is considered demanding.

> *"They [health professionals and HEWs] don't get any extra money or incentives. There are also no trainings to improve their knowledge. So many employees leave and look for other jobs (…..). In the meantime, health facilities remain closed" Key informant from Afder ZHD, Somali Region.*

Excessive workload

Excessive workload is among the key demotivating and quality limiting factor among HEWs. HEWs are overloaded with increasing number of service packages, kebele-level meetings, political commitments, and other activities not directly related with their responsibilities. Usually, several initiatives are cascaded down to HEWs without considering their workload. They are also overburdened with increasing number of service packages and frequent campaigns. Even HEWs working in predominately urban regions like DDCA and Harar are demotivated due to work burden and lack of incentives. Specially in relation to immunization, implementing campaigns and collecting vaccines from health centers for every vaccination day are considered among the most tiresome activities for HEWs.

> *"At kebele-level many activities of the local government are implemented through HEWs. These are not only engaged in health-related activities, but also in agriculture, education and political networking" Key informant from Debariq Zuria WoHO, Amhara region*
>
> *"As refrigerators are not available at some health posts, HEWs are expected to travel for 3 to 4 hours to the nearby health center to collect the vaccines. After providing the service, they are also expected to return back the remaining supplies." Key informant from SW RHB*

In urban settings like AACA, health professionals working at EPI rooms of health centers frequently complained of excessive workload, lack of incentives and crowded working environment. Health professionals are usually deployed to the EPI rooms on rotation basis and many don't enjoy working there due to the aforementioned reasons. In predominately urban regions, HEWs are primarily engaged in promotion of vaccination service and referral of under-immunized children to nearby health centers.

Health workers' demand for unjustified benefit

Health workers are becoming increasingly reluctant to be involved in mobile, outreach and demand-creation activities without receiving payments. This is specially reported from Gambella, Somali, and Afar regions. As health workers are receiving per diems in PIRI and

vaccination program led by NGOs, the expect the same in other activities. Usually per diems associated with trainings are considered as incentives and health workers tend to be reluctant to implement programs that they have not been trained for. For example, in Afar region, it has been reported that health professionals who have not been trained on EPI are not resistant to work at the EPI room. Sometimes when health workers get transferred from one health facility to the another, they claim that they have not been trained for the program and demand for a new round of training. Specially after the introduction of IRT, the frequency of trainings has declined, and this has demotivated HEWs.

> *"Previously, when we go to the community for vaccination, we used to be paid at least 15 birr. Nowadays, we do not even get a penny" Regional MCH department representative*

Unavailability on duty and lack of staff controlling mechanism

Nowadays, many HEWs reside in the towns and their availability on duty is limited. For example, in Gambella region, an extreme case that few health workers are leaving in Addis Ababa has been reported. Frequent maternity leaves also limiting the availability of health workers. Reportedly, HEWs frequently fail to appear at health posts or outreach cites despite appointing mothers for vaccination. This has negatively affected the demand for the service. In many settings, even health centers, are not being opened on time to serve their clients.

> *"There are many health professionals who receive salary but are not available on duty (….). It is difficult to take administrative measures because the issue can get 'politicized'" key informant from Gambella region*

In general, the mechanism for ensuring the regular availability of HEWs and health workers on duty is weak. Previously, kebele leaders were accountable to ensure the availability of the HEWs on their job, but recently health centers have taken over the responsibility. As a result, assuring availability of HEW on their duty is becoming more and more difficult. In DDCA some HEWs have been allowed to pursue their education in regular working hours this has limited their availability on duty. In Somali region, in many health posts only one HEW is available hence frequent closure of health posts occur when the HEWs engage in training or when they are on leave. In Somali region many HEWs are engaged in additional income generating activities hence their availability on duty is limited.

> *"Many HEWs leave their workplace on Friday to towns where they live. They return back on Monday. So, they provide service only from Tuesday to Thursday" Key informant from Teltele Woreda, Oromia*
>
> *"HEWs work one or two days in a week and go back to Harar" Kebele leader, Harari region*
>
> *"One of the major problems with HEWs is that they are not regularly available at health*

post (…). Caregivers bring their children for vaccination, but no one is available to give the service" Key informant from Gambella RHB

Engagement of public hospitals in vaccination service

In most regions, distinct vaccination catchment areas independent of health centers are assigned to primary hospitals. Hospitals are expected to serve the catchment population through organizing static and outreach services. Yet, hospitals are not adequately engaged in provision of vaccination service as they are extensively overloaded with the curative service. In most setting, the engagement of hospitals in outreach and campaign activities is minimal. In isolated settings where HEWs are expected to be supervised by primary hospitals, HEWs complain that they are not adequately supported.

Hospitals (primary hospitals) frequently assume that vaccination is the duty of health posts and health centers. But the misconception is gradually improving. Conversely in Afar region, hospitals and health centers serve their surrounding communities better than health posts do, apparently due to weaker HEP. In many settings hospitals only provided selected antigens (BCG and OPV-0) and work in specific hours (e.g., morning hours) and selected days of the week. Even failure to provide BCG and OPV-0 to babies born in the hospital has been reported because of poor coordination between EPI and delivery units and absence of refrigerator in delivery wards. In major urban areas including AACA, referring hospital births to the nearest health center for BCG and OPV-0 is a common practice.

"Some health centers do not provide immunization services because they assume vaccination is the duty of health posts" key informant from SNNP RHB

"Hospitals have to support us. There is overcrowding here. How come […] Hospital fails to provide OPV and BCG vaccines to babies born there?" Key informant from a health center, AACA

"Hospitals and health centers consider that vaccination service provision is the sole responsibility of the health posts. Only 10% of the vaccination service is provided by hospitals and health centers" Key informant from South Omo ZHD, SNNP region

Many primary hospitals do not include immunization targets in their annual plan. Others, plan based on previous year performance because they do not have clearly defined catchment population. In some settings, the role of hospitals in EPI is limited to linking hospital born infants with health posts or health centers. Even some hospitals simply discharge hospital births without connecting them with EPI service.

"All five hospitals in our zone are actively engaged in providing BCG vaccination at birth. But providing complete vaccination service remains a gap" Key informant from Agew Awi ZHD, Amhara region

Hospitals also receive limited support from zonal and district health offices on EPI. Some hospitals reported that they have no adequate refrigerators and even borrow vaccines from nearby health centers (e.g., Asita hospital, Afar region). Accordingly, they have limited engagement in planning and evaluating the program. Hospital managers sometimes assume that they are only accountable to regional health bureaus; accordingly, the are reluctant to work with ZHDs or WoHOs. Sometimes, hospitals collect vaccines, cards and registry books from nearby health centers.

In most hospitals caregivers coming for vaccination have to take their medical records from the card room first (as patients seeking medical care) to cause long waiting hours and dissatisfaction. As most hospitals don't have health posts under their span of control, they rarely engage in community mobilization and have limited options to trace defaulters.

Positively, nearly all hospitals have assigned fulltime health professionals on rotation basis to work on EPI. This has a shortcoming because health professional that have not been trained on immunization would also be assigned to the EPI room. In general, health professionals are less motivated to work on EPI because they are not entitled to overtime payments (reported from Amhara and SNNP). The temperature of the refrigerators is not usually monitored in the weekends because EPI focal persons are not entitled to overtime payments.

> *"There are only two trained vaccinators in the hospital. If you assign another professional to the EPI room, he will not accept it claiming that he has not been trained for EPI."*
> *Key informant from Asaita hospital, Afar region*

Usually, hospitals assign small and sub-standard rooms for EPI because the program receives little attention. Even hospitals without a room dedicated for EPI and that provide the service on the corridors have been encountered during the study. In hospital setting, EPI is considered as a fringe job so adequate and motivated personnel is not usually assigned.

Engagement of the private sector in EPI

Except for AACA, DDCA, Harari and urban areas of Oromia, the health system has done little in terms of engaging the private sector. In Dire Dawa and Harari, few private hospitals are engaged in EPI, but the health facilities have been criticized for not closely monitoring defaulters and frequently fail to establish linkage with the public sector in terms of reporting their performance. In Harar and Oromia regions smaller clinics are interested to engage in EPI, but they could not be able to fulfill the refrigerator requirements. The same has also been reported from Sidama region. In Amhara region, private hospitals have been engaged in vaccination service before; however, due to failure to adhere to the cold chain standards, the initiative has been abandoned.

In AACA more than 40 private facilities have fulfilled the criteria and are providing vaccination service. Along with the Health Bureau, partner organizations are providing

technical support in terms of training, mentorship, and service standardization. In the city, another major opportunity for the private sector is the wide-held belief that private facilities provide better quality service that their public counterparts. Conversely, a challenge is that private health facilities do not regularly report their performance to the health system via the DHIS.

Defaulter tracing

Most of the health officials and health workers that we interviewed considered dropout from vaccination program as a major problem. Specially MCV-1 to MCV-2 dropout is very high as the latter has not been adequately promoted. The problem is more pressing in pastoralist communities due to mobility and weakness of the HEP. Dropout is also very high conflict-affected settings where vaccination service is not accessible or not provided regularly. In urban areas, EPI focal person frequently reported high dropouts which is likely due to self-transfer of caregivers to other health facilities.

Frontline heath workers frequently fail to provide basic information including appointment dates to caregivers leading to high dropouts. In urban regions like Harar and Dire Dawa private health facilities providing vaccination service did little to trace defaulters. In Afar and Somali, the mobile and outreach services lack regularity causing dropout of children from the vaccination program. Recurrent draught also contributes to this end. In Harari region, vaccination programs are frequently interrupted due to frequent campaign-based activities organized by the RHB.

In Chire woreda (Sidama region) and Guangua Woreda (Amhara region), households having multiple agricultural lands practice seasonal migration and their children tend to discontinue vaccination. Seasonal migration to hard-to-reach fertile lowland areas (Agew Awi zone of Amhara region, West Omo zone of SW region), dryland areas (Neuer zone of Gambella), and coffee producing areas (SW region) have also contributed to this end. Inadequate supply of vaccination cards and poor card retention also make defaulter tracing challenging.

Systematic approach has not been instated to trace defaulters. HEWs sometimes only tally children who received vaccines and do not record their names making defaulter tracing difficult. Earlier the HDA network was supporting the default tracing efforts in many regions. But nowadays, the network is largely passive. The demotivated HEWs are less and less interested to be engaged in the demanding work of tracing defaulters. Though a "tickler box" system is reportedly in use to trace defaulters, the effectiveness and scale of implementation are questionable.

In urban areas tracing defaulters via phone is sometimes conducted. The practice is described to be useful by EPI focal persons that we interviewed. It also improves caregiver – client relationship. But the challenges are, EPI focal persons have limited access to phone lines, there is no budget to cover air time and EPI logbooks do not provide space to register phone number of the caregivers. Conversely, trancing through HEWs is more difficult in

urban areas because of lack of permanent address and absence of house numbers in many urban areas.

> *"Sometimes when I call mothers to remind their vaccination schedule, they get very happy and say 'I thought I was the only one concerned about my child, glad to know that you are concerned too" EPI Focal person, Chagni Hospital, Amhara region*

In general, the health system lacks an established mechanism to trace defaulters. However, small-scale attempts have been made to trace dropouts through engaging formal and informal community leaders (Somali region), scheduling mop-up campaigns (Amhara and Sidama regions), close follow-up of mothers starting from pregnancy and identifying dropout children using vaccination log books, house-to-house campaigns, and FHTs (urban areas).

Missed opportunity and service integration

According to the key informants, the existing national guidelines (e.g., IMNCI and the Ethiopian Primary Health Care Clinical Guidelines) promote the integration of vaccination service with clinical care of children. At health center level, the fact that MCH services are under a case team also enables integration among them. However, in practice, immunization program has not been adequately integrated with other MCH services including nutritional screening, vitamin A supplementation and family planning. Consequently, missed opportunities are high. Sometimes mothers following ANC or giving birth at health facilities do not receive adequate information about vaccination. Sick infants coming to health facilities are not adequately screened for vaccination status. Health campaigns are usually organized for predefined and specific services making integration practically impossible. In Afar and Somali regions, giving birth at health facility is relatively less common and this has limited the uptake of BCG and OPV-0 vaccines.

> *"Health workers only focus on the service the caretakers came for. No one is asking 'did your child get vaccinated?'" Key informant from Somali RHB*

The practice of screening the vaccination history of children coming for other health services and vaccinating them when needed, is not universally practiced. Likewise providing other services to infants coming for vaccination is not very common. One major bottleneck for horizontal integration is unavailability of static service provision on daily basis. Sometimes babies born at hospitals may not even get BCG and Polio-0, due to lack of coordination between the delivery and EPI rooms. Similarly, with the intension of reducing vaccine wastage, mothers who give birth at health facilities are usually appointed for some other day for receiving BCG and may not return back to get the vaccine.

Reasons for weak horizontal integration include carelessness, demotivation and overload of health workers. Lack of information about the age and vaccination history of the child and failure of caregivers to bring the vaccination card are also common challenges. In

relation to vaccination cards, sometimes cards are not filled properly or contradict with the information provided by the mother leading to dilemma in vaccinating children. In general, there is no mechanism to ensure that the existing integration guidelines are implemented at ground level. In hospitals, lack of physical proximity between EPI and other MCH rooms also contributed to high rates of missed opportunity.

> *"Some health workers implement it [service integration] well. Some don't even take history properly; they just write on prescription and send the mother out" Key informant from Loka Abaya WoHO, Sidama region*
>
> *"If the health worker has good motivation, he may provide integrated vaccination service as part of his job; however, in many cases this is not the case" key informant Sewena WoHO, Oromia region*

The potential of multi-sectorial integration, like that of integration of EPI with PSNP has not been adequately explored. In Somali region, though many children are covered by food aid programs, systematic integration is weak. Conversely, in urban areas, schools or childcare centers have vaccination requirements and this might have increased the utilization of the service. However, rural schools do not have such requirements.

> *"Few mothers used to show vaccine hesitancy. They had fears that vaccines may cause fever. But now it is not a problem. Without vaccination cards they cannot take their children to schools" WDA member, AACA*

Catchup vaccination

In general, many children in hard-to-reach and pastoralist settings have not received vaccination as per the schedule due to a multitude of service delivery and demand side barriers. In many settings, the recent political instability has interrupted vaccination service provision for several months and many missed children are already out the target age for routine vaccination. However, there is lack of understanding how children who failed to receive their vaccination in the first year of age, can be targeted later on. In terms of resources, usually vaccine requirements are estimated based on number of infants eligible for vaccination, hence vaccines are not adequate to cover children above the age of one year.

Key informants both from the government and partners sides emphasized that catchup vaccination should receive better attention. Further, there is no nationally agreed guideline for implementing catchup vaccination. On a positive note, Oromia RHB reported that it has developed its own catch-up guideline. UNICEF and other partners are supporting the MoH in the development of the guideline. PIRI is also being implemented to "catch up" missed vaccinations in hard-to-reach area.

Leadership

Key informants from partner organizations and from the lower level of the health system suggested the presence of leadership commitment gaps in implementing EPI and other health programs. Reportedly, the focus of the health system swing from one program to the another depending on contemporary situation and support from donors. According to the key informants, few years back much attention used to be given to the "model-household" initiative. Now the attention has shifted to Community Based Health Insurance (CBHI). So specific programs don't get sustained attention.

Due to the on-going political instability in the country, the commitment of the government to implement health programs is declining. For instance, in Amhara region, due to the ongoing conflict the budget allocated for the health sector and availability of vehicles for implementing field programs have reduced. The same has been reported in Afar and specific districts of SNNP regions (e.g., Surma district). In many settings no budget is available to conduct semi-annual review and Performance Monitoring Team (PMT) meetings.

The priority given to various health services also differ from setting to setting. For instance, in pastoralist settings of Somali and Borena, more attention is given to food aid and outbreak response. On the other hand, in Loka Abaya, the focus is on malaria control. In such settings EPI is not getting the attention that it deserves. Reportedly, in some settings where partners are actively engaged in EPI, the responsibility of coordinating the program would be left to the organizations. At times when NGOs complete their program, vaccination coverage declines because of poor phaseout strategy.

> *"Child vaccination programs are regarded as the sole responsibility of NGOs" Key informant from Gamo ZHD, SNNP region*

Commonly zonal and woreda health officials externalize their underachievement to absence of partners and lack of budget or other resources (e.g., vehicles). Officials in many cases do not accept the presence of low vaccine coverage in their setting and frequently externalized the occurrence of VPD outbreaks to vaccine impotency, drought and imported cases from nearby areas. Shortage of budget, conflict, and lack of information about target population size are also frequently presented as reasons for unsatisfactory coverage. Frontline health workers frequently complain that they are not receiving adequate support from their managers both in terms of inputs and supervision. Performance monitoring and review meetings are not regularly conducted due to various reasons including negligence.

> *"The woreda health officers only expect reports from us. They only come when our performance declines. They are not doing what is expected from them." A health professional from Harari region*

Many health programs are being implemented through campaign-based approach and this has hindered the implementation of routine programs. Especially when consecutive campaigns are organized routine programs would be abandoned for considerable time. According to a key informant from Harari region, frequent campaigns seriously affected the regular implementation of vaccination service in the region.

> *"There were many missed children due to the campaigns (…). This is because when there is a campaign, HEWs would be entirely engaged and health posts get closed, during CBHI campaign the whole staff was out" key informant from Harari RHB*

Administrative instability due to dissolution and formation of districts, and turnover of political leaders limited the institutional strength and leadership of the WoHOs to implement health programs. Due to resource shortage, redirection of budget to unintended program is practiced. For example, budge allocated for running EPI campaigns is sometimes redirected to support other health programs.

> *"If there is a budget coming for Polio campaign, we use it for nutritional screening, deworming, and vitamin A supplementation service." Key informant from South Omo ZHD, SNNP region*
>
> *"There is a fund coming from [….] to support EPI Equity program. This fund is meant to cover the per-diem, fuel and other costs required for vaccination program. However, this money has been used partially for other programs" Key informant from Gamo ZHD, SNNP region*

Other leadership-related challenges that had implications for EPI have also been reported. In many cases the vaccine system is too dependent on partners, and when vaccination programs phaseout, coverage declines. Especially this is true in developing and newly formed regions where the HEP is fragile. In few regions, partners questioned the commitment of the health system for implementing EPI. In Somali region partner organization expressed their reservation on the commitment of district health officials for implementing vaccination programs. The lack of commitment is reportedly due to absence of incentives and strong accountability system.

> *"We have been supporting the region to implement the PIRI. We expected them to do social mobilization, supportive supervision, and monthly review meetings. But I think they were not considering these activities as their own" Representative from a partner organization, Afar region*
>
> *"Core activities like capacity building, M&E and implementation of programmatic activities like distribution of materials and coordination of campaigns are being implemented by NGOs. The managers at district levels do not give [adequate] attention". Representative from a partner organization, Oromia region*

"In my opinion, accountability and incentive are two important factors that are lacking there [at district health offices]." Partner organization working on EPI in Somali region

Weakening of the HEP and HDA Network

Most of the key informants from the government and partners sides asserted that the HEP is becoming weaker to support EPI and other routine programs. In all the regions, the HEP is not functioning as it used to do ten years back due to lack of political attention, demotivation of HEWs, disintegration of the WDA/HDA network. The commitment of the sector to support and control HEW is also declining.

"The HEP is weaker and HDA network is dysfunctional" Key informant from Sheka ZHD, SW region

Until recently the HDA has been actively supporting community-level implementation of various programs including immunization. But recently the network is becoming inactive. In remote areas of SW and SNNP regions, weak health center and health post linkage is reported as a barrier for vaccination service. Many informants have hopped that the new HEP Roadmap will resolve the bottlenecks of the program.

SBCC and Community Mobilization for Vaccination

Diversity of SBCC activities

In all regions regular and diverse Social Behavioral Change Communication (SBCC) efforts are not being implemented for promoting EPI. Few partner organizations reported that they are implementing integrated demand creation activities, but the scale is limited. The frequently reported challenges for not having stronger SBCC activities are the weaking of HDA network, decline in motivation of HEWs and lack of budget for community mobilization activities. SBCC and community mobilization activities are usually included in the woreda health office plans. However, in most setting the plans are not being translated into practice. According to many respondents, active community mobilization is only done during vaccination campaigns.

Most key informants reported basic resources needed for community mobilization including job aids for frontline health workers, wall charts, posters, audio-visual aids and megaphones are usually scare in most settings. Typically, for motivating caregivers, vaccination certificate is issued upon completion of vaccination. However, this is not universally done due to shortage of certificates. Conversely, family health card is widely available but has not been adequately utilized. Audio-visual aids provided by partner organizations are also not adequately used once the respective programs phaseout.

"Previously, there were lot of posters for promoting vaccination. Health education used to be provided at the health centers in the morning. Now…." Key informant from Loka Abaya WoHO, Sidama region

Disseminating health messages and reminders through mobile phone is not being practiced across the board. Conversely, the following positive findings have been reported regarding IEC/SBCC-related issues. HEWs have received SBCC trainings through IRTs. Translation of SBCC materials to local languages or development of new ones has been reported in Gambella, BG and SNNP regions. The use of local FM radios as a platform to promote immunization was also reported in multiple regions. Plan to establish additional community groups (like men development army) for promoting health was also reported in SNNP, SW and BG regions.

Inter-personal communication

Promotion of vaccination is normally done through interpersonal communication channels via HEWs and HDA/WDA members. Even this is getting weaker due to the disintegration of the HDA/WDA network. In general, systematic and diverse SBCC activities and community mobilization are limited due to shortage of resources. In Gambella, demand creation campaigns like social dialogues are not being conducted regularly due to shortage of budget. The same resource problem was also blamed in BG and Sidama regions for not working actively in SBCC endeavor. Professionals are also not motivated to be engaged in such activities unless they receive special payments.

Previously, Community Conversation and Pregnant Women's Forum were used as important platforms for disseminating key MCH messages. In most regions, pregnant women forum has been helping to raise the awareness of women on childhood vaccination. However, recently the attention to these platforms is declining and such sessions are being organized very rarely. The underlying reasons are demotivation of HEWs, disintegration of the HAD network, lack of resource to cover transportation and refreshment expenses.

Engagement if HDA/WDA in community mobilization

Previously HEWs used to mobilize the community to promote vaccination through organizing regular house-to-house visit and by engaging HDA members. The HDA network also had an important community mobilization role through identifying eligible children for vaccination, tracing defaulters, and organizing community level meetings like the pregnant women's forum. Such interpersonal communication activities are now becoming rare with declining motivation of HEWs and weakening of the HDA structure. Community mobilization and SBCC efforts are even weaker in developing and newly formed regions due to the fragile HEP. Though HDA/WDA members play an important role in community mobilization, their trustworthiness is limited. Sometimes caregivers defy the advices given by HDA/WDA members assuming that they are mobilizing the community just to receive per diems. HDA/WDA members are also increasingly demanding for incentives to mobilize community.

"The community mostly trusts messages from health workers. They do not give weight to messages delivered by us (volunteer community workers)" HDA member, Borena zone, Oromia region

"The problem is, HDAs demand incentives and they do not want to go home empty-handed. With the current expensive living situation, no one serves free" Key informant from Gamo ZHD, SNNP region

Counseling by health workers

Health workers sometimes fail to provide comprehensive information about vaccination (including purpose of the vaccination, appointment dates and management of side effects) when they immunize children. Workload, carelessness and lack of job aids contributed to this gap. Specially, failure to provide information about side effects has contributed to vaccination discontinuation. In general, the interpersonal communication skill of health workers was described suboptimal, and this might have contributed to high dropouts.

"One of the major problems is that the health workers do not transfer the five basic key messages to the mothers. This is what we understand from our [field] visits. The key messages are not delivered to mothers for example when she should return…" Key informant from Afar RHB

Among specific antigens, the newly introduced vaccines (MCV 2 and IPV) are inadequately promoted. MCV-2 utilization is low primarily because caregivers assume vaccination of children ends at nine months of age. While giving MCV-1 at nine months of age, health workers frequently forget to inform caregivers that MCV-2 has to be taken at 15 months of age. Accordingly, coverage of MCV-2 is low.

"After providing MCV 1, health workers don't properly counsel and appoint mother for MCV 2" Key informant from Loka Abaya WoHO, Sidama region

Engaging influential community member and informal institutions

In many KII and FGDs, apart from health workers, religious and clan leaders, and teachers are considered to be respected and credible sources of information. However, such community members have not been adequately engaged in the dissemination of vaccination information. Small-scale practice of community mobilization using clan leaders and elders (Somali region) and religious leaders (Amhara and Sidama regions) have been reported. In North Gondar of Amhara region, vaccination schedules are commonly communicated using religious institutions and outreach days are also aligned with monthly religious holidays. In Sidama region, reportedly elders, grandparents and few religious leaders discourage mothers from vaccinating their children.

"For example, there is a health center guard called Abebe [changed name] who usually walks around the villages to disseminate vaccination campaign message using a megaphone. And the people mock him 'here comes [Abebe] again'. But the same massage would be taken better if we had used elders and religious leaders" Key informant from Loko Abaya district, Sidama region

SBCC and community mobilization in urban settings

Though the urban population has good awareness on the benefits of vaccination, pocket resistances are sometimes observed. The urban population is usually not covered in BCC interventions due to the assumption that its knowledgeable. Contacting caregivers is also not as easy as rural areas. Impoverished and street families, illegal settlements and slum areas have not been adequately addressed by IEC/BCC interventions. In urban areas like Addis Ababa, IEC/BCC activities are limited to posting wallcharts and banners. In AACA, reportedly the link between HDA/WDA and HEWs has declined since the introduction of the FHT initiative. In DDCA, reportedly HDA/WDA members have received a semi-formal training. In DDCA, women who had been working as traditional birth attendants are now engaged by health centers to work as Community Health Agents (CHAs).

Immunization Financing

The EPI program is primarily financed by donors and partners and the health system allocates little direct budget for the program. Operational costs including expenses for training, supervision and transportation during campaigns are also covered by partners. This has created donor dependency and many informants considered it as the major threat to the long-term sustainability of EPI in Ethiopia. The heavy involvement of the partners in the EPI program might have compromised the sense of ownership of the health sector. As it stands, the vaccination program can seriously be impacted by donor fatigue or donor policy changes.

"It has been more than 40 years since Ethiopia started the vaccination program. But the program is still donor-dependent and does not stand by itself" Regional EPI Focal Person

"Otherwise, there is no money allocated for vaccination from the government. (…….) Our role is organizing/facilitating the partners working in EPI" Regional MCH Director

The government is indirectly investing in terms of building health facilities and covering salaries to health workers. According to officials from MoH, the cost of procuring vaccines is largely unaffordable to the government. Currently the Ethiopian government is co-financing about one-fifth of the total vaccine cost excluding distribution costs and the rest is covered by GAVI. Most of the vaccines except BCG, Td and OPV are donated by partners and for the rest government co-finances 0.2USD per dose. However, the contribution of the government for procuring vaccines has substantially increased over the last few years.

The vaccination program largely suffers from budget deficiencies to implement routine programmatic activities. Many key informants reported that budget shortage has restricted them from organizing trainings, implementing micro plans, supplying fuel and kerosene for vehicles and refrigerators, and covering per dimes for outreach activities. In Amhara region, shifting budget from other programs to support the EPI was reported. In the same region, the recent war has consumed the regional budget, and little is left to implement health programs. Conversely, in Somali region health workers are more interested to be engaged in EPI than any other program because the program has incentives.

Planning, Monitoring and Evaluation

Planning for vaccination

Regarding the vaccination planning process, the information that we received from top level decisionmakers and health professionals was divergent. According to top level managers, in most of the regions (except the predominately urban regions), woreda-based and micro plans are being implemented. Micro plans are developed on semi-annual basis through bottom-up approach. In the process health posts first develop their plans disaggregated by villages, review meetings are arranged at district and higher levels to compile and finalize the plan. Based on the micro plan, monthly and weekly plans, and targets to be covered by statistic and outreach activities are worked out. Inputs needed to implement the plan including supplies and manpower are also included in the micro plan.

According to top-level managers the strength of the microplanning is highly variable across regions. The planning process is stronger in Amhara region while the opposite is true in SW, Gambella, and predominately urban regions. In Afar, Somali, and remote areas of SW regions, microplanning is not being actively implemented for various reasons including weak HEP, lack of commitment and difficulty to engage the community. In Oromia, microplanning is commonly used only for campaigns.

According to low-level mangers and health workers, bottom-up planning is not being implemented at ground level. Practically, planning is done centrally at district level by using population conversion factors and then targets are distributed to the health facilities proportion to their catchment population size.

> *"Micro plans are usually developed for the sake of completion. HEWs develop micro plans simply because they are required to do so. The plans are not translated into practice" Key informant from Agew Awi ZHD, Amhara region*
>
> *"We have no role in the planning vaccination activities. The plans come directly from the woreda health office and health center" HEW, Chire Woreda, Sidama region*

Even if micro-plans are developed, they are not frequently translated in to practice. Reported challenges included demotivation of health workers, lack of training, support and

follow-up, shortage of budget and other inputs, and failure of health workers to complete plans on time. Some HEWs reportedly demand for payment for conducting head counts for micro plans. HEWs also think that developing micro plans according to the RED/REC approach is bulky and time taking. Few woreda health officers also considered RED/REC as donor/partner driven and resource-intensive strategy that cannot be implemented at ground level with the existing resources. At health center level, EPI focal persons are also not adequately engaged in the planning processed. In Gambella it was reported that health workers intentionally under plan due to reluctance. In Sidama region micro plans are not prepared with adequate details due to negligence.

> *"The main essence of RED/REC is microplanning. However, micro plans are not translated into practice due to budget shortage". Key informant from WHO Vaccination Program Officer*
>
> *"We never used the RED/REC strategy for planning. It requires more resources and time" Key informant Gamo ZHD, SNNP region*
>
> *"RED/REC strategy has not been implemented. We didn't get any training on it." Key informant from Hamer WoHO, SNNP region*

According to the key informants, the biggest challenge encountered while planning for vaccination is lack of reliable conversion factors for estimating denominators. Faulty conversion factors usually result in over- or under-estimation of eligible children. In RED/REC this is expected to solved by conducting head counting at village level; however, this cannot be regularly done due to excessive workload of HEWs. Expansion of the Community Health Information System (CHIS) at ground level, may in the long run solve this problem. In Addis Ababa and Harari faulty conversion factors have caused under planning. In Addis Ababa, getting dependable denominator is very difficult due to massive in-migration and displacements within the city.

Monitoring, evaluation and learning

The data that we get from top and low-level decisionmakers regarding monitoring, evaluation and learning (MEL) were divergent. According to top level managers, in most regions vaccination coverage is being evaluated by Performance Monitoring Team (PMT). The PMT identify key indicators from each program and deliberate on them. At regional level, district health offices are compared head-to-head and those with special needs would be supported. In addition to PMT, the program is evaluated on quarterly or semi-annual basis through review meetings at different levels of the health system. As part of the semi-annual evaluation of HEP, EPI is also reviewed. From the review meetings, action points are taken and districts that need special support would be identified and supported. Regional EPI focal person reported the vaccination program is supported with regular (semiannual) program specific and integrated supportive supervisions. Supervisions are also cascaded to all levels of the health system.

However, top level managers (especially from developing regions) admitted that review meetings, PMT and supportive supervision are not regularly conducted due to shortage of budget, shortage of manpower and lack of motivation. In general, lack of feedback to frontline health workers is also raised as a weakness of the M&E approach.

According to lower-level decision makers, partners and health workers, in most of the zones and districts that we studied, regular review meetings and supportive supervision are not being conducted due to shortage of budget or negligence. In Amhara region, the recent political conflict has diverted the attention of the officials from the routine activities and regular review meetings (including PMT and review meetings) are not being organized. In AACA, one barrier for providing supportive supervision is shortage of manpower at sub-city level. Key informants from partner organizations also reported that PMT is less effective due to lack of regularity.

Nearly all of the health centers have designated health professionals to provide supportive supervision to HEWs. However, supervisions are not conducted as per the schedule due to the aforementioned barriers. According to health workers, WoHO management is less committed to regularly implementing MEL activities. In many regions, PMTs meet sporadically and feedback are not provided as required. Sometimes HEW supervisors fail to provide feedbacks during field visits.

"We don't have adequate budget to conduct M&E activities regularly. What we get is not even enough to buy consumables." Key informant from Chire WoHO, Sidama region

"According to the standard, ZHD is expected to supervise the WoHO quarterly, but we didn't do that. The district should supervise health centers every month, and health center should visit health posts on weekly basis. But in practice this has not been done" Key informant Sheka ZHD, SW region

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The rollout of District Health Information System (DHIS)-2 has facilitated the M&E efforts for all programs including EPI. DHIS-2 has also been useful for improving timeliness, reducing paperwork, and giving feedback to health facilities and districts. The system has also reduced false reporting because once the data is entered into the system; it cannot be edited at a higher level. RHBs are working towards strengthen the system through training and deployment of Health Information Technology (HIT) professionals. However, unavailability of computers at health centers level, limited access to electricity and internet connection, skill gaps remain major challenges. Conversely, small-scale attempts to distribute tablet computers to frontline health workers was reported in DDCA and SW region. Shortage and frequent turnover of HIT professionals, demotivation due to lack of career structure are affecting the implementation of the DHIS.

The CHIS in also being used as population registry system but the system is not being updated regularly due to weak HDA/WDA network and shortage of registration forms.

CHIS is also rudimentary in pastoralist and other hard-to-reach areas. In many settings social network platforms like Telegram and WhatsApp are being used for reporting vaccination data. In Chire woreda (Sidama region) reports are not being timely shared with higher bodies due to months of power interruption.

Data Quality for Decision-making

All groups of respondents (decisionmakers, managers, health professionals and partners) agreed that, despite recent improvements, poor data quality remains a major concern. The respondents admitted that the data reported by the vaccination program lacks quality and identified this as a major pain point. Common indicators of poor data quality include discrepancy between community-based surveys (e.g., DHS, Rapid Connivence Survey) and DHIS-based reports, vaccination coverage reports not compatible with vaccine supplies received, difference between DHIS and program-based reports, and occurrence of VPD outbreak in reportedly high coverage districts. Sometimes coverage figures reported at a higher level cannot be validated at lower levels.

> *"The admin report does not correspond with the actual number of zero-dose children on the ground" Key informant from Gamo ZHD, SNNP Region*

Causes of poor data quality include lack of reliable denominators, lack of value for data, demotivation of HEWs, carelessness, miscommunication among HEWs working in a same health facility, skill gaps and data fabrication. Improper documentation at health posts, shortage of recording formats and carelessness contribute to this end as well. Sometimes health workers provide little attention to record keeping and fail to properly fill tally and registry books despite vaccinating large number of children. In many cases tally sheets are not completed at real-time due to shortage of stationaries or carelessness.

> *"At health post level, what is found in the tally sheet cannot be the same in the logbook" Key informant from SNNP RHB*

Health Information Technologists (HIT) frequently commit data entry errors because they have limited understanding on health-related issues. HITs are largely demotivated because their salary is lower than health professionals with similar level of qualification. They also don't have meaningful carrier development structure within the system.

Checking agreement among the tally sheet, registration logbook and reports is not usually done by frontline managers. In general, there is also no established mechanism to validate reports with community-level service coverage figures. Routine Data Quality Assessment (RDQA), Performance of Routine Information System Management (PRISM) and Lot Quality Assurance Sampling (LQAS) are not being implemented as planned. As reported from different settings, the major challenges to validate original data sources with reports are workload, demotivation, lack of vehicles, and inaccessibility of health posts.

"According to the report that we are receiving, there are no zero-dose children in our catchment area. However, we cannot validate it further because there is no budget to cover field expenses. Budget shortage is a major bottleneck to conduct data quality assessment." Key informant from Gulele Sub-city Health Department, AACA

In most of the study settings the problem of data fabrication is gradually improving over the last few years. The extent of the problem, however, appears to be different from region to region. According to a higher official from MoH, data quality concerns had been less serious in Addis Ababa, Amhara, and Tigray regions. Respondents from Amhara region did not consider data fabrication as a major problem as well. Conversely, in Somali and Sidama regions, the problem persisted despite repeated trainings.

"There are issues remain unsolved in this regard [false data reporting]. There are also honest HEWs who provide reliable data" Key informant from Chire WoHO, Sidama region

Unhealthy competition among districts on vaccination coverage and screening health workers for higher education opportunities based on performance are contributing to false reporting. According to many respondents, the underlying cause of data fabrication is lack of accountability system. There is also no data accountability policy in place at all levels of the system. Data fabrication is not usually seriously taken, and no major administrative measures are being taken.

"152 districts reported coverage figures beyond the vaccine supplies they received. Unfortunately, I haven't seen anyone held accountable for reporting false data" Key informant from MoH

"If we found false reporting, we will educate the health worker who committed the mistake. But we are not taking any other measure" Key informant from Loka Abeya WoHO, Sidama region

Sometimes higher bodies are also resistant to accept low vaccination coverage data so health facilities and health workers are indirectly forced to report false data. Sometimes when health officials receive unsatisfactory reports, they order HEWs to revise and resubmit their reports.

"Sometimes official also demand health workers to modify and resubmit reports. Yes, we have to speak the truth" Key informant from Loka Abaya WoHO, Sidama region

In general, the practice of using vaccination data for decision making is better at higher (federal and regional) level. Districts are compared based on coverage rate and feedback are given. Underachievers would be identified and followed closely. However, the practice of using data for decision making declines as we go down to the lower level. The data use practice is even lower in developing and newly formed regions.

"There isn't much to say about it [use of data for decision making]. Specially at health center and health post level, it is just reporting the numbers". Key informant from SW RHB

Lack of dependable denominator and use of erroneous conversion factors are major causes of poor data quality across the board. As the 2007 national census is already outdated, vaccination programing is being led by centrally determined conversion factors that do not represent the reality on the ground. Faulty conversion factors usually result in over- or under-coverage reports. Head counting is not usually done due to lack of resources and demotivation of HEWs. Furthermore, head counts are also affected by coverage problem and are not frequently updated. Expansion of the CHIS may ultimately resolve the problem.

Demand-side Barriers

Vaccine rejection and resistance

Resistance to childhood routine vaccination has not been reported across all the regions. Vaccination resistance is usually against TT and HPV targeting adolescent girls and Covid-19 for adults. Especially the first two are frequently linked with causing infertility. In nearly all the settings we studied (except remote areas in SW and Gambella regions), no major resistance to childhood vaccination has been reported. Religious or cultural barriers are almost non-existent as well. Absence of resistance to childhood vaccinations is considered as an opportunity by many of the informants. Most respondents described vaccine resistance as something they used to experience in the past. In some settings, resistance to vaccine is not serious because they have strong trust on the government and health system. However, during supplementary immunization campaigns/ activities, parents sometimes resist to vaccinate their children claiming that the child has already been vaccinated.

Lack of active demand for vaccination

Though resistance against vaccination is rare, self-initiated demand for childhood vaccination remain unsatisfactory due to lack of awareness and absence of sustained SBCC interventions. Specially, the recently introduced vaccines like MCV-2 have not been adequately promoted. Active community demand was reported in Amhara region while the demand is lower in regions developing and newly formed regions.

"Today on my way I saw everybody, women and men, at the veterinary clinic begging to have their cattle get vaccinated first. I told them to show similar demand for children's vaccines too" HDA leader, Loka Abaya district, Sidama region

The demand of the community to vaccination service provided through statistic service is unsatisfactory. Some of the contributing reasons are unavailability of health workers at facility and lack of vaccines at health posts. As reported from Loka Abaya district of

Sidama region, caregivers sometimes request HDA members to organize door-to-door vaccination instead of outreach sessions. Similar problem has also been encountered in Amhara region. Even some caregivers demand for food aid to vaccinate their children (SNNP, Sidama and Amhara regions).

> *"We used to vaccinate children as their parents receive food aid. Later on, mothers who do not get flour start to reject vaccination" Key informant from Turmi Health Center, SNNP Region*

Knowledge about vaccination

In many cases caregivers may tell that vaccination prevent diseases but in-depth understanding is lacking. Caregivers reportedly lack detailed understanding on the schedule and benefits of each vaccination. FGDs that we conducted with local women suggested that caregivers are largely aware of the importance of vaccines for protecting children from different diseases. However, very few managed to list VPDs beyond measles and polio. Some even considered Kwashiorkor, skin diseases like scabies, trachoma and intestinal parasites as VPDs. Awareness on vaccination schedule was also suboptimal. In many FGDs wrong assertions like vaccination starts at 45 days of age and ends at 9 months were commonly reflected. Even some HDA/WDA members reported the same.

> *"As a standard, health workers provide education to the community to start vaccination after 45 days of birth" HDA Member, Gamo zone, SNNP region*

Fear of side effects of vaccination

Health workers in many cases do not provide adequate information about side effects of vaccines. Caregivers also lack comprehensive understanding about side effects of vaccines and do not frequently know how to deal with them when side effects occur. Reportedly, children dropout out of the EPI program due to occurrence of side effects like fever, irritability and swelling of BCG vaccination site. When children develop side effects, caregivers sometimes get criticized by husbands and mother-in-law for vaccinating the children.

> *"[when infants] face side effects like fever after vaccination, mothers avoid vaccination in the next appointment day" Key informant from Amhara RHB*
>
> *"Sometimes when we mobilize the community for vaccination, few mothers hide their children fearing that it may develop fever if vaccinated" WDA member, Debariq Zuria Woreda, Amhara region*
>
> *"My child was sick for two days after taking vaccination. I decided not to vaccinate him again." FGD discussant, Gardamarta woreda, SNNP region*

Misconception about vaccination

In most FGDs mothers mentioned that previously they used to doubt the importance of vaccines and had different misconceptions. However, such gaps have gradually improved. For instance, In Sidama, previously infants used to be given a traditional herb "Hamessa" to protect them from illness, nowadays vaccinating children is becoming a norm.

> *"Previously mothers used to resist vaccination claiming that "Jesus is their vaccine". Now, after understanding that vaccinated children are less likely to suffer from diarrhea and pneumonia, the resistance is declining" Key informant from Chire WoHO, Sidama region*

In Amhara region one major practice commonly reported was that, mothers prefer to delay vaccination until the infants gets baptized. Fearing side effects, concerns about taking multiple vaccination at a time and fear of injections were the most common demand-side barriers reported across the settings. In urban areas, educated parents resist booster doses provide through campaigns by justifying that the child has already been vaccinated. During the KII and FGDs, the following isolated misconceptions have also been reported in different settings (Table 30).

Table 30: Small-scale misconceptions about childhood vaccination reported in different settings

Misconceptions	Setting
Taking vaccines' side effects of seriously	All regions
Concerns about multiple vaccination injections at a time	Many regions
"We were raised up without receiving vaccination, so why we it is needed now?"	Many regions
Fear of injections especially early in life	Many regions
Injection may cause nerve damage and paralysis	Many regions
Fear of evil eye specially during the first few months of life	Many regions
Rejecting vaccines by assuming that God protects the child from illness	SNNP and Sidama regions
Infants should not be vaccinated until they get baptized	Amhara region
If infants exposed to sun they may develop 'mich'	Amhara region
Infants should not be injected unless sick	SW region

Mother should not go outdoor in the first few months after giving birth	SNNP, SW and Afar regions
Vaccination aggravates febrile disease	Amhara, SW and Afar regions
Sick children should not be vaccinated	Afar region
If the child takes the routine vaccine, there is no need of taking other vaccines (e.g., booster doses provided during campaigns)	Urban areas
Small-scale resistance due to traditional religious beliefs	Gambella, Oromia

Service dissatisfaction as demand side barrier

In major urban areas overcrowding at vaccination centers and long waiting time and cause dissatisfaction. In most urban areas including Addis Ababa, the population to health center ratio is high, so long waiting time and overcrowding at the health centers discourage caregivers from vaccinating their children. The existing open vial policy that requires certain number of children to be available for providing a BCG or measles vial is also a major cause of dissatisfaction. In many settings multidose vaccines are only provided in selected days and this causes client dissatisfaction.

> *"In the outreach site, HEWs tell mothers to wait until the required number of children to open the vial are available. At the end of the day, if adequate number of children are not available, they will be reappointed for some other day" WDA member, Guangua woreda, Amhara region*

Other demand-side barriers

In general, there is weak social accountability mechanism to improve inefficiencies and performance of the health system. There is no mechanism through citizens provide feedback to the health system regarding coverage of different health services including vaccination service. Kebele leaders are frequently engaged in community mobilization but they play no role in providing feedback to the health system. In vaccination service context, establishing social accountability system may ensure availability of health workers on their duty, improve data quality and service satisfaction.

Domestic workload, poverty, and large family size are among the major demand-side barriers to utilize vaccination service. Though vaccination service is provided free of charge, transportation cost is unaffordable for many poor families. In remote areas of Gambella

and SW regions, home delivery is common and, as a result, coverage of BCG and OPV-0 is low.

In Somali region, women commonly have multiple children so they may not travel to nearby health facilities to seek vaccination service fearing that no one would take care of their children at home. In Somali, Afar, and remote areas of SW regions, women are culturally required to handle not only household chores, but also outdoor activities like cattle keeping. Accordingly, they literally have no time to take their infants to health posts. Lack of access to time and energy saving technologies also overburden women with household. In Amhara region, missing vaccination appointments due to repeated religious holidays was reported.

According to a key informant from different regions, misconceptions and rumors about Covid-19 vaccine have affected the trust of the community on all vaccines. According to the FGD discussants, during the earlier stages of the Covid-19 outbreak demand for childhood vaccination was very low fearing that health professionals are likely to be infected with the virus. Specially the problem was a serious challenge in urban settings. Gradually the fear has resolved and currently Covid-19 has no major effect on care seeking behavior.

The other demand side barrier is forgetting immunization schedule due to illiteracy and domestic workload, and this has its own contribution to drop out of the vaccination program. In Afar, Somali and Borena of Oromia region, the hostile climate limits movement caregivers for seeking health services. In Somali, Afar, and parts of SW regions, clan leaders are highly influential in their respective communities; however, they have not been adequately engaged in promoting vaccination. In SW, Sidama and Amhara regions, reportedly elders and grandparents exert negative influence on vaccination.

> *"At times grandmothers advise mothers not to vaccinate their children by arguing that the children have already been vaccinated by God" HEW, Chire Woreda, Sidama region*

Gender-related Barriers

Gender and vaccination service utilization

Across the regions, gender-specific barriers for vaccination have not been reported. Boys and girls appear to have equal access to vaccination service. The gender of the vaccinator also has no meaningful effect on the utilization of the service and caregivers don't have major preference on the gender of the service provided. According to most respondents, gender-related factors have more pronounced implications to maternity services, rather than EPI. In all of the study settings, we haven't come across with household or community level factors that hinder utilization of vaccination service differentially in boys and girls. Similarly, the health care system provides vaccination service in equitable manner for both.

In many cultures (Somali, Sidama, Gamo, Surma), boys are preferred than girls, but this appears to have no major effect on utilization of vaccination service. In Amhara region, Orthodox Christian caregivers prefer to delay the first vaccination until the child gets baptized (80 days for females and 40 days for boys). This means female babies tend to commence vaccination (specially BCG and Polio 0) later than their counterparts.

> *"In the Somali culture, boys are preferred over girls, but I don't think that affects the utilization of the service." Kebele leader, God God District, Somali region*

Men engagement in vaccination

Men appear to have little or no involvement in making sure that their children are receiving vaccines. This is because childcare is culturally defined as the role of women. Taking children to vaccination centers and communicating with frontline health workers is usually considered as the duty of women. Even health workers reflected a similar gender stereotyping, that may even discourage fathers further from taking care of their children.

In many cases, frontline health workers interact mainly with mothers so that husbands 'awareness on vaccination is usually limited. In the FGDs, involvement of men in childcare (including vaccination) was frequently described as the culture of the urban community. In Somali region extreme reports like "men don't know where children get vaccinated", and "vaccination of children is not the concern of men" have been raised during the FGDs with local women. In Afar and Somali, women are responsible to handle household chores as well as many outdoor activities, so they may not be able to take their child for vaccination unless they get supported by other family members.

> *"Usually, men are not aware whether their children have received their vaccines or not. Men have other important obligations that hinder them from taking young children to health facilities." A key informant from Somali RHB*

Access to and control over resources

In patriarchal society of Ethiopia with male-dominated power structure, women have limited decision-making power and control over resources. This indirectly affects care seeking behavior because men usually are not as concerned as mothers when it comes to childcare. Unfortunately, women are not adequately empowered, and they usually need to secure permission and money for transportation from their husbands to take their children to health institutions. In many settings (as reported specially from developing regions like Gambella, Afar and Somali) men sometimes control the movement of their partners and this may affect utilization of health services.

"Though a woman has good awareness of vaccination, she may not bring her child to vaccination because she may have no money for transportation. The money is in his pocket" Key informant from a partner organization working in Afar region

"When we ask mothers to bring their infants for vaccination, they tell us that they have to secure permission from their husbands first. Sometimes they decline to come claiming that their husband was not willing" Health professional from Somali region

Gender specific vaccination data analysis

Vaccination programs have no practice of collecting and analyzing gender-specific data because decisionmakers are confident that gender has no effect on vaccination service provision and utilization. This also holds true for programs being implemented by partner organizations. The exceptions are programs being implemented among refugee population and during vaccination surveys, like in Rapid convenience Survey (RCS), whereby gender data is collected as a contextual information. The DHIS system also does not disaggregate vaccination indicators by sex. While providing vaccination service, HEWs sometimes tally boys and girls separately, but the data is not analyzed and reported in gender disaggregated manner.

Other gender-related barriers

Usually HEWs and HDAs only interact with women regarding MCH issues including vaccination. Community mobilization efforts like pregnant women forum also disregard men. On the other hand, women have limited access to mass media messages. On a positive note, the planned establishment of Men Development Army may help to promote engagement of men in MCH services. In Afar region, women are not traditionally allowed to go out of home and accordingly they have limited information about health services. They also have limited access to the tradition information system of "Dagu".

Reportedly female-headed households how lower health care seeking practice due to poverty and workload. Specially in IDP and refugee camps, female-headed households are common and their care seeking is low.

Vaccine Logistic System

Vaccine supply after the "last mile" transition

RHBs have been responsible for delivering vaccines and other related supplies within their regions. However, since 2016, Ethiopian Pharmaceutical Supply Agency (EPSA) has taken the responsibility of distributing vaccines and supplies directly to hospitals and health centers through its regional hubs. According to most respondents, the "last mile/ direct delivery" has improved the logistic system and the health system has considered it as a major opportunity. Yet many health facilities (especially in remote areas) remain inaccessible to EPSA and hence distributions are made indirectly through district health offices. The key informants reported several success stories about the last mile delivery.

For instance, remote zones in Somali region used to collect the vaccines from Jijiga town, but now it is being directly delivered to zones and districts.

> *"Before the transition, the EVM score was below 50% in BG region. But after EPSA took over the system, the score reached above 80%" Key informant from Assosa EPSA hub*
>
> *"After the transition there is no problem of distributing the vaccines to districts. Now the problem is distributing the supply from districts to health facilities." Key informant from Oromia RHB*

In general, regional EPSA hubs are discharging their duty optimally and have good working relationship with RHBs. In terms of logistic supply, EPI has received better attention as compared to others. EPSA has supply chain strategy, guideline, and standard operating procedures (SOP) for managing the vaccine logistic system. EPSA has also employed EPI focal persons. According to many respondents, the existing logistic system for vaccination is even better that the system for other medical supplies. The presence of logistic officers at WoHOs is also one enabling factor for the vaccine logistic system.

Existing challenges in the vaccine logistic system

Supply interruption

Despite the success of the "last mile delivery", occasional supply interruptions or inadequate supply of vaccine due to national stockout or procurement delays, have been reported. Recently national stockouts have been reported for BCG, Rota and OPV. The other major causes of interruption were: EPSA's shortage of vehicles to distribute vaccines timely to all districts (Somali and SW regions), unmanageably large catchment areas for some hubs (e.g., Somali region), long distance between health centers and health posts (Somali and Afar regions), shortage of budget to transport vaccines from health centers to remote health posts (many regions), and poor road conditions. In some of the districts of Amhara, Afar, SNNP and Sidama regions that we studied, EPSA reportedly provide inadequate vaccines that did not match the requirements of the WoHOs.

> *"But we don't have any means of transporting the vaccines from health center to health posts" Key informant from Teltele WoHO, Borena zone, Oromia region*
>
> *"Sometimes children go to the health post. But health workers send them back by saying 'vaccines are over'" Influential community member, Teltele woreda, Oromia region*

Failure to request for vaccines on time

Failure of WoHOs to submit vaccination requisition form (VRF) on time and delay in compiling the VRFs are also blockages to the vaccine logistic system. Respondents from EPSA frequently complained that districts and health facilities do not submit VRF timely

on monthly basis, causing artificial vaccine shortage. This problem has been reported in all regions. Due to inaccessibility, many health facilities in Gambella, BG, SW, Afar and Somali regions don't frequently submit their request on time. Late or incomplete reporting apparently due to negligence is also common. So, it means, the facility will miss the supply for the next 30 days as PFSA does not provide supplies without request.

> *"We gave training on timely reporting of [vaccine] needs. But, due to staff turnover, the outcome is not as what we expected. Still continuous training is needed." Key informant from Hawassa EPSA Hub*

Difficulty to correctly estimate vaccine needs

Districts and health facilities are expected to estimate their vaccine needs based on their catchment population size, and this sometimes results in over- or under-forecasting. Hospitals with no predefined catchment population sometimes estimate requirement based on their recent performance. Occasionally health facilities and district health offices fail to optimally estimate their vaccine needs due to erroneous conversion factors that underestimate number of target population, difficulty to predict number of target children because of pastoralist nature of the population, and influx of refugees and IDPs.

Conflict, road closure and interruption of vaccine supply

Road blockages due to conflict is frequently interrupting vaccine supply to regional hubs and districts. The current political instability in north Ethiopia has affected the vaccine logistic system in Afar and Amhara regions. The vaccine supply to western Afar has been compromised due to interruption of supply from Mekelle and Dessie hubs. The conflict in western Oromia and BG regions has also disrupted the vaccine supply in the areas for more than 6 months. At the time of the study, the supply for EPSA Assosa hub has been interrupted for more than 3 months. The same hub has failed to distribute the supply for western Oromia for more than 8 months due to security problems.

> *"For the last 3-4 months we have not received the vaccines because of the road closure. We have been using the supplies that we have at hand. Now, almost four or five antigens have stocked out." Key informant from Assosa EPSA Hub*

Due to the conflict in southern Oromia, EPSA Hawassa hub is not covering Borena, West Arsi and Kofele areas. As a make shift strategy, some of the areas have been redirected to the Arba Minch hub. Sporadic political instability in SNNP, SW and Gambella regions also affect the logistic system. Attempts have been made to dispatch the supply via chartered planes but that has been too costly to EPSA. In addition to political instability, poor road conditions and adverse weather conditions like flooding hamper timely distribution of vaccines in regions like Gambella, SW and Amhara.

"Two weeks ago, vaccines have been supplied to the ZHD, but we did not get it due to the ongoing political instability in the area" Key informant from Surma WoHO, SW region

"Especially during the rainy season, the entire districts of the zone except one would be cut-off due to flooding" Key informant from Neur ZHD, Gambella region

Vaccine supply situation in remote areas

In general, hiccups in the supply of vaccines and other logistics are being encountered less frequently in most settings. However, the situation in remote areas of Somali, Gambella, SNNP and SW regions is less promising. In such settings interruption of vaccination supply for a month or two is commonly encountered.

"In the last two months we have not been supplied with Penta and PCV vaccines" Key informant from West Omo ZHD, SW region

"We have already requested the vaccine supply for the month of May but it has not been delivered. Vaccination coverage is very low due to interruption of supply" Key informant from Gikawo WoHO, Gambella region

"If we get BCG, we may not have Penta. When we get Penta, then PCV (….)." Key informant from a health center in Surma woreda, SW region

In remote areas of SNNP and SW region EPSA frequently fail to supply vaccines to all WoHOs and "dump" the supply at zonal centers. Sometimes EPSA leave the supply for one district or health center in another and inform the earlier to collect the supply by itself. However, this may not be feasible for the recipient due to shortage vehicles or budget for covering per diem and fuel.

"EPSA damps our monthly vaccine supply at Kemba district. To collect it from Kamba, it requires vehicle, fuel and per diem. This delays our work" Key informant from Gardamarta WoHO, SNNP region

"EPSA is expected to bring the vaccines to districts. But they usually damp it at the zone capital" Key informant from West Omo ZHD, SW region

Other challenges

The recent Covid 19 vaccination campaign has overstretched the vaccine logistic system and somehow compromised the distribution of routine vaccines. Recently the national vaccination program has expanded. Furthermore, as outbreak response, additional vaccines including single dose Cholera vials are being distributed. This has somehow overstretched the vaccine logistic system. Especially during vaccination campaigns, the supply volume is too big and overstretches the EPSA logistic system.

Distributing of vaccines by drivers without any technical knowhow was also commonly reported by health facilities and WOHOs. Sometimes health bureaus are not copied of the stock of vaccines distributed to districts or health facilities making planning at regional level difficult.

> *"Usually, drivers without any technical knowledge bring the vaccines to the health facility. If you tell them the supply is inadequate or excess or the VVM is not OK, they don't understand anything" Key informant from Chagni Hospital, Amhara region*

Mobile phone application for stock management

With the support of JSI, a digitized approach to manage the vaccine logistic system using the mobile-based inventory management application (mBrana) was introduced at district health offices and health facilities levels. The "mBrana" mobile application had been effectively used by WoHOs and health facilities to monitor their vaccine logistic system and it was well accepted by the end users. Unfortunately, the application is currently not functional because the program that introduced the initiative had phased out. Lack of IT supplies and technicians at lower level of the system have also affected the sustainability of the program.

Logistics of other vaccine-related supplies

Previously imbalance in the supply of vaccines and other supplies (e.g., syringes and diluents) used to be encountered very frequently; but now such problems are becoming rare. In most of the settings that we studied, no major shortage of syringes, diluents, vaccine carriers and safety boxes have been reported. However, shortage of vaccination cards and certificates were commonly experienced at different scales in most of the districts.

However sporadic shortage of safety box, vaccine carriers and boxes (Somali region, Sewna and Teltele districts of Oromia region, West Omo zone of SW region), ice bags (West Omo zone, SW region), syringes and needles (Gambella SW, SNNP and Sidama regions), diluents (Afar region, South Omo zone, SNNP region), OPV dropper (Gamo zone, SNNP region) have been encountered. Though bundled vaccine supplies are provided by EPSA, the bundling is sometimes flawed.

The cold chain system

Success stories

Over the last few years, the availability of vaccine refrigerators at health posts has considerably improved due to mass distribution of Solar Direct Drive (SDD) refrigerators. The increasing availability of biomedical technicians and organization of frequent refrigerator maintenance campaigns had also positive contributions. Inventory of refrigerators is also being done more frequently. More and more health professionals have received training

on EVM. The issue of EVM has also been into the IRT of HEWs. The practice of monitoring temperature using the fridge-tag system is also improving across the regions. Integration of refrigerator preventive maintenance training into Immunization in Practice training was also reported as a success story.

Shortage of functional refrigerators

Except for AACA, the availability of functional cold chain system is unsatisfactory throughout the country. Recently SDD refrigerators have been distributed in mass across the country. Specially in the last three years more than 6,000 refrigerators have been installed. However, health posts and newly established health centers even in the major regions like Amhara and SNNP still have limited access to refrigerators. Especially, the problem in developing and newly established regions like Sidama, SW and Gambella regions is more pressing.

In the newly established SW region and in Amhara region, reportedly less than 50% of the health facilities have SDD. Further, due to the recent conflict in the regions, refrigerators have been damaged or robbed. In Amhara region the old kerosene powered refrigerators are not working due to lack of kerosene. Positively, the region has recently received more than 800 SDD refrigerators that will be distributed to health facilities soon. MoH has also planned to replace old refrigerators that served for more than ten years throughout the country.

> *"Out of the 33 health posts in our district only seven have solar refrigerators" Key informant from Debariq Zuria WoHO, Amhara region*

In health posts that don't have their own refrigerators, HEWs are expected to collect the vaccines from nearby health centers in the morning and return the reminders in the evening. Sometimes HEWs fail to collect the vaccine from the health center and refer the mothers instead. In Amhara region, such health posts are only engaged in a monthly outreach service.

> *"There is Chilbo kebele over that mountain. There are many zero-dose children there. Regular vaccination service is not provided there because the health post does not have a refrigerator" Key informant from Gardamarta WoHO, SNNP region*

Spare parts and maintenance of refrigerators

Refrigerators frequently stay out of work due to problems that can easily be prevented or maintained. For instance, lack of UPS causes refrigerator burnout secondary to power fluctuation. Scarcity of technicians for maintaining refrigerators and shortage of spare parts like that of solar panel from SDD refrigerators are major challenges. In many cases refrigerators are provided to RHBs without adequate spare parts making maintenance difficult. In Amhara, Sidama and SW regions, most of the existing refrigerators are old and are hence liable to technical failures.

In settings where refrigerators are available, they are generally not handled with care and health workers are not aware of the preventive maintenance needed. Incidents in which newly SDD refrigerators fail before serving even for a year have been reported. At times when the available refrigerators fail, they are not maintaining timely due to lack of skilled technicians, shortage of budget and bureaucratic administrative system. Normally SDD refrigerator supplies provide guarantee against technical failures, but they don't provide timely maintenance service when problems are encountered. In Afar region, newly purchased refrigerators are not functioning because the supplier has not installed them.

In all the regions, inadequate supply of spare parts for broken refrigerators, including recently distributed SDDs, remains a major boatneck. As reported from different regions including Somali and Sidama, some health posts have stopped providing vaccination service due to broken refrigerators. As reported from Debariq Zuria woreda, recently refrigerators have been distributed to health centers, but some of them are not functional because health workers are not aware how to operate them. In Gambella region and Surma district of SW region theft of the solar panels was reported as a major challenge.

> *"Most health posts or health centers have non-functional refrigerators. Especially when the SDD refrigerators fail, they remain out of service for long time due to lack of spare parts and qualified technicians" Key informant from Gambella RHB*

Shortage of skilled biomedical technicians

In general, biomedical technicians are available at zonal and district levels in all regions. In Addis Ababa two biomedical engineers are available at sub-city level. However, scarcity of senior technicians was reported in Sidama, SW, Harari, Afar and Somali regions. Some of the key informants from Amhara and SW regions and DDCA expressed their reservations over the skills of the available biomedical technicians. In most settings, refrigerators are not being maintained timely due to shortage of skilled biomedical technicians at districts level, and lack of timely response by officials.

> *"Once a refrigerator is broken, it is very unlikely that it would be properly maintained. The technicians have a serious skill gap" Key informant from Gulele Sub-city Health Department, AACA*

Shortage of refrigerated tracks and cold storage capacity

Most of the PFSA hubs do not have refrigerated tracks for distributing vaccines so they rather use vaccine boxes. Gambella and Assosa PFSA hubs only have one vehicle at their disposal for distributing vaccines through of their catchment area. Similar complaints also came from Jijiga, Jimma Hawassa and Dire Dawa hubs. The bad road conditions in the regions like Gambella, SW, Afar and Somali regions mean the tracks frequently break and stay out of service for long time. Accordingly, when the vehicle is broken down the vaccine

supply would be interrupted, or they must rent or borrow cars from other projects/sectors. Shortage of vehicle and fuel also limit the effective use of the available vehicles across the regions including Gambella and BG.

Central and regional EPSA hubs have large cold storage capacity that can accommodate the expanding needs of the country. However, district health offices and health facilities in regions like Gambella and Oromia, have limited storage capacity. Sometimes, regional hubs may intend to distribute extra vaccine supplies to health facilities for various reasons (e.g., anticipating supply interruption); however, the storage capacity of the facilities does not allow so. Reportedly, the storage capacity of SDD refrigerators is small. In Sidama region (Chire woeda) storage capacity at health centers level is inadequate as compared to the catchment population size and vaccine shortage is encountered during campaigns. The same was reported from Awi zone. Limited storage capacity is identified a possible challenge for possible introduction of single dose vials. In some health centers oxytocin is stored with vaccines due to shortage of refrigerators.

> *"During our field visits, we frequently observe that the refrigerators [at health facilities] are fully stocked. The available storage capacity at the lower level is limited" Key informant from Oromia RHB*
>
> *"We only have two regenerators for the health center and health posts. At least we need four. We do not have adequate storage capacity to receive all the vaccines we need" Key informant from Chire WoHO, Sidama region*

Frequent power interruption and shortage of kerosene

Limited access to electricity or frequent power outage are among the challenges of the cold chain system. At central and regional EPSA hubs, this is not a major problem because backup generators are availability. At district and health facility levels, the problem is addressed through having alternative power sources. Yet, power outage occurs due to shortage of fuel, lack of budget to purchase kerosene and absence of automatic power back up system. Accordingly, at health centers and hospitals level frequent power interruptions and lack of dependable power backup system threatens the cold chain system across the country. Though most hospitals and health centers using electric-powered refrigerators have backup generators, generators failures and shortage of fuel occur.

> *"In our hospital, there are adequate number of refrigerators provided by (…..), but we face frequent and prolonged power interruption. Our main problem is electricity (…..). It is not possible to use the generator for 24 hours." Key informant from Klwan Hospital, Afar region*

In many settings (e.g., Sidama, SW, SNNP regions and Awi zone of Amhara region. Borena zone of Oromia), due to shortage of budget for purchasing fuel, kerosene-powered

refrigerator installed at health centers are not functioning. In many cases kerosene is not adequately available in the market. For instance, in Awi zone, Kerosine has not available in the market for more than two years.

> *"You can't get kerosene in the market even if you have the budget." MCH Directorate Director, Sheka ZHD, SW region*

Effective vaccine management and temperature monitoring

Partners are increasingly supporting the Effective Vaccine Management (EVM) initiative. Training of health professionals on EVM and a mechanism to monthly report temperature monitoring data had been initiated. This has improved EVM score in many regions. The Fridge-Tag technology has been introduced to closely monitor the cold chain system. However, despite the trainings and initiatives, sometimes health workers are reluctant to monitor the temperature and fail conduct simple procedures like the Shake test. Staff turnover has limited the effectiveness of the EVM training. EVM self-assessment is not regularly made due to the bulkiness of the checklist. In North Gondar zone, remoteness of health posts and their catchment area has compromised the EVM system.

In all of the regions the temperature of cold chain system is being monitored at scale using the fridge-tag system. However, shortage or malfunctioning of fridge-tag was reported in Sidama (Chire woreda), Afar and Gambella (Gikawo woreda) regions. According to a report from AACA, the fridge-tag device that has an operating lifetime of 2 years, is being used for more years because of shortage of new supply. Though refrigerators are expected to be monitored on daily basis, due to reluctance and lack of overtime payments, monitoring is not being done in the weekends. Recording false temperature data has been reported from AACA.

Vaccine wastage

Close vials wastage

Vaccine wastage appears to be unacceptably high in all regions and has not been successfully reduced so far. In the zones and districts that we studied, both open and close vial wastage are reportedly common.

Incidents of bulk wastage due to distribution of nearly expired vaccines to regional hubs and excessive heat exposure during region-level distribution were reported by Bahir Dar and Semera EPSA hubs, respectively. In Somali region wastage due to overstock was reported. The Semera hub reported bulk wastage of Penta and PCV products due to excess supply (or possibly underutilization) from the center. Distribution of vaccines at stage II of VVM are commonly and usually end up in wastage.

During vaccination campaigns, vaccines are distributed in mass to health facilities without optimal forecasting, and this ultimately results in expiry. Sometimes, campaign planning

is made at higher level and excess supply is "pushed" towards the lower levels. Vaccine wastage following campaigns reported to be common in Gambella and BG regions.

> *"(…..) but in campaigns, wastage of polio and measles vaccines is very high. I think the main reason for this is ill planning" Key informant from EPSA Assosa Regional hub*
>
> *"Wastage is high specially during campaigns" Key informant from Erer WoHO, Harari region*

Though the quality of the vaccination supply is evaluated VVM, at ground level health workers sometimes fail or ignore to monitor the cold chain system as recommended and this results in close vial wastage. Failure to monitor temperature over the weekends due to lack of overtime payments is also reported. Close vial wastage due to expiry (Somali and Sidama regions), interruption of vaccination service for a long period due to conflict (SW region), heat exposure due to long travels or malfunctioning of refrigerators (Somali, Afar and Amhara regions), power interruptions (Sidama region) have also been reported.

> *"The primarily cause of vaccine wastage is associated with health workers. The refrigerator needs to be checked twice a day. They open [multidose] vials without assessing how many children are available for vaccination" Key informant from Gambella RHB*

Open vial wastage

According to the national direction, with the aim of reducing open vial wastage, health workers should only open a multidose vial (measles and BCG) given certain number of children are available for vaccination. However, the direction is sometimes violated for different reasons and health workers open multidose vials for too few children. Open vial wastage of multidose vials is commonly encountered due to low turnout for vaccination. Specially wastage in IDP and refugee settings is common because of smaller number of children eligible for vaccination. PCV vials that can be used for 28 days after being opened are sometimes wasted because health workers fail to register the day and time the vial was opened.

> *"I have to be frank here. Vaccine wastage is very high. For example, 50% wastage is expected for BCG, but actually its beyond that. It may be up to 60 or 70%" Key informant Sheka ZHD, SW region*

Efforts to reduce vaccine wastage

To reduce vaccine wastage, RHBs in collaboration with EPSA hubs, have organized training on EVM. However, only few health workers received the training, refreshers are not organized, and new recruits have not been trained. To improve the cold chain system, Fridge-tags are installed to continuously monitor the temperature system. Regional

EPSA hubs also practice transfer of near-to-expiry vaccines from one hub to the other with the aim of preventing wastage. Logistic trainings are also given to districts to improve their stock management system.

In some cases, EPSA hubs argued facility-level vaccine wastage is the issue of the RHB so they are not trying to mitigate it. The system also lacks strong vaccine audit including reverse logistic system. In general, there is no accountability for vaccine wastage and the attention given to reducing wastage is minimal. Vaccine wastage is not systematically monitored in most settings. Data on vaccine wastage is not regularly reported as expected.

> *"We don't have a system for monitoring vaccine wastage. We did not assess vaccine wastage independently for each vaccine" Key informant from Oromia RHB*

Established mechanism to disposed wasted vaccines appears to be lacking. Though HEWs are expected to incarnate vaccine wastes at their facility, during campaigns and outreach activities they sometimes leave the wastes in the field. Health centers also practice different ways of disposing vaccine waste, including disposing in the garbage pit to incineration. Many incinerators constructed at Regional EPSA hubs are not functional. Sometimes, vaccines are collected and incinerated in the presence of EPSA, Food and Drug Authority (FDA) and local security forces.

> *"We do not have any written guideline on how to dispose vaccine wastes. Also, we have not received any orientation" Key informant from Teltele woreda, Borena zone, Oromia region*

Reaching Special Underserved Populations

Hard-to-reach areas

Generally, the health care system has limited strategies to reach to hard-to-reach areas in a sustainable manner. Consequently, in such settings vaccination coverage is low and outbreaks of VPDs, especially measles, is common. In most of the districts that we included in the barrier-enabler study, measles outbreak was described as "common problem".

> *"Measles regularly occurs here. Previously we use to experience measles outbreak in several districts, three, four woredas. But this year we have experienced in only two woredas. Polio was also identified in Kucha." Key informant Gamo ZHD, SNNP region*

Nationally, Periodic Intensification of Routine Immunization (PIRI) is being implemented in selected 140 districts with low vaccination coverage. In Amhara region, intermittent mop-up activities by which health center staff provide special support to HEWs deployed in hard-to-reach areas has been reported. Hard-to-reach areas in Sidama region are irregularly reached through campaigns. however, areas that have not been reached for

more than a year had been reported in Chire woreda.

Many hard-to-reach districts also don't have adequate budget, motorbikes and vehicles to implement outreach activities regularly. The increasing demotivation of frontline health workers means they are more and more reluctant to serve hard-to-reach areas. According to a key informant from an NGO working in north Gondar area, HEWs are not willing to accompany them while they arrange mobile outreach service to hard-to-reach areas.

> *"In order to dispatch a motor bike there [to remote area called Jawi], we have to expend 2000-3000 br. That is simply unaffordable to us" Key informant from Agew Awi ZHD, Amhara region*

In Akobo woreda of Gambella region, lack of boats to reach areas cutoff by seasonal flooding is a major blockade. In Loka Abaya of Sidama region, some communities could not be adequately reached because they are located on the other side of the Bilate Military camp. A special permission is needed to pass via the camp and reach the communities. In Agew Awi and North Gondar zones, some remote areas are unsafe to health workers due to presence of bandits.

In regions like Sidama and Amhara, remote areas are too challenging for female HEWs. But male HEWs have not been deployed. As reported from Amhara region, female HEWs usually avoid traveling to hard-to-reach areas due to fear of sexual violence and because its physically challenging to them and they fear sexual violence. Hard-to-reach areas in Sidama region are irregularly reached through campaigns. however, areas that have not been reached for more than a year had been reported in Chire woreda. Conversely in pastoralist settings of Somali, Afar, South and West Omo of SNNP and SW regions, males are deployed as full-fledged or assistant HEWs.

> *"HEWs are afraid to go these remote villages because they are women" Key informant from Debariq WoHO, Amhara region*
>
> *"The HEP has to engage both male and female HEWs. It is not possible to cover hard-to-reach areas through female HEWs alone" Key informant from Semen Mountain Mobile Medical Services Organization*

People living around international and inter-regional boarder areas

People located near to international boundaries frequently have limited access to vaccination service and outbreaks of VPDs are common. Specially, areas bordering Somalia, Kenya and South Sudan are underserved. Limited access to service, conflict and presence of cross-boundary nomads are the underlying causes of VPD outbreaks in such settings. In Somali region, in districts bordering Somalia measles outbreak reportedly occur every year. In Gambella region bordering South Sudan, cross boundary ethnic conflicts limited vaccination service provision and utilization.

Remote areas of SNNP, SW regions bordering Kenya and Inter-regional boundaries (e.g., Sidama – Oromia, SNNP – Oromia, Amhara-BG) are also underserved due to inaccessibility, inter-regional migration, boarder conflicts and presence of bandits.

Inter-regional boundaries (e.g., Sidama – Oromia, SNNP – Oromia, Amhara-BG) are also underserved due to inaccessibility, inter-regional migration, boarder conflicts and presence of bandits. For instance, outbreaks of measles are frequent in Sidama region bordering Oromia; and in Amhara region bordering BG region. Boarder areas that had not been accessed for more than a year had been reported in Chire woreda of Sidama region. In the Sidama – Oromia boundary areas where people with mixed ethnic background are living, vaccination service is politicized and people don't want to get vaccinated by health workers with different ethnic background. This has contributed to low coverage in Chire woreda. In remote areas of Loka Abaya district, some communities are more accessible to the health facilities of the bordering Wolita zone but they don't get the service due to ethnic polarization.

Pastoralists

Pastoralist regions (Somali and Afar), districts (those in Oromia, Gambella, SW and SNNP regions), and isolated communities in Sidama and DDCA are not adequately reached with the EPI. Pastoralist settings are commonly affected by VPD and dropout is also common. Apart from the mobility and dispersed settlement pattern, pastoralists have limited access to health service due to poor road network and health infrastructure. Such areas are also prone to conflicts and security problems. Pastoralists frequently cross international and interregional boundaries (e.g., SNNP – Oromia, Somali –Oromia, DDCA –Somali region) making them difficult to serve.

"The pastoralist communities living in DDCA seasonally migrate to Somali region. But HEWs cannot cross and work there" Key informant from Melka Jeldu Health Center, DDCA

The existing HEP in most pastoralist areas is very weak and health posts are not functional for various reasons. Many health posts are also not strategically located near to water sources and pasture. HDA/WDA network is also non-existent in most pastoralist settings. In regions like Somali and Afar, health centers are the major service outlets for vaccination service.

"In our zone, most zero-dose children live in predominately pastoralist communities. Most live in the remotest areas bordering Kenya and South Sudan" Key informant from South Omo Zone, SNNP region

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Though manpower shortage is commonly reported across all the regions, the problem appears to be more pressing in pastoralist settings. Turnover of health workers is also very common. HEWs in pastoralist settings normally have weak academic background and skill

gaps. The hot climatic condition preclude HEWs from organizing outreach sessions and traveling to remote areas. In Borena, HEWs don't want to travel deep into remote areas fearing that they might be bitten by sandfly and develop leishmaniasis. Reportedly, HEWs are not regularly available at health posts due to climatic factors and shortage of water.

In most pastoralist areas there is no meaningful service delivery strategy that takes the nomadic nature of the population into consideration. Integrated mobile outreach strategy is only implemented in few districts that are being supported by partner organizations. Limited access to health institutions, shortage of transportation and manpower limit vaccination service provision to pastoralists. In Sidama region, limited efforts are being made to reach to semi-pastoralist communities located to Belate river. On a positive note, in Afar region, a practice of tracking the movement of pastoralist communities through the Dagu system has been reported.

"Health workers cannot reach the pastoralists over all that distance." Key informant from EOC-DICAC

"Pastoral communities remain inaccessible for 3 to 4 months during the dry season" Key informant from Hammer WoHO, SNNP region

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Demand-side barriers relevant to pastoralist areas include, low awareness about the benefits of vaccination, giving more value too food aid rather than health services, and reduced care seeking due to recurrent drought and adverse climatic conditions. High fertility rate and practice of polygamy also limit ability of parents to give optimal care to their children. Women's domestic workload appears to be higher in pastoralist communities like Somali and Surma.

"Due to the drought, people do not have time to bring their children to the health center. They have to move and search for water." Key informant from Kori WoHO, Afar region

"In Surma culture, women are expected to do everything including farming. Her husband observes while she works on the farm because he has already paid dowry, including cattle and a Kalashnikov, to her parents. She is simply too busy to bring her child to vaccination center" Key informant from Surma WoHO, SW Region

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Conflict-affected areas

In Amhara and Afar regions, due to the recent political conflict, outbreaks of VPDs (measles, pertussis) are being encountered very frequently and dropout rates have dramatically increased. Outbreaks are even being reported in urban areas like Debariq town. Even prior to the recent political instability, most of the conflict-affected areas have been underserved due to their physical inaccessibility. Conflict has seriously affected the delivery of vaccination service not only in northn Ethiopia, but also in western Oromia and pocket areas in SNNP, SW and Gambella regions. Transboundary conflicts affect health service provision in remote areas of Gambella.

"Due to the conflict, we have not provided any vaccination serve in these areas [two kebeles] for over nine months" Key informant from Hamer WoHO, SNNP Region

"Measles and whooping cough were previously eradicated, but after the discontinuation of regular vaccination services [due to the recent conflict], the diseases have reemerged" Kebele leader, Ewa woreda, Afar region

Though small-scale mop-up campaigns have been organized, conflict-affected areas have not been adequately reached so far. Despite the relative stability over the last few months, many areas (including those areas that were not under government control at the time of the study) remain unsafe and inaccessible to health worker. In many settings, bandits limited safe movement of health professionals and deployment to the field is not possible unless accompanied by security guards. In conflict affected areas staff turnover is also very high.

"Most health professionals in the conflict-affected areas have not started their regular work. Consequently, the vaccination program is not fully functional" Key informant from North Gonder ZHD Amhara region

The recent conflict in northern Ethiopia has caused widespread destruction of health facilities in Amhara and Afar regions. Though this study did not include Tigray, the situation there could even be worse. Looting of refrigerators and other medical and office equipment have also been reported. Some health facilities have been restored to provide emergency service. Yet, EPI is not considered as part of the emergency service package. Even a health facility that partly serves as a military camp has been reported. Despite repeated visits and pledge from many NGOs, conflict-affected areas have not received meaningful support so far. In conflict-affected areas of north Gondar, movement without carrying identity cards was not allowed and this has limited the care-seeking practice. In war affected districts of Afar (e.g., Ewa) meaningful health programs have not been implemented for more than a year.

"For example, there were four refrigerators in a health center, and all were completely destroyed. As a result, the facility could not provide vaccination service" Key informant from Debariq Zuria WoHO

"We have not been operating since July 2020" Key informant from Ewa WoHO, Afar region

The political instability has also far-reaching consequence beyond the conflict-affected areas because the attention of high-level decisionmakers has shifted to more burning political issues, resources are being diverted to the war and health workers have been deployed to war affected areas. EPI and other basic health services are also being monitored less frequently. In conflict affected areas of SW region, health workers have to be escorted by security personnel to provide health service in remote districts (e.g., Surma).

"From September to December 2021 we have been deployed to the warfront. So, we have not implemented any vaccination activities". A health professional from Debariq Zuria woreda

"As you may see, some of the health center rooms [including the EPI room] are occupied by soldiers. So, health service is provided in the remaining rooms. Clients were very hesitant to get service in such a situation. But now they have got accustomed to the soldiers" Health Professional from Dib Bahir Health Centre, Debariq Zuria woreda

"If there is budget, the police will be assigned to escort you and you will work safely. If there is no budget…..?" Key informant from a health center in Surma woreda, SW region

Internally displaced people

Generally, health facilities in the host community are responsible to provide all health services, including vaccination, to IDPs. Few IDP centers also have their own health workers and network of volunteer Community Health Workers (CHWs) employed and engaged by partner organizations like UNICEF and International Organization of Migration (IOM). IDPs are commonly reached through static and campaign--based activities. Typically, vaccination service is provided once per month or less frequently.

Some IDP centers (e.g., those in Afar and Sewena district of Oromia region) are located in remote areas where access to health services is limited. In such settings, woreda health offices are not able to provide immunization service due to shortage of vehicles and budget. Usually, no special resource is allocated for district health offices to reach to IDPs. As a result, providing only campaign-based polio vaccination is a normal practice.

"It has been more than two months since the vaccination service was given in this camp" CHW, Galimeda IDP Camp, Afar region

"Children in IDP centers are not getting vaccination like people in other settings. IDP centers are located far from health posts, we cannot reach them because of transportation problem" Key informant from Sewena WoHO, Oromia region

Among IDPS, in general vaccination coverage is low and dropout from the EPI is common due to multiple supply and demand-side barriers. From the demand perspective, vaccination is usually a secondary issue for IDPs who are struggling to secure the basic living requirements. During working hours their availability in the camp is also limited because they frequently move around. Many also don't have the financial resources for covering the transportation cost to travel to nearby health facilities.

"For the IDPs having infants, vaccination is a secondary issue. Their interest is food aid" Health professional working at Debariq IDP center, Amhara region

"Sometimes when health services are not provided as expected, the IDPs don't complain

or ask why the service is not available. They don't have the courage, because they are strangers to the community" CHA, Shimlaku IDPs Site, Dabat Worda

From supply perspective, the major challenges are unmanageable large IDP size that overwhelms the already weak health system of the host community, assimilation into the host community, shortage of refrigerators at the camp clinics and lack of information about the vaccination history of the children. Conversely, few IDP centers are too small to get attention. Furthermore, many district health offices have limited information about the number and whereabouts of the assimilated IDPs. Even the information about the in-camp IDPs is not continually updated. In Afar region, vaccination is not provided optimally to the IDPs reportedly because of shortage of vaccine supply.

"[in this makeshift health facility], the major problem is absence of vaccine supply. That's why children are not getting vaccinated. Even if there is vaccine, there are no refrigerators and cold boxes to store the vaccines." Health worker from Galimeda IDP camp, Afar region

Health services provided for IDPs are also not well integrated so missed opportunities are common. Reportedly, little has been done to integrate humanitarian supports with health services like vaccination. Voluntary CHWs play important role in awareness creation and mobilization of the IDPs. However, the network is not strong in many camps and different standalone networks are established by NGOs for implementing various programs. There is also no mechanism for recognize and motivate good performing CHWs.

"When vaccination and food aid are provided together, many children were brought forward. But when you say only vaccination is available, the IDPs reject you" Health professional working at an IDP center in Sewena woreda, Oromia region

Vaccination programs in IDP centers are not adequately supervised by the government because performance plans are not integrated into the WoHO plans. IDP coordinators are also not represented in PMTs. Health officials in the host communities covertly reflected that they are not responsible or have no resource to service IDPs.

"If we provide vaccination service to the IDPs then we will not have adequate vaccine for the local community. We are receiving inadequate vaccine supply" Key informant from Asita hospital

Refugees

According to an informant from Refugees and Returnees Service (RRS), zero-dose and underimmunized children are unlikely to exist in refugee camps, because CHAs implement community-based tracing and referral. However, new entries are usually under-immunized, and outbreaks occur in refugee centers before they get admitted into camps. Recently

the same has happened in Dolo Ado area. Key informants from Somali RHB reported that vaccination coverage in refugee camp is much better than in the host population.

According to the Disease Prevention Coordinator of RRS, the agency, with the support of UNHCR, MoH, UNICEF and WHO, is extensively engaged in provision of vaccination service and implementation of integrated SBCC activities. Vaccination service is provided at local health centers and satellite clinics at the camps. Service is also being provided through static and outreach modalities. Child health days and supplementary vaccination campaigns are organized for mopping-up under-vaccinated children.

UNHCR regional officers reported integration of vaccination service with nutrition/food aid programs has improved uptake of vaccination service by refugees. Defaulters are also being tracked by community health workers and through implementing defaulter card system. According to top level officials from RSS and UNHCR, in general, there is no systematic blockade that prevent refugees from utilization vaccination service. Ethiopia has a vaccination program for refugees, and partner organizations working in refugee camps receive vaccination supplies from the existing system.

Service delivery related barriers that hinder provision of vaccination service in refugee population include inaccessibility of camps. In terms of HRH-related factors, staff turnover and demotivation of health professionals and community health workers in the camps are key boatnecks. Health workers are demotivated due to inaccessibility of refugee centers, high workload, and inadequate remuneration.

In refugee population, the extent of acceptance of vaccination is heterogenous depending on the culture of the source population they originated from. Usually, refugees show vaccine hesitancy until they get adequately exposed to SBCC interventions. The also frequently travel in and out of the camp, or cross boundaries, without notifying authorities contributing to dropout from vaccination program. This is especially common in camps found in Gambella and Somali regions. Instability of the refugee population also affects ground level implementation of vaccination program. Conversely, one important facilitator is the fact that refugees require to complete vaccination for moving abroad.

Pertaining to vaccination supply, shortage of vaccines has been encountered in refugee camps located in Gambella, Somali and BG regions due to large influx of refugees and interruption of vaccine supply secondary to political instability. Inadequacy or failure of refrigerators is also a major challenge. According to regional UNHCR officers, open vaccine wastage is not a major concern because of large clusters of refugee population.

According to key informants from RRS and UNHCR, in each camp a health system comprising a medical director, health professionals and network of CHWs has been established. At ground level volunteer CHWs are actively engaged in linking refugees with the health service in the host community. They also engage in community mobilization, awareness creation, organizing outreach and campaign activities, and tracing defaulters.

However, in the camps that we studied, specific clinics that provide vaccination service to the refugee population were not available. Refugees are rather linked with the health facilities in the host community and get vaccination services for free. Health professionals in the camps provide static vaccination service for new arrivals. Refugee camps also get vaccine supplies and trainings from the nearby woreda health office. Outreach sessions are scheduled at the camps by district health offices.

According to partner organizations like UNHCR, in general accessing refugee population and tracing defaulters is not challenging because refugee camps are located in accessible setting in concentrated manner. But, outbreak of measles intermittently occurs specially among new arrivals. As refugees get vaccination service from health facilities found in the host communities, all the boatnecks of the health system affect them as well.

Conversely, among Somalian refugees located near to Kenyan border dropout is common because of free movement of refugees across the boundary. The refugees sometimes miss appointments because they are not familiar with the Ethiopian calendar. In Gambella region, lack of clear distinction between the host and refugee population affects health service provision. In order to access food aid, host community members present themselves as refugees.

The situation of the refugee camps located in the conflict-affected north Gondar zone is entirely different. The camp was recently shifted from Tigray region and due to the recent conflict in the area, supply of vaccines and medications had been interrupted for months. The health facilities in the host community are also not functioning well. As a result, vaccination coverage is unsatisfactory.

According to the refugees, strong SBCC for promoting vaccination appears to be absent in the camps. Alike the host communities, small scale misconceptions like malnourished children should not be vaccinated, vaccination may cause disability and receiving multiple vaccines at a time my harm the baby, have been reported. Most of the discussants also take vaccine side effects seriously, and this was reported as a major reason for not vaccinating or discontinuing vaccination. According to the FGDs that we conducted with caregivers in refugee camps (Eritrean and South Sudanese refugees), knowledge towards vaccination appears to be suboptimal. Many caregivers could not correctly identify the common VPDs and listed scabies and intestinal parasites as VPDs. Many refugees also assumed that vaccination should be started at 45 days of age. However, the general attitude of both the refugees towards vaccination was positive.

Frequent interruption of vaccine supplies especially in refugee camps found in conflict-affected areas of north Ethiopia was reported as a major challenge. Absence of health facilities in the camps, frequent transfer from one camp to another, unpredictable flow of refugees, long waiting lines at nearby health centers and language barriers between health workers and the refugees have been identified as challenges as well. Unlike the responses we got from high-level respondents during our situational analysis, there appears

to be weak link between vaccination service and food aid programs. One challenge for integration is the two services are usually provided by different bodies.

> *"They do screen our children for malnutrition and provide treatment when needed. But they don't ask about their vaccination history" An Eritrean refugee in Alem-Wach camp*

Underserved communities in urban settings

In general, vaccination service coverage is satisfactory in most urban settings like Addis Ababa, Harar, Dire Dawa and other towns. Coverage usually exceeds 100% due to faulty conversion factors or in-migration from adjacent regions. High coverage figures due to underestimated denominators usually provide false reassurance to health officials.

> *"Based on the understanding that Addis Ababa is major city, many assume that the vaccination coverage is satisfactory. But people who have migrated from the surrounding areas of Oromia have not been adequately reached" UNICEF Focal Person, AACA Health Bureau*

Urban slums, impoverished and street families, daily laborers and urban communities bordering other regions (e.g., parts of AACA and Harari region bordering Oromia; parts of DDCA bordering Somali and Oromia regions) have relatively lower vaccination coverage. Sporadic occurrence of VPDs (specially measles) has also been reported in urban areas like DDCA and Harari, particularly in areas bordering rural communities. Though DDCA and Harari region are considered urban regions, they also include rural populations having relatively low access to services. DDCA also includes small migratory pastoralist communities. In SNNP region, reportedly zero-dose and under-immunized children are common in urban settings like Arba Minch, Chencha and Selam Ber. Apart from the static service, the urban health system has limited mechanism to reach to disadvantaged communities.

> *"There are zero-dose children among street families.Providing service to such families is challenging because they are mobile" Key informant from Addis Ketema Sub-city Health Department, AACA.*

Urban settings also include families that are difficult to serve due to various reasons including unavailability at home during working hours, keeping doors closed for health workers due to security concerns and doubting the skill and trust of HEWs. Sometimes educated and well-to-do urban dwellers reject vaccines based on rumors circulating on social media.

Surveillance of Vaccine Preventable Diseases

The Ethiopian disease surveillance system monitors more than 20 epidemic-prone diseases targeted for eradication/elimination including Acute Flaccid Paralysis/polio, measles, and neonatal tetanus, and other diseases of public health importance. Among VPDs, measles outbreak frequently occurs in hard-to-reach, conflict-affected and pastoralist communities. According to regional Public Health Emergency Management (PHEM) officers, the underlying causes of outbreaks are poor vaccination coverage or presence of clusters of unvaccinated children. Some also blamed it on externalities like drought.

> *"Most of the time what we observe in measles outbreak settings is that 70% or 80% children are not vaccinated" Key informant from PHEM team of Oromia RHB*

The PHEM system normally collects surveillance data based on weekly reports. In many regions active case search is not regularly implemented due to budget constraints. When suspected cases are identified, samples are taken and sent to EPHI for laboratory confirmation. If the result is positive, this will be communicated to relevant bodies for action. When an outbreak is detected, a rapid response team which consists of clinicians and other surveillance members is deployed. Although the importance of operational research for disease surveillance is evident, in most of the regions, the PHEM system do not have senior researchers.

The role of PHEM in monitoring of adverse events following immunization (AEFI) activities is limited, if not none. There is also role confusion whether AEFI has to be followed by PHEM's or EFDA's system. Unlike other regions, in AACA, AEFI has received better attention and it is being reported.

> *"With regard to monitoring of adverse effects following immunization, PHEM's mandate is disease notification as it is clearly stipulated in the National Guideline. This is the responsibility of the EFDA not ours." Regional PHEM Officer*
>
> *"Previously adequate attention was not given to AEFI. It was not an area of focus, there were no reports and appropriate responses. Currently reporting AEFI is part of our job." PHEM Officer from AACA*

The surveillance information system is not fully digitized. For instance, lower-level health systems report paper-based data to the central/regional institutes. There are also major data quality concerns. The low value given to data and lack of accountability contributed to poor data quality.

> *"One reason for poor data quality is the low value given to data at all levels. There is no system of appreciation for good performers and accountability for poor performers." Regional PHEM Officer*

In most the regions, the presence of a relatively strong PHEM structure and a national guideline would be considered as strengths. However, the small health workforce especially at district and health facilities levels has limited the capacity of the system to easily detect and respond to epidemics. The surveillance system in the pastoralist regions is weak and there is a high chance that easily preventable diseases might develop into an epidemic. Although there is a strong surveillance system in place in AACA, more emphasis is given to outbreak control than prevention. Leaving routine activities aside and focusing on a campaign is also threatening the national PHEM system.

> *"A weakness of the PHEM system is focusing on campaign activities and most of the time we are engaged on controlling an outbreak rather than engaging in prevention." Regional PHEM Officer*

Partnership for Vaccination

As compared to other programs, partners' interest to support EPI is better at all levels of the health system. GAVI is the major donor covering nearly four fifth of the national budget for procuring vaccines. It also supports administration and supply of other vaccine commodities. In many EPSA hubs, with the support of GAVI, cold houses have been built or renovated. GAVI is supporting different initiative related to data quality, human capacity development, and supportive supervision. USAID, Bill & Melinda Gates Foundation, and Rotary International are also important indirect donors.

UNICEF is a major/core partner supporting the health system at all levels and in almost all regions. UNICEF provides technical and financial supports and build the human capacity of the health system. With funds from GAVI and Ethiopian government, UNICEF procures the national vaccine supply and is heavily engaged in the vaccine logistic system. At lower levels of the health system, UNICEF is involved in demand promotion, supporting microplanning, M&E and data quality assurance activities. Along with polio and measles vaccination campaigns, UNICEF conducts Random Convivence Surveys (RCS) and the information is used to inform M&E efforts. The agency also works towards reaching underserved urban population via urban immunization support program.

UNICEF also works towards reducing vaccine inequity through identifying and targeting equity zones. In most of the under-served settings that we studied; UNICEF is the only partner supporting the EPI program technically and financially. UNICEF quarterly support many districts with modest financial support. UNICEF and GAVI also support selected districts with low vaccination coverage by implementing the PIRI program.

WHO is another core partner for the national vaccination program at federal and regional levels. The agency provides technical and financial assistance to FMoH, RHBs, EPHI and PHEM system. In terms of monitoring and evaluation the EPI, WHO is considered as the lead partner. WHO is engaged in supporting microplanning, introduction of new vaccines,

surveillance of VPDs and development of training manuals. The agency supports the PIRI program.

CDC is among the core partners providing technical support to the ministry and RHBs. CDC is working to reduce dropout rate and missed opportunities in the vaccination service. CDC promotes defaulter tracing through strengthening the ticklers boxes system. CDC develops and distributes different EPI tools and documents. Recently the center distributed the fridge tag technologies in mass for monitoring the cold chain system. In Oromia region, the organization is supporting selected zones in improving data quality and M&E activities. CDC is also engaged in human capacity development through organizing trainings.

In relation to refugees, UNHCR, UNICEF and WHO are providing technical and financial supports to RRS/ARRA. UNHCR provided vehicles and motorbikes dedicated for serving refugees and is involved in the direct implementation of vaccination programs among refugee in Somali, Gambella, and BG regions. It also covers personnel costs of clinics found in refugee centers. UNICEF is also engaged in supplying and installing SDD refrigerators to the health facilities found in the host communities.

CHAI is heavily engaged in supporting the establishment and maintenance of the cold chain system and monitoring temperature at all levels of the system starting from the central EPSA. CHAI is engaged in supporting the EVM, including installment and maintenance of refrigerators in multiple regions. In Afar and Somali, the organization assisted regional level planning, review meeting, performance evaluation, and supportive supervision. In urban areas the organization worked towards strengthening public-private partnership for immunization program. CHAI has also supported the recent introduction of PCV in Ethiopia.

PATH is supporting the MoH and selected two regions (Afar and Somali) to improve coverage and access to routine vaccination service and advance vaccine equity. The organization engages in advocacy and demand creation activities and supports data quality and initiatives including strengthening of the DHIS-2. PATH supports the implementation of the PIRI program in Afar and Somali regions.

Transform PHC/JSI had provided technical support to many regions, spearheaded the introduction of the mBrana system, supported the EVM initiative (BG and Sidama regions) and facilitated microplanning and use of data for decision making (Gambella region). Amref Health Africa/Transform HDR is working in BG, Afar, Gambella and Somali regions on quality improvement initiatives and community mobilization. Save the Children technically and financially supported Gambella, Afar and Somali RHBs by donating motorbikes and implementing ground level vaccination programs.

Many RHBs have established EPI Task Forces or Technical Working Groups (TWGs) involving major EPI partners, and this has improved the coordination among stakeholders.

The Task Forces are engaged in mobilizing resource, reviewing, and evaluating EPI programs, and overseeing implementation of vaccination campaigns. However, in many cases, Task Forces don't regularly convene limiting their effectiveness. In Gambella and BG regions Cold Chain Taskforce are also established and are working towards improving the cold chain system. Some regions (e.g., Gambella) reported difficulty to establish effective coordination among their partners.

Across all regions target areas for partners are determined in consultation with RHBs. Nevertheless, reportedly, in regions like BG region distribution of partners remain somehow unfair. Similarly, the newly established SW region has limited partners and only Transform PHC (apart from WHO and UNICEF) is supporting them. Predominately urban regions (AACA, DDCA and Harari regions) also have few partners. In developing regions like Gambella and BG, it has been reported that partners don't want to work in remote districts. Sometimes NGOs phaseout their programs without establishing ownership in system.

Respondents from the zones and woredas of Somali, Afar, Gambella and SW regions complained about the absence of partners to support them on EPI. Key informants from the predominately urban regions also complained the same. Reportedly, most of the existing partners in Somali and Afar regions are focused on nutrition-related programs. On safety concerns, reportedly NGOs also avoid working in remote and boarder districts. Most of the partners implement immunization program for a short period of time so meaningful change does not occur. Sometimes NGOs conclude their program abruptly to cause sharp decline in vaccination coverages.

> *"Vaccination coverage is decreasing; it is not like before. It used to be supported by an NGO, but now the program is discontinued due to security concerns" Key informant from Kibish Health Centre, Surma woreda, SW region*
>
> *"Our district used to be supported by the PIRI program, recently the support has been discontinued abruptly and we don't know why. The RHB said nothing why it has been discontinued" Key informant from Gikawo WoHO, Gambella region*

Higher learning institutions can potentially contribute to the EPI through conducting independent service coverage surveys. Yet, they have not been meaningfully engaged so far.

FORMATIVE ASSESSMENT

Making progress towards reaching zero-dose and under-immunized children requires a granular understanding of where there are gaps in access or uptake, why those gaps exist, and what can be done to address them. The findings of zero-dose quantitative and qualitative studies showed that vaccination service was delivered in most regions of the country through various approaches such as static, mobile, outreach and campaign-based strategies. However, regular implementation of these approaches is lacking due to multiple factors. Therefore, the zero-dose evaluation study tried to address those important questions and forwarded key recommendations to strengthening existing strategies and to build new innovative strategies to reach zero-dose and under-immunized children in underserved setting population in Ethiopia. Presented below are some of the identified gaps in the implementation of these strategies, lessons learned from other countries' experiences and how they can be efficiently implemented in underserved and special setting population in Ethiopia.

Mobile Health Services for Developing and Pastoralist Regions

Recent estimates indicate that about 120 million pastoralists and agro-pastoralists live worldwide, of which 41.7% reside only in sub-Saharan Africa (SSA). Pastoralists live in areas often described as marginal, remote, conflict prone, food insecure and associated with high levels of vulnerability. Pastoral communities of Ethiopia occupy 61% of the total land mass and 97% of Ethiopian pastoralists found in low land areas of Afar, Somali and Borena, parts of Guji, Bale, parts of East Hararghe zones of Oromia, and South Omo and Bench Maji zones of SNNP and SW regions (Mohammed, 2019). According to our findings, the performance of pastoralist areas is relatively lower compared to other parts of the country.

Mobile service delivery is important in areas with limited health infrastructure, mobile populations and scattered and conflict-affected areas, and improves access to life-saving health and nutrition services. In Afar and Somali, and Oromia (Borena and Guji) and Gambella (Neur and Anuak zones) implemented the mobile health services approach mainly focusing on Nutrition services. On other hand, SNNP, SW and Amhara regions also have implemented mobile health services with a limited experience.

However, the mobile strategy has not been effective due to several reasons including shortage of resources, scarcity of partners to support the initiative, limited number of mobile teams, irregularity in field deployment, and wide catchment area. In Somali and Afar regions, as the mobile teams are operating under PHEM, they are more focusing on nutrition and emergency responses while overlooking the vaccination services. In the same regions, the mobile teams are deployed and managed by RHBs, so the service

provision has not been decentralized to the lower level. As reported from Afar and Somali regions, mobile service provision has not been accompanied by community mobilization. The other threat to the engagement of the team in vaccination program is the difficulty in maintaining the cold chain system during prolonged field engagement in hot climatic settings. In general, the health system lacks a strong mobile outreach system to reach the underserved setting population in pastoralist and developing regions in Ethiopia.

A study done in Afghanistan, a country with an increasing level of conflict, showed a consistent association between implementation of mobile services and improved coverage of important MCH services including vaccination. The study concluded that mobile service is an essential service and not just an extra option for the most hard-to-reach and deprived mothers and children in Afghanistan. Governments and funders of health programs with remote and conflict-affected populations need to invest in the implementation and evaluation of mobile services (Edmond et al., 2020).

A study conducted in underserved communities in Nigeria thought to be at substantial risk for polio transmission also demonstrated and justified the use of resolute mobile teams to improve not only polio immunization but also routine immunization coverage, delivery of other basic PHC services, and improved community linkages. Over implementation period of two years, the percentage of children aged 12–23 months seen with a vaccination card increased from a mere 19% to 49%. Full immunization coverage also went up by a similar margin (16% to 50%). The increase in routine coverage was significant but still lower than the expected coverage of >80% (Ongwae et al., 2017).

Therefore, the following context-specific approaches are suggested to be implemented in developing regions and pastoralist communities of Ethiopia.

- Mobile approach should be considered as part of a comprehensive strategy to reach all target populations during annual EPI microplanning and updated regularly.
- In the development of the microplanning process, key stakeholders such as health staff from all levels of the health system, community leaders, woreda administration and other relevant sectors should be included.
- It is also important to secure funding for mobile services through mobilizing from the government, development partners, CSOs and communities
- Capacity building of health care workers (HEWs, health staff, woreda health office staff) on developing REC/RED micro plan, identifying underserved target and monitor immunization services is critical.
- Engaging available and relevant community platforms (religious and clan leaders, traditional birth attendants, volunteer community members, women, and youth associations) to identify and reach all eligible children in their catchment area.
- Increase and implement the number of service delivery points for missed communities in areas that cannot be reached by regular static approach through expanding outreach and mobile sessions.

- Establish strong link between PHEM to MCHN directorates in the management and deployment of mobile outreach teams.
- Mobile and nutrition health teams should be engaged and should be owned by government.

Hard-to-reach Areas

Outreach vaccination service

Hard-to-reach areas include rural remotes, off-roads, distant from health facilities and difficult topographical features (mountains, hills, depressions, crossing large rivers/lakes etc.). Outreach vaccination service is the provision of vaccination services by healthcare providers who travel from a fixed center to surrounding villages (above 5 kilometers) on foot, by motorcycle/horse/mule and return to base the same day. According to our findings, some of the challenges associated with the implementation of outreach modality include: shortage of budget, inaccessibility of outreach sites due to multiple factors, missing outreach sessions and work overload of HEWs. In almost all regions, shortage of motor bikes, vehicles, bicycle and fuel and operational costs limit implementation of outreach program. Therefore, the following context-specific approaches are suggested to be implemented in hard-to-reach, IDPs and conflict affected areas of Ethiopia.

- Strengthen and engage community platforms (religious and clan leaders, traditional birth attendants, volunteer community members, women, and youth association) and CSOs to help in identifying and bringing zero-dose and under-immunized children in their catchment areas.
- Develop a strategy for staff retention especially in developing and pastoralist regions.
- Advocate to mobilize resources for increased allocation of budget for operational cost to conduct outreach vaccination services. Conduct catchup vaccination in conflict affected areas and then restore routine immunization services through maintaining and equipping damaged health facilities.
- Conduct integrated immunization service with other key services.
- For areas not fully managed by government, partner with CSO, NGOs and UN-agencies and fully leverage the Gavi ZIP REACH intervention to provide complementary services.
- Strengthening public private partnership with private for-profit and non-profit health service providers to increase access to vaccination and basic package of health care services.
- Strengthening the HEP to help in identifying and linking zero-dose and under-immunized children in their catchment areas.
- Integrating vaccination to services provided by mobile clinics, Faith Based Clinics and all primary health facilities established.
- Strengthening multi-sectoral collaboration and engagement for the integrated service provisions including EPI.

Strengthening the PIRI program

PIRI is a term that describes a spectrum of time-limited, intermittent activities/campaigns used to administer routine vaccinations to unvaccinated and under-vaccinated populations and/or raise awareness of the benefits of vaccination. PIRIs can take many forms such as global and national vaccination days/weeks. The vaccine doses provided during a PIRI activity are considered routine immunization services (Njoh et al., 2022).

Vaccination through PIRI can be provided in all settings where vaccination coverage is low including urban, semi-urban, non-remote, remote rural areas and mobile population. Therefore, the following context-specific approaches are suggested to be implemented in hard-to-reach, IDPs and conflict affected areas of Ethiopia.

- Use updated demographic data to develop micro planning and to forecast the required amounts of commodities.
- Convene frequent meetings with stakeholders participating in the implementation of PIRI to secure resource, commitment, and service integration from a broad base of support
- PIRI needs to be performed by each PHCU in its catchment area.
- Mobilize resources for the implementation of PIRI
- Establish strong referral linkage with the health facilities to ensure continuity of service Capacity building of health care workers (HEWs, HC staff, woreda health office staff) in the planning and implementation of PIRI Develop, implement, and monitor integrated district and PHCU level micro-plans that address gender and equity barrier (support each health facility to develop facility level micro-plan particularly identifying and targeting underserved communities)
- Strengthen PHCU structure (linkage between health center and health post) to conduct regular monitoring and evaluation of immunization performance. Implement targeted PIRI activities - quarterly across woredas

Strengthening Static Service in Accessible Rural, Semi-urban and Urban Slum Areas

Non-remote rural areas are densely populated areas relatively not far from the health facilities and/or have road access. In these areas, Health facilities are available as per the national standard. Such areas have to be reached through strengthening the static vaccination platform.

Despite the recent direction by the MoH to provide static vaccination service on daily basis, regular availability of the static service remains limited. In many settings static service is not being provided on regular basis due to closure of health facilities, unavailability of health workers, shortage of refrigerators, frequent campaign-based activities, lack of active demand for vaccination, shortage of vaccines and scheduled provision of the EPI service. Limited case flow and fear of vaccine wastage also limited the attention provided to the static approach.

Providing statistic vaccination service only once in a month or once a week are frequently reported as targets or success stories. In BG, Gambella and SW regions, some health posts irregularly provide static service, and the community assumes the routine service is no more available. In Sidama, health posts may only provide static service during market days. In Afar and Somali regions, due to "climatic factors" vaccination service is not provided in the afternoon. In predominately urban regions usually vaccination service is only provided in the morning hours. The single most important barrier to provide static vaccination service is shortage of refrigerators at health post level. Across all the regions (excluding urban settings), health posts frequently don't have their own refrigerators, and vaccines are rather stored in the nearby health centers.

Strengthening and expanding static vaccination service delivery points needs to the primary focus in the immunization system. The following context-specific approaches are suggested to be implemented through static services.

- Ensure for the health facilities are providing immunization service on daily bases and close monitoring and follow up service provision.
- Schedule fixed days other than working days to provide opportunities for parents to vaccinate their children such as evening/weekend sessions.
- Organize outreach services and/or targeted PIRI to slum areas in city administrations (regional capitals and other major cities).
- Capacity building of health care workers (HEWs, health center staff, district health office) and accountability mechanisms to improve quality of service.
- Strengthen planning, monitoring and evaluation system for the EPI services to identify and reach underserved populations.
- Strengthen birth registration with electronic methods/digital systems like eCHIS to identify newborns and zero-dose children.
- Work with vital statistics and civil registration to track and link newborn children to health facilities particularly to urban slum areas.
- Work/advocate to expand the roll of urban HEWs and/or Family Health Team to provide routine immunization services in the city administrations.
- Integration of routine immunization service during other national wide supplementary immunization activities like campaigns for measles, polio etc.
- In slum areas having no health facility within the catchment area, work with private health sectors to provide routine immunization service to the slum population; and establish outreach and temporary fixed sites to provide the vaccination services.
- Develop, implement, and monitor integrated district and PHCU level micro-plans that address and consider gender and equity barrier.
- Support each health facility to develop facility level micro-plan particularly identifying and targeting underserved communities.
- Vaccinate children with false contraindication.

- Improve communication skill of health care workers to avoid lack of information/ misinformation of vaccines.
- Increase male/fathers' involvement to decrease gender and related barriers.
- Reduce waiting time through extending service delivery points (additional outreaches and mobile as appropriate) and hours as per the national immunization guideline across targeted facilities.
- Strengthen and expand the role of urban HEWs and/or Family Health Team to improves routine vaccination services in urban settings.
- Organize regular supportive supervision to health facilities to monitor the use of micro plans for planning immunization session monthly
- Reaching every hard-to-reach area through local mapping of target children for vaccination.
- Improve leadership and management of health facilities to increase services availability on regular bases.
- Improve vaccine logistic system at PHCU level especially at the health post level.

IDPs, Conflict-affected Areas and Refugee Campus

IDPs are people displaced from their homes/ place of habitual residence because of human induced and natural disasters. Conflict affected areas are places where conflict is prevalent. Refugees are people who have fled war, violence, conflict, or persecution and have crossed an international border to find safety in another country. Based on our zero-dose survey report, in 2022 conflict-affected settings and IDPs have considerable load of zero-dose and under-immunized children. Conversely, the contributions of refugees and urban slums were relatively lower.

The qualitative B&E study identified many supply and demand-side barriers in these settings. Road blockages due to conflict is frequently interrupting vaccine supply. For example, the current political instability in north Ethiopia has also affected the vaccine logistic system in Afar and Amhara regions and vaccine supply to western Afar has been also compromised due to interruption of supply from Mekelle and Dessie hubs. The conflict in western Oromia and BG regions has also disrupted the vaccine supply in the areas for more than 6 months. Sporadic political instability in SNNP, SW and Gambella regions also affect the logistic system. In addition to political instability, poor road conditions and adverse weather conditions like flooding hamper timely distribution of vaccines in regions like Gambella, SW and Amhara.

The following strategies and interventions are recommended to reach IDPs, refugees and conflict-affected areas.

- Advocate to mobilize resources for increased allocation of budget for operational cost to conduct outreach vaccination services. Conduct catchup vaccination in conflict affected areas and then restore routine immunization services through maintaining and equipping damaged health facilities.

- Conduct integrated immunization service through hit-and-run approach in conflict affected areas in Ethiopia. Quick in-and-out operations, using windows of opportunity, such as temporary cease fires, to access the targeted area and conduct vaccination within a short timeline.
- For areas not fully managed by government, partner with CSO, NGOs and UN-agencies and fully leveraging the Gavi ZIP REACH intervention to provide complementary services
- Work with security forces in conflict affected areas to facilitate transportation of vaccines and other supplies needed for immunization. Vaccination at transit points with frontline workers placed at the borders to vaccinate those exiting or entering hard-to-access and security compromised areas.
- Establish a cross-border vaccination team to reach cross boarder migrants.
- Strengthen vaccination services at health facilities/clinics established in refugee camps.
- Conduct integrated immunization service through hit-and-run approach at zonal level in conflict affected areas in Afar, Amhara, Oromia, and BG, Tigray regions.
- Integrating vaccination to services provided by mobile clinics, Faith Based Clinics and all primary health facilities established in refugee camps.
- Strengthening multi-sectoral collaboration and engagement for the integrated service provisions including EPI.

Cross-cutting Issues

Using innovative technologies including drone technology

Drones are one of the developing technologies that are reshaping the transportation system in many parts of the world including low-income countries in Africa. Earlier, the main use of drones was for a military expedition; however, today the drones can be seen in commercial and civilian use, making their way in several other sectors such as e-commerce, mining, chemicals industry, forest conservation, construction, geography mapping, filmmaking, petrochemicals, public safety, and many others.

Similarly, the healthcare industry is no exception to drone delivery systems. Drones are providing a new dimension to the healthcare system and consumers. Extensive research is already being done in this area with some countries beginning to benefit from this type of drone application. Unmanned Aerial Vehicles (UAV) appeared to be a possible good alternative for delivering medical supplies (like blood samples, vaccines and other medicines) to non-accessible areas and in temporary efforts during emergencies. The quality of vaccines or blood samples carried by traditional methods and UAVs remains almost the same (Haidari, et al, 2016).

For instance, different health material transport initiatives have been tested in Switzerland, United States, Netherlands, Bhutan, Papua New-Guinea, Tanzania, Rwanda, Ghana, Malawi and Haiti, even along with the support of UNICEF, MSF or WHO (Haidari et al., 2016; Ochieng et al, 2020). These drones have a load capacity of up to 2 kg, their autonomy is about 30-40 minutes and are able to cover 10 km in 18 minutes at best.

The future use of drones in healthcare also is very thought provoking. The rapid delivery of vaccines, medications and supplies right to the source could quash outbreaks of life-threatening communicable diseases. Finally, while Remotely Piloted Aircraft Systems for the transportation of health materials are proved to be time efficient in emergency scenarios in good weather conditions, their potential remains limited by their size and design, meaning they will probably not replace helicopters for larger essentials deliveries, but they will serve as a complement (Emery, 2016).

Therefore, based on the above-mentioned experiences and recommendation we suggested the following strategies and interventions in Ethiopia immunization services to reach zero-dose and under-immunized children in underserved setting population Ethiopia, especially in hard-to-reach remote areas.

- Explore the different possibilities of vaccine delivery strategies in remote rural and conflict-affected including drone technology.
- Identify and map the areas which area eligible for drone-based vaccine supplies. If feasible, implement the vaccine transport through drones in the identified and mapped areas.
- Use of electronic registration for vaccinated children to have a better information system which may play a key role in producing the information that will guide the strategic, managerial, and operational decisions of the EPI. The ultimate goal is to have information that fulfills three criteria: quality, coverage, and credibility.
- Sending reminder text message using smartphones to caregivers can be used as quick default tracing mechanism in urban and semi-urban areas where access to smartphones is high.
- The systems also produce essential data for monitoring and accountability, both from an administrative standpoint (to higher hierarchical levels) and to the beneficiary population in general.

Integrating vaccination service with other essential services

Lack of horizontal service integration was identified by the situational analysis as one of the key service delivery bottlenecks that must be addressed to reduce vaccine inequity and missed opportunities for vaccination. Immunization program has not been adequately integrated with other MCH services including nutritional screening, vitamin A supplementation and family planning, which resulted in high missed opportunity. Sometimes mothers following ANC or giving birth at health facilities do not receive adequate orientation on vaccination. Sick infants coming to health facilities are not adequately screened for vaccination status. Health campaigns are usually organized for predefined and specific services making integration impractical, the potential of multi-sectorial integration, like that of integration with PSNP has not been explored.

There are several lessons learned from coordinating immunization activities with other services such as MCH services and nutrition programs.

First, integration of child survival interventions minimizes redundant activities (e.g., health worker supervision), thereby reducing costs. Second, leveraging the existing infrastructure by conducting activities in a mix of health-care posts including schools, health facilities, and community vaccination posts was critical in reaching the target population. Most importantly, the programs found that coordinated co-implementation is a potential and often overlooked solution for increasing the coverage of community-based programs without compromising quality. This coordinated approach is also important for health system strengthening, where cross-sector activities can be used to drive broader system improvements (Mwingira et al., 2016)

Here are possible mechanizes by which immunization and other services can be integrated.

- Review the existing tools and process to identify key challenges/ barriers for integration and develop a strategy to address them.
- Develop guidelines and tools for integrated supportive supervision and performance review at all levels.
- Collaboration with other programs that provide community level services such as Nutrition programs, PSNP, Water, Sanitation and Hygiene (WASH), and school heath activities.
- Conduct integrated outreach immunization sessions to hard-to-reach areas by increasing sessions in each district.
- If vaccines are delivered through campaigns, adding non-vaccine related interventions should be carefully planned on a case-by-case basis, not to compromise the vaccine service quality. If there is a demand for them, the integrated approach can in turn positively impact the vaccination outcome.
- Provide training on integration of EPI with other essential services at all levels. Use disease-focused campaigns such as measles and polio SIA to integrate with multi antigens to reach missed children
- Integration of routine immunization with COVID-19 vaccination Integrate COVAX resources (TAs, cold chain equipment and funds) to strengthen routine immunization.
- Advocacy to leadership to ensure routine immunization is part of the attentions including in allocation of resources for integration
- Accelerate the endorsement of catch-up guideline and consider integration during implementation.
- Clients who visit the health facility for maternal, child, nutrition and other related services should be linked to immunization service. Services such as MCH services and nutrition programs should be provided in an integrated manner.
- The health sector should work closely with organizations/partners supporting people to integrate immunization services with maternal and child health and nutrition services.
- Strengthening monitoring mechanism for integrated EPI and other services.
- As resources are always in short supply during an emergency, integration of vaccination delivery with other humanitarian interventions is essential to success.

Engaging private and civil society health facilities in EPI

The global immunization community is increasingly urging countries to engage more closely with the private sector in coordinating, planning, and monitoring immunization activities. In April 2017, the WHO's Strategic Advisory Group of Experts (SAGE) recommended that national immunization programs increase their collaboration and communication with private providers, and as a first step, assess the private sector's role in immunization service delivery. Moreover, in the 2017 SAGE Decade of Vaccines GVAP Assessment Report, one of the key recommendations stated that 'Countries should broaden and deepen their engagement with civil society organizations to enhance the performance and reach of their national immunization programs'. Such engagement not only contributes to increasing vaccination coverage and equity but also to improving the quality of immunization services delivered by private providers and their reporting to the government of vaccinations administered, VPDs, and AEFI – key areas where the private sector has been traditionally weak in many countries.

Based on zero-dose survey report, except AACA, DDCA, Harari and urban areas of Oromia, the health system has done little in terms of engaging the private sector. In Dire Dawa and Harari, few private hospitals are engaged in EPI, but the health facilities have been criticized for not closely monitoring defaulters and frequently fail to establish linkage with the public sector. In Harari and Oromia regions, smaller clinics are interested to do the same, but they could not be able to fulfill the refrigerator requirements. Sidama region is also trying to engage private providers, but ongoing challenge is inability of the health facilities to purchase prequalified refrigerators. In Amhara region, hospitals have been engaged in vaccination service before but due to failure to adhere to the cold chain standard, the initiative is now abandoned. However, in AACA more than 40 private facilities have fulfilled the criteria and are providing the service.

Similar study conducted in Sudan indicated that private providers have been critical in filling gaps in government services in hard-to-reach areas and among marginalized populations, thus reducing inequities to access. Sudan's public health sector, especially at the state level, is collaborating closely with the private providers by supplying vaccines, injection devices and in some cases, cold chain equipment free-of-charge and vaccinators. Sudan's public–private sector engagement also represents an efficient approach and possible cost savings to the government (Ahmed et al., 2019).

In Nigeria, private health facilities have been shown to have a modest contribution to immunization in four local governments practicing Public Private Partnership (PPP). In addition, they have also helped to make routine immunization accessible in most parts of the local governments involved in the PPP. In 2010, the mean DPT3 coverage was 95% in the 4 PPP regions and 59% in the other 13 regions (target 80%). This discrepancy in immunization coverage between PPP local governments and other local government areas may be because health facilities offering immunization services might be more accessible to people in PPP local governments. Contracting services to non-profit non-governmental

organizations has also been showed to improve access to immunization and other primary health care services in Bangladesh, Cambodia and Senegal. In Ghana, it is estimated that 40% of total immunization are delivered by non-profit civil society organizations and mission hospitals through their outreaches and community-based outreaches (Oluoha et al., 2014).

JSI conducted a situational analysis in June 2018 in two health zones of Kinshasa, Democratic Republic of The Congo, to analyze bottlenecks and challenges facing urban populations, specifically access and utilization of routine immunization services by urban poor communities. A key finding from this assessment was that while private and faith-based health facilities significantly outnumbered governmental facilities, only about one-quarter of such facilities offered routine immunization services. Another challenge identified was in regulating the quality of immunization services at private health facilities, as they are not included in standardized EPI training and capacity building activities. Monitoring and management of vaccine storage are similarly unregulated due to the public-private divide. The EPI, therefore, has limited insight into vaccination at private health facilities, as they are not included in administrative health reporting mechanisms. This intensifies the opaqueness of denominator estimations for urban populations in Kinshasa and the country (JSI, 2018).

Other literature also suggest that NGOs often play a key role in immunization service delivery than do private for-profit providers in low-income countries, since their facilities are situated in rural as well as urban areas. Further, NGO services are more likely to be coordinated with public services, either through formal contracts or through more loosely structured mechanisms in low-income countries. In middle-income countries, the private for-profit sector is active and plays a number of roles. It often acts to facilitate early adoption of new vaccines and technologies before introduction and generalization by the public sector (Levin & Kaddar, 2011).

Strategies recommended to strengthen private sector engagement in EPI include:

- Advocate and support the provision of immunization services by private sector facilities, especially in urban settings where they have a strong presence. This should include reporting into the national Health Information System.
- Conduct rapid capacity assessment of private health facilities. The assessment should include mapping of health facilities that provide/don't provide routine immunization services.
- In slum areas having limited access to health facilities, work with private health sectors to provide routine immunization service; and establish outreach and temporary fixed sites to provide the vaccination services.
- Advocate and link private health facility managers with EPI activities, so they are better able to plan and provide routine immunization services.
- Involving the private sector in policy and program setting – for example, private providers can be represented on national immunization technical advisory groups as well as other policymaking organizations.

- Introducing financial and other types of incentives to increase immunization coverage and/or access to services.
- Regulation of service quality, payment mechanisms and fees of private providers.
- Engage private health facility associations to advocate and support the delivery of immunization services by private health facilities
- Build capacity of private health facilities on delivery of EPI, including provision of supportive supervision.
- Support the private health facilities to report using DHIS2

Enhance responsibility and accountability of healthcare providers/ Leadership

Zero-dose supply and demand side barrier analysis report showed that nowadays many HEWs live in towns and their availability on their duty is limited. In developing regions like Gambella, reportedly health workers even live in Addis Ababa and receive salaries without being on duty. Reportedly, HEWs in Gambella and BG regions frequently fail to appear at health posts or outreach sites despite appointing mothers for vaccination. This has negatively affected the demand for the service. Even health centers, are not opened on time to serve their clients. In general, the mechanism for controlling HEWs to assure their regular availability on duty is weak. District health offices sometime lack commitment to assure the availability of health professionals working at health centers. Similarly, kebele level officials are doing little to make sure that HEWs are regularly available on their duty. To enhance responsibility and accountability of healthcare providers the following interventions are recommended.

- Devise HEWs control mechanism such as daily activity and weekly report while they are on duty to assure their regular availability.
- Taking administrative measures for HEWs who are not available at their duty
- Improve immunization service delivery set-up (waiting and vaccination area) across targeted health facilities in each selected woredas by providing on-job training, experience sharing including joint monitoring and learning visits, supervision and feedback, and advocacy
- Consider male as HEWs to minimize absence of HEW due to maternity leave and to reach hard-to-reach areas as well.
- Staff retention and motivation mechanisms including incentives and improving career development opportunities for HEWs.

Women empowerment and Male Engagement

Findings of the zero-dose evaluation survey indicated that women are not adequately empowered, and they usually need to secure permission and money for transportation from their husbands to bring their infants to the vaccination centers. In Afar and Somali, women are responsible to handle nearly all the household chores so they may not be able to take their child for vaccination unless they get support from their partners. Further,

vaccination programs did little to engage men. Usually HEWs and HDAs only interact with women regarding MCH issues including vaccination. Community mobilization efforts like pregnant women conference also disregard men. As a result, lack of women empowerment and poor engagement of men in MCH programs have limited the utilization of the service.

The prevalence of zero-dose and under-immunized children and dropout rates declined with women's increasing power in household decision-making. Women's land and house ownership, husbands support in household chores, engagement of both partners in household resource allocation, and women's better access to information about what is happening in the community were all associated with lower rates of zero-dose, under-immunization, and dropout.

To this end, we recommend the following interventions:

- Planning to establish Men Development Army to promote engagement of men in MCH services.
- Develop, implement, and monitor integrated district and PHCU level micro-plans that address gender and equity barrier.

Advocacy and Communication

According to our qualitative study, in all regions regular and diverse SBCC efforts are not being implemented for promoting vaccination. The frequently reported challenges for not having stronger SBCC activities are the weaking structure of HDA network, decline in the motivation of HEWs and lack of budget for community mobilization activities. Most key informants reported basic resources needed for community mobilization are usually scare in most settings. Conversely, family health card is widely available but has not been adequately utilized. Audio-visual aids provided by partner organizations are also not adequately used once the respective programs phaseout.

We found that frequently promotion of vaccination was primarily done through interpersonal communication through HEWs and HDA/WDA members. But interpersonal communication is also getting weaker due to the disintegration of the HDA/WDA network. Previously, Community Conversation and Pregnant Women's Forum were used as important platforms for disseminating key MCH messages. However, recently the attention to these platforms is declining and they are being organized very rarely. The underlying reasons are demotivation of HEWs, disintegration of the HAD network, lack of resource to cover transportation and refreshment expenses.

Previously HEWs used to mobilize the community for vaccination program through organizing regular house-to-house visit and by engaging HDA members. Such interpersonal communication activities are now becoming rare with declining motivation of HEWs and weakening of the HDA structure. Though HDA/WDA members play an important role in mobilizing the community, their trustworthiness in communicating health messages is limited. In many KIIs and FGDs, religious leaders, clan leaders (Somali region), and

teachers are considered to be respected and credible sources of information. However, such community members have not been adequately engaged.

Health workers reportedly fail to provide comprehensive information about vaccination when they provide vaccination service to children. Workload, carelessness, and lack of job aid contributed to this gap. Specially, failure to provide information about side effects has contributed to vaccination discontinuation.

In order to improve advocacy and SBCC activities the following interventions are recommended.

- Use different communication channels to raise awareness and promote demand for vaccine uptake
- Engage trustworthy sources of information including religious leaders, clan leaders
- Aware and communicate caretakers the importance of vaccination care to get services for their children all the time.
- Advocacy and communication on catchup immunization guideline with partners to mobilize resource
- Improve immunization service delivery set-up across targeted health facilities in each selected woredas by providing on-job training, experience sharing including joint monitoring and learning visits, supervision and feedback, and advocacy
- Tailored/context-based demand and communication activities at special settings like urban slum areas and underserved setting population.
- Building the capacity of health workers on counseling skills.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

Situational analysis

The situational analysis has availed a SWOT analysis needed for informing the national zero-doze strategy. The study has also mapped missed populations in every region (except Tigray) including hard-to-reach areas, marginalized pastoralist, and semi-pastoralist populations, underserved urban communities like those in slum areas, informal settlements and street families, conflict affected settings, IDPs and refugees. The information is imperative for targeting zero-dose and underimmunized children in equitable manner.

Vaccination coverage survey

With the exception of urban slums, vaccination coverage is unsatisfactory in all the

remote, hard-to-reach and special populations that we studied. Specially the coverage of newly introduced vaccines (IPV and MCV) is disappointingly low. Vaccination coverage is affected by availability, distance and functionality of nearby health facilities. The pooled prevalence of zero-dose and under-immunized children in hard-to-reach and underserved settings of Ethiopia were 33.7% and 62.8%, respectively. The highest prevalence was in the developing regions, followed by IDPs and pastoralist populations.

In terms of actual numbers, conflict-affected areas have the highest burden of missed children. Pastoralist populations, developing regions, and newly formed regions also harbor 100,000 plus zero-dose children. Penta-1 to -3 and Penta-1 to MCV-1vaccination dropout rates are staggeringly high. The study witnessed considerable socio-economic inequality in vaccination coverage and dropout rates as measured by household wealth index, maternal and paternal education and place of residence (urban vs rural).

In general, missed opportunities for vaccination are rare in maternal service provision. However, missed opportunities during family planning and sick child care services provision appear to be very common.

Most of the respondents have heard of routine childhood vaccines and knew at least one VPD. Yet, the awareness on specific VPDs appears to be low. Less than a quarter of the respondents were aware that Pertussis, Tetanus Pneumonia Diphtheria Meningitis and Hepatitis B are vaccine preventable. The leading barriers that hinder caregivers from vaccinating their children are absence of vaccination service in the locality, and failure of health workers to visit the village, closure of vaccination cite, absence of vaccine and domestic workload.

Though vaccination service coverage is balanced between boys and girls, multiple gender-related factors seem to affect utilization of the service. Women's lack of power in household decision making, domestic work load, ownership of resources and access to information.

The health facility survey suggested considerable number of health facilities are non-functional in terms of vaccination service provision. Furthermore, regular provision of static and outreach service is largely sub-optimal. Interruption of service due to hiccups in the vaccine logistic system are commonly encountered.

Barrier-enabler analysis

The study has identified several service delivery and demand-side blockades for provision and utilization of vaccination service in underserved settings including hard-to-reach, conflict affected and displaced populations. The generated evidence has policy and programmatic implications for improving vaccine coverage in Ethiopia in equitable manner and achieve the Immunization Agenda 2030.

The study has identified key service delivery bottlenecks that must be addressed for reducing vaccine inequity. This includes unsatisfactory health service coverage, poor

functionality of health posts, scarcity of health workers, weak horizontal service integration for reducing missed opportunity, weak defaulter tracing mechanism, poor engagement of private facilities and public hospitals in EPI, lack of regular and diverse SBCC to promote vaccination and poor counselling skills of health workers.

Recently the HEP is getting weaker and the WDA/HDA network is disintegrating, posing a serious threat to the PHC system in Ethiopia. Key supply-side barriers also include inaccessibility and lack of functionality of health posts in hard-to-reach areas, destruction of health infrastructure due to the ongoing political unrest, weak health center to health post linkage, and low facility-to-population ratio specially in urban areas. Lack of skilled workforce and staff turnover specially in the developing regions, suboptimal staff motivation and retention system, and unavailability of HEWs on duty are also contemporary challenges.

EPI is being delivered through a mix of static, outreach and mobile activities. The static approach is not regularly available due to frequent closure of health facilities, demotivation of HEWs, provision of the service only in selected days and hours, and frequent implementation of campaign-based activities. The coverage of PIRI is also geographically limited. Important challenges to the outreach modality include shortage of budget, lack of transportation service, and inaccessibility of outreach sites. In many settings, outreach modality is not being regularly executed as well, due to resource constraints. In pastoralist regions mobile outreach strategy has not been implemented at scale. Challenges include shortage of resources, limited geographic coverage, scarcity of partners to support the initiative, irregularity in field deployment, and lack of effective implementation strategy.

Pertaining to the vaccine logistic system, the "last mile/direct delivery" strategy has substantially improved the vaccine logistic system in the country. Mass distribution and maintenance of SDD refrigerators, and rollout of the EVM system are positive initiative for improving the cold chain system. However, many districts and health facilities remain inaccessible to EPSA. Outstanding challenges are frequent failure and lack of timely maintenance of broken refrigerators due to skill gap and spare part problems, scarcity of resource to transport vaccines from districts to health facilities, limited storage capacity at lower-level of the system and failure of district offices to request vaccine reequipments on time. Vaccine wastage, both open and close vial wastage, is also a concern.

Pertaining to demand-side blockades, resistance to routine childhood vaccination in general is rare and such challenges are limited to few remote pocket areas. Yet self-initiated demand has not been established in most settings due to poor access to vaccination service, service dissatisfaction and absence of sustained SBCC interventions. Specially, the recently introduced vaccines like MCV-2 and IPV have not been adequately promoted. The single most demand-side barrier appears to be fear of vaccination side effects. Small-scale misconceptions due to religious beliefs, cultural norms and misconceptions, have also been reported. In general, the health system has a weak social accountability mechanism to improve its inefficiencies.

In terms of gender, boys and girls appear to have equal access to vaccination. Though son preference is common in many communities in Ethiopia, it has limited implication for vaccination. The gender of the vaccinator does not have meaningful effect on the utilization of the service as well. However, other gender-related blockages have been identified. Culturally, taking children to vaccination service is considered as the duty of the mothers. Even health workers show a similar gender stereotyping. The health system rarely engages fathers in delivering MCH services including immunization. Usually, vaccinators interact only with mothers; despite they have limited decision making power and control over household resources. Women's domestic workload is a major cause for vaccination dropout. Specially, female-headed households have poor care seeking practice due to poverty and workload. The health system, does not take gender into consideration while planning, implementing and evaluation vaccination programs.

Recommendations

1. In terms of reducing vaccine inequity, investing in pastoralist populations and developing regions is needed. However, increasing coverage requires implementing tailored programs in conflict-affected areas and hard-to-reach settings in major regions of Ethiopia.

2. Health facilities in several conflict-affected areas are not functional due to destruction of infrastructure and displacement of health workers. FMOA and RHBs should introduce a strategy for rebuilding the health system. The strategy should include comprehensive audit of functionality of health facilities, establishment of emergency fund, and short- and long-term solutions to deliver PHC including immunization service.

3. In ongoing conflict settings, vaccination should be provided through makeshift strategies including coordinating vaccine and humanitarian aid delivery, implementing coordinated hit-and-run programs, negotiating access to conflict areas (e.g., peace corridors, days of tranquility, truces to immunize children), collaboration with the security system, and strengthening linkage with international partners working in conflict affected areas.

4. The health care system has limited strategies to reach to hard-to-reach areas in a meaningful manner. Standardized mop-up strategy for covering hard-to-reach areas in regular manner has to be designed. Specially underserved settings around inter-national and -regional boundaries should be prioritized. Strengthening the routine vaccination service through supporting and expanding the PIRI program, implementing monthly Child Health Days or quarterly Child Health Weeks may help to improve the routine vaccination program in remote areas.

5. Pockets of local inequities should be reduced through implementing "Reaching Every Community" or "Reaching Every Child" (REC) strategy. Districts with low vaccination coverage have to be supported technically and financially to effectively implement the RED/REC strategy. The practical challenges of implementing the RED/REC should be systematically explored and mitigated.

6. The pastoralist and semi-pastoralist population of Ethiopia have to be reached through expansion of integrated mobile outreach strategy. As the strategy is likely to be costly, cost-effective mechanisms including integration of services and optimizing frequency of field deployments should be explored. The strategy should also be standardized for content, frequency and resource needs. The possibility of integrating the strategy with the developing "mobile clinics" deployment in remote areas should be worked out.

7. In pastoralist regions health posts should provide meaningful vaccination service through increasing availability of SDD refrigerators and building the capacity of HEWs.

8. FMOA should consider deployment of male HEWs in remote settings of all regions. Male HEWs have comparative advantages in terms of reaching hard-to-reach areas and reduce the impact of extended maternity leaves on the provision of PHC. Brining male HEWs on board may also foster of fathers' engagement in MCH service utilization.

9. The increasing demotivation of HEWs should be addressed through providing meaningful carrier development opportunities and other financial and non-financial incentives. Hardship benefits should be considered for HEWs deployed in remote areas in all regions. Furthermore, the availability of HEW on their duty has to be ensured by engaging kebele leaders and establishing social accounting system.

10. The disintegrating HDA/WDA network should be revitalized by introducing an efficient incentive system. The system may include performance-based financial and non-incentives including recognition of outstanding HDA/WDA members, exemption from CBHI premiums, assuring preferential access to health services, and supporting in professional developments. The recruitment, training, retention, and performance appraisal system should be standardized. The community should be involved in the selection and performance appraisal of HDA/WDA members. Women and men should be engaged as HDA members without any gender stereotyping.

11. Integration of vaccination service with highly demanded services like PSNP and supplementary feeding programs likely boosts uptake of vaccination service specially in conflict- affected settings including among IDPs and refugees. Multisectoral integration like requiring vaccination certificate to admit children to the formal education system in both rural and urban areas, should also be considered.

12. Defaulting from the vaccination program should be reduced through strengthening and scaling up the "tickler box" system. In rural areas defaulting should be mitigated through engaging HDA/WDA network. In urban and peri-urban areas, the feasibility of using mobile phone-based SMS reminders should be piloted.

13. Catch-up vaccination strategy aiming to provide optimal protection for children who have failed to receive vaccination as per the schedule should be developed. Relevant trainings should also be cascaded to create common understanding on the matter.

14. The existing pre-service training curricula for all health science programs in Ethiopia should be reviewed, and if necessary revised, to ensure that contemporary issues on

EPI are well addressed. Strengthening the pre-service training may reduce the cost associated with in-service training.

15. In general, the routine vaccination service is not available when needed due to multiple reasons. MoH, RHBs and WoHOs have to ensure that static service is provided routinely at all hospitals, health centers and health posts. A standard to guide the role and responsibilities of public hospitals in vaccination program should be introduced to make sure that all primary hospitals are actively engaged in EPI. The outreach vaccination delivery platform should also be standardized and supported, technically and financially.

16. The MoH and RHBs have to engage private and non-governmental health providers in the provision of vaccination service without compromising important principles of quality, equity, and financial protection. Private health facilities should be supported through capacity building training, establishing access to vaccines and prequalified refrigerators.

17. Fear of side effects of vaccination and lack of information about how to handle minor side effects like fever and irritability after vaccination are major demand side barriers in all settings. Health workers have to provide comprehensive information on management of side effects. A comprehensive job aid may help to remind health workers to provide a holistic information to caregivers. Trainings on basic counseling skills should be integrated into the IRT for HEWs.

18. At community level, SBCC and community mobilization efforts should be diversified and intensified. The use of different channels of communication (interpersonal, mass media, print media) should be promoted. Community dialogues including pregnant women form should be revitalized, standardized and supported. Partner organization should also support the forum through allocating "petty cash" for covering fringe transportation and refreshments expenses. Influential formal and informal community leaders should be engaged in community mobilization. A package for training such influential community members should be developed. Engaging informal community structures like Edir in promoting vaccination service should also be considered.

19. The MoH and RHBs along with their partners have to ensure that SDD refrigerators are available in all health posts including those in hard-to-reach areas. Health workers should be oriented on preventive maintenance of refrigerators. Annual inventory of refrigerators should be conducted.

20. Reintroducing the mBrana software or initiating another mobile-based vaccine logistics management information system is needed to modernize the collection, communication and use of digitized data for effective decision-making. The capacity of the existing health information technicians in the health system needs to be built, and system ownership has to be promoted.

21. Reducing multidose vials (BCG and measles) to smaller vial sizes is important reduce vaccine wastage and improve satisfaction with EPI. The possible shift has to be informed by robust costing and logistic analyses. Piloting may also be needed.

22. In extremely hard-to-reach areas, the potential use of small drones for distributing vaccine supply to remote health posts should be considered. The feasibility and cost-efficiency of using medical drones in the Ethiopian setting should be studied.

23. Improving access to long-range cold boxes (with a minimum cold life of 96 hours) may help to improve the vaccine logistic system in remote areas. Such commodities may also be required for implementing the integrated mobile outreach strategy in pastoralist areas.

24. The health system should continue to address data quality concerns through preserving the "Information Revolution" momentum. Data quality concerns should be proactively addressed through by the capacity of frontline health workers, increasing value for data and instating data accountability system at all levels. Efforts to triangulate routine reports with community level data should be strengthened through establishing vaccination coverage surveillance system. In this regard regional universities could be important partners.

25. While the direction taken recently be Ethiopian government to co-finance the immunization program should be recognized; the government has to commit and mobilize additional resources to transit to fully self-financed immunization program.

26. The health system should embrace a social accountability system by which communities use to hold service providers accountable for underperformance. Such system boosts accessible and better-quality healthcare.

27. To ensure that migrates have non-discriminatory and equitable access to basic services including vaccination service, PHC service delivery standard for IDPs and refugees should be developed by engaging relevant partners.

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ANNEX:DATA COLLECTION TOOLS

Annex I: Data collection tools for the situational assessment

Project HOPE

Reaching zero dose and under immunized children in remote areas of Ethiopia

In-depth interview guide for situational analysis of vaccination program in Ethiopia(Tool 1.1)

To be used with the following respondent at Ministry of Health level:

- MCHN Directorate Director/Representative, EPI Team leader
- Policy and Planning, Monitoring and Evaluation Directorate Director/Representative
- Health Extension and Primary Health Care Directorate/Representative
- Health System and Special System Directorate Director/Representative

Information and consent:

Introduction and propose of the study: good morning/Good afternoon. Thank you for the interest to discuss with me today. My name is_____ and I'm working for Project HOPE – Ethiopia. Project HOPE receives grant for conducting evaluation research on "Reaching zero dose and under immunized children in remote areas of Ethiopia" and as part of this research we are undertaking a situational analysis of the Ethiopian immunization program. The study will help us to understand the strength and weakness of the program and identify under-immunized settings in Ethiopia. You are selected for this interview purposely based on your expertise in the area We would very much appreciate your participation in this study.

Procedures: if you agree to take part in this study, we will discuss about the aforementioned issue for about 60 minutes. I will also audio record the interview so that I will be able to transcribe it later on.

Risks and Benefits: we believe there are no risks to you from participating in this study. You will not be directly benefited from taking part in the study. However, your participation will help us to better understand the circumstances around zero dose and under-immunized children and improve Ethiopia's health system. It will also help us to reducing zero dose children by providing equitable and quality immunization services across Ethiopia's primary health care system.

Compensation: you will not be paid for participating in this study.

Confidentiality: we will keep your answers confidentially. We will not share your answers with others who are not member of the research team. Your name and other facts that might help people recognize you will not appear when we present this study to others or publish its results. Your recorded voice will be stored on password-protected computers.

Voluntary participation and withdrawal: taking part in this study is voluntary. You can choose not to take part in the study or ask us to leave, and if you do agree to participate you can stop the interview at any time or skip any questions that you don't want to answer. There are no right or wrong answers. We just want to hear more about your own ideas and experiences. Also, after finishing the interview, you can refuse to have your answers included in the study.

Contact person: if you have any questions, I will be happy to answer them. And in case you ever want to contact the principal investigator, you should call +251916822815 and ask for Dr. Samson Gebremedhin. You can also contact the ethics committee that approved the research project through: tel _____ or e-mail address: _____.

Comprehension: Do you have any questions about the interview? If so, I will be glad to explain.

Consent: if you wish to be in this study, please sign here: _____

Reminder for the interviewer: If written consent is given, proceed to the interview. If she/he is not willing to take part in the study, thank her/him and discontinue the interview.

Basic information about the in-depth interview

Name of the interviewer: _____

Name of the notetaker: _____

Locality (region, city): _____/_____

Date of interview: _____

Venue of interview: _____

Beginning and ending times of the interview: _____/_____

Code number: _____

Basic profile of the respondent

Position: _____

Region: _____

Organization: _____

Years of experience in the organization: _____

Sex: _____

Interview guide questions

1. How do you describe the recent trends in vaccination coverage and incidence of common vaccine preventable diseases in Ethiopia?
    - Probe: reasons for increasing or decreasing coverage
    - Probe: outbreak situation of vaccine preventable diseases
2. In Ethiopia **which specific settings and populations** are considered as zero dose and under-immunized by the Ministry?
    - Probe: which specific geographic areas have low vaccination coverage or high incidence of vaccine preventable diseases?
    - Probe: Developing regions, pastoralist communities, urban slums, hard-to-reach areas, IDPs and migrants
    - Probe: What are the root causes for low vaccination coverage in these settings and populations?
3. What **service delivery-related barriers** preclude zero-dose and under-immunized children from being vaccinated?
    - Probe: limited physical access to health service, topography, functionality of health facilities during working hours
    - Probe: unavailability of health workers, lack of incentives and motivation, workload
    - Probe: engagement of the private sector in EPI programs
    - Probe: do the reasons differ by urban, remote rural, and fragile settings?
    - Probe: what is being done to address these service-delivery related barriers? What are the existing gaps?
4. How do you describe the existing **vaccine supply and logistic system** in Ethiopia?
    - Probe: availability and uninterrupted supply of vaccine, syringes, and safety boxes for vaccination
    - Probe: availability of refrigerators at health facilities including health posts
    - Probe: challenges in the cold chain system and maintenance of refrigerators
    - Probe: practice of effective vaccine management system
    - Probe: what is being done to improve the existing vaccine supply and logistic system?
    - Probe: vaccine waste: extent and causes
5. What **are the demand-related barriers** that prevent zero-dose and under-immunized children from being vaccinated?
    - Probe: socio-cultural factors, vaccine hesitancy, health literacy
    - Probe: mobility of the pupation
    - Probe: what is being done to address these demand-related barriers? What are the existing gaps?
    - Probe: efforts to improve interpersonal communication, social mobilization and demand creation activities

6. What **gender-related barriers** might zero-dose or under-immunize children or their families face to accessing services?
    - Probe: gender related barriers from both supply and demand sides
    - Probe: access to and control over resources both at household and community levels
    - Probe: unequal decision-making power at household level and community structures
    - Probe; unequal representation and power imbalance in the leadership positions in community and health structures
    - Probe: lack of access to information and economic dependency
    - Probe: lack of equal division of labor/workload and domestic violence
    - Probe: practice of gender-disaggregated data analysis
7. Could you please give us a brief overview of the **immunization financing** system in Ethiopia?
    - Probe: major financing sources
    - Probe: plan and challenges of domestic immunization financing
    - Probe: approaches for financing ground level activities including training, transportation, supportive supervision, collecting data
8. What are the **practices and challenges of planning** for vaccination program in Ethiopia?
    - Probe: approaches to estimate denominator
    - Probe: standardization of planning
    - Probe: practice of encouraging regions and districts to make micro plans to identify local problems and adopt corrective solutions
9. How does the Ministry use **data for decision making** for improving vaccination program at different levels of the health system?
    - Probe: what are the standard EPI core data sources? How is the practice of data management and extraction?
    - Probe: analyzing data to prioritize districts with poor access
10. What is the ministry doing to improve **data quality** for vaccination program in Ethiopia? What are the causes of poor data quality in the immunization program of Ethiopia?
    - Probe: negligence, false data reporting, skill gaps, health workers value for data
    - Probe: underlying reasons for major coverage discrepancy between HMIS data community-based surveys
    - Probe: what are the challenges of the DHIS 2 implementation in relation to vaccination program?
    - Probe: data quality initiatives (lots of quality assurance), data quality self-assessment (DQS)
    - Probe: data accountability, triangulation and verification mechanisms
11. What specific **strategies and interventions** are being implemented to improve the coverage, utilization, quality and equity of immunization service in Ethiopia?
    - Probe: use of diverse (static, outreach and mobile) service delivery outlets
    - Probe: what is being done to reach to zero dose and under-immunized children specially in underserved populations

- Probe: specific programs including RED/REC
- Probe: complementary vaccine delivery strategies (enhanced catch-up immunization, periodic intensified routine immunization, mop-up and default tracing).
- Probe: small scale programs that need to be scaleup
- Probe: integration of service (including multisectoral integration) to reduced missed opportunities
- Probe: based on your opinion, which intervention working and not working? What are the challenges of the existing program?

12. How does the Ministry implement and promote **monitoring, evaluating and learning** activities in the vaccination program in Ethiopia?

- Probe: challenges in implementing monitoring, evaluation and learning
- Probe: existing HMIS indicators
- Probe: supportive supervision

13. What is the ministry doing to improve the **quality** of immunization service in Ethiopia?

- Probe: approached to evaluate and ensure service quality
- Probe: regular review meeting and supportive supervision
- Probe: immunization-specific supportive supervision
- Probe: capacity building

14. In your opinion, **what new interventions** required to improve vaccination programs in Ethiopia

- Probe: targeted interventions to reach to zero dose and under-immunized children
- Probe: what innovations are needed to strengthen access to zero-dose children and missed communities in the long term?
- Probe: How can service delivery approaches be tailored to reach specific underserved areas?

15. Based on the expertise, what are the major **strength and weakness** of the Ethiopian vaccination program?

- Probe: how can the weakness be addressed?
- Probe: what are the common challenges and how they are being addressed?
- Probe: success stories

16. What are the major **opportunities and threats** to the vaccination program in Ethiopia?

- Probe: threats including political instability, Covid 19 outbreak, vaccine hesitancy
- Probe: what is being done by the ministry and its partners to maximize the opportunities and mitigate the threats?

17. Who are you major **stakeholders and partners** in the financing and implementation of vaccination programs in Ethiopia? In what specific areas do they support you?

- Probe: technical assistance needs of the ministry

18. Before I conclude the discussion, is there anything you would like to add or recommend?

Project HOPE

Reaching zero dose and under immunized children in remote areas of Ethiopia

In-depth interview guide for situational analysis of vaccination program in Ethiopia(Tool 1.2)

To be used with the following respondent at regional level:

- MCHN Directorate Director
- EPI Team leader
- Health Extension Program Directorate

Information and consent:

Introduction and propose of the study: good morning/Good afternoon. Thank you for the interest to discuss with me today. My name is_____ and I'm working for _____. Project HOPE receives grant for conducting evaluation research on "Reaching zero dose and under immunized children in remote areas of Ethiopia" and as part of this research we are undertaking a situational analysis of the Ethiopian immunization program. The study will help us to understand the strength and weakness of the program and identify under-immunized settings in Ethiopia. You are selected for this interview purposely based on your expertise in the area. We would very much appreciate your participation in this study.

Procedures: if you agree to take part in this study, we will discuss about the aforementioned issue for about 60 minutes. I will also audio record the interview so that I will be able to transcribe it later on.

Risks and Benefits: we believe there are no risks to you from participating in this study. You will not be directly benefited from taking part in the study. However, your participation will help us to better understand the circumstances around zero dose and under-immunized children and improve Ethiopia's health system. It will also help us to reducing zero dose children by providing equitable and quality immunization services across Ethiopia's primary health care system.

Compensation: you will not be paid for participating in this study.

Confidentiality: we will keep your answers confidentially. We will not share your answers with others who are not member of the research team. Your name and other facts that might help people recognize you will not appear when we present this study to others or publish its results. Your recorded voice will be stored on password-protected computers.

Voluntary participation and withdrawal: taking part in this study is voluntary. You can choose not to take part in the study or ask us to leave, and if you do agree to participate you can stop the interview at any time or skip any questions that you don't want to answer. There are no right or wrong answers. We just want to hear more about your own ideas and experiences. Also, after finishing the interview, you can refuse to have your answers included in the study.

Contact person: if you have any questions, I will be happy to answer them. And in case you ever want to contact the principal investigator, you should call + 251916822815 and ask for Dr. Samson Gebremedhin.

Comprehension: Do you have any questions about the interview? If so, I will be glad to explain.

Consent: if you wish to be in this study, please sign here: _____

Reminder for the interviewer: If written consent is given, proceed to the interview. If she/he is not willing to take part in the study, thank her/him and discontinue the interview.

Basic information about the in-depth interview

Name of the interviewer: _____

Name of the notetaker: _____

Locality (region, city): _____/_____

Date of interview: _____

Venue of interview: _____

Beginning and ending times of the interview: _____/_____

Code number: _____

Basic profile of the respondent

Region: _____

Position: _____

Organization: _____

Years of experience in that position: _____Sex: _____

Interview guide questions

1. How do you describe the recent trends in vaccination coverage and incidence of common vaccine preventable diseases in the region?
    - Probe: reasons for increasing or decreasing coverage
    - Probe: outbreak situation of vaccine preventable diseases
2. In the region, which **specific settings and populations** are considered as zero dose and under-immunized by the RHB?
    - Probe: which specific geographic areas have low vaccination coverage or high incidence of vaccine preventable diseases?
    - Probe: what are two or three districts in the region with the lowest coverage of vaccination program?
    - Probe: pastoralist communities, urban slums, hard-to-reach districts, IDPs and migrants
    - Probe: What are the root causes for low vaccination coverage in these settings and populations?
3. What **service delivery-related barriers** preclude zero-dose and under-immunized children from being vaccinated?
    - Probe: limited physical access to health service, topography, functionality of health facilities during working hours
    - Probe: unavailability of health workers, lack of incentives and motivation, workload
    - Probe: engagement of the private sector in EPI programs
    - Probe: do the reasons differ by urban, remote rural, and fragile settings?
    - Probe: what is being done to address these service-delivery related barriers? What are the existing gaps?
4. How do you describe the existing **vaccine supply and logistic system** in your region?
    - Probe: availability and uninterrupted supply of vaccine, syringes, and safety boxes for vaccination
    - Probe: availability of refrigerators at health facilities including in health posts
    - Probe: challenges in the cold chain system and maintenance of refrigerators
    - Probe: practice of effective vaccine management system
    - Probe: what is being done to improve the existing vaccine supply and logistic system?
    - Probe: vaccine wastage and underlying causes.
5. In your region, what are the **demand-related barriers** that prevent zero-dose and under-immunized children from being vaccinated?
    - Probe: socio-cultural and economic factors, vaccine hesitancy, health literacy
    - Probe: mobility of the pupation
    - Probe: what is being done to address these demand-related barriers? What are the existing gaps?
6. What **gender-related barriers** might zero-dose or under-immunize children or their families face to accessing services?
    - Probe: gender related barriers from both supply and demand sides
    - Probe: access to and control over resources both at household and community levels

- Probe: unequal decision-making power at household level and community structures
- Probe: unequal representation and power imbalance in the leadership positions in community and health structures
- Probe: lack of access to information and economic dependency
- Probe: lack of equal division of labour/workload
- Probe: practice of gender-disaggregated data analysis

7. Could you please give us a brief overview of the **immunization financing** system in the region?

   - Probe: major financing sources
   - Probe: plan and challenges of domestic immunization financing
   - Probe: approaches for financing ground level activities including training, transportation, supportive supervision, data collection

8. What are the **practices and challenges** of planning for vaccination program in the region?

   - Probe: approaches to estimate denominator
   - Probe: standardization of planning
   - Probe: practice of encouraging zones and districts to make micro plans to identify local problems and adopt corrective solutions

9. How does the RHB use **data for decision making** for improving vaccination program at different levels of the health system?

   - Probe: what are the standard EPI core data sources? How is the practice of data management and extraction?
   - Probe: analysing data to prioritize districts with poor access

10. What is the RHB doing to improve **data quality** for vaccination program in the region? What are the causes of poor data quality in the immunization program of the region?

    - Probe: negligence, false data reporting, skill gaps, health workers value for data
    - Probe: underlying reasons for major coverage discrepancy between DHIS data and community-based surveys
    - Probe: what are the challenges of the DHIS 2 implementation in relation to vaccination program?
    - Probe: data quality initiatives
    - Probe: data accountability, triangulation and verification mechanisms

11. What specific **strategies and interventions** are being implemented to improve the coverage, utilization, quality and equity of immunization service in the region?

    - Probe: use of diverse (static, outreach and mobile) service delivery outlets
    - Probe: what is being done to reach to zero dose and under-immunized children specially in underserved populations
    - Probe: specific programs including RED/REC
    - Probe: complementary vaccine delivery strategies (enhanced catch-up immunization, periodic intensified routine immunization, mop-up and default tracing).
    - Probe: small scale programs that need to be scaleup

- Probe: integration of service (including multisectoral integration) to reduced missed opportunities
- Probe: based on your opinion, which intervention working and not working? What are the challenges of the existing program?

12. What **SBCC, community engagement and mobilization strategies** are being implement to improve the utilization of vaccination program in your region?
    - Probe: how can the SBCC, community engagement and mobilization strategies be improved?
13. How does the RHB implement and promote **monitoring, evaluating and learning** activities in the vaccination program in the region?
    - Probe: challenges in implementing monitoring, evaluation and learning
    - Probe: existing HIS indicators
    - Probe: supportive supervision
14. What is the RHB doing to improve the quality of immunization service in the region?
    - Probe: approached to evaluate and ensure service quality
    - Probe: regular review meeting and supportive supervision
    - Probe: immunization-specific supportive supervision
    - Probe: capacity building, input and structure
    - Probe: supportive supervision provided by FMoH
15. In your opinion, **what new interventions** required to improve vaccination programs in your region?
    - Probe: targeted interventions to reach to zero dose and under-immunized children
    - Probe: what innovations are needed to strengthen access to zero-dose children and missed communities in the long term?
    - Probe: How can service delivery approaches be tailored to reach specific underserved areas?
16. Based on the expertise, what are the major **strength and weakness** of the vaccination program in your region?
    - Probe: how can the weakness be addressed?
    - Probe: what are the common challenges and how they are being addressed?
    - Probe: success stories
17. What are the major **opportunities and threats** to the vaccination program in your region?
    - Probe: threats including political instability, Covid 19 outbreak, vaccine hesitancy
    - Probe: what is being done by the RHB and its partners to maximize the opportunities and mitigate the threats?
18. Who are you major **stakeholders and partners** in the financing and implementation of vaccination programs in your region? In what specific areas do they support you?
    - Probe: technical assistance needs of the RHB
19. Before I conclude the discussion, is there anything you would like to add or recommend?

Project HOPE

Reaching zero dose and under immunized children in remote areas of Ethiopia

In-depth interview guide for situational analysis of vaccination program in Ethiopia(Tool 1.3)

To be used with the following respondent:

- Multilateral agencies, NGOs and donors working on immunization program at federal level
- NGOs working on immunization program at regional level
- UNHCR and ARRA (at federal level)

Information and consent:

Introduction and propose of the study: good morning/Good afternoon. Thank you for the interest to discuss with me today. My name is_____ and I'm working for _____. Project HOPE receives grant for conducting evaluation research on "Reaching zero dose and under immunized children in remote areas of Ethiopia" and as part of this research we are undertaking a situational analysis of the Ethiopian immunization program. The study will help us to understand the strength and weakness of the program and identify under-immunized settings in Ethiopia. You are selected for this interview purposely based on your expertise in the area. We would very much appreciate your participation in this study.

Procedures: if you agree to take part in this study, we will discuss about the aforementioned issue for about 60 minutes. I will also audio record the interview so that I will be able to transcribe it later on.

Risks and Benefits: we believe there are no risks to you from participating in this study. You will not be directly benefited from taking part in the study. However, your participation will help us to better understand the circumstances around zero dose and under-immunized children and improve Ethiopia's health system. It will also help us to reducing zero dose children by providing equitable and quality immunization services across Ethiopia's primary health care system.

Compensation: you will not be paid for participating in this study.

Confidentiality: we will keep your answers confidentially. We will not share your answers with others who are not member of the research team. Your name and other facts that might help people recognize you will not appear when we present this study to others or publish its results. Your recorded voice will be stored on password-protected computers.

Voluntary participation and withdrawal: taking part in this study is voluntary. You can choose not to take part in the study or ask us to leave, and if you do agree to participate you can stop the interview at any time or skip any questions that you don't want to answer. There are no right or wrong answers. We just want to hear more about your own ideas and experiences. Also, after finishing the interview, you can refuse to have your answers included in the study.

Contact person: if you have any questions, I will be happy to answer them. And in case you ever want to contact the principal investigator, you should call + 251916822815 and ask for Dr. Samson Gebremedhin.

Comprehension: Do you have any questions about the interview? If so, I will be glad to explain.

Consent: if you wish to be in this study, please sign here: _____

Reminder for the interviewer: If written consent is given, proceed to the interview. If she/he is not willing to take part in the study, thank her/him and discontinue the interview.

Basic information about the in-depth interview

Name of the interviewer: _____

Name of the notetaker: _____

Locality (region, city): _____/_____

Date of interview: _____

Venue of interview: _____

Beginning and ending times of the interview: _____/_____

Code number: _____

Basic profile of the respondent

Region: _____

Position: _____

Organization: _____

Years of experience in that position: _____Sex: _____

Interview guide questions

1. How do you describe the recent trends in vaccination coverage and incidence of common vaccine preventable diseases in Ethiopia or in regions/settings where your organization is working?
    - Probe: reasons for increasing or decreasing coverage
    - Probe: outbreak situation of vaccine preventable diseases
2. How is your **organization supporting the Ethiopia government/RHB** in improving the vaccination program and coverage in the country/region (or special settings like refugees and IDPs)?
    - Probe: geographic scope and programmatic areas of interest
    - Probe: stakeholders and partners
    - Probe: community mobilization and SBCC approaches
    - Probe: monitoring evaluation and learning activities
    - Probe: implementation challenges and success stories
    - Probe: specific programs for refugees and IDPs
3. In your opinion, **which specific settings and populations** are considered as zero dose and under-immunized?
    - Probe: which specific geographic areas have low vaccination coverage or high incidence of vaccine preventable diseases?
    - Probe: pastoralist communities, urban slums, hard-to-reach districts, IDPs and migrants
    - Probe: What are the root causes for low vaccination coverage in these settings and populations?
4. Based on the expertise, what **service delivery-related barriers** preclude zero-dose and under-immunized children from being vaccinated?
    - Probe: limited physical access to health service, topography, functionality of health facilities during working hours
    - Probe: unavailability of health workers, lack of incentives and motivation, workload
    - Probe: problems with the vaccine supply and logistic system (including vaccine wastage)
    - Probe: engagement of the private sector in EPI programs
    - Probe: do the reasons differ by urban, remote rural, and fragile settings?
    - Probe: what is being done to address these service-delivery related barriers? What are the existing gaps?
5. What do you think are the **demand-related barriers** that prevent zero-dose and under-immunized children from being vaccinated?
    - Probe: socio-cultural and economic factors, vaccine hesitancy, health literacy
    - Probe: mobility of the pupation
    - Probe: what is being done to address these demand-related barriers? What are the existing gaps?

6. What **gender-related barriers** might zero-dose or under-immunize children or their families face to accessing services?
    - Probe: gender related barriers from both supply and demand sides
    - Probe: practice of gender-disaggregated data analysis
7. Based on your expertise, what specific strategies and interventions are being implemented by the MoH/RHB to improve the coverage, utilization, quality and equity of immunization service in Ethiopia?
    - Probe: use of diverse (static, outreach and mobile) service delivery outlets
    - Probe: what is being done to reach to zero dose and under-immunized children specially in underserved populations
    - Probe: specific programs including RED/REC
    - Probe: complementary vaccine delivery strategies (enhanced catch-up immunization, periodic intensified routine immunization, mop-up and default tracing).
    - Probe: small scale programs that need to be scaleup
    - Probe: integration of service (including multisectoral integration) to reduced missed opportunities
    - Probe: based on your opinion, which intervention are working and not working? What are the challenges of the existing program?
8. Based on the expertise, what are the major **strength and weakness (including challenges)** of the vaccination program in Ethiopia or settings where your organization is working?
    - Probe: data quality problems, use of data for decision making
    - Probe: problems with microplanning (estimation of denominators)
    - Probe: how can the weakness be addressed?
    - Probe: what are the common challenges and how they are being/can be addressed?
    - Probe: success stories
9. What are the major **opportunities and threats** to the vaccination program in Ethiopia or settings where your organization is working?
    - Probe: threats including political instability, Covid 19 outbreak, vaccine hesitancy
    - Probe: what is being done by the MoH/RBH and its partners to maximize the opportunities and mitigate the threats?
10. In your opinion, **what new interventions** required to improve vaccination programs in Ethiopia/region?
    - Probe: targeted interventions to reach to zero dose and under-immunized children
    - Probe: what innovations are needed to strengthen access to zero-dose children and missed communities in the long term?
    - Probe: How can service delivery approaches be tailored to reach specific underserved areas?
11. Before I conclude the discussion, is there anything you would like to add or recommend?

Project HOPE

Reaching zero dose and under immunized children in remote areas of Ethiopia

In-depth interview guide for situational analysis of vaccination program in Ethiopia(Tool 1.4)

To be used with the following respondent at federal and regional levels:

- EPSA focal persons at federal level, regional hubs or regional health bureaus

Information and consent:

Introduction and propose of the study: good morning/Good afternoon. Thank you for the interest to discuss with me today. My name is_____ and I'm working for _____. Project HOPE receives grant for conducting evaluation research on "Reaching zero dose and under immunized children in remote areas of Ethiopia" and as part of this we are undertaking a situational analysis of the Ethiopian immunization program. The study will help us to understand the strength and weakness of the program and identify under-immunized settings in Ethiopia. You are selected for this interview purposely based on your expertise in the area. We would very much appreciate your participation in this study.

Procedures: if you agree to take part in this study, we will discuss about the aforementioned issue for about 60 minutes. I will also audio record the interview so that I will be able to transcribe it later on.

Risks and Benefits: we believe there are no risks to you from participating in this study. You will not be directly benefited from taking part in the study. However, your participation will help us to better understand the circumstances around zero dose and under-immunized children and improve Ethiopia's health system. It will also help us to reducing zero dose children by providing equitable and quality immunization services across Ethiopia's primary health care system.

Compensation: you will not be paid for participating in this study.

Confidentiality: we will keep your answers confidentially. We will not share your answers with others who are not member of the research team. Your name and other facts that might help people recognize you will not appear when we present this study to others or publish its results. Your recorded voice will be stored on password-protected computers.

Voluntary participation and withdrawal: taking part in this study is voluntary. You can choose not to take part in the study or ask us to leave, and if you do agree to participate you can stop the interview at any time or skip any questions that you don't want to answer. There are no right or wrong answers. We just want to hear more about your own ideas and experiences. Also, after finishing the interview, you can refuse to have your answers included in the study.

Contact person: if you have any questions, I will be happy to answer them. And in case you ever want to contact the principal investigator, you should call +251916822815 and ask for Dr. Samson Gebremedhin.

Comprehension: Do you have any questions about the interview? If so, I will be glad to explain.

Consent: if you wish to be in this study, please sign here: _____

Reminder for the interviewer: If written consent is given, proceed to the interview. If she/he is not willing to take part in the study, thank her/him and discontinue the interview.

Basic information about the in-depth interview

Name of the interviewer: _____

Name of the notetaker: _____

Locality (region, zone, kebele): _____/_____/_____

Date of interview: _____

Venue of interview: _____

Beginning and ending times of the interview: _____/____

Code number: _____

Basic profile of the respondent

Position: _____

Region: _____

Organization: _____

Interview guide questions

1. How do you describe the existing immunization supply chain and logistic system in the country or in your region starting from vaccine arrival to distribution?
    - Probe: needs forecasting
    - Probe: distribution system including supply and pick up lines, packaging and use of refrigerated trucks and cold boxes
    - Probe: challenges in the distribution system
    - Probe: indicators for quality of vaccine products
    - Probe: infrastructure and cold chain capacity
    - Probe: temperature management system
    - Probe: stock management system (safety stock level, maximum and reorder levels)
2. How do you describe the **availability of uninterrupted supply** of vaccine, syringes, and safety boxes for vaccination program in the country or region or health facility?
    - Probe: are vaccine and other supplies available when needed?
    - Probe: experience of stockout at national, regional, district and facility levels
    - Probe: causes of stockout and supply interruption
3. How is the **availability and adequacy of functional cold chain** at health facilities level including in health posts?
    - Probe: what challenges do you commonly encounter in the cold chain system?
    - Probe: availability of Solar Direct Drive (SDD) refrigerators, cold boxes and vaccine carriers
    - Probe: causes of cold chain failure including lack of maintenance of refrigerators and shortage of spare parts
    - Probe: increased storage demand due to introduction of new vaccines
    - Probe: power outage and presence of backup generator
4. Do you think **vaccine wastage** is a major problem in the national/regional vaccine logistic system?
    - Probe: extent of vaccine wastage at all levels of the supply system
    - Probe: experience of waste monitoring system
    - Probe: causes of vaccine wastage
    - Probe: lack of knowledge of recommended storage conditions and improper vaccine handling by health workers
    - Probe: which vaccines are most affected?
    - Probe: proper implementation of multi dose vaccine policy,
    - Probe: how best do you implement vaccine wastage monitoring system? What indicators and data sources are used to monitor vaccine wastage?
    - Probe: what should be done to reduce vaccine wastage?

5. How do dispose vaccine at all levels of the health system?
    - Probe: what are the challenges in vaccine disposal system? Availability of incinerators
    - Probe: how is vaccine disposal reported through the system?
6. How do you **monitor and evaluate** the health of the immunization supply chain and logistic system?
    - Probe: supply chain data generation and use for decision making
    - Probe: use of shake test, Vaccine Vial Monitors for quality control
7. What is being done to **improve** the existing vaccine supply and logistic system?
    - Probe: training and human capacity needs
    - Probe: what new interventions are needed?
    - Probe: success stories
8. Based on the expertise, what are the major **strength and weakness** of the vaccine logistic system?
    - Probe: presence of policy and standards, and guidelines
    - Probe: adequacy of human resources for immunization logistics
    - Probe: vaccine logistic information system
    - Probe: system efficiency and agility including integration with other supply systems
    - Probe: engagement of the private sector
    - Probe: how can the weakness be addressed?
9. What are the major **opportunities and threats** to the vaccine logistic system?
    - Probe: do you think that adequate attention is given to the vaccine logistic system by the government, donors and partners? Why?
    - Probe: adequacy of investment in vaccine logistic system
    - Probe: changing vaccine landscape and introduction of new vaccines
    - Probe: effect of the Covid 19 outbreak and ongoing political conflict
    - Probe: system digitization and its implementing challenges
    - Probe: what is being done by the Ministry/RHB and its partners to maximize the opportunities and mitigate the threats?
10. Who are you major **stakeholders and partners** in improving the immunization supply chain and logistic system of the country/region?
    - Probe: technical assistance needs
11. Before I conclude the discussion, is there anything you would like to add or recommend?

Project HOPE

Reaching zero dose and under immunized children in remote areas of Ethiopia

In-depth interview guide for situational analysis of vaccination program in Ethiopia(Tool 1.5)

To be used with the following respondent at federal and regional level:

- EPHI: Director of Health System and Reproductive Health Research
- EPHI: Vaccine preventable disease team leader
- Regional Public Health Institutes

Information and consent:

Introduction and propose of the study: good morning/Good afternoon. Thank you for the interest to discuss with me today. My name is_____ and I'm working for _____. Project HOPE receives grant for conducting evaluation research on "Reaching zero dose and under immunized children in remote areas of Ethiopia" and as part of this research we are undertaking a situational analysis of the Ethiopian immunization program. The study will help us to understand the strength and weakness of the program and identify under-immunized settings in Ethiopia. You are selected for this interview purposely based on your expertise in the area. We would very much appreciate your participation in this study.

Procedures: if you agree to take part in this study, we will discuss about the aforementioned issue for about 60 minutes. I will also audio record the interview so that I will be able to transcribe it later on.

Risks and Benefits: we believe there are no risks to you from participating in this study. You will not be directly benefited from taking part in the study. However, your participation will help us to better understand the circumstances around zero dose and under-immunized children and improve Ethiopia's health system. It will also help us to reducing zero dose children by providing equitable and quality immunization services across Ethiopia's primary health care system.

Compensation: you will not be paid for participating in this study.

Confidentiality: we will keep your answers confidentially. We will not share your answers with others who are not member of the research team. Your name and other facts that might help people recognize you will not appear when we present this study to others or publish its results. Your recorded voice will be stored on password-protected computers.

Voluntary participation and withdrawal: taking part in this study is voluntary. You can choose not to take part in the study or ask us to leave, and if you do agree to participate you can stop the interview at any time or skip any questions that you don't want to answer. There are no right or wrong answers. We just want to hear more about your own ideas and experiences. Also, after finishing the interview, you can refuse to have your answers included in the study.

Contact person: if you have any questions, I will be happy to answer them. And in case you ever want to contact the principal investigator, you should call + 251916822815 and ask for Dr. Samson Gebremedhin.

Comprehension: Do you have any questions about the interview? If so, I will be glad to explain.

Consent: if you wish to be in this study, please sign here: _____

Reminder for the interviewer: If written consent is given, proceed to the interview. If she/he is not willing to take part in the study, thank her/him and discontinue the interview.

Basic information about the in-depth interview

Name of the interviewer: _____

Name of the notetaker: _____

Locality (region, city): _____/_____

Date of interview: _____

Venue of interview: _____

Beginning and ending times of the interview: _____/_____

Code number: _____

Basic profile of the respondent

Region: _____

Position: _____

Organization: _____

Years of experience in that position: _____Sex: _____

Interview guide questions

1. How do you describe the recent trends in incidence of common childhood vaccine preventable diseases (VPDs) in Ethiopia/in the region?
    - Probe: VPDs under surveillance, which vaccine prevalent able diseases are more commonly reported by the PHEM system
    - Probe: reasons for increasing or decreasing trends
2. In Ethiopia/in the region, **which specific settings and populations** are more affected by VPDs?
    - Probe: pastoralist communities, urban slums, hard-to-reach districts, IDPs and migrants Probe: what are two or three districts in the region which are very commonly affected by VPDs?
3. What **service delivery-related barriers** are leading to low vaccination coverage and continued occurrence of VPD Ethiopia/in the region?
    - Probe: limited physical access to health service, topography, functionality of health facilities during working hours
    - Probe: unavailability of health workers, lack of incentives and motivation, workload
    - Probe: vaccine supply and logistic system
    - Probe: do the reasons differ by urban, remote rural, and fragile settings?
    - Probe: what is being done to address these service-delivery related barriers? What are the existing gaps?
4. In Ethiopia/in your region, what are the **demand-related barriers** is leading to low vaccination coverage and continued occurrence of VPDs?
    - Probe: socio-cultural and economic factors, vaccine hesitancy, health literacy
    - Probe: mobility of the pupation
    - Probe: gender related factors
    - Probe: what is being done to address these demand-related barriers? What are the existing gaps?
5. Whenever you come across with outbreak of VPDs, what specific **public health** response do you usually undertake?
    - Probe: practice of using data for decision making
    - Probe: availability of real-time data for action
    - Probe: challenges in taking timely public health response system
    - Probe: effectiveness of specific interventions in controlling the outbreak
6. How do you describe the **quality of data** gendered by the PHEM system on VPD? What are the causes of poor data quality in monitoring VPDS in Ethiopia/in the region?
    - Probe: negligence, false data reporting, skill gaps, health workers value for data
    - Probe: what are the challenges you commonly encounter regarding data quality?
    - Probe: how is the practice of data management and extraction?
    - Probe: data quality initiatives

- Probe: data accountability, triangulation and verification mechanisms
- Probe: underlying reasons for major vaccine coverage discrepancy between DHIS data and community-based surveys

7. Do you think that the health system is **doing enough** to control VPDs in Ethiopia/in the region?
    - What specific strategies and interventions are being implemented to improve the coverage, utilization, quality and equity of immunization service in Ethiopia/in the region?
    - Probe: what is being done to reach to zero dose and under-immunized children specially in underserved populations
    - Probe: small scale programs that need to be scaleup
    - Probe: integration of service to reduced missed opportunities
    - Probe: based on your opinion, which interventions are working and which are not working?
8. What **SBCC, community engagement and mobilization strategies** are being implement to control VPDs and improve the utilization of vaccination program in Ethiopia/in your region?
    - Probe: how can the SBCC, community engagement and mobilization strategies be improved?
9. In your opinion, **what new interventions and strategies** required to eliminate vaccine preventable diseases and improve vaccination service coverage in Ethiopia/in your region?
    - Probe: targeted interventions to reach to zero dose and under-immunized children
    - Probe: what innovations are needed to strengthen access to zero-dose children and missed communities in the long term?
    - Probe: How can service delivery approaches be tailored to reach specific underserved areas?
10. How do you describe the use of **research and scientific evidence** for improving vaccination service and reducing VPDs in Ethiopia/in the region?
    - Probe: what operational research have you conducted on the topic? What were the key findings of such research?
    - Probe: how do you translate research into practice
11. How does the PHEM conducts surveillance of adverse events following immunization (AEFI)? What are the challenges in this regard?
12. Based on the expertise, what are the major **strength and weakness** of the PHEM system (including surveillance and research) in the region in monitoring and taking timely response against VPDs?
    - Probe: how can the weakness be addressed?
    - Probe: what are the common challenges and how they are being addressed?
    - Probe: success stories

-

13. What are the major **opportunities and threats** PHEM system (including surveillance and research) in monitoring and taking timely response against VPDs?
    - Probe: threats including political instability, Covid 19 outbreak, vaccine hesitancy
    - Probe: what is being done by the RHB and its partners to maximize the opportunities and mitigate the threats?
14. Who are you major **stakeholders and partners** in monitoring VPDs in Ethiopia/in the region? In what specific areas do they support you?
    - Probe: technical assistance needs of the ministry
15. Before I conclude the discussion, is there anything you would like to add or recommend?

Annex II: Community-based survey tool

Project HOPE

Reaching zero dose and under immunized children in remote areas of Ethiopia

Assessment of vaccination coverage among children 12-35 months in underserved areas of Ethiopia

Introduction/Purpose: My name is_____ and I'm working for Project HOPE. We are conducting an assessment on immunization coverage among children 12-35 months in your area. We would very much appreciate your participation in this survey since you are a mother/caregiver of a child 12-35 months living in _____ kebele. In total, 4,560 mothers or caregivers will be asked to take part in this study.

Procedures: If you agree to take part in this study, I would like to ask you about the vaccination status of the child. This information will help us to plan better immunization services in your area. The questionnaire normally takes about 30 minutes to complete. Additionally, we would like to examine the vaccination records of your child. Further, my field supervisor may visit your household and ask you few questions in order to countercheck the information I collected from you.

Risks and benefits: We believe there are minimal risks to you or your child from participating in this study. Your child should not experience any discomfort whatsoever. Taking part in this research study may not benefit you personally, but we may learn new things that will help others.

Compensation: You will not be paid for participating in this study.

Confidentiality: We will keep your answers confidential to the best of our ability. We will not share your answers with any of your neighbors or family. We will use a number instead of your name on study forms. Your name and other facts that might help people recognize you will not appear when we present this study to others or publish its results. Any information that might identify you will be kept separate from your answers, and your answers will be kept in a secure place for analyses by the researchers only.

Voluntary participation and withdrawal: Taking part in this study is voluntary. You can choose not to talk to us or ask us to leave, and if you do agree to participate you can stop the interview at any time or skip any questions that you don't want to answer. There are no right or wrong answers. We just want to hear more about your own ideas and experiences. Also, after finishing the interview, you can refuse to have your answers included in the study. Whether or not you choose to participate will not affect the services you receive from the health system in any way.

Contact Persons: If you have any questions, I will be happy to answer them. And in case you ever want to contact someone from the office we work for, I can write down the telephone number for the Principal Investigator from Project HOPE. You should call this number +251916822815 and ask for Dr. Samson Gebremedhin. If you wish to contact someone from the institutional review board that approached the study, please contact the Institutional Review Board Office by calling _____.

Comprehension check: Do you have any questions about the survey? Please let me know if anything I have stated is not clear and I will be happy to explain it further to ensure you understand.

Do you accept participating in the survey? Yes_____ No_____

_____ _____

Name and signature of the participant Date

Section I: Basic information about the interview			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
101	Date of interview (dd/mm/yy) In Gregorian calendar	|___|___|/|___|___|/|___|___|	
102	Team number	|___|___|	
103	Supervisors' name		
104	Interviewers' name		
105	Region	Tigray…(01) Afar…(02) Amhara…(03) Oromiya…(04) Somali…(05) Benishangul-Gumuz…(06) SNNPR…(07) Sidama…(08) Southwestern…(09) Gambella…(10) Harari…(11) Addis Ababa city administration…(12) Dire Dawa city administration…(13)	
106	Name of the woreda		
107	Name of the kebele/IDP center/refugee camp		
108	EA code	|__|__|__|__|__|__|__|__|__|__|__| NA…(99)	

Section I: Basic information about the interview			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
109	Language of interview	Amharic…(01) Afan Oromo…(02) Tigrigna…(03) Afar…(04) Somali…(05) Sidaamu Afoo…(06) If other (specify)…(96)	
110	Number of visits to household by the interviewer	First…(01) Second…(02) Third…(03)	
111	Translator used?	No…(01) Yes…(02)	
112	Time the interview started Place of residence	|___|___|: |___|___| |___|___|	

Section II: Socio-demographic information			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
201	Full name of the child		
202	Age of [Name] in months Age in completed months	|___|___| months I don't know/not sure…(99)	
203	Date of birth of [Name] In Ethiopian calendar If "don't know" enter "99"	|___|___| Day |___|___| Month |___|___| Year	
204	Sex of [Name]	Boy…(01) Girl…(02)	
205	Relationship of caregiver to [Name]	Mother…(01) Father…(02) Other primary caregiver…(03)	
206	Sex of the respondent	Male…(01) Female…(02)	
207	Age of the respondent In completed years If "don't know" enter "99"	|___|___| Years Don't know/Not sure…(99)	
208	What is the highest level of school you completed?	No formal education…(01) Preschool…(02) Primary education (1-6)…(03) Secondary education (7-12)…(04) Tertiary education…(05)	
209	Can you read in any language?	Yes…(01) No…(02)	If 208 = 01

Section II: Socio-demographic information			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
210	Number of years of formal education	|___|___| Years	If 208 = 03 or 04 or 05
211	What is your current marital status?	Single (not ever married)…(01) Married/living together…(02) Separated…(03) Divorced…(04) Widowed…(05)	
212	What is your religion?	Orthodox…(01) Catholic…(02) Protestant…(03) Muslim…(04) Traditional…(05) If other (specify)…(96)	
213	Place of residence	Urban…(01) Rural…(02)	
214	What is your main occupation? That is, what kind of work do you mainly do?	Unemployed…(01) Housewife…(02) Unskilled manual…(03) Skilled manual…(04) Agriculture…(05) Petty trade…(06) Trade…(07) Solider/guard/police…(08) Driver…(09) Professional…(10) Student…(11) Retired…(12) If other (specify)…(96)	

Section II: Socio-demographic information			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
215	Educational status of your husband/ partner	No formal education…(01) Preschool…(02) Primary education (1-6)…(03) Secondary education (7-12)…(04) Tertiary education…(05) Don't know/Not sure…(99)	If 211 = 02
216	What is your (husband's/ partner's) occupation? That is, what kind of work does he mainly do?	Unemployed…(01) Housewife…(02) Unskilled manual…(03) Skilled manual…(04) Agriculture…(05) Petty trade…(06) Trade…(07) Solider/guard/police…(08) Driver…(09) Professional…(10) Student…(11) Retired…(12) If other (specify)…(96)	If 211 = 02
217	Sex of the household head	Male…(01) Female…(02)	
218	Relationship of the respondent to the household head	HH head…(01) Wife/Husband…(02) Son or daughter…(03) Grand child…(04) Parents (& in-laws)…(05) Brother/sister (& in-laws)…(06) Not related…(07) Other relative…(96)	
219	Do you own a mobile telephone?	Yes…(01) No…(02)	

Section III: Household characteristics			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
301	What is the roofing material (for the main house)? Check with your observation Select one primary material only	Corrugated material…(01) Thatch or grass…(02) Wood and mud…(03) Reed or bamboo…(04) Concrete/Cement/Brick tiles…(05) Plastic…(06) If other (specify)…(96)	
302	What is the floor material (for the main house)? Check with your observation Select one primary material only	Mud/dirt alone/cow dung…(01) Bamboo/wood (not finished)…(02) Wood (finished)…(03) Concrete/Cement/Tiles…(04) _____If other (specify)…(96)	
303	What is the wall material (for the main house)? Check with your observation Select one primary material only	Wood and mud…(01) Wood or reed and bamboo…(02) Plywood or other finished wood…(03) Stone and mud or stone alone…(04) Plastic or fabrics…(05) Corrugated material…(06) Concrete/Bricks and cement /Stone and cement …(07) If other (specify)…(96)	
304	What type of fuel does your household mainly use for cooking?	Electricity…(01) LPG/Natural gas/Biogas…(02) Kerosene…(03) Coal/Charcoal…(04) Wood…(05) Crop residue/straw/shrubs/grass…(06) Animal dung…(07) If other (specify)…(96)	

Section III: Household characteristics			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
305	Is the cooking usually done in the house, in a separate building, or outdoors?	In the house…(01) In a separate room/kitchen…(02) Outdoors…(03) If other (specify)…(96)	
306	How many rooms in this household are used for sleeping?	|___|___| No of sleeping Rooms	
307	Are there any windows in the house? Check with your observation	Yes…(01) No…(02)	
308	Does this household own any livestock, herds, other farm animals, or poultry?	Yes…(01) No…(02)	> 310
309	How many of the following animals does this household own? If "0" enter "00"		
A	Milk cows, oxen?	|___|___|	
B	Other cattle?	|___|___|	
C	Horses, donkeys, or mules?	|___|___|	
D	Camels?	|___|___|	
E	Goats?	|___|___|	
F	Sheep?	|___|___|	
G	Chickens or other poultry?	|___|___|	
H	Beehives?	|___|___|	
310	Does any member of this household own any agricultural land?	Yes…(01) No…(02)	> 312

Section III: Household characteristics			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
311	How many hectares of agricultural land do members of this household own? If "don't know" enter "99"	|___|___|.|___|___| hectares Not willing to respond…(95) Don't know…(99)	
312	Does any member of this household own any land residential/housing purpose?	Yes…(01) No…(02)	> 314
313	How many m2 of residential/ housing land do members of this household own? If "don't know" enter "99"	|___|___|.|___|___| m2 Not willing to respond…(95) Don't know…(99)	
314	Does your household or member of the household have the following functional items?		
A	A watch or clock	Yes…(01)	No…(02)
B	A radio	Yes…(01)	No…(02)
C	A television	Yes…(01)	No…(02)
D	CD/DVD player	Yes…(01)	No…(02)
E	A mobile telephone	Yes…(01)	No…(02)
F	A non-mobile telephone	Yes…(01)	No…(02)
G	A refrigerator	Yes…(01)	No…(02)
H	A Table	Yes…(01)	No…(02)
I	A chair	Yes…(01)	No…(02)
J	An electric mitad	Yes…(01)	No…(02)
K	Pressure lamp	Yes…(01)	No…(02)

Section III: Household characteristics			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
L	A kerosene lamp	Yes…(01)	No…(02)
M	Torch	Yes…(01)	No…(02)
N	A bicycle	Yes…(01)	No…(02)
O	A motorcycle	Yes…(01)	No…(02)
P	An animal – drawn cart	Yes…(01)	No…(02)
Q	A bajaj	Yes…(01)	No…(02)
R	Car or truck	Yes…(01)	No…(02)
315	Does your household have electricity?	Yes…(01) No…(02)	
316	Do you have any kind of health insurance for members of your household for the last one year?	Yes…(01) No…(02)	> 318
317	If answer is 'Yes' for 316, write the type of health insurance?	Community Health Insurance…(01) Social Health insurance…(02) Private Health Insurance…(03) Don't know…(99)	
318	Does any member of this household have a bank account?	Yes…(01) No…(02)	

Section III: Household characteristics			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
319	What is the main source of drinking water for members of your household? Select one primary source only	Piped into dwelling…(01) Piped into yard or plot…(02) Public tap/standpipe…(03) Tube well/borehole…(04) Protected well…(05) Unprotected well…(06) Protected spring…(07) Unprotected spring…(08) Rainwater collection…(09) Tanker-truck…(10) Cart with small tank/drum…(11) Surface water…(12) Bottled water…(13) If other (specify)…(96)	
320	What does this household mainly use for disposal of human urine and feces? Select one primary source only	Flush to sewer or septic system…(01) Simple pit latrine with floor/slab…(02) Pit latrine without floor/slab…(03) VIP with floor/slab (04) Composting/dry latrine (05) Bucket latrine (06) No facility, field, bush, plastic bag (07) If other (specify)…(96)	
321	Total number of household members	|___|___|	
322	Total number of under five children in the household	|___|___|	

Section IV: Access to health service			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
401	In there any health facility in your kebele?	Yes…(01) No…(02)	
402	What is the nearest health facility to your household?	Health Post…(01) Health center…(02) Public hospital…(03) Private clinic…(04) If other (specify)…(96) Don't know…(99)	
403	How long does it take for you to walk to the nearest health facility? If < 1hr record in minutes	|___|___|: |___|___| Hours Minutes	
404	In the last 3 months, was this household visited by a health extension worker?	Yes…(01) No…(02) Not aware of HEWs…(95) Not sure/Don't know…(99)	> 407 > 407 > 407
405	In the last 3 months, how many times did the HEWs visit this household?	|___|___| visits Don't know …(99)	
406	During the most recent visit of the HEW had in the last 3 months, what specific health messages were discussed? Multiple responses possible Probe, anything else?	Exclusive breastfeeding for 6 mos…(01) Complementary feeding…(02) Promotion of postnatal care…(03) Growth monitoring of children…(04) Vaccination…(05) Sanitation and waste disposal…(06) Family planning…(07) If other (specify)…(96)	
406	In the last 1 month, was this household visited by a health extension worker?	Yes…(01) No…(02) Not sure/Don't know…(99)	

Section IV: Access to health service			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
407	In the last 3 months, was this household visited by a health development army (HDA) member/volunteer?	Yes…(01) No…(02) Not aware of HDA/volunteer…(95) Not sure/Don't know…(99)	> 411 > 411 > 411
408	In the last 3 months, how many times did the health development army member/ volunteer visit this household?	|___|___| visits Don't know …(99)	
409	During the most recent visit the HDA/volunteer had in the last 3 months, what specific health messages were discussed? Multiple responses possible Probe, anything else?	Exclusive breastfeeding for 6 mos…(01) Complementary feeding…(02) Promotion of postnatal care…(03) Growth monitoring of children…(04) Vaccination…(05) Sanitation and waste disposal…(06) Family planning…(07) If other (specify)…(96)	
410	In the last 1 month, was this household visited by a HDA/ volunteer?	Yes…(01) No…(02) Not sure/Don't know…(99)	

411	How often do you get health-related information through the following?	Never	Rarely	Sometimes	Often	Always	DK
A	Health workers at health institution	1	2	3	4	5	99
B	Home visit by CHWs	1	2	3	4	5	99
C	TV	1	2	3	4	5	99
D	Radio	1	2	3	4	5	99
E	Newspaper, magazine	1	2	3	4	5	99
F	Banner and poster	1	2	3	4	5	99
G	SMS	1	2	3	4	5	99
H	Family/friend/neighbor	1	2	3	4	5	99

Section V: Maternal health service utilization			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
501	When you were pregnant with [NAME], did you receive antenatal care form a health worker?	Yes…(01) No…(02) Not sure/Don't know…(99) Not applicable…(95)	> 505 > 505 > 601
502	When you were pregnant with [NAME], where did you go for antenatal care? Multiple responses possible	Health post…(01) Health center…(02) Public hospital…(03) Private hospital or clinic…(04) NGO clinic/health center…(05) Home…(06) If other (specify)…(96)	
503	When you were pregnant with [NAME], how many ANC visits have you had?	|___|___| visits Not sure/Don't know…(99)	
504	During the ANC, did you receive any information about childhood vaccination?	Yes…(01) No…(02) Not sure/Don't know…(99)	
505	Who assisted with the delivery of [NAME]? Probe: anyone else?	No one…(01) Health professionals (Doctor/nurse/midwife….)…(02) Health Extension worker…(03) Traditional birth attendant…(04) Family/relative/friend…(05) If other (specify)…(96)	

Section V: Maternal health service utilization			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
506	Where did you give birth to [NAME]?	Own home…(01) other home…(02) Health post…(03) Health center…(04) Public hospital…(05) Private hospital or clinic…(06) NGO clinic/health center…(07) Maternity home…(08) If other (specify)…(96)	
507	I would like to ask you about checks on your or [NAME]'s health after delivery, for example, someone asking you questions about your or [NAME]'s health or examining you or your baby. Within the first 6 mos of delivery, did anyone check on your or [NAME]'s health?	Yes…(01) No…(02) Not sure/Don't know…(99)	> 601 > 601
508	Within the first 6 months of birth, who checked on your or [NAME]'s health? Multiple responses possible	Health professionals (Doctor/nurse/midwife….)…(01) Health Extension worker…(02) Traditional birth attendant…(03) If other (specify)…(96)	
509	During this check, did you receive any information about childhood vaccination?	Yes…(01) No…(02) Not sure/Don't know…(99)	

Section VI: Knowledge and attitudes on vaccination			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
601	Have you ever heard about routine vaccination for children?	Yes…(01) No…(02)	> 701
602	What are the advantages of vaccinating children? Multiple responses possible	To protect them from diseases…(01) Does not have any benefit…(02) If other (specify)…(96) Not sure/Don't know…(99)	
603	Would you please mention childhood diseases that can be prevented by immunization? Multiple responses possible probe: anything else?	Tuberculosis…(01) Polio…(02) Diphtheria…(03) Pertussis…(04) Tetanus…(05) Measles…(06) Pneumonia…(07) Meningitis…(08) Hepatitis B…(09) Diarrheal Diseases…(10) Don't Know…(99) If other (specify)…(96)	If 602 = 01
604	What would be the disadvantages of vaccinating children? Multiple responses possible	Side or adverse effects…(01) May make them sick…(02) Takes time…(03) If other (specify)…(96) Not sure/Don't know…(99)	
605	How likely is it that your child will get a vaccine preventable disease if unvaccinated?	Very likely…(01) Somewhat likely…(02) Not likely at all…(03) Not sure/Don't know…(99)	

Section VI: Knowledge and attitudes on vaccination			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
606	How serious would it be if your child got a vaccine preventable disease?	Very serious…(01) Somewhat serious…(02) Not serious at all…(03) Not sure/Don't know…(99)	
607	When do you think a child should start on immunization?	At birth…(01) First few weeks…(02) First few months…(03) Later…(04) Don't Know…(99)	
608	Where can you take a child to be vaccinated? Multiple responses possible	Outreach cites…(01) Health post…(02) Health centre…(03) Hospital…(04) Private clinic, hospital…(05) If other (specify)…(96) Don't know/not sure…(99)	
609	When [NAME] was less than the age of 1 year, have you received any information or message about vaccination to children?	Yes…(01) No…(02)	> 612

Section VI: Knowledge and attitudes on vaccination			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
610	What was your source of information? Or where did you get the information? Multiple responses possible Probe: anyone else?	Health professionals (doctors, nurses….)…(01) Health extension workers…(02) Volunteer community health workers…(03) Radio…(04) TV…(05) Newspaper, magazine…(06) Other printed materials (poster, banner) …(07) Husband/partner…(08) Family/friend/neighbor…(08) Religious/community leaders…(08) If other (specify)…(96) Don't know/not sure…(99)	
611	What messages have you heard about immunization? Multiple responses possible Probe: anything else?	Importance of vaccination…(01) About vaccination campaigns…(02) Where to get routine vaccination…(03) Timing for vaccination…(04) Return to next doses of vaccination…(05) Possible adverse events vaccination…(06) Harms of vaccination…(07) If other (specify)…(96) Don't know/not sure…(99)	
612	When [NAME] was less than the age of 1 year, were you informed about possible adverse events (like mild fever) of vaccination?	Yes…(01) No…(02)	> 614

Section VI: Knowledge and attitudes on vaccination			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
613	Were you told what to do if your child experiences adverse effects (like mild fever) following vaccination?	Yes…(01) No…(02)	
614	Have you refused a vaccination offer by health worker for [NAME]?	Yes…(01) No…(02)	> 616
615	If yes, why did you refuse?	Too many shoots at visit…(01) Child was ill…(02) Has already been vaccinated…(03) Fear of injection pain…(04) Fear of risk of disease transmission…(05) Fear of side effects…(06) Doubts on the benefit of the vaccine…(07) Did not trust the health worker…(08) If other (specify)…(96)	
616	Do you believe that there are some children who should not be vaccinated or might be hurt by vaccination?	Yes…(01) No…(02) Not sure…(99)	> 618 > 618
617	Which children do you think should not receive vaccination? Multiple responses possible	Newborns…(01) Sick children…(02) Physically handicapped children…(03) If other (specify)…(96)	
618	Do you have any fear, doubts, suspicions about having [NANE] vaccinated?	Yes…(01) No…(02) Not sure…(99)	> 620 > 620

Section VI: Knowledge and attitudes on vaccination			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
619	What doubts/suspicion/fear do you have about your child vaccination?	Vaccinations cause side effects…(01) Vaccinations can make children sick…(02) Vaccinations sterilize children…(03) If other (specify)…(96)	
620	Do you recommend children in your community like [NAME] to get vaccinated?	Yes…(01) No…(02) Not sure…(99)	> 622 > 622
621	Why don't you recommend other caregivers to get their children vaccinated? Multiple responses possible	Don't believe vaccines are useful…(01) Causes side effect/ make them sick…(02) Injection can transmit diseases…(03) It's against social/religious norm…(04) If other (specify)…(96)	
622	Are you satisfied with the vaccination service provision in your area?	Yes…(01) No…(02) Not sure…(99)	> 701 > 701
623	Why you are not satisfied with the vaccination service provided in your area? Multiple responses possible Probe: anything else?	Vaccination service not accessible…(01) Vaccination site closed/vaccinator absent …(02) No vaccine at the vaccination cite…(03) Long waiting time…(04) Vaccinator not friendly/has poor communication skill…(05) Vaccination site is dirty/not clean…(06) Vaccinator not willing to open multivial…(07) Vaccination is expensive…(10) If other (specify)…(96)	

Section VII: Child immunization history			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
701	Do you have a card or another document where [NAME]'s vaccinations are written down?	Yes, has card or another document…(01) No, no card or other document…(02)	> 706
702	May I see the card or other document where [NAME]'s vaccinations are written down?	Yes, card or another document seen…(01) No, no card or other document seen…(02)	> 704 > 706
703	If not seen, why?	Does not want to show…(01) Kept in the health facility…(02) Missed…(03) Locked in another place…(04) If other (specify)…(96)	
704	Data collector: copy the following information from the vaccination card or document Enter "99" if card/document shows that a dose was given, but no date is recorded.		

	Vaccines			Date given (dd/mm/yy)
A	BCG	Yes…(01)	No…(02)	|__|__|/|__|__|/|__|__|
B	Polio-0	Yes…(01)	No…(02)	|__|__|/|__|__|/|__|__|
C	Polio-1	Yes…(01)	No…(02)	|__|__|/|__|__|/|__|__|
D	Polio-2	Yes…(01)	No…(02)	|__|__|/|__|__|/|__|__|
E	Polio-3	Yes…(01)	No…(02)	|__|__|/|__|__|/|__|__|
F	Penta-1	Yes…(01)	No…(02)	|__|__|/|__|__|/|__|__|
G	Penta-2	Yes…(01)	No…(02)	|__|__|/|__|__|/|__|__|
H	Penta-3	Yes…(01)	No…(02)	|__|__|/|__|__|/|__|__|
I	PCV-1	Yes…(01)	No…(02)	|__|__|/|__|__|/|__|__|
J	PCV-2	Yes…(01)	No…(02)	|__|__|/|__|__|/|__|__|
K	PCV-3	Yes…(01)	No…(02)	|__|__|/|__|__|/|__|__|
L	Rota-1	Yes…(01)	No…(02)	|__|__|/|__|__|/|__|__|
M	Rota-2	Yes…(01)	No…(02)	|__|__|/|__|__|/|__|__|
N	Measles-1	Yes…(01)	No…(02)	|__|__|/|__|__|/|__|__|
O	Measles-2	Yes…(01)	No…(02)	|__|__|/|__|__|/|__|__|

Section VII: Child immunization history			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
705	I want to take the picture of [NAME]'s vaccination card or document so that it will help me to counter check the information I filled. Are you willing? Data collector: if the caregiver consented take the snap short and upload the picture.	Yes…(01) No…(02)	>801 >801
706	Did [NAME] ever receive any vaccinations to prevent [NAME] from getting diseases, including vaccinations received in campaigns or immunization or child health days?	Yes…(01) No…(02) Don't know/Not sure…(99)	> 801 > 801
707	Data collector: Ask the mother whether the child has received the following vaccinations or not		
A	Has [NAME] ever received a BCG vaccination against tuberculosis, that is, an injection in the arm or shoulder that usually causes a scar?	Yes…(01) No…(02) Don't know/Not sure…(99)	
B	Has [NAME] ever received oral polio vaccine, that is, two drops in the mouth to prevent polio?	Yes…(01) No…(02) Don't know/Not sure…(99)	> E > E
C	Did [NAME] receive the first oral polio vaccine in the first two weeks after birth or later?	First two weeks…(01) Later…(02)	

Section VII: Child immunization history			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
D	How many times did [NAME] receive the oral polio vaccine?	|___| number of times	
E	Has [NAME] ever received a pentavalent vaccination, that is, an injection usually given on the left upper thigh sometimes at the same time as polio drops?	Yes…(01) No…(02) Don't know/Not sure…(99)	> G > G
F	How many times did [NAME] receive the pentavalent vaccine?	|___| number of times	
G	Has [NAME] ever received a pneumococcal vaccination, that is, an injection usually given on the right upper thigh to prevent pneumonia?	Yes…(01) No…(02) Don't know/Not sure…(99)	> I > I
H	How many times did [NAME] receive the pneumococcal vaccine?	|___| number of times	
I	Has [NAME] ever received a rotavirus vaccination, that is, liquid in the mouth to prevent diarrhea?	Yes…(01) No…(02) Don't know/Not sure…(99)	> K > K
J	How many times did [NAME] receive the rotavirus vaccine?	|___| number of times	
K	Has [NAME] received the first measles vaccination, that is, an injection in the arm to prevent measles given at 9 months?	Yes…(01) No…(02) Don't know/Not sure…(99)	
L	Has [NAME] received the second measles vaccination, that is, an injection in the arm to prevent measles given at 15 months?	Yes…(01) No…(02) Don't know/Not sure…(99)	

Section VII: Child immunization history			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
708	Does [NAME] have a BCG scar at the left upper arm? Check with your observation	Yes…(01) No…(02) Not possible to observe…(99)	
709	In addition to what is recorded on the document or what I asked you before, did [NAME] receive any other vaccinations, including vaccinations received in campaigns or immunization days or child health days? If "yes" probe for vaccinations and fill under 707	Yes…(01) No…(02) Don't know/Not sure…(99)	
710	Data collector: If vaccination card or document is not available, visit the nearby health facility, access the medical record of the child and fill the following information. Enter "99" if card/document shows that a dose was given, but no date is recorded. Select "99" if the data is not accessible.		

A	BCG	Yes (01)	No (02)	Data not accessible (99)	__/__/____	701=02
B	Polio-0	Yes (01)	No (02)	Data not accessible (99)	__/__/____	
C	Polio-1	Yes (01)	No (02)	Data not accessible (99)	__/__/____	
D	Polio-2	Yes (01)	No (02)	Data not accessible (99)	__/__/____	
E	Polio-3	Yes (01)	No (02)	Data not accessible (99)	__/__/____	
F	Penta-1	Yes (01)	No (02)	Data not accessible (99)	__/__/____	
G	Penta-2	Yes (01)	No (02)	Data not accessible (99)	__/__/____	
H	Penta-3	Yes (01)	No (02)	Data not accessible (99)	__/__/____	
I	PCV-1	Yes (01)	No (02)	Data not accessible (99)	__/__/____	
J	PCV-2	Yes (01)	No (02)	Data not accessible (99)	__/__/____	
K	PCV-3	Yes (01)	No (02)	Data not accessible (99)	__/__/____	
L	Rota-1	Yes (01)	No (02)	Data not accessible (99)	__/__/____	
M	Rota-2	Yes (01)	No (02)	Data not accessible (99)	__/__/____	
N	Measles-1	Yes (01)	No (02)	Data not accessible (99)	__/__/____	
O	Measles-2	Yes (01)	No (02)	Data not accessible (99)	__/__/____	

Section VIII: Barriers and enables to vaccination			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
801	From the information your provided, your child is under vaccinated for his/her age. What makes it difficult for you to ensure that your child is vaccinated against all the vaccine preventable diseases? Multiple responses possible probe: anything else?	Absence of health facility in the locality/ Vaccination service not accessible…(01) Health workers did not come to the village…(02) Vaccination site closed/vaccinator absent …(03) No vaccine at the vaccination cite…(04) Long waiting time…(05) Vaccinator not friendly/poor relationship with the vaccinator…(06) Domestic workload…(07) Vaccination is of no use…(08) Vaccination hurts children/make them sick…(09) My husband discouraged me…(10) Others in the family/community discouraged me…(11) Cultural or religious norms or beliefs…(12) Fear of cost associated with vaccination…(10) If other (specify)…(96) Don't know/Not sure…(99)	(704_N = 01) OR (707_K = 01)

Section VIII: Barriers and enables to vaccination			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
802	From the information your provided, your child is adequately vaccinated for his/her age. What makes it easier for you to ensure that your child is vaccinated against all the vaccine preventable diseases? Multiple responses possible probe: anything else?	Proximity of health facility/outreach site…(01) Door to door campaigns…(02) Vaccinations are important for children …(03) My husband supported/encouraged me…(04) Community health workers' follow up…(05) Others supported/encouraged me…(04) It is normal to vaccinate children …(06) If other (specify)…(96) Don't know/Not sure…(99)	(704_N = 02) OR (707_K = 02 OR 99)
803	Do most of the people around you approve of you vaccinating [NAME] every time needed?	Yes…(01) No…(02) Don't know/Not sure…(99)	
804	Who are the people that approve of you vaccinating your child?	Husband/partner…(01) Parents/ parents in laws…(02) Other family members…(03) Neighbors/peers…(04) Religious/community leaders…(05) If other (specify)…(96)	803=01
805	Who are the people that disapprove of you vaccinating your child?	Husband/partner…(01) Parents/ parents in laws…(02) Other family members…(03) Neighbors/peers…(04) Religious/community leaders…(05) If other (specify)…(96)	803=02

Section VIII: Barriers and enables to vaccination			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
806	How difficult would it be to get your child vaccinated? Very difficult, somewhat difficult, not difficult at all	Very difficult…(01) Somewhat difficult…(02) Not difficult at all…(03)	
807	How difficult was it to remember the vaccination schedule of [NANME]	Very difficult…(01) Somewhat difficult…(02) Not difficult at all…(03)	
808	Does your religion approve of vaccinating your child?	Yes…(01) No…(02) Don't know/Not sure…(99)	
809	Are there any cultural rules or taboos that you know of against vaccinating children?	Yes…(01) No…(02) Don't know/Not sure…(99)	

Section IX: Service integration			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
901	Late me take you to the time [NAME] was under the age of 1 year? During this time did you visit a health facility for any service?	Yes…(01) No…(02) Don't know/Not sure…(99)	>1001 >1001
902	Why did you visit the health facility then? Multiple responses possible probe: anything else?	Antenatal or postnatal care…(01) Family planning…(02) Sick childcare …(03) Growth monitoring…(04) To collect bed net…(05) Therapeutic or supplementary feeding program…(06) If other (specify)…(96) Don't remember/Not sure…(99)	902
903	While you visited the health facility for the service, did the health worker asked you about the vaccination status of [Name]or encouraged you to vaccinate [Name]?		

A	Antenatal or postnatal care	Yes, at least once…(01)	No…(01)	902=01
B	Family planning	Yes, at least once…(01)	No…(01)	902=02
C	Sick childcare	Yes, at least once…(01)	No…(01)	903=03
D	Growth monitoring	Yes, at least once…(01)	No…(01)	904=04
E	To collect bed net	Yes, at least once…(01)	No…(01)	905=05
F	Therapeutic/supplementary feeding program	Yes, at least once…(01)	No…(01)	906=06

Section X: Gender empowerment			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
1001	Who usually decides how the money you earn will be used: you, your (husband/partner), or you and your (husband/partner) jointly?	Respondent…(01) Jointly…(02) Husband/partner…(03) Has no earnings …(95) If other (specify)…(96)	211 = 02
1002	Who usually decides how your (husband/ partner's) earnings will be used: you, your (husband/partner), or you and your (husband/partner) jointly?	Respondent…(01) Jointly…(02) Husband/partner…(03) Husband has no earnings …(95) If other (specify)…(96)	211 = 02
1003	Who usually makes decisions about making major household purchases?	Respondent…(01) Jointly…(02) Husband/partner…(03) Someone else …(95)	211 = 02
1004	Who usually makes decisions about health care for yourself: you, your (husband/ partner), you and your (husband/ partner) jointly, or someone else?	Respondent…(01) Jointly…(02) Husband/partner…(03) Someone else …(95)	211 = 02
1005	Who usually makes decisions about health care for [NAME]: you, your (husband/partner), you and your (husband/ partner) jointly, or someone else?	Respondent…(01) Jointly…(02) Husband/partner…(03) Someone else …(95)	211 = 02
1006	Who usually makes decisions about visits to your family or relatives?	Respondent…(01) Jointly…(02) Husband/partner…(03) Someone else …(95)	211 = 02

Section X: Gender empowerment			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
1007	Does your husband help you with household chores like caring and looking after children, cooking, cleaning the house and doing other work around the house?	Yes…(01) No…(02) Don't know/Not sure…(99)	211 = 02
1008	Does he help you almost every day, at least once a week or rarely?	Almost every day…(01) About once per week…(02) Rarely …(03)	1007 = 01
1009	Do you own this or any other house either alone or jointly with someone else?	Alone only…(01) Both alone and jointly…(02) Jointly only…(03) Does not own…(04) 211 = 02	211 = 02
1010	Do you own any agricultural or non-agricultural land either alone or jointly with someone else?	Alone only…(01) Both alone and jointly…(02) Jointly only…(03) Does not own…(04)	211 = 02
1011	In the last complete 24 hours (starting yesterday morning to today's morning, how many hours did you spend working?	|___|___| hours	211 = 02
1012	Who generates income for household consumption?	Respondent…(01) Husband/partner…(02) Both…(03) If other (specify)…(96)	
1013	Who allocates money for health expenses?	Respondent…(01) Husband/partner…(02) Both…(03) If other (specify)…(96)	

Section X: Gender empowerment			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
1014	Who saves money from the income generation activity?	Respondent…(01) Husband/partner…(02) Both…(03) If other (specify)…(96)	
1015	Does anyone of the family member have access to credit scheme?	yes…(01) No…(02) Don't know…(03)	
1016	Who has access to the credit scheme in the community?	Alone only…(01) Both alone and jointly…(02) Jointly only…(03) Does not own…(04)	1015 = 01
1017	Have your family ever approached by community representatives or government authorities to attend in different social and health related meetings?	yes…(01) No…(02) Don't know…(03)	
1018	If yes, who usually attends the social and health related meetings organized by community representatives or government authorities?	Respondent…(01) Husband/partner…(02) Both…(03) If other (specify)…(96)	1017 = 01
1019	Have you or any one of your family members ever taken training on health, reproductive health or immunizations organized by nearby health facilities?	yes…(01) No…(02) Don't know…(03)	

Section X: Gender empowerment			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
1020	If yes who usually participate in the training?	Respondent…(01) Husband/partner…(02) Both…(03) If other (specify)…(96)	1019 = 01
1021	Is any of you or your family have any representation as a committee member or leader in the community gathering, community-based organization, health committee or government structure?	yes…(01) No…(02) Don't know…(03)	
1022	If yes who usually have a role in the committee?	Respondent…(01) Husband/partner…(02) Both…(03)	1021 = 01
1023	Who has more access to information about what is happening in the community with regard to health updates and vaccination campaigns?	Respondent…(01) Husband/partner…(02) Both…(03)	
1024	Is there kind of family dialogue among your family members on free discussion about health issues including immunization?	yes…(01) No…(02) Don't know…(03)	
1025	If yes, who usually initiates the dialogue?	Respondent…(01) Husband/partner…(02) Both…(03) If other (specify)…(96)	1024 = 01
This is the end of our interview. Thank you very much for taking part in this interview.			

Section XI: Endnotes			
No	**Question and reminders**	**Choices or answer spaces**	**Skip**
1101	Time the interview started Local time, 12-hour clock (AM/PM)	|___|___|: |___|___| |___|___|	
1102	GPS location	Latitude: _____ Longitude: _____ Altitude: _____	
1103	Form completion status	Complete…(01) Incomplete…(02)	

Annex III: Data collection tools for the Barrier & Enabler Analysis

Project HOPE

Reaching zero dose and under immunized children in remote areas of Ethiopia

In-depth interview guide for situational analysis of vaccination program in Ethiopia(Tool 2.1)

To be used with the following respondent at Ministry of Health level:

- MCHN Directorate Director/Representative, EPI Team leader
- Policy and Planning, Monitoring and Evaluation Directorate Director/Representative
- Health Extension and Primary Health Care Directorate/Representative
- Health System and Special System Directorate Director/Representative

Information and consent:

Introduction and propose of the study: good morning/Good afternoon. Thank you for the interest to discuss with me today. My name is_____ and I'm working for Project HOPE – Ethiopia. Project HOPE receives grant for conducting evaluation research on "Reaching zero dose and under immunized children in remote areas of Ethiopia" and as part of this research we are undertaking a situational analysis of the Ethiopian immunization program. The study will help us to understand the strength and weakness of the program and identify under-immunized settings in Ethiopia. You are selected for this interview purposely based on your expertise in the area We would very much appreciate your participation in this study.

Procedures: if you agree to take part in this study, we will discuss about the aforementioned issue for about 60 minutes. I will also audio record the interview so that I will be able to transcribe it later on.

Risks and Benefits: we believe there are no risks to you from participating in this study. You will not be directly benefited from taking part in the study. However, your participation will help us to better understand the circumstances around zero dose and under-immunized children and improve Ethiopia's health system. It will also help us to reducing zero dose children by providing equitable and quality immunization services across Ethiopia's primary health care system.

Compensation: you will not be paid for participating in this study.

Confidentiality: we will keep your answers confidentially. We will not share your answers with others who are not member of the research team. Your name and other facts that might help people recognize you will not appear when we present this study to others or publish its results. Your recorded voice will be stored on password-protected computers.

Voluntary participation and withdrawal: taking part in this study is voluntary. You can choose not to take part in the study or ask us to leave, and if you do agree to participate you can stop the interview at any time or skip any questions that you don't want to answer. There are no right or wrong answers. We just want to hear more about your own ideas and experiences. Also, after finishing the interview, you can refuse to have your answers included in the study.

Contact person: if you have any questions, I will be happy to answer them. And in case you ever want to contact the principal investigator, you should call + 251916822815 and ask for Dr. Samson Gebremedhin. You can also contact the ethics committee that approved the research project through: tel _____ or e-mail address:

Comprehension: Do you have any questions about the interview? If so, I will be glad to explain.

Consent: if you wish to be in this study, please sign here: _____

Reminder for the interviewer: If written consent is given, proceed to the interview. If she/he is not willing to take part in the study, thank her/him and discontinue the interview.

Basic information about the in-depth interview

Name of the interviewer: _____

Name of the notetaker: _____

Locality (region, city): _____/_____

Date of interview: _____

Venue of interview: _____

Beginning and ending times of the interview: _____/_____

Code number: _____

Basic profile of the respondent

Region: _____

Position: _____

Organization: _____

Years of experience in that position: _____Sex: _____

Interview guide questions

1. How do you describe the recent **trends in vaccination coverage** and incidence of common vaccine preventable diseases in Ethiopia?
    - Probe: reasons for increasing or decreasing coverage
    - Probe: outbreak situation of vaccine preventable diseases
2. In Ethiopia **which specific settings and populations** are considered as zero dose and under-immunized by the Ministry?
    - Probe: which specific geographic areas have low vaccination coverage or high incidence of vaccine preventable diseases?
    - Probe: Developing regions, pastoralist communities, urban slums, hard-to-reach areas, IDPs and migrants
    - Probe: What are the root causes for low vaccination coverage in these settings and populations?
3. What **service delivery-related barriers** preclude zero-dose and under-immunized children from being vaccinated?
    - Probe: limited physical access to health service, topography, functionality of health facilities during working hours
    - Probe: unavailability of health workers, lack of incentives and motivation, workload
    - Probe: engagement of the private sector in EPI programs
    - Probe: do the reasons differ by urban, remote rural, and fragile settings?
    - Probe: what is being done to address these service-delivery related barriers? What are the existing gaps?
4. How do you describe the existing **vaccine supply and logistic system** in Ethiopia?
    - Probe: availability and uninterrupted supply of vaccine, syringes, and safety boxes for vaccination
    - Probe: availability of refrigerators at health facilities including health posts
    - Probe: challenges in the cold chain system and maintenance of refrigerators
    - Probe: practice of effective vaccine management system
    - Probe: what is being done to improve the existing vaccine supply and logistic system?
    - Probe: vaccine waste: extent and causes
5. What are the **demand-related barriers** that prevent zero-dose and under-immunized children from being vaccinated?
    - Probe: socio-cultural factors, vaccine hesitancy, health literacy
    - Probe: mobility of the pupation
    - Probe: what is being done to address these demand-related barriers? What are the existing gaps?
    - Probe: efforts to improve interpersonal communication, social mobilization and demand creation activities

6. What **gender-related barriers** might zero-dose or under-immunize children or their families face to accessing services?
    - Probe: gender related barriers from both supply and demand sides
    - Probe: access to and control over resources both at household and community levels
    - Probe: unequal decision-making power at household level and community structures
    - Probe; unequal representation and power imbalance in the leadership positions in community and health structures
    - Probe: lack of access to information and economic dependency
    - Probe: lack of equal division of labour/workload and domestic violence
    - Probe: practice of gender-disaggregated data analysis
7. Could you please give us a brief overview of the **immunization financing** system in Ethiopia?
    - Probe: major financing sources
    - Probe: plan and challenges of domestic immunization financing
    - Probe: approaches for financing ground level activities including training, transportation, supportive supervision, collecting data
8. What are the **practices and challenges of planning** for vaccination program in Ethiopia?
    - Probe: approaches to estimate denominator
    - Probe: standardization of planning
    - Probe: practice of encouraging regions and districts to make micro plans to identify local problems and adopt corrective solutions
9. How does the Ministry use **data for decision making** for improving vaccination program at different levels of the health system?
    - Probe: what are the standard EPI core data sources? How is the practice of data management and extraction?
    - Probe: analysing data to prioritize districts with poor access
10. What is the ministry doing to improve **data quality** for vaccination program in Ethiopia? What are the causes of poor data quality in the immunization program of Ethiopia?
    - Probe: negligence, false data reporting, skill gaps, health workers value for data
    - Probe: underlying reasons for major coverage discrepancy between HMIS data community-based surveys
    - Probe: what are the challenges of the DHIS 2 implementation in relation to vaccination program?
    - Probe: data quality initiatives (lots of quality assurance), data quality self-assessment (DQS)
    - Probe: data accountability, triangulation and verification mechanisms
11. What specific **strategies and interventions** are being implemented to improve the coverage, utilization, quality and equity of immunization service in Ethiopia?
    - Probe: use of diverse (static, outreach and mobile) service delivery outlets
    - Probe: what is being done to reach to zero dose and under-immunized children specially in underserved populations

- Probe: specific programs including RED/REC
- Probe: complementary vaccine delivery strategies (enhanced catch-up immunization, periodic intensified routine immunization, mop-up and default tracing).
- Probe: small scale programs that need to be scaleup
- Probe: integration of service (including multisectoral integration) to reduced missed opportunities
- Probe: based on your opinion, which intervention working and not working? What are the challenges of the existing program?

12. How does the Ministry implement and promote **monitoring, evaluating and learning** activities in the vaccination program in Ethiopia?

    - Probe: challenges in implementing monitoring, evaluation and learning
    - Probe: existing HMIS indicators
    - Probe: supportive supervision

13. What is the ministry doing to improve the **quality** of immunization service in Ethiopia?

    - Probe: approached to evaluate and ensure service quality
    - Probe: regular review meeting and supportive supervision
    - Probe: immunization-specific supportive supervision
    - Probe: capacity building

14. In your opinion, **what new interventions** required to improve vaccination programs in Ethiopia

    - Probe: targeted interventions to reach to zero dose and under-immunized children
    - Probe: what innovations are needed to strengthen access to zero-dose children and missed communities in the long term?
    - Probe: How can service delivery approaches be tailored to reach specific underserved areas?

15. Based on the expertise, what are the major **strength and weakness** of the Ethiopian vaccination program?

    - Probe: how can the weakness be addressed?
    - Probe: what are the common challenges and how they are being addressed?
    - Probe: success stories

16. What are the major **opportunities and threats** to the vaccination program in Ethiopia?

    - Probe: threats including political instability, Covid 19 outbreak, vaccine hesitancy
    - Probe: what is being done by the ministry and its partners to maximize the opportunities and mitigate the threats?

17. Who are you major **stakeholders and partners** in the financing and implementation of vaccination programs in Ethiopia? In what specific areas do they support you?

    - Probe: technical assistance needs of the ministry

18. Before I conclude the discussion, is there anything you would like to add or recommend?

Project HOPE

Reaching zero dose and under immunized children in remote areas of Ethiopia

In-depth interview guide for situational analysis of vaccination program in Ethiopia(Tool 2.2)

To be used with the following respondent at regional level:

- MCHN Directorate Director
- EPI Team leader
- Health Extension Program Directorate

Information and consent:

Introduction and propose of the study: good morning/Good afternoon. Thank you for the interest to discuss with me today. My name is_____ and I'm working for Project HOPE – Ethiopia. Project HOPE receives grant for conducting evaluation research on "Reaching zero dose and under immunized children in remote areas of Ethiopia" and as part of this research we are undertaking a situational analysis of the Ethiopian immunization program. The study will help us to understand the strength and weakness of the program and identify under-immunized settings in Ethiopia. You are selected for this interview purposely based on your expertise in the area We would very much appreciate your participation in this study.

Procedures: if you agree to take part in this study, we will discuss about the aforementioned issue for about 60 minutes. I will also audio record the interview so that I will be able to transcribe it later on.

Risks and Benefits: we believe there are no risks to you from participating in this study. You will not be directly benefited from taking part in the study. However, your participation will help us to better understand the circumstances around zero dose and under-immunized children and improve Ethiopia's health system. It will also help us to reducing zero dose children by providing equitable and quality immunization services across Ethiopia's primary health care system.

Compensation: you will not be paid for participating in this study.

Confidentiality: we will keep your answers confidentially. We will not share your answers with others who are not member of the research team. Your name and other facts that might help people recognize you will not appear when we present this study to others or publish its results. Your recorded voice will be stored on password-protected computers.

Voluntary participation and withdrawal: taking part in this study is voluntary. You can choose not to take part in the study or ask us to leave, and if you do agree to participate you can stop the interview at any time or skip any questions that you don't want to answer. There are no right or wrong answers. We just want to hear more about your own ideas and experiences. Also, after finishing the interview, you can refuse to have your answers included in the study.

Contact person: if you have any questions, I will be happy to answer them. And in case you ever want to contact the principal investigator, you should call + 251916822815 and ask for Dr. Samson Gebremedhin.

Comprehension: Do you have any questions about the interview? If so, I will be glad to explain.

Consent: if you wish to be in this study, please sign here: _____

Reminder for the interviewer: If written consent is given, proceed to the interview. If she/he is not willing to take part in the study, thank her/him and discontinue the interview.

Basic information about the in-depth interview

Name of the interviewer: _____

Name of the notetaker: _____

Locality (region, city): _____/_____

Date of interview: _____

Venue of interview: _____

Beginning and ending times of the interview: _____/_____

Code number: _____

Basic profile of the respondent

Region: _____

Position: _____

Organization: _____

Years of experience in that position: _____Sex: _____

Interview guide questions

1. How do you describe the recent **trends in vaccination coverage** and incidence of common vaccine preventable diseases in the region?
    - Probe: reasons for increasing or decreasing coverage
    - Probe: outbreak situation of vaccine preventable diseases
2. In the region, **which specific settings and populations** are considered as zero dose and under-immunized by the RHB?
    - Probe: which specific geographic areas have low vaccination coverage or high incidence of vaccine preventable diseases?
    - Probe: what are two or three districts in the region with the lowest coverage of vaccination program?
    - Probe: pastoralist communities, urban slums, hard-to-reach districts, IDPs and migrants
    - Probe: What are the root causes for low vaccination coverage in these settings and populations?
3. What **service delivery-related barriers** preclude zero-dose and under-immunized children from being vaccinated?
    - Probe: limited physical access to health service, topography, functionality of health facilities during working hours
    - Probe: unavailability of health workers, lack of incentives and motivation, workload
    - Probe: engagement of the private sector in EPI programs
    - Probe: do the reasons differ by urban, remote rural, and fragile settings?
    - Probe: what is being done to address these service-delivery related barriers? What are the existing gaps?
4. How do you describe the existing **vaccine supply and logistic system** in your region?
    - Probe: availability and uninterrupted supply of vaccine, syringes, and safety boxes for vaccination
    - Probe: availability of refrigerators at health facilities including in health posts
    - Probe: challenges in the cold chain system and maintenance of refrigerators
    - Probe: practice of effective vaccine management system
    - Probe: what is being done to improve the existing vaccine supply and logistic system?
    - Probe: vaccine wastage and underlying causes.
5. In your region, what are the **demand-related barriers** that prevent zero-dose and under-immunized children from being vaccinated?
    - Probe: socio-cultural and economic factors, vaccine hesitancy, health literacy
    - Probe: mobility of the pupation
    - Probe: what is being done to address these demand-related barriers? What are the existing gaps?
6. What **gender-related barriers** might zero-dose or under-immunize children or their families face to accessing services?
    - Probe: gender related barriers from both supply and demand sides

- Probe: access to and control over resources both at household and community levels
- Probe: unequal decision-making power at household level and community structures
- Probe: unequal representation and power imbalance in the leadership positions in community and health structures
- Probe: lack of access to information and economic dependency
- Probe: lack of equal division of labor/workload
- Probe: practice of gender-disaggregated data analysis

7. Could you please give us a brief overview of the **immunization financing** system in the region?

   - Probe: major financing sources
   - Probe: plan and challenges of domestic immunization financing
   - Probe: approaches for financing ground level activities including training, transportation, supportive supervision, data collection

8. What are the **practices and challenges of planning** for vaccination program in the region?

   - Probe: approaches to estimate denominator
   - Probe: standardization of planning
   - Probe: practice of encouraging zones and districts to make micro plans to identify local problems and adopt corrective solutions

9. How does the RHB use **data for decision making** for improving vaccination program at different levels of the health system?

   - Probe: what are the standard EPI core data sources? How is the practice of data management and extraction?
   - Probe: analysing data to prioritize districts with poor access

10. What is the RHB doing to improve **data quality** for vaccination program in the region? What are the causes of poor data quality in the immunization program of the region?

    - Probe: negligence, false data reporting, skill gaps, health workers value for data Probe: underlying reasons for major coverage discrepancy between DHIS data and community-based surveys
    - Probe: what are the challenges of the DHIS 2 implementation in relation to vaccination program?
    - Probe: data quality initiatives
    - Probe: data accountability, triangulation and verification mechanisms

11. What specific **strategies and interventions** are being implemented to improve the coverage, utilization, quality and equity of immunization service in the region?

    - Probe: use of diverse (static, outreach and mobile) service delivery outlets
    - Probe: what is being done to reach to zero dose and under-immunized children specially in underserved populations
    - Probe: specific programs including RED/REC

- Probe: complementary vaccine delivery strategies (enhanced catch-up immunization, periodic intensified routine immunization, mop-up and default tracing).
- Probe: small scale programs that need to be scaleup
- Probe: integration of service (including multisectoral integration) to reduced missed opportunities
- Probe: based on your opinion, which intervention working and not working? What are the challenges of the existing program?

12. What **SBCC, community engagement and mobilization strategies** are being implement to improve the utilization of vaccination program in your region?

    - Probe: how can the SBCC, community engagement and mobilization strategies be improved?

13. How does the RHB implement and promote **monitoring, evaluating and learning** activities in the vaccination program in the region?

    - Probe: challenges in implementing monitoring, evaluation and learning
    - Probe: existing HIS indicators
    - Probe: supportive supervision

14. What is the RHB doing to improve the quality of immunization service in the region?

    - Probe: approached to evaluate and ensure service quality
    - Probe: regular review meeting and supportive supervision
    - Probe: immunization-specific supportive supervision
    - Probe: capacity building, input and structure

15. Probe: supportive supervision provided by FMoH In your opinion, **what new interventions** required to improve vaccination programs in your region?

    - Probe: targeted interventions to reach to zero dose and under-immunized children
    - Probe: what innovations are needed to strengthen access to zero-dose children and missed communities in the long term?
    - Probe: How can service delivery approaches be tailored to reach specific underserved areas?

16. Based on the expertise, what are the major **strength and weakness** of the vaccination program in your region?

    - Probe: how can the weakness be addressed?
    - Probe: what are the common challenges and how they are being addressed?
    - Probe: success stories

17. What are the major **opportunities and threats** to the vaccination program in your region?

    - Probe: threats including political instability, Covid 19 outbreak, vaccine hesitancy
    - Probe: what is being done by the RHB and its partners to maximize the opportunities and mitigate the threats?

18. Who are you major **stakeholders and partners** in the financing and implementation of vaccination programs in your region? In what specific areas do they support you?

    - Probe: technical assistance needs of the RHB

19. Before I conclude the discussion, is there anything you would like to add or recommend?

Project HOPE

Reaching zero dose and under immunized children in remote areas of Ethiopia

In-depth interview guide for situational analysis of vaccination program in Ethiopia(Tool 2.3)

To be used with the following respondent:

- Multilateral agencies, NGOs and donors working on immunization program at federal level
- NGOs working on immunization program at regional level
- UNHCR and RRS/ARRA (at federal level)

Information and consent:

Introduction and propose of the study: good morning/Good afternoon. Thank you for the interest to discuss with me today. My name is_____ and I'm working for Project HOPE – Ethiopia. Project HOPE receives grant for conducting evaluation research on "Reaching zero dose and under immunized children in remote areas of Ethiopia" and as part of this research we are undertaking a situational analysis of the Ethiopian immunization program. The study will help us to understand the strength and weakness of the program and identify under-immunized settings in Ethiopia. You are selected for this interview purposely based on your expertise in the area We would very much appreciate your participation in this study.

Procedures: if you agree to take part in this study, we will discuss about the aforementioned issue for about 60 minutes. I will also audio record the interview so that I will be able to transcribe it later on.

Risks and Benefits: we believe there are no risks to you from participating in this study. You will not be directly benefited from taking part in the study. However, your participation will help us to better understand the circumstances around zero dose and under-immunized children and improve Ethiopia's health system. It will also help us to reducing zero dose children by providing equitable and quality immunization services across Ethiopia's primary health care system.

Compensation: you will not be paid for participating in this study.

Confidentiality: we will keep your answers confidentially. We will not share your answers with others who are not member of the research team. Your name and other facts that might help people recognize you will not appear when we present this study to others or publish its results. Your recorded voice will be stored on password-protected computers.

Voluntary participation and withdrawal: taking part in this study is voluntary. You can choose not to take part in the study or ask us to leave, and if you do agree to participate you can stop the interview at any time or skip any questions that you don't want to answer. There are no right or wrong answers. We just want to hear more about your own ideas and experiences. Also, after finishing the interview, you can refuse to have your answers included in the study.

Contact person: if you have any questions, I will be happy to answer them. And in case you ever want to contact the principal investigator, you should call + 251916822815 and ask for Dr. Samson Gebremedhin.

Comprehension: Do you have any questions about the interview? If so, I will be glad to explain.

Consent: if you wish to be in this study, please sign here: _____

Reminder for the interviewer: If written consent is given, proceed to the interview. If she/he is not willing to take part in the study, thank her/him and discontinue the interview.

Basic information about the in-depth interview

Name of the interviewer: _____

Name of the notetaker: _____

Locality (region, city): _____/_____

Date of interview: _____

Venue of interview: _____

Beginning and ending times of the interview: _____/_____

Code number: _____

Basic profile of the respondent

Region: _____

Position: _____

Organization: _____

Years of experience in that position: _____Sex: _____

Interview guide questions

1. How do you describe the recent **trends in vaccination coverage** and incidence of common vaccine preventable diseases in Ethiopia or in regions/settings where your organization is working?
    - Probe: reasons for increasing or decreasing coverage
    - Probe: outbreak situation of vaccine preventable diseases
2. How is your **organization supporting the Ethiopia government/RHB** in improving the vaccination program and coverage in the country/region (or special settings like refugees and IDPs)?
    - Probe: geographic scope and programmatic areas of interest
    - Probe: stakeholders and partners
    - Probe: community mobilization and SBCC approaches
    - Probe: monitoring evaluation and learning activities
    - Probe: implementation challenges and success stories
    - Probe: specific programs for refugees and IDPs
3. In your opinion, **which specific settings and populations** are considered as zero dose and under-immunized?
    - Probe: which specific geographic areas have low vaccination coverage or high incidence of vaccine preventable diseases?
    - Probe: pastoralist communities, urban slums, hard-to-reach districts, IDPs and migrants
    - Probe: What are the root causes for low vaccination coverage in these settings and populations?
4. Based on the expertise, what **service delivery-related barriers** preclude zero-dose and under-immunized children from being vaccinated?
    - Probe: limited physical access to health service, topography, functionality of health facilities during working hours
    - Probe: unavailability of health workers, lack of incentives and motivation, workload
    - Probe: problems with the vaccine supply and logistic system (including vaccine wastage)
    - Probe: engagement of the private sector in EPI programs
    - Probe: do the reasons differ by urban, remote rural, and fragile settings?
    - Probe: what is being done to address these service-delivery related barriers? What are the existing gaps?
5. What do you think are the **demand-related barriers** that prevent zero-dose and under-immunized children from being vaccinated?
    - Probe: socio-cultural and economic factors, vaccine hesitancy, health literacy
    - Probe: mobility of the pupation
    - Probe: what is being done to address these demand-related barriers? What are the existing gaps?

6. What **gender-related barriers** might zero-dose or under-immunize children or their families face to accessing services?
    - Probe: gender related barriers from both supply and demand sides
    - Probe: practice of gender-disaggregated data analysis
7. Based on your expertise, what specific **strategies and interventions** are being implemented by the MoH/RHB to improve the coverage, utilization, quality and equity of immunization service in Ethiopia?
    - Probe: use of diverse (static, outreach and mobile) service delivery outlets
    - Probe: what is being done to reach to zero dose and under-immunized children specially in underserved populations
    - Probe: specific programs including RED/REC
    - Probe: complementary vaccine delivery strategies (enhanced catch-up immunization, periodic intensified routine immunization, mop-up and default tracing).
    - Probe: small scale programs that need to be scaleup
    - Probe: integration of service (including multisectoral integration) to reduced missed opportunities
    - Probe: based on your opinion, which intervention are working and not working? What are the challenges of the existing program?
8. Based on the expertise, what are the major **strength and weakness (including challenges)** of the vaccination program in Ethiopia or settings where your organization is working?
    - Probe: data quality problems, use of data for decision making
    - Probe: problems with microplanning (estimation of denominators)
    - Probe: how can the weakness be addressed?
    - Probe: what are the common challenges and how they are being/can be addressed?
    - Probe: success stories
9. What are the major **opportunities and threats** to the vaccination program in Ethiopia or settings where your organization is working?
    - Probe: threats including political instability, Covid 19 outbreak, vaccine hesitancy
    - Probe: what is being done by the MoH/RBH and its partners to maximize the opportunities and mitigate the threats?
10. In your opinion, **what new interventions** required to improve vaccination programs in Ethiopia/region?
    - Probe: targeted interventions to reach to zero dose and under-immunized children
    - Probe: what innovations are needed to strengthen access to zero-dose children and missed communities in the long term?
    - Probe: How can service delivery approaches be tailored to reach specific underserved areas?
11. Before I conclude the discussion, is there anything you would like to add or recommend?

Project HOPE

Reaching zero dose and under immunized children in remote areas of Ethiopia

In-depth interview guide for situational analysis of vaccination program in Ethiopia(Tool 2.4)

To be used with the following respondent at federal and regional levels:

- EPSA focal persons at federal level, regional hubs or regional health bureaus

Information and consent:

Introduction and propose of the study: good morning/Good afternoon. Thank you for the interest to discuss with me today. My name is_____ and I'm working for Project HOPE – Ethiopia. Project HOPE receives grant for conducting evaluation research on "Reaching zero dose and under immunized children in remote areas of Ethiopia" and as part of this research we are undertaking a situational analysis of the Ethiopian immunization program. The study will help us to understand the strength and weakness of the program and identify under-immunized settings in Ethiopia. You are selected for this interview purposely based on your expertise in the area We would very much appreciate your participation in this study.

Procedures: if you agree to take part in this study, we will discuss about the aforementioned issue for about 60 minutes. I will also audio record the interview so that I will be able to transcribe it later on.

Risks and Benefits: we believe there are no risks to you from participating in this study. You will not be directly benefited from taking part in the study. However, your participation will help us to better understand the circumstances around zero dose and under-immunized children and improve Ethiopia's health system. It will also help us to reducing zero dose children by providing equitable and quality immunization services across Ethiopia's primary health care system.

Compensation: you will not be paid for participating in this study.

Confidentiality: we will keep your answers confidentially. We will not share your answers with others who are not member of the research team. Your name and other facts that might help people recognize you will not appear when we present this study to others or publish its results. Your recorded voice will be stored on password-protected computers.

Voluntary participation and withdrawal: taking part in this study is voluntary. You can choose not to take part in the study or ask us to leave, and if you do agree to participate you can stop the interview at any time or skip any questions that you don't want to answer. There are no right or wrong answers. We just want to hear more about your own ideas and experiences. Also, after finishing the interview, you can refuse to have your answers included in the study.

Contact person: if you have any questions, I will be happy to answer them. And in case you ever want to contact the principal investigator, you should call + 251916822815 and ask for Dr. Samson Gebremedhin.

Comprehension: Do you have any questions about the interview? If so, I will be glad to explain.

Consent: if you wish to be in this study, please sign here: _____

Reminder for the interviewer: If written consent is given, proceed to the interview. If she/he is not willing to take part in the study, thank her/him and discontinue the interview.

Basic information about the in-depth interview

Name of the interviewer: _____

Name of the notetaker: _____

Locality (region, city): _____/_____

Date of interview: _____

Venue of interview: _____

Beginning and ending times of the interview: _____/_____

Code number: _____

Basic profile of the respondent

Region: _____

Position: _____

Organization: _____

Years of experience in that position: _____Sex: _____

Interview guide questions

1. How do you describe the **existing immunization supply chain and logistic system** in the country or in your region starting from vaccine arrival to distribution?
    - Probe: needs forecasting
    - Probe: distribution system including supply and pick up lines, packaging and use of refrigerated trucks and cold boxes
    - Probe: challenges in the distribution system
    - Probe: indicators for quality of vaccine products
    - Probe: infrastructure and cold chain capacity
    - Probe: temperature management system
    - Probe: stock management system (safety stock level, maximum and reorder levels)
2. How do you describe the **availability of uninterrupted supply** of vaccine, syringes, and safety boxes for vaccination program in the country or region or health facility?
    - Probe: are vaccine and other supplies available when needed?
    - Probe: experience of stockout at national, regional, district and facility levels
    - Probe: causes of stockout and supply interruption
3. How is the **availability and adequacy of functional cold chain** at health facilities level including in health posts?
    - Probe: what challenges do you commonly encounter in the cold chain system?
    - Probe: availability of Solar Direct Drive (SDD) refrigerators, cold boxes and vaccine carriers
    - Probe: causes of cold chain failure including lack of maintenance of refrigerators and shortage of spare parts
    - Probe: increased storage demand due to introduction of new vaccines
    - Probe: power outage and presence of backup generator
4. Do you think **vaccine wastage** is a major problem in the national/regional vaccine logistic system?
    - Probe: extent of vaccine wastage at all levels of the supply system
    - Probe: experience of waste monitoring system
    - Probe: causes of vaccine wastage
    - Probe: lack of knowledge of recommended storage conditions and improper vaccine handling by health workers
    - Probe: which vaccines are most affected?
    - Probe: proper implementation of multi dose vaccine policy,
    - Probe: how best do you implement vaccine wastage monitoring system? What indicators and data sources are used to monitor vaccine wastage?
    - Probe: what should be done to reduce vaccine wastage?
5. How do dispose vaccine at all levels of the health system?
    - Probe: what are the challenges in vaccine disposal system? Availability of incinerators
    - Probe: how is vaccine disposal reported through the system?

6. How do you **monitor and evaluate** the health of the immunization supply chain and logistic system?
    - Probe: supply chain data generation and use for decision making
    - Probe: use of shake test, Vaccine Vial Monitors for quality control
7. What is being done to **improve** the existing vaccine supply and logistic system?
    - Probe: training and human capacity needs
    - Probe: what new interventions are needed?
    - Probe: success stories
8. Based on the expertise, what are the major **strength and weakness** of the vaccine logistic system?
    - Probe: presence of policy and standards, and guidelines
    - Probe: adequacy of human resources for immunization logistics
    - Probe: vaccine logistic information system
    - Probe: system efficiency and agility including integration with other supply systems
    - Probe: engagement of the private sector
    - Probe: how can the weakness be addressed?
9. What are the major **opportunities and threats** to the vaccine logistic system?
    - Probe: do you think that adequate attention is given to the vaccine logistic system by the government, donors and partners? Why?
    - Probe: adequacy of investment in vaccine logistic system
    - Probe: changing vaccine landscape and introduction of new vaccines
    - Probe: effect of the Covid 19 outbreak and ongoing political conflict
    - Probe: system digitization and its implementing challenges
    - Probe: what is being done by the Ministry/RHB and its partners to maximize the opportunities and mitigate the threats?
10. Who are you major **stakeholders and partners** in improving the immunization supply chain and logistic system of the country/region?
    - Probe: technical assistance needs
11. Before I conclude the discussion, is there anything you would like to add or recommend?

Project HOPE

Reaching zero dose and under immunized children in remote areas of Ethiopia

In-depth interview guide for situational analysis of vaccination program in Ethiopia(Tool 2.5)

To be used with the following respondent at federal and regional level:

- EPHI: Director of Health System and Reproductive Health Research
- EPHI: Vaccine preventable disease team leader
- Regional Public Health Institutes

Information and consent:

Introduction and propose of the study: good morning/Good afternoon. Thank you for the interest to discuss with me today. My name is_____ and I'm working for Project HOPE – Ethiopia. Project HOPE receives grant for conducting evaluation research on "Reaching zero dose and under immunized children in remote areas of Ethiopia" and as part of this research we are undertaking a situational analysis of the Ethiopian immunization program. The study will help us to understand the strength and weakness of the program and identify under-immunized settings in Ethiopia. You are selected for this interview purposely based on your expertise in the area We would very much appreciate your participation in this study.

Procedures: if you agree to take part in this study, we will discuss about the aforementioned issue for about 60 minutes. I will also audio record the interview so that I will be able to transcribe it later on.

Risks and Benefits: we believe there are no risks to you from participating in this study. You will not be directly benefited from taking part in the study. However, your participation will help us to better understand the circumstances around zero dose and under-immunized children and improve Ethiopia's health system. It will also help us to reducing zero dose children by providing equitable and quality immunization services across Ethiopia's primary health care system.

Compensation: you will not be paid for participating in this study.

Confidentiality: we will keep your answers confidentially. We will not share your answers with others who are not member of the research team. Your name and other facts that might help people recognize you will not appear when we present this study to others or publish its results. Your recorded voice will be stored on password-protected computers.

Voluntary participation and withdrawal: taking part in this study is voluntary. You can choose not to take part in the study or ask us to leave, and if you do agree to participate you can stop the interview at any time or skip any questions that you don't want to answer. There are no right or wrong answers. We just want to hear more about your own ideas and experiences. Also, after finishing the interview, you can refuse to have your answers included in the study.

Contact person: if you have any questions, I will be happy to answer them. And in case you ever want to contact the principal investigator, you should call + 251916822815 and ask for Dr. Samson Gebremedhin.

Comprehension: Do you have any questions about the interview? If so, I will be glad to explain.

Consent: if you wish to be in this study, please sign here: _____

Reminder for the interviewer: If written consent is given, proceed to the interview. If she/he is not willing to take part in the study, thank her/him and discontinue the interview.

Basic information about the in-depth interview

Name of the interviewer: _____

Name of the notetaker: _____

Locality (region, city): _____/_____

Date of interview: _____

Venue of interview: _____

Beginning and ending times of the interview: _____/_____

Code number: _____

Basic profile of the respondent

Region: _____

Position: _____

Organization: _____

Years of experience in that position: _____Sex: _____

Interview guide questions

1. How do you describe the recent **trends** in incidence of common childhood vaccine preventable diseases (VPDs) in Ethiopia/in the region?
    - Probe: VPDs under surveillance, which vaccine prevalent able diseases are more commonly reported by the PHEM system
    - Probe: reasons for increasing or decreasing trends
2. In Ethiopia/in the region, **which specific settings and populations** are more affected by VPDs?
    - Probe: pastoralist communities, urban slums, hard-to-reach districts, IDPs and migrants
      Probe: what are two or three districts in the region which are very commonly affected by VPDs?
3. What **service delivery-related barriers** are leading to low vaccination coverage and continued occurrence of VPD Ethiopia/in the region?
    - Probe: limited physical access to health service, topography, functionality of health facilities during working hours
    - Probe: unavailability of health workers, lack of incentives and motivation, workload
    - Probe: vaccine supply and logistic system
    - Probe: do the reasons differ by urban, remote rural, and fragile settings?
    - Probe: what is being done to address these service-delivery related barriers? What are the existing gaps?
4. In Ethiopia/in your region, what are the **demand-related barriers** is leading to low vaccination coverage and continued occurrence of VPDs?
    - Probe: socio-cultural and economic factors, vaccine hesitancy, health literacy
    - Probe: mobility of the pupation
    - Probe: gender related factors
    - Probe: what is being done to address these demand-related barriers? What are the existing gaps?
5. Whenever you come across with outbreak of VPDs, what specific **public health response** do you usually undertake?
    - Probe: practice of using data for decision making
    - Probe: availability of real-time data for action
    - Probe: challenges in taking timely public health response system
    - Probe: effectiveness of specific interventions in controlling the outbreak
6. How do you describe the **quality of data** gendered by the PHEM system on VPD? What are the causes of poor data quality in monitoring VPDS in Ethiopia/in the region?
    - Probe: negligence, false data reporting, skill gaps, health workers value for data
    - Probe: what are the challenges you commonly encounter regarding data quality?
    - Probe: how is the practice of data management and extraction?
    - Probe: data quality initiatives

- Probe: data accountability, triangulation and verification mechanisms
- Probe: underlying reasons for major vaccine coverage discrepancy between DHIS data and community-based surveys

7. Do you think that the health system is **doing enough** to control VPDs in Ethiopia/in the region?
    - What specific strategies and interventions are being implemented to improve the coverage, utilization, quality and equity of immunization service in Ethiopia/in the region?
    - Probe: what is being done to reach to zero dose and under-immunized children specially in underserved populations
    - Probe: small scale programs that need to be scaleup
    - Probe: integration of service to reduced missed opportunities
    - Probe: based on your opinion, which interventions are working and which are not working?
8. What **SBCC, community engagement and mobilization strategies** are being implement to control VPDs and improve the utilization of vaccination program in Ethiopia/in your region?
    - Probe: how can the SBCC, community engagement and mobilization strategies be improved?
9. In your opinion, what **new interventions and strategies** required to eliminate vaccine preventable diseases and improve vaccination service coverage in Ethiopia/in your region?
    - Probe: targeted interventions to reach to zero dose and under-immunized children
    - Probe: what innovations are needed to strengthen access to zero-dose children and missed communities in the long term?
    - Probe: How can service delivery approaches be tailored to reach specific underserved areas?
10. How do you describe the use of **research and scientific evidence** for improving vaccination service and reducing VPDs in Ethiopia/in the region?
    - Probe: what operational research have you conducted on the topic? What were the key findings of such research?
    - Probe: how do you translate research into practice
11. How does the PHEM conducts surveillance of adverse events following immunization (AEFI)? What are the challenges in this regard?
12. Based on the expertise, what are the major **strength and weakness** of the PHEM system (including surveillance and research) in the region in monitoring and taking timely response against VPDs?
    - Probe: how can the weakness be addressed?
    - Probe: what are the common challenges and how they are being addressed?
    - Probe: success stories
13. What are the major **opportunities and threats** PHEM system (including surveillance and research) in monitoring and taking timely response against VPDs?
    - Probe: threats including political instability, Covid 19 outbreak, vaccine hesitancy

- Probe: what is being done by the RHB and its partners to maximize the opportunities and mitigate the threats?

14. .Who are you major stakeholders and partners in monitoring VPDs in Ethiopia/in the region? In what specific areas do they support you?

- Probe: technical assistance needs of the ministry

15. Before I conclude the discussion, is there anything you would like to add or recommend?

Project HOPE

Reaching zero dose and under immunized children in remote areas of Ethiopia

In-depth interview guide for barrier-enabler study(Tool 2.6)

To be used with the following respondent at Zonal Health Department level:

- Zonal Health Department Head/Representative
- MCHN Focal Person/Representative
- EPI Team leader
- Health Extension Program Coordinator

Information and consent:

Introduction and propose of the study: good morning/Good afternoon. Thank you for the interest to discuss with me today. My name is_____ and I'm working for Project HOPE – Ethiopia. Project HOPE receives grant for conducting evaluation research on "Reaching zero dose and under immunized children in remote areas of Ethiopia" and as part of this research we are undertaking a situational analysis of the Ethiopian immunization program. The study will help us to understand the strength and weakness of the program and identify under-immunized settings in Ethiopia. You are selected for this interview purposely based on your expertise in the area We would very much appreciate your participation in this study.

Procedures: if you agree to take part in this study, we will discuss about the aforementioned issue for about 60 minutes. I will also audio record the interview so that I will be able to transcribe it later on.

Risks and Benefits: we believe there are no risks to you from participating in this study. You will not be directly benefited from taking part in the study. However, your participation will help us to better understand the circumstances around zero dose and under-immunized children and improve Ethiopia's health system. It will also help us to reducing zero dose children by providing equitable and quality immunization services across Ethiopia's primary health care system.

Compensation: you will not be paid for participating in this study.

Voluntary participation and withdrawal: taking part in this study is voluntary. You can choose not to take part in the study or ask us to leave, and if you do agree to participate you can stop the interview at any time or skip any questions that you don't want to answer. There are no right or wrong answers. We just want to hear more about your own ideas and experiences. Also, after finishing the interview, you can refuse to have your answers included in the study.

Contact person: if you have any questions, I will be happy to answer them. And in case you ever want to contact the principal investigator, you should call + 251916822815 and ask for Dr. Samson Gebremedhin.

Comprehension: Do you have any questions about the interview? If so, I will be glad to explain.

Consent: if you wish to be in this study, please sign here: _____

Reminder for the interviewer: If written consent is given, proceed to the interview. If she/he is not willing to take part in the study, thank her/him and discontinue the interview.

Basic information about the in-depth interview

Name of the interviewer: _____

Name of the notetaker: _____

Locality (region, city): _____/_____

Date of interview: _____

Interview guide questions

1. How would you describe the **vaccination coverage** situation and incidence of common vaccine preventable diseases in your zone?
    - Probe: recent trends in vaccination coverage in the zone
    - Probe: outbreaks of vaccine preventable diseases in the zone
2. In your zone, **which specific settings and populations** are considered as under-immunized?
    - Probe: which specific districts have low vaccination coverage or high incidence of vaccine preventable diseases?
    - Probe: in which areas are the most missed children need to be targeted?
3. In your zone, what are **the supply-related barriers** that prevent zero-dose and under-immunized children from being vaccinated?
    - Probe: is vaccination service available where and when needed in the zone?
    - Probe: is vaccination service receiving equal attention by the healthy system and health workers?
    - Probe: limited access to health service, unavailability of health workers, inefficient vaccine logistic system, unavailability of equipment, demotivated health workers…..
    - Probe: Effect of the Covid 19 outbreak on the provision of routine vaccination programs
    - Probe: what is being done to address these supply-related barriers? What are the existing gaps?
4. How do you describe the existing **vaccine supply and logistic system** in your zone?
    - Probe: availability of refrigerators at health facilities including health posts
    - Probe: challenges in the cold chain system and maintenance of refrigerators
    - Probe: practice of effective vaccine management system
5. In your zone, what **individual/family level factors** hinder the utilization of vaccination program?
    - Probe: vaccine hesitancy (doubts about vaccine safety and effectiveness), health literacy, economic factors
    - Probe: what is being done to address these barriers? What are the existing gaps?
6. In your zone, are there **socio-cultural factors** that hinder the utilization of vaccination program?
    - Probe: cultural and religious beliefs, vaccine related rumors
    - Probe: what is being done to address these socio-cultural barriers? What are the existing gaps?
7. In your zone, what **gender-related barriers** might zero-dose and under-immunized children or their families face to accessing services?
    - Probe: gender related barriers from both supply and demand sides
    - Probe: Husband involvement in immunization program
    - Probe: gender related barriers from both supply and demand sides
    - Probe: access to and control over resources both at household and community levels

- Probe: unequal decision-making power at household level and community structures
- Probe: unequal representation and power imbalance in the leadership positions in community and health structures
- Probe: lack of access to information and economic dependency
- Probe: lack of equal division of labor/workload
- Probe: practice of gender-disaggregated data analysis

8. What are the **practices and challenges of planning** for vaccination program in your area?

   - Probe: approaches to estimate denominator
   - Probe: standardization of planning across district
   - Probe: practice of encouraging regions and districts to make micro plans to identify local problems and adopt corrective solutions

9. How does the ZHD use **data for decision making** for improving vaccination program in the area?

   - Probe: what are the standard EPI core data sources?
   - Probe: practice of analyzing to prioritize districts with poor access

10. What is the ZHD doing to improve **data quality** for vaccination program in the zone? What are the causes of poor data quality in the immunization program in your area?

    - Probe: negligence, false data reporting, human capacity problems
    - Probe: underlying reasons for major coverage discrepancy between HMIS data community-based surveys
    - Probe: what are the challenges you encounter while implementing DHIS 2 in the area?
    - Probe: Data accountability, triangulation and verification mechanisms

11. What specific **strategies and interventions** are being implemented to improve the coverage, utilization, quality and equity of immunization service in the zone?

    - Probe: use of diverse (static, outreach and mobile) vaccination service delivery outlets
    - Probe: what is being done to reach to zero dose and under-immunized children specially in underserved populations
    - Probe: specific programs including RED/REC, interventions to reduced missed opportunities
    - Probe: complementary vaccine delivery strategies (enhanced catch-up immunization, periodic intensified routine immunization, mop-up and default tracing).
    - Probe: small scale programs that need to be scaleup
    - Probe: integration of service (including multisectoral integration) to reduced missed opportunities
    - Probe: based on your opinion, which intervention working and not working? What are the challenges of the existing program?

12. What SBCC, community engagement and mobilization strategies are being implement to improve the utilization of vaccination program in your zone?

    - Probe: how can the SBCC, community engagement and mobilization strategies be improved?

13. In your opinion, **what new interventions** required to improve vaccination programs in your area?
    - Probe: targeted interventions to reach to zero dose and under-immunized children
    - Probe: what innovations are needed to strengthen access to zero-dose children and missed communities in the long term?
14. How does the ZHD implement and promote **monitoring, evaluating and learning** activities in the vaccination program in Ethiopia?
    - Probe: approached to evaluate and ensure service quality
    - Probe: existing HMIS indicators
    - Probe: supportive supervision
15. What is the ZHD doing to improve the quality of immunization service in the area?
    - Probe: regular review meeting and supportive supervision
    - Probe: immunization-specific supportive supervision
    - Probe: capacity building
16. Who are you major **stakeholders and partners** in the implementation of vaccination programs in zone? In what specific areas do they support you?
    - Probe: technical assistance needs of the ZHD
    - Probe: how does the RHB support you in planning, implementing and monitoring vaccination programs? What should be done?
17. Before I conclude the discussion, is there anything you would like to add or recommend?

Project HOPE

Reaching zero dose and under immunized children in remote areas of Ethiopia

In-depth interview guide for barrier-enabler study(Tool 2.7)

To be used with the following respondent at woreda health office level:

- Woreda Health Office Head/Representative
- MCH Focal Person/Representative
- EPI Team leader
- Health Extension Program focal person

Information and consent:

Introduction and propose of the study: good morning/Good afternoon. Thank you for the interest to discuss with me today. My name is_____ and I'm working for Project HOPE – Ethiopia. Project HOPE receives grant for conducting evaluation research on "Reaching zero dose and under immunized children in remote areas of Ethiopia" and as part of this research we are undertaking a situational analysis of the Ethiopian immunization program. The study will help us to understand the strength and weakness of the program and identify under-immunized settings in Ethiopia. You are selected for this interview purposely based on your expertise in the area We would very much appreciate your participation in this study.

Procedures: if you agree to take part in this study, we will discuss about the aforementioned issue for about 60 minutes. I will also audio record the interview so that I will be able to transcribe it later on.

Risks and Benefits: we believe there are no risks to you from participating in this study. You will not be directly benefited from taking part in the study. However, your participation will help us to better understand the circumstances around zero dose and under-immunized children and improve Ethiopia's health system. It will also help us to reducing zero dose children by providing equitable and quality immunization services across Ethiopia's primary health care system.

Compensation: you will not be paid for participating in this study.

Confidentiality: we will keep your answers confidentially. We will not share your answers with others who are not member of the research team. Your name and other facts that might help people recognize you will not appear when we present this study to others or publish its results. Your recorded voice will be stored on password-protected computers.

Voluntary participation and withdrawal: taking part in this study is voluntary. You can choose not to take part in the study or ask us to leave, and if you do agree to participate you can stop the interview at any time or skip any questions that you don't want to answer. There are no right or wrong answers. We just want to hear more about your own ideas and experiences. Also, after finishing the interview, you can refuse to have your answers included in the study.

Contact person: if you have any questions, I will be happy to answer them. And in case you ever want to contact the principal investigator, you should call + 251916822815 and ask for Dr. Samson Gebremedhin.

Comprehension: Do you have any questions about the interview? If so, I will be glad to explain.

Consent: if you wish to be in this study, please sign here: _____

Reminder for the interviewer: If written consent is given, proceed to the interview. If she/he is not willing to take part in the study, thank her/him and discontinue the interview.

Basic information about the in-depth interview

Name of the interviewer: _____

Name of the notetaker: _____

Locality (region, city): _____/_____

Date of interview: _____

Interview guide questions

1. How would you describe the **vaccination coverage** situation and incidence of common vaccine preventable diseases in your woreda?
    - Probe: recent trends in vaccination coverage in the zone
    - Probe: outbreaks of vaccine preventable diseases in the zone
2. In your woreda, **which specific settings and populations** are considered as under-immunized?
    - Probe: which specific kebeles have low vaccination coverage or high incidence of vaccine preventable diseases?
    - Probe: in which areas are the most missed children need to be targeted?
3. In your woreda, what are the **supply-related barriers** that prevent zero-dose and under-immunized children from being vaccinated?
    - Probe: is vaccination service available where and when needed in the zone?
    - Probe: is vaccination service receiving equal attention by the healthy system and health workers?
    - Probe: limited access to health service, unavailability of health workers, inefficient vaccine logistic system, unavailability of equipment, demotivated health workers…..
    - Probe: Effect of the Covid 19 outbreak on the provision of routine vaccination programs
    - Probe: what is being done to address these supply-related barriers? What are the existing gaps?
4. How do you describe the existing **vaccine supply and logistic system** in your woreda?
    - Probe: availability of refrigerators at health facilities including health posts
    - Probe: challenges in the cold chain system and maintenance of refrigerators
    - Probe: practice of effective vaccine management system
5. In your woreda, what **individual/family level factors** hinder the utilization of vaccination program?
    - Probe: vaccine hesitancy (doubts about vaccine safety and effectiveness), health literacy, economic factors
    - Probe: what is being done to address these barriers? What are the existing gaps?
6. In your woreda, are there **socio-cultural factors** that hinder the utilization of vaccination program?
    - Probe: cultural and religious beliefs, vaccine related rumors
    - Probe: what is being done to address these socio-cultural barriers? What are the existing gaps?
7. In your woreda, what **gender-related barriers** might zero-dose and under-immunized children or their families face to accessing services?
    - Probe: gender related barriers from both supply and demand sides
    - Probe: Husband involvement in immunization program
    - Probe: practice of gender-disaggregated data analysis

- Probe: gender related barriers from both supply and demand sides
- Probe: access to and control over resources both at household and community levels
- Probe: unequal decision-making power at household level and community structures
- Probe: unequal representation and power imbalance in the leadership positions in community and health structures
- Probe: lack of access to information and economic dependency
- Probe: lack of equal division of labor/workload

8. What are the **practices and challenges of planning** for vaccination program in your area?
    - Probe: approaches to estimate denominator
    - Probe: standardization of planning across district
    - Probe: practice of encouraging regions and districts to make micro plans to identify local problems and adopt corrective solutions
9. How does the woreda health office use **data for decision making** for improving vaccination program in the area?
    - Probe: what are the standard EPI core data sources?
    - Probe: practice of analyzing to prioritize districts with poor access
10. What is the woreda health office doing to improve **data quality** for vaccination program in the zone? What are the causes of poor data quality in the immunization program in your area?
    - Probe: negligence, false data reporting, human capacity problems
    - Probe: underlying reasons for major coverage discrepancy between HMIS data community-based surveys
    - Probe: what are the challenges you encounter while implementing DHIS 2 in the area?
    - Probe: Data accountability, triangulation and verification mechanisms
11. What specific **strategies and interventions** are being implemented to improve the coverage, utilization, quality and equity of immunization service in the area?
    - Probe: use of diverse (static, outreach and mobile) vaccination service delivery outlets
    - Probe: what is being done to reach to zero dose and under-immunized children specially in underserved populations
    - Probe: specific programs including RED/REC, interventions to reduced missed opportunities
    - Probe: complementary vaccine delivery strategies (enhanced catch-up immunization, periodic intensified routine immunization, mop-up and default tracing).
    - Probe: small scale programs that need to be scaleup
    - Probe: integration of service (including multisectoral integration) to reduced missed opportunities
    - Probe: based on your opinion, which intervention working and not working? What are the challenges of the existing program?

12. What SBCC, community engagement and mobilization strategies are being implement to improve the utilization of vaccination program in your woreda?
    - Probe: how can the SBCC, community engagement and mobilization strategies be improved?
13. In your opinion, **what new interventions r**equired to improve vaccination programs in your area?
    - Probe: targeted interventions to reach to zero dose and under-immunized children
    - Probe: what innovations are needed to strengthen access to zero-dose children and missed communities in the long term?
14. How does the woreda health office implement and promote **monitoring, evaluating and learning** activities in the vaccination program in Ethiopia?
    - Probe: approached to evaluate and ensure service quality
    - Probe: existing HMIS indicators
    - Probe: supportive supervision
15. What is the woreda health office doing to improve the quality of immunization service in the area?
    - Probe: regular review meeting and supportive supervision
    - Probe: immunization-specific supportive supervision
    - Probe: capacity building
16. Who are you major **stakeholders and partners** in the implementation of vaccination programs in zone? In what specific areas do they support you?
    - Probe: technical assistance needs of the office
    - Probe: how does the ZHD support you in planning, implementing and monitoring vaccination programs? What should be done?
17. Before I conclude the discussion, is there anything you would like to add or recommend?

Project HOPE

Reaching zero dose and under immunized children in remote areas of Ethiopia

In-depth interview guide for barrier-enabler study(Tool 2.8)

To be used with the following health workers:

- Health professionals working in general and primary hospitals (medical director, MCH focal person)
- Health professionals working at health centres (health centre head/medical director, PHC focal person, EPI focal person)
- Health extension workers

Information and consent:

Introduction and propose of the study: good morning/Good afternoon. Thank you for the interest to discuss with me today. My name is_____ and I'm working for Project HOPE – Ethiopia. Project HOPE receives grant for conducting evaluation research on "Reaching zero dose and under immunized children in remote areas of Ethiopia" and as part of this research we are undertaking a situational analysis of the Ethiopian immunization program. The study will help us to understand the strength and weakness of the program and identify under-immunized settings in Ethiopia. You are selected for this interview purposely based on your expertise in the area We would very much appreciate your participation in this study.

Procedures: if you agree to take part in this study, we will discuss about the aforementioned issue for about 60 minutes. I will also audio record the interview so that I will be able to transcribe it later on.

Risks and Benefits: we believe there are no risks to you from participating in this study. You will not be directly benefited from taking part in the study. However, your participation will help us to better understand the circumstances around zero dose and under-immunized children and improve Ethiopia's health system. It will also help us to reducing zero dose children by providing equitable and quality immunization services across Ethiopia's primary health care system.

Compensation: you will not be paid for participating in this study.

Confidentiality: we will keep your answers confidentially. We will not share your answers with others who are not member of the research team. Your name and other facts that might help people recognize you will not appear when we present this study to others or publish its results. Your recorded voice will be stored on password-protected computers.

Voluntary participation and withdrawal: taking part in this study is voluntary. You can choose not to take part in the study or ask us to leave, and if you do agree to participate you can stop the interview at any time or skip any questions that you don't want to answer. There are no right or wrong answers. We just want to hear more about your own ideas and experiences. Also, after finishing the interview, you can refuse to have your answers included in the study.

Contact person: if you have any questions, I will be happy to answer them. And in case you ever want to contact the principal investigator, you should call + 251916822815 and ask for Dr. Samson Gebremedhin. You can also contact the ethics committee that approved the research project through: tel _____ or e-mail address: _____.

Comprehension: Do you have any questions about the interview? If so, I will be glad to explain.

Consent: if you wish to be in this study, please sign here: _____

Reminder for the interviewer: If written consent is given, proceed to the interview. If she/he is not willing to take part in the study, thank her/him and discontinue the interview.

Basic information about the in-depth interview

Name of the interviewer: _____

Name of the note-taker: _____

Name of the health facility: _____

Type of health worker:

Health professional ○ Health extension worker ○

Type of health facility:

Heath post ○ Health center ○ Primary hospital ○ General hospital ○

Date of Interview: _____

Beginning and ending times of interview: _____/_____

Interview guide questions

1. How would you describe the **vaccination coverage** situation and incidence of common vaccine preventable diseases in your catchment area?
    - Probe: recent trends in vaccination coverage in the catchment area
    - Probe: outbreaks of vaccine preventable diseases in the catchment area
    - Probe: vaccination service coverage and dropout rate at the health facility
    - Probe: extent of missed opportunity
    - Probe: in which areas are the most missed children found?
2. How do you **feel about your work in vaccinating children**? Are there aspects that you enjoy and aspects that you do not enjoy?
    - Probe: how important is your work in vaccination?
    - Probe: what proportion of time would you estimate you spend on vaccination?
    - Probe: What do you normally say to a mother before vaccinating her child? What do you normally say to a mother after vaccinating her child?
3. In your opinion, **what are the main reasons** why some children in your area have incomplete or delayed vaccinations?
    - Probe: reasons for dropout of the immunization program
    - Probe: reasons for missed opportunities
4. Does your health facility offer all the vaccines in the national schedule **every day** of the working days of the week?
    - Probe: reasons for not providing vaccination service throughout the week
    - Probe: is vaccination service available where and when needed in the catchment area?
    - Probe: vaccination service delivery outlets: static, mobile, outreach
    - Probe: what are your day-to-day implementation challenges?
5. In your catchment area, **what service delivery related barriers** prevent zero-dose and under-immunized children from being vaccinated?
    - Probe: is vaccination service receiving equal attention by the healthy system and health workers?
    - Probe: limited physical access to health service (availability, physical distance, topography)
    - Probe: do you feel that your health facility has sufficient staff available for vaccinating all eligible children?
    - Probe: incentives to health workers, motivation
    - Probe: effect of the political instability and Covid 19 outbreak on the provision of routine vaccination programs
    - Probe: what is being done to address these supply-related barriers? What are the existing gaps?

6. How do you describe the existing **vaccine supply and logistic system** in your catchment area/health facility?
    - Probe: does your health facility have the needed cold chain capacity, vaccine, syringes, and safety boxes for vaccination?
    - Probe: adequate and uninterrupted supply of vaccines and other inputs needed
    - Probe: availability of refrigerators at health facilities including health posts
    - Probe: challenges in the cold chain system and maintenance of refrigerators
    - Probe: practice of effective vaccine management system
7. In your catchment area, what **individual/family level factors** hinder the utilization of vaccination program?
    - Probe: how do you think most parents in your area feel about vaccination?
    - Probe: vaccine hesitancy (doubts about vaccine safety and effectiveness), health literacy, economic constraints, workload
    - Probe: what is being done to address these barriers? What are the existing gaps?
8. In your catchment area, are there **socio-cultural factors** that hinder the utilization of vaccination program?
    - Probe: cultural and religious beliefs, vaccine related rumors
    - Probe: mobility of the population
    - Probe: what is being done to address these socio-cultural barriers? What are the existing gaps?
9. In your catchment area, what **gender-related barriers** might zero-dose and under-immunized children or their families face to accessing services?
    - Probe: gender related barriers from both supply and demand sides
    - Probe: husband involvement in immunization program
    - Probe: gender related barriers from both supply and demand sides
    - Probe: access to and control over resources both at household and community levels
    - Probe: unequal decision-making power at household level and community structures
    - Probe: unequal representation and power imbalance in the leadership positions in community and health structures
    - Probe: lack of access to information and economic dependency
    - Probe: lack of equal division of labor/workload
    - Probe: practice of gender-disaggregated data analysis
10. What are the **practices and challenges of planning** for vaccination program in your catchment area?
    - Probe: approaches to estimate denominator
    - Probe: practice of micro plans to identify local problems and adopt corrective solutions
    - Probe: practice of analyzing to prioritize kebeles/villages with poor access
11. What is the health facility/what are you doing to improve **data quality** for vaccination program in your facility?
    - Probe: data utilization for decision making

- Probe: what are the causes of poor data quality in the immunization program in your area?
- negligence, false data reporting, skill gaps, pressure from immediate supervisors
- Probe: underlying reasons for major coverage discrepancy between DHIS2 data and community-based surveys
- Probe: what are the challenges you encounter while implementing DHIS 2 in the area? (NB: not applicable to data collectors)
- Probe: data accountability and verification mechanisms

12. In your catchment area, what specific **interventions** are being implemented to improve the coverage, quality and equity of immunization service?

    - Probe: use of diverse (static, outreach and mobile) vaccination service delivery outlets
    - Probe: what is being done to reach to zero dose and under-immunized children specially in underserved populations
    - Probe: complementary vaccine delivery strategies (enhanced catch-up immunization, periodic intensified routine immunization, mop-up and default tracing).
    - Probe: small scale programs that need to be scaleup
    - Probe: integration of service (including multisectoral integration) to reduced missed opportunities, challenges in reducing missed opportunity
    - Probe: based on your opinion, which intervention working and not working? What are the challenges of the existing program?

13. What **SBCC, community engagement** and mobilization strategies do you commonly used for improving the utilization of vaccination program in your catchment area?

    - Probe: does your facility involve community leaders and groups in promoting immunization?
    - Probe: engagement of women's group in SBCC activities
    - Probe: does your facility, or the HDA/volunteer members, contact families of dropouts to alert, remind and motivate them to have their infant vaccinated?
    - Probe: how can the SBCC, community engagement and mobilization strategies be improved?
    - Probe: what challenges do you commonly encounter while implementing SBCC and community engagement activates?

14. In your opinion, **what new interventions** required to improve vaccination programs in your catchment area?

    - Probe: what could your health facility do to improve its immunization coverage?
    - Probe: targeted interventions to reach to zero dose and under-immunized children

15. What is the **woreda health office** doing to improve the quality of immunization service in the area?

    - Probe: how does the woreda health office support you in planning, implementing and monitoring vaccination programs? What should be done?

- Probe: regular review meeting and supportive supervision
- Probe: immunization-specific supportive supervision
- Probe: capacity building
- Probe: what could the district health office do to help your facility to improve its immunization coverage?

16. [for only health professionals working at health centers] How do you **monitor and evaluate the performance of health extension workers** in your catchment area?

- Probe: supportive supervision, immunization specific supportive supervision
- Probe: approached to evaluate and ensure service quality
-

17. What are your major community level partners in the implementation of vaccination programs in your area? In what specific areas do they support you?

- Probe: what are your experiences and challenges while working with these partners?
- Probe: role of health development army members, approach to motivate and support them

18. Before I conclude the discussion, is there anything you would like to add or recommend?

Project HOPE

Reaching zero dose and under immunized children in remote areas of Ethiopia

Draft guide for barrier-enabler study(Tool 2.9)

To be used with the following respondent at community level:

- Volunteer community health workers/VCHWs

Information and consent:

Introduction and propose of the study: good morning/Good afternoon. Thank you for the interest to discuss with me today. My name is_____ and I'm working for Project HOPE – Ethiopia. Project HOPE receives grant for conducting evaluation research on "Reaching zero dose and under immunized children in remote areas of Ethiopia" and as part of this research we are undertaking a situational analysis of the Ethiopian immunization program. The study will help us to understand the strength and weakness of the program and identify under-immunized settings in Ethiopia. You are selected for this interview purposely based on your expertise in the area We would very much appreciate your participation in this study.

Procedures: if you agree to take part in this study, in a group comprising local VCHW in your village we will discuss about the utilization of vaccination service. The discussion will take about two hours. I will also audio record the discussion so that we could be able to go through our discussion later.

Risks and Benefits: we believe there are no risks to you from participating in this study. You will not be directly benefited from taking part in the study. However, your participation will help us to better understand the immunization barriers at multiple levels in your community. We believe, the findings will be used to improve the health system to reducing zero dose children by providing equitable and quality immunization services.

Compensation: you will not be paid for participating in this study.

Confidentiality: we will keep your answers confidentially. We will not share your opinions with others who are not member of the research team. Your name and other facts that might help people recognize you will not appear when we present this study to others or publish its results. Your recorded voice will be stored in such a way that it will only be accessible to researchers.

Voluntary participation and withdrawal: taking part in this study is voluntary. You can choose not to take part in the study or ask us to leave, and if you do agree to participate you can stop the interview at any time or skip any questions that you don't want to answer. There are no right or wrong answers. We just want to hear more about your own ideas and experiences. Also, after finishing the interview, you can refuse to have your answers included in the study.

Contact person: if you have any questions, I will be happy to answer them. And in case you ever want to contact the principal investigator, you should call + 251916822815 and ask for Dr. Samson Gebremedhin. You can also contact the ethics committee that approved the research project through: tel _____ or e-mail address: _____.

Comprehension: Do you have any questions about the interview? If so, I will be glad to explain.

Consent: if you wish to be in this study, please sign here: _____

Reminder for the interviewer: If written consent is given, proceed to the interview. If she/he is not willing to take part in the study, thank her/him and discontinue the interview.

In-depth interview guides

1. What do you think are the **reasons** for vaccinating children?
    - Probe: knowledge on vaccine preventable diseases
    - Probe: perceived belief on the efficacy of vaccines
2. What do you think that the community knows about the **reasons** for vaccinating children?
    - Probe: knowledge on vaccine preventable diseases
    - Probe: perceived belief on the efficacy of vaccines
    - Probe: do you think that the community members know when their children should be vaccinated?
3. Do you think that vaccination causes any problem to your children?
    - Probe: Do you think vaccines make the baby sick?
    - Probe: vaccine hesitancy, misconceptions
    - Probe: How the communities think about vaccine hesitancy, misconception?
4. How would you describe the pattern of vaccination utilization in your local community?
    - Probe: recent changes in the utilization vaccination services
    - Probe: reasons for increasing/decreasing coverage
    - Probe: your role in increasing of vaccine coverage
5. Are there socio-cultural factors that hinder the utilization of vaccination program?
    - Probe: cultural and religious beliefs, vaccine related rumors
    - Probe: what is being done by the local health system to address these socio-cultural barriers? What are the existing gaps?
    - Probe: what do people in your community think about the vaccine?
    - Probe: how religious leaders or other key community member support the vaccination service in your community
    - Probe: what is your role in mitigating of some vaccine related myth in your community
6. Why do some mothers vaccinate their children while others not?
    - Probe: why do people in this community want to be get vaccination?
    - Probe: information, misinformation, attitudes towards vaccine, fear of side effects, trust in medical system/health care worker?
    - Probe: do you think that you are showing as a role model in vaccination program? How?
7. In your community, is vaccination service available where and when needed?
    - Probe: physical access of vaccination program to the communities?
    - Probe: functionality of health facilities during working hours?
    - Probe: what activities will be done by health department, community-based organization, community volunteers and other organization play to make sure every get the vaccine?
    - Probe: dose the health system approaches you in planning of child vaccination program?

8. Do you think that there is any doubt in your community which can affect the child vaccination service?
    - Probe: gender effect, any cultural barrier, paternal involvement in child vaccination
    - Probe: your effort in mitigating or avoiding such community myth/doubt to enhance male involvement in child vaccination program
    - Probe: evil eye problem, the relationship between evil eye with AEFI
    - Probe: how do you support or educate when this event has happened in the community
9. In your community, what are **the service-related barriers** that prevent zero-dose and under-immunized children from being vaccinated?
    - Probe: is vaccination service available where and when needed in the community?
    - Probe: is vaccination service receiving equal attention by the health system and health workers?
    - Probe: limited access to health service, unavailability of health workers, inefficient vaccine logistic system, unavailability of equipment, demotivated health workers…..
    - Probe: what is being done to address these service-related barriers? What are the existing gaps?
10. How common is under vaccination in your area?
    - Probe: why children are under-immunized?
    - Probe: in which areas are the most missed children need to be targeted?
    - Probe; what efforts has been done by the health system to reach out these missed children,
    - Probe; which type of intervention you proposed to reach out this under immunized children Probe: which service delivery strategy is preferable in your community to improve the vaccination utilization, why? (Static, outreach, mobile)
11. In your community, what **individual/family level factors** hinder the utilization of vaccination program?
    - Probe: vaccine hesitancy (doubts about vaccine safety and effectiveness), health literacy, economic factors
    - Probe: what community or individual believes which hinder child vaccinated?
    - Probe: what should be done to address these barriers? What are the existing gaps?
    - Probe: How do you think the partner/male involvement in child vaccination?
12. What specific **strategies should be done** to improve the coverage, utilization of immunization service in your community?
    - Probe: What should be done to reach to zero dose and under-immunized children in your community
    - Probe: the facility in your community involves community leader and groups in promoting Immunization
    - Probe: the community-based individuals you work with, contact families of dropouts to alert remind and motivate them to have their infant vaccinated?

13. What SBCC, community engagement and mobilization strategies are being implemented to improve the utilization of vaccination program in your community?
    - Probe: how can the SBCC, community engagement and mobilization strategies?
    - Probe: why would people in the community will not get vaccination?
    - Probe: who are trusted and untrusted source of message in this community?
    - Probe: which channel of information is more importance in the community to create awareness creation about child vaccination and to mitigate vaccine related myth?
    - Probe: wo you think that SBCC message is reachable to the user in your community?
    - Are these messages developed and available in the local language?
14. Before I conclude the discussion, is there anything you would like to add?

Project HOPE

Reaching zero dose and under immunized children in remote areas of Ethiopia

Focus group guide for barrier-enabler study(Tool 2.10)

To be used with the following respondent at community level:

- Mothers/caregivers of children 12-35 months in selected kebeles, refugee camps and IDPs

Information and consent:

Introduction and propose of the study: good morning/Good afternoon. Thank you for your interest in talking with me today. My name is_____ and I'm working for _____. Project HOPE receives grant for conducting evaluation research on "Reaching zero dose and under immunized children in remote areas of Ethiopia" and as part of this we are undertaking a study to understand why some caregivers immunize their children while others not. You are selected for this interview purposely because you have a child eligible for vaccination. We would very much appreciate your participation in this study.

Procedures: if you agree to take part in this study, in a group comprising local women in your village, we will discuss about factors that facilitate or hinder utilization of vaccination service. The discussion will take about two hours. I will also audio record the discussion so that we could be able to go through our discussion later.

Risks and Benefits: we believe there are no risks to you from participating in this study. You will not be directly benefited from taking part in the study. However, your participation will help us to better understand the immunization barriers in your community. We believe, the findings will be used to provide accessible, equitable and quality immunization services.

Compensation: you will receive 50 birrs as a compensation for your time.

Confidentiality: we will keep your answers confidentially. We will not share your opinions with others who are not member of the research team. Your name and other facts that might help people recognize you will not appear when we present this study to others. Your recorded voice will be stored in such a way that it will only be accessible to the researchers.

Voluntary participation and withdrawal: taking part in this study is voluntary. You can choose not to discuss with us, and if you do agree to participate you can stop the interview at any time or skip any questions that you don't want to discuss. There are no right or wrong answers. We just want to hear more about your own ideas and experiences.

Contact person: if you have any questions, I will be happy to answer them. And in case you ever want to contact the principal investigator, you should call this number +251916822815 and ask for Dr. Samson Gebremedhin. You can also contact the ethics committee that approved the research project through: tel _____ or e-mail address: _____.

Comprehension: Do you have any questions about the interview? If so, I will be glad to explain.

Consent: if you wish to be in this study, please sign here: _____

Reminder for the interviewer: If written consent is given, proceed to the interview. If she/he is not willing to take part in the study, thank her/him and discontinue the interview.

Basic information about the FGD

Name of the facilitator: _____

Name of the notetaker: _____

Locality (region, zone, kebele): _____

Date of discussion: _____

Venue of discussion: _____

Beginning and ending times of discussion: _____/_____

Profile of the FGD participants

No	First name	Age	Vaccination utilization (Optimal, Suboptimal)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

Guiding questions

1. In your opinion, what do you think is the **purpose** of vaccination? How important is it for your children to get all the recommended vaccinations?
    - Probe: knowledge about vaccine preventable diseases
    - Probe: knowledge about vaccination schedule
    - Probe: perceived belief on the usefulness of vaccines
2. Do you have any **concerns** about getting your children vaccinated?
    - Probe: how safe do you feel that vaccination is?
    - Probe: vaccine hesitancy, misconceptions, fear if infection, fear of multiple injection
    - Probe: perceived risks associated with vaccinating a child
    - Probe: Have any of you not brought your child because of this concern?
3. How would you describe the **pattern of vaccination utilization** in your local community?
    - Probe: recent changes in the utilization vaccination services
    - Probe: reasons for increasing/decreasing utilization
    - Probe: missed areas and segments of the community
4. In your community, **why do some caregivers vaccinate** their children while others not? Why do some caregivers completely utilize all the vaccines recommended by health workers while others interrupt?
    - Probe: can you please explain the reasons why your child has had only some or none of the vaccinations he or she is eligible to receive; [or] all of his or her vaccinations?
5. Based on your opinion and observations, in your locality, is vaccination service **available and accessible** where and when needed?
    - Probe: how convenient for you are the days and hours when vaccinations are offered?
    - Probe: availability and physical accessibility (including topography) of health facilities
    - Probe: presence of multiple service delivery outlets: static, mobile, house-to-house
    - Probe: availability of essential medical supplies
    - Probe: impact of political instability and Covid 19 outbreak
6. How do you describe the **performance and motivation of local health workers** in the provision of health services including vaccination?
    - Probe: availability, adequacy and motivation of health workers
    - Probe: communication including counseling skills
7. How **satisfied** are you with the vaccination service being provided in your locality?
    - Probe: how friendly are the health workers/vaccinators?
    - Probe: actual and preferred vaccination delivery approach (static, outreach, mobile)
8. What major **positive or negative experiences** have you encountered while utilizing vaccination or other health services in your locality?
    - Probe: mistreatment or abuse by health workers, experience of forced vaccination
    - Probe: health workers' poor communication and interaction with clients

- Probe: long waiting time, referral for vaccination
- Probe: health workers' refusal to open a multi-dose vial of vaccines
- Probe: how common are such incidents?
- Probe: how much did your previous vaccination experiences influence your decision to return for additional vaccinations?

9. What **community engagement and mobilization** approaches are being used to improve the utilization of vaccination program in your community?

    - Probe: interpersonal advice and home visit by HEWs
    - Probe: community mobilization through health development army members/volunteers
    - Probe: community mobilization at local events, through local media
    - Probe: engagement of religious and other influential community members
    - Probe: engagement of women's group in SBCC activities
    - Probe: what is the most trustworthy health information source to you, why?

10. What **socio-cultural factors** hinder or encourage you or other caregivers from getting your children vaccinated?

    - Probe: cultural and religious beliefs, vaccine related rumors
    - Probe: mobility of the community
    - Probe: what is being done by the local health system to address these socio-cultural barriers? What are the existing gaps?

11. What **gender related factors** hinder or encourage you or other caregivers from getting your children vaccinated?

    - Probe: women are not allowed to travel alone to health facilities to seek health care
    - Probe: access to and control over resources both at household and community levels
    - Probe: unequal decision-making power at household level and community structures
    - Probe: unequal representation and power imbalance in the leadership positions in community and health structures
    - Probe: lack of access to information and economic dependency
    - Probe: lack of equal division of labor/workload
    - Probe: practice of gender-disaggregated data analysis

12. What other **individual or family level factors** hinder or encourage caregivers from getting their children vaccinated?

    - Probe: domestic workload, economic constraints, influence of others
    - Probe: who makes final decision regarding utilization of vaccination service?

13. How do you describe your **husbands/partners support** in getting your children vaccinated?

    - Probe: do you think your partners are as knowledgeable and concerned as you regarding child vaccination? Why or why not?
    - Probe: have you witnessed any effort by health workers to reach to husbands/patterns regarding vaccination of children?

14. Apart from you and your partner, **who else decides or influence your decision** to seek or not seek immunization service for your child?
    - Probe: Do some people advise you not to get your child vaccinated? If so, who and what do they say? How do you feel about that?
    - Probe: role of religious and community leaders, traditional birth attendants or other community members
    - Probe: role of mother-in-law, grandmothers or other family members
    - Probe: peer pressure
15. Can you please share your ideas for how vaccination services could be improved in your area?
    - Probe: how can **local caregivers in your community** be supported so that they would get their children vaccinated as recommended?
    - Probe: how can HEWs and HDA/volunteers be better supported?
16. Before I conclude the discussion, is there anything you would like to add?

Project HOPE

Reaching zero dose and under immunized children in remote areas of Ethiopia

In-depth Interview guide for barrier-enabler study(Tool 2.11)

To be used with the following respondent at community level:

- Clan leaders, religious leaders, and community/influential leaders

Information and consent:

Introduction and propose of the study: good morning/Good afternoon. Thank you for your interest in talking with me today. My name is_____ and I'm working for Project HOPE – Ethiopia. Project HOPE receives grant for conducting evaluation research on "Reaching zero dose and under immunized children in remote areas of Ethiopia" and as part of this, we are undertaking barrier-enabler analysis for the utilization of vaccination program in your community. You are selected for this interview purposely because you have child eligible for vaccination. We would very much appreciate your participation in this survey.

Procedures: if you agree to take part in this study, in a group comprising local women in your village we will discuss about the utilization of vaccination service. The discussion will take about two hours. I will also audio record the discussion so that we could be able to go through our discussion later.

Risks and Benefits: we believe there are no risks to you from participating in this study. You will not be directly benefited from taking part in the study. However, your participation will help us to better understand the circumstances around zero dose and under-immunized children and improve Ethiopia's health system. It will also help us to reducing zero dose children by providing equitable and quality immunization services across Ethiopia's primary health care system.

Compensation: you will not be paid for participating in this study.

Confidentiality: we will keep your answers confidentially. We will not share your opinions with others who are not member of the research team. Your name and other facts that might help people recognize you will not appear when we present this study to others or publish its results. Your recorded voice will be stored in such a way that it will only be accessible to researchers.

Voluntary participation and withdrawal: taking part in this study is voluntary. You can choose not to talk to us or ask us to leave, and if you do agree to participate you can stop the interview at any time or skip any questions that you don't want to answer. There are no right or wrong answers. We just want to hear more about your own ideas and experiences. Also, after finishing the discussion, you can refuse to have your answers included in the study.

Contact person: if you have any questions, I will be happy to answer them. And in case you ever want to contact the principal investigator, you should call +251916822815 and ask for Dr. Samson Gebremedhin. You can also contact the ethics committee that approved the research project through: tel _____ or e-mail address: _____.

Comprehension: Do you have any questions about the interview? If so, I will be glad to explain.

Consent: if you wish to be in this study, please sign here: _____

Reminder for the interviewer: If written consent is given, proceed to the interview. If she/he is not willing to take part in the study, thank her/him and discontinue the interview.

In-depth interview guide questions

1. What do you think are the **benefits or harms** of vaccinating children?
    - Probe: knowledge on vaccine preventable diseases
    - Probe: vaccine hesitancy, misconceptions
    - Probe: perceived belief on the efficacy of vaccines
2. What do you think that the community knows about the reasons for vaccinating children?
    - Probe: knowledge on vaccine preventable diseases
    - Probe: perceived belief on the efficacy of vaccines
    - Probe: do you think that the community members know when their children should be vaccinated?
3. Do the community members think that vaccination causes any problem to children?
    - Probe: vaccine hesitancy, misconceptions
    - Probe: What effect has vaccination had on this community
    - Probe: gender effect, any cultural barrier, paternal involvement in child vaccination
    - Probe: evil eye problem, the relationship between evil eye with AEFI
    - Probe: their experience related to this vaccination related problem, and their contribution to avert this in the community
4. How would you describe the pattern of vaccination utilization in your local community?
    - Probe: recent changes in the utilization vaccination services
    - Probe: reasons for increasing/decreasing coverage
    - Probe: their contribution for the improvement of vaccination utilization in the community
5. Why do some families vaccinate their children while others not?
    - Probe: Why do people in this community want to get vaccination, and why not?
    - Probe: Information, misinformation, attitudes towards vaccine, fear of side effects, trust in medical system/health care worker
    - Probe: Their contribution towards this activity in the community

6. Is vaccination service available where and when needed?
    - Probe: physical access to vaccination service?
    - Probe: Functionality of health facilities during working hours?
    - Probe: What role can the health department, community-based organization and other organization play to make sure everyone gets the vaccine?
    - Probe: What would make it easier for individuals in the community to get the child vaccinated?
    - Probe: Does the current COVID-19 pandemic and conflict affected vaccination utilization?
7. Probe: which service delivery strategy is preferable, why? (Static, outreach, mobile) Do you believe that AEFI have an impact on community child vaccination service utilization, how? and why?
    - Probe: how leaders support when this event has happened in the community
    - Probe: how do they communicate to the health workers regarding to this kind of event
8. In your locality, **which specific settings and populations** are considered as under-immunized?
    - Probe: in which areas are the most missed children need to be targeted?
    - Probe: Why they are missed?
    - Probe: how the missed children can be managed?
9. In your community, what are the **service-related barriers** that prevent zero-dose and under-immunized children from being vaccinated?
    - Probe: is vaccination service receiving equal attention by the health system and health workers?
    - Probe: limited access to health service, unavailability of health workers, inefficient vaccine logistic system, unavailability of equipment, demotivated health workers…..
    - Probe: Effect of the Covid 19 outbreak on the provision of routine vaccination services
    - Probe: what is being done to address these service-related barriers? What are the existing gaps?
    - Probe: Their engagement and involvement in decisions like service site selection, and others
10. In your community, are there **socio-cultural factors** that hinder the utilization of vaccination program?
    - Probe: what do people in your community think about the vaccine?
    - Probe: cultural and religious beliefs, vaccine related rumors
    - Probe: vaccine hesitancy (doubts about vaccine safety and efficacy), health literacy, economic factors
    - Probe: what is being done to address these socio-cultural barriers? What are the existing gaps?
    - Probe: how community leaders support the vaccination service in your community
    - Probe: Any key barriers that people in your community are likely to face if they went out to get vaccination

11. What **gender related factors** hinder or encourage you or other caregivers from getting your children vaccinated?
    - Probe: women are not allowed to travel alone to health facilities to seek health care
    - Probe: access to and control over resources both at household and community levels
    - Probe: unequal decision-making power at household level and community structures
    - Probe: unequal representation and power imbalance in the leadership positions in community and health structures
    - Probe: lack of access to information and economic dependency
    - Probe: lack of equal division of labor/workload
12. Probe: practice of gender-disaggregated data analysis What specific **strategies should be done** to improve the coverage, utilization of immunization service in your community?
    - Probe: what should be done to reach to zero dose and under-immunized children in your community
13. What **SBCC, community engagement and mobilization** strategies are being implemented to improve the utilization of vaccination program in your community?
    - Probe: how can the SBCC, community engagement and mobilization strategies?
    - Probe: engagement of women's group in SBCC activities
    - Probe: who are trusted and untrusted source of message in this community?
    - Probe: what have they heard about child vaccination from trusted source?
    - Probe: what have they heard from untrusted source about child vaccination?
    - Probe: which channel of information is important in the community to create awareness about child vaccination and to mitigate vaccine related myth?
14. Before I conclude the discussion, is there anything you would like to add?

ZERO TOLERANCE FOR ZERO DOSE CHILDREN

NOVEMBER

2022

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