

# Strategies for reducing zero-dose and under-immunized children in Bangladesh: Findings from an implementation research

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## Acronyms

|         |  |
|---------|--|
| AHI     | Assistant Health Inspector                                       |
| AHO     | Assistant Health Officer   |
| ANC     | Antenatal Care   |
| AOR     | Adjusted Odds Ratio  |
| BCC     | Behavior Change Communication                                    |
| BCG     | Bacillus Calmette-Guérin   |
| BCLH    | Bangladesh Country Learning Hub                                  |
| BeSD    | Behavioral and Social Driver                                     |
| CC      | City Corporation / Community Clinic                              |
| BDT     | Bangladeshi Taka   |
| BeSD    | Behavioral and Social Drivers                                    |
| CES     | Coverage Evaluation Survey                                       |
| CHCP    | Community Health Care Provider                                   |
| CSO     | Civil Society Organization                                       |
| DGHS    | Directorate General of Health Services                           |
| DHIS    | District Health Information System                               |
| DID     | Difference-in-Differences  |
| DNCC    | Dhaka North City Corporation                                     |
| EPI     | Expanded Programme on Immunization                               |
| FPI     | Family Planning Inspector  |
| ERC     | Ethical Review Committee   |
| FRA     | Field Research Assistant   |
| FGD     | Focus Group Discussion   |
| FRO     | Field Research Officer   |
| FVC     | Full Vaccination Coverage  |
| FWC     | Family Welfare Center  |
| FWV     | Family Welfare Visitor   |
| GoB     | Government of Bangladesh   |
| HA      | Health Assistant   |
| HCD     | Human-centered Design  |
| HI      | Health Inspector   |
| HR      | Human Resources  |
| HTR     | Hard-to-reach  |
| HSD     | Health Services Division   |
| icddr,b | International Centre for Diarrhoeal Disease Research, Bangladesh |
| IDI     | In-depth Interview   |
| IPC     | Interpersonal Communication                                      |
| IR      | Intervention Research  |
| IRMMA   | Identify, Reach, Monitor, Measure, and Advocate                  |
| KAP     | Knowledge, Attitudes and Practice                                |
| KII     | Key Informant Interview  |
| LQAS    | Lot Quality Assurance Sampling                                   |
| MNC&AH  | Maternal Neonatal Child and Adolescent Health                    |
| MO      | Medical Officer  |
| MOHFW   | Ministry of Health and Family Welfare                            |

|        |   |
|--------|---|
| MR     | Measles Rubella                             |
| MT-EPI | Medical Technologists-EPI                   |
| NGO    | Non-governmental Organization               |
| OPV    | Oral Polio Vaccine                          |
| PCV    | Pneumococcal Conjugate Vaccine              |
| Penta  | Pentavalent                                 |
| PSU    | Primary Sampling Unit                       |
| SACMO  | Sub-Assistant Community Medical Officer     |
| SIMO   | Surveillance & Immunization Medical Officer |
| SHN    | Surjer Hashi Network                        |
| TOT    | Training of Trainers                        |
| UHC    | Upazila Health Complex                      |
| UH&FPO | Upazila Health & Family Planning Officer    |
| UI     | Under-immunized                             |
| UNICEF | United Nations Children's Fund              |
| VPD    | Vaccine Preventable Disease                 |
| WHO    | World Health Organization                   |
| ZD     | Zero-dose                                   |
| ZDLH   | Zero-Dose Learning Hub                      |

## Executive Summary

Over the decades, Bangladesh has experienced stellar success in the vaccination coverage – from a mere 2% in the year 1985 to 81.6% in 2023. The Expanded Programme on Immunization (EPI) is considered to be one of the most successful health programs but the success of EPI has been uneven throughout the country. About 16-20% of the children remain continuously unvaccinated or under vaccinated which leaves critical gaps in protection and vulnerability to outbreaks of vaccine preventable diseases (VPDs). There is a growing need to identify the pockets of zero-dose (ZD-missing of 1<sup>st</sup> dose of pentavalent) and under-immunized (UI-missing of 3<sup>rd</sup> dose of pentavalent) children in Bangladesh and dive deeply into the reasons behind the low immunization uptake.

With support from Gavi, the Vaccine Alliance, the Bangladesh Zero-Dose Learning Hub (ZDLH) was set up to alleviate the predicament of ZD/UI children within the country. The ZDLH conducted this implementation research (IR) within the existing health systems, aligning Gavi's Identify, Reach, Monitor, Measure, and Advocate (IRMMA) framework to generate evidence-based interventions that would enable to reduce the number of ZD and UI children in Bangladesh. The objectives of the IR were to:

1. Develop and test appropriate approaches to reach ZD children and missed communities and to bring them into the health system to achieve full immunization
2. Identify key barriers and enabling factors to reach ZD and UI children and to bring them into the health system through full immunization

This study followed a quasi-experimental pre-post design to assess the impact of the interventions including economic evaluation. The areas with high number of ZD and UI children, based on findings from our previously conducted rapid assessment, were selected for study areas. The selected interventions implemented in the study areas were designed to be area-specific given the prominent differences in landscape of Bangladesh. Innovative and evidence-based intervention were designed and implemented at the intervention areas. In contrast, no activities were implemented at the comparison areas. We conducted both process and impact evaluation to assess the impact of the interventions. Both baseline and endline household surveys were conducted for evaluation of impact of the interventions. The study population encompassed children aged 4.5 months (4 months 15 days) to 23 months and the respondents were their caregivers (usually mothers). A sample of 12,756 caregivers (n=6,362 in the intervention areas and n=6,394 in the comparison areas) were interviewed in the baseline survey, and 12,974 caregivers (n=6,459 in the intervention areas and n=6,515 in the comparison areas) in the endline survey.

The study findings showed that the most promising interventions of this study encompassed: evening sessions that enabled working mothers to vaccinate their children on-schedule in urban slums, E-screening checklist which was detected as a very promising intervention and might be scaled up on priority basis, E-Tracker that has helped commence online registration, crash programmes in hard-to-reach (HTR) areas, community engagement. Results from this study also showed a reduction in the prevalence of ZD/UI in intervention areas of hilly, plain and urban areas but an increase in the respective comparison areas. For char and coastal areas, the prevalence of ZD/UI had increased in both intervention and comparison areas, but the increase was less pronounced in intervention areas than comparison areas. The study also found that children from haor, coastal and urban areas were more than twice likely to be ZD/UI compared to children living in plain areas. Similarly, caregivers with greater number of children and their household located more than a kilometer further from the EPI centre were

more likely to have ZD/UI children. In contrast, children of caregivers with higher level of education were less likely to be ZD/UI.

Some of the core challenges that we faced in conduction of this IR were shortages of vaccine, logistics such as vaccination cards and human resource (HR) shortages; political unrest and frequent movement/transfer of concerned officials from national to upazila levels with vaccine shortages being the prime challenge. All of these factors also played a crucial role in rendering the children ZD/UI in study areas. Nevertheless, we detected a positive impact of the interventions in mitigating the increase in number of ZD/UI children at the intervention areas compared to the comparison areas over time. The economic evaluation also demonstrated that, the interventions were both economically viable and impactful in reducing the immunization gap among missed communities. Although implementation costs varied across intervention areas, the programme leveraged existing health system structures and demonstrated strong potential for scalability. Overall, this economic evaluation provides compelling evidence to support continued and expanded investment in strategies to reach ZD and UI children in Bangladesh as part of the country's progress toward universal immunization coverage ([Economic evaluation report](#)). Given our study findings, we recommend scaling up the promising interventions such as evening sessions, E- screening checklist, and E tracker. Notably, E-Tracker has helped commence online registration, but further efforts are required from EPI to make E-Tracker fully functional. We also recommend ample and uninterrupted supply of vaccines and logistics such as EPI card that enables caregivers to know vaccination information of their children and due dates for subsequent doses, greater and ample availability of HR such as health assistants (HAs), strengthening monitoring and supervision at field level, emphasizing on area-specific plans: since a single general planning that covers the whole country is unsuitable and increasing coordination and involvement. Other recommendations are available with details in the sections below where we provide all information related to this IR that we have conducted.

## 1. Background

Over the decades, Bangladesh has witnessed a stellar rise in the vaccination coverage- from 2% in the year 1985 to 64% in 2005, 83.9% in 2019 and 81.6% in 2023 (1-3). The Expanded Programme on Immunization (EPI) is considered to be one of the most successful health programs in the country and the vaccination coverage has ranged between 80-84% over the past decade (4). However, the success of EPI has been uneven within the country (5). Inequities in immunization coverage and uptake persist with high number of deaths ensuing from vaccine preventable diseases (VPDs) in some parts of Bangladesh (6). Notably, the 16-20% of children are continuously unvaccinated or under vaccinated which leaves critical gaps in protection and vulnerability to outbreaks such as Measles. The success of the EPI now depends on the ability to identify and reach these vulnerable and underserved communities. The country's vast and diverse landscape with pockets of hard-to-reach (HTR), vulnerable and underserved communities and migrant populations in urban areas are considered key barriers to achieving the highest possible vaccination rates and comprehending key operational challenges is critical to improving programme efforts.

There is a growing need to identify the pockets of zero-dose (ZD-missing of 1<sup>st</sup> dose of pentavalent) and under immunized (UI-missing of 3<sup>rd</sup> dose of pentavalent) children in Bangladesh and dive deeply into the reasons behind the low immunization uptake. A recent rapid assessment used multiple approaches to identify such pockets and found five rural districts and one urban (Dhaka North City Corporation (DNCC)) areas with high ZD and UI children (7-9). These districts are Sunamganj (haor/wetlands), Rangamati (hilly area), Gaibandha (char area--sandy/silty land surrounded by water), Noakhali (coastal area), Sherpur (plain land).

Pro-equity interventions being used at ZD pocket areas will help apprise what may or may not require change to effectively reach ZD children and missed communities and identify potential gaps in ZD programmatic thinking. A number of intervention studies were conducted prior to the commencement of Bangladesh zero-dose learning hub (ZDLH). The ZDLH reviewed findings of different studies to select effective interventions for this study. To exemplify, a study conducted in urban slums showed significant improvement in child vaccination coverage after implementation of following intervention package: (a) an extended EPI service schedule; (b) training for service providers on valid doses and management of side-effects; (c) a screening tool to identify immunization needs among clinic attendants; and (d) an EPI support group for social mobilization (10). Training of field staff and their supervisors on valid doses and policy change to eliminate barriers relating to geographical boundaries were found effective interventions in rural HTR areas by another study (11). A technology-based intervention which was administered within the existing public health system to electronically register each child's birth and remind mothers about upcoming vaccination dates with text messages was effective to improve full immunization coverage among children living in rural HTR areas and urban streets (12). Furthermore, a number of alternative strategies were tested to improve child immunization in rural HTR areas which included modified EPI service schedules, organizing EPI days, organizing afternoon or evening sessions, EPI support groups, use of screening tool in health centers other than EPI spots, training of service providers on valid doses, involvement of interested volunteers in pushing vaccines and management of side effects, elimination of geographical barriers (13). Adopting such evidence-based interventions in the routine EPI system would also help Gavi to adjust its policies and programmatic guidance and inform what types of interventions represent opportunities to be scaled or adjusted in other settings and to communicate on relevant, feasible and sustainable ZD approaches to excite and empower partners in the Alliance about the new ZD strategic priority.

This implementation research (IR), conducted by Bangladesh ZDLH within the existing health systems, played an important role in aligning country action with Gavi-learning priorities. The ZDLH in Bangladesh conducted the IR aligning Gavi's Identify, Reach, Monitor, Measure, and Advocate (IRMMA) framework for developing evidence-based interventions to reduce ZD and UI children. This was accomplished by working in conjunction with the Government of Bangladesh (GoB), development partners and civil society organizations (CSOs) of the country.

## 2. Objectives

The objectives of the study were to:

1. Develop and test appropriate approaches to reach ZD children and missed communities and to bring them into the health system to achieve full immunization
2. Identify key barriers and enabling factors to reach ZD and UI children and to bring them into the health system through full immunization

## 3. Methods

### Study design

This study followed a quasi-experimental pre-post design to assess the impact of the interventions including economic evaluation. Both baseline and endline household surveys were conducted following this design framework. The baseline survey was conducted from September to December 2023, prior to implementation of the interventions. Duration of the IR was 18 months. After completion of the intervention period, the endline household survey was conducted from March to May 2025.

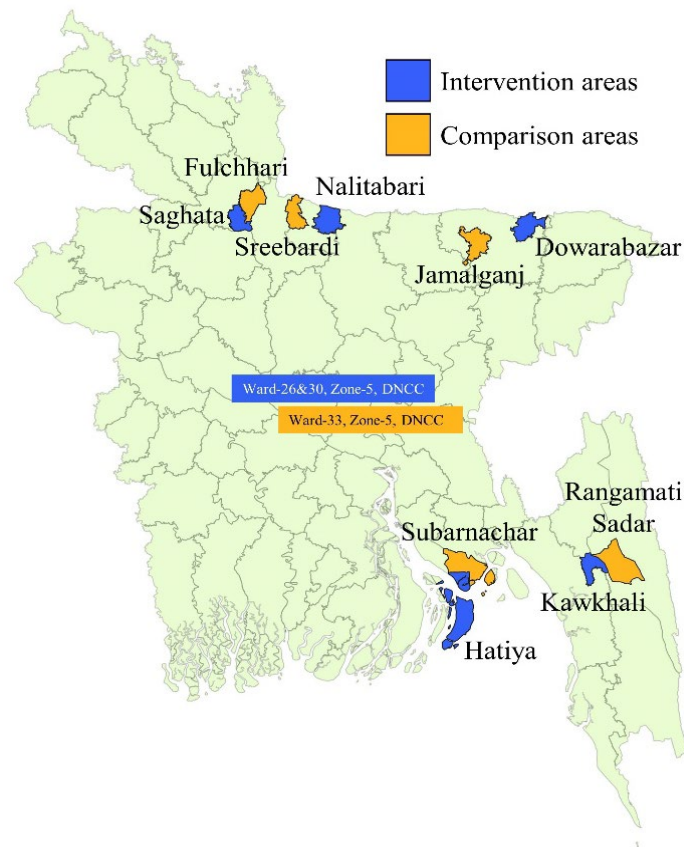
### Study population

The study population encompassed children aged 4.5 months (4 months 15 days) to 23 months and the respondents were their caregivers (usually mothers). The lower age limit of 4.5 months was set to allow for a delay of up to one month in obtaining the scheduled 3rd dose of Penta (recommended at 14 weeks of age).

### Study area

This study used findings from the rapid assessment to select areas with high ZD and UI children (7) . The areas identified as missed communities were divided into six intervention and six comparison areas to conduct household surveys before and after implementation of interventions in those areas (**Annexure A: [Table A1](#)**). The map in **Figure 1**, displays the geographical location of selected intervention and comparison areas.

**Figure 1:** Selected intervention and comparison areas



### **Design of interventions**

Notably, the landscape and problems of each of the selected area are different. Thus, we proposed different and area-specific interventions for each of the six categories of the areas to implement within the existing health system of Bangladesh.

The area-specific interventions that were implemented designed following several steps:

*First step:* We identified evidence-based interventions that were implemented in HTR areas and with HTR populations of Bangladesh. These interventions have previously contributed to increasing full vaccination coverage (FVC) and decreasing left out, drop out and invalid doses among the children of those areas.

*Second step:* Key immunization stakeholders were interviewed through rapid assessment and asked to mention the effective interventions or strategies to reduce ZD/UI. Revisions of initially selected interventions were made based on the findings. The details procedure and findings are available in the rapid assessment report (7).

*Third step:* We shared the interventions identified through above-mentioned procedures with EPI stakeholders by conducting in-person meetings and seminar where we shared findings from the rapid assessment. Afterwards, we revised the interventions according to comments/suggestions received from the meetings and seminar.

*Fourth step:* We used a human-centered design (HCD) approach. HCD was implemented as a tool to complement other quantitative and qualitative work to understand the drivers of non-vaccination within families, and the interventions likely to be successful in improving uptake of routine immunization.

Standard HCD tools, including persona development and journey mapping were used to generate insights to refine the interventions. The report on HCD is available in [Annexure B](#). Based on the results/recommendations of aforementioned steps, the following area-specific interventions, tabulated in **Table 1** were designed and implemented:

**Table 1:** Area-specific interventions implemented at IR areas

| Geographical location  | Interventions implemented  |
|--|--|
| All Areas  | <ul style="list-style-type: none"> <li>• Training of service providers</li> <li>• E-Tracker (e-registration, e-messaging, e-monitoring)</li> <li>• Use of E-screening checklist (except urban area)</li> <li>• Distribution of Behavior Change Communication (BCC) materials</li> <li>• Modified EPI session schedule (Evening Session / Crash Programme/ Additional Session)</li> </ul> |
| Saghata Gaibandha (Char- sandy/silty land surrounded by water) | Advocacy with community leaders  |
| Dowarabazar, Sunamganj (Haor-wetlands)                         | Strengthen EPI support groups (Union Parishad members, Landlord, Teachers, Imams etc)  |
| Kawkhali, Rangamati (Hilly)                                    | <ul style="list-style-type: none"> <li>• Advocacy with community leaders</li> <li>• Involvement of existing Non-Governmental Organization (NGO) community workers</li> </ul>   |
| Hatiya, Noakhali (Coastal)                                     | <ul style="list-style-type: none"> <li>• Health education through Community Health Care Providers (CHCP)</li> <li>• E-supervision checklist</li> </ul>   |
| Nalitabari, Sherpur (Plain land)                               | Courtyard meeting with mothers of newborns, childrens caregivers   |
| Ward-26&30, Zone-5, DNCC(Urban)                                | <ul style="list-style-type: none"> <li>• Community engagement (landlord, club/committee member, Imam etc.)</li> <li>• Health education through NGO counsellors</li> </ul>  |

The interventions were implemented at the intervention areas. In comparison areas, the interventions were not implemented. Baseline and endline survey data collection were conducted in all areas. Detailed descriptions of the interventions are available in [Annexure C](#).

### **Evaluation of the interventions**

We conducted both impact and process evaluations to assess changes in vaccination of ZD children after implementation of the interventions.

#### **a. Impact evaluation**

We evaluated impact of the intervention at the client level. This included surveys before- and after-implementation of interventions in the intervention and comparison areas. A four-cell (intervention and non-intervention, pre and post comparison) study design was conducted to assess intervention effects. The indicators measured before- and after- implementation included coverage of 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> doses of pentavalent and number of ZD children. The baseline also measured the status of ZD children identification.

### *Sample selection process for impact evaluation of IR study*

Stated prior, the study population encompassed caregivers of children aged 4.5-23 months. The primary outcome was the prevalence of ZD and UI children.

Although EPI service delivery differs between rural and urban areas, the study design, sampling design and enumeration of households with children aged 4.5-23 months were similar in both areas.

### **Sample size**

We applied the World Health Organization (WHO) - recommended cluster sampling methodology for this study (14). The required sample size for each area was 1150 considering 6% prevalence of ZD, 5% significance level, 80% power, a design effect of 1.58 (according to WHO vaccination coverage cluster surveys: reference manual (14)) and 10% non-response rate. Overall, we needed to interview a total of 13,800 (=1150\*12) eligible respondents from the selected 12 areas per household survey. Because the rapid assessment had shown that the number of ZD children in hilly and urban areas might be less than the required sample size, we used the 'take all' procedure for these areas.

### **Sample selection process for rural areas**

#### *Sampling design and sampling frame*

A stratified two-stage random cluster sampling design was followed to minimize travel time and costs to conduct the survey. An updated list of EPI outreach centers is available in each upazila health complex (UHC) which were considered as the sampling frame for primary sampling units (PSUs).

#### *Selection of PSUs*

On average, each upazila (sub-district) has about 200 EPI clusters. At the first stage, we selected 75 clusters from each upazila following the Coverage Evaluation Survey (CES) 2019 (1). These 75 clusters were chosen using systematic random sampling technique instead of probability proportional to size (PPS) to cover all unions (the lowest administrative unit) within each upazila. We did not use PPS because smaller clusters from HTR areas could have been excluded.

#### *Selection of households*

A household enumeration operation was conducted in each selected cluster (catchment area of EPI outreach center) for segmentation before conducting the household interview. Clusters with 150 households or more were segmented into segments of 75 households each. On an average there were three segments within in a cluster. Afterwards, a segment from each cluster was randomly chosen following lottery method. As the average household size is 4.1 and about 4.3% of the total population are children aged <2 years (15), it was expected that there would 13~14 (=75×4.1×4.3%) eligible children within one selected segment.. The first household was visited through spinning method from a corner of the selected cluster/segment. Afterwards, households were visited sequentially along the cluster boundary in a clockwise direction, moving toward the EPI center. The supervisor observed field workers daily in order to ensure all eligible households were included for the interview. If any selected segment/cluster contained fewer than 15 eligible children, we randomly chose another segment and interviewed the nearest eligible respondents until 15~16 interviews were completed.

### **Sample selection process in urban areas**

In urban areas, we purposively chose slum areas from each selected ward of zone-5 of DNCC for both intervention and comparison areas on the basis of population density, size of the slums, EPI performance and consultation with EPI stakeholders. A complete household listing operation was conducted in selected study areas. Since the number of eligible households were fewer than required sample size, we

followed “take-all” criteria in selecting households in urban slum and hilly areas for interviewing caregivers of children aged 4.5-23 months. Since most mothers in the slum areas were unavailable during day time due to work, we conducted the interview sessions at two different times- four days a week from 9:00 am to 3:00 pm and two days a week from 3:00 pm to 8:00 pm to minimize non-response.

### **Data collection for impact evaluation**

We designated a total of three teams and two supervisors (one assigned to each upazila) at each of the five IR rural districts. Two teams with one supervisor were assigned at the DNCC. The supervisors and data collectors were expert in immunization and conducting survey.

We used a survey questionnaire to collect information via in-person interview. The questionnaire was translated to Bengali. The survey questionnaire was pilot-tested prior to data collection. Informed consent and script documents were available in paper form. Informed consent for data collection was taken and respondents signed a hard copy before interview. Data were entered into a cloud-based system called KoboToolbox using TAB. A copy of the household survey questionnaire is available in [Annexure D](#).

### **Data analysis for impact evaluation**

The prime outcomes of the study were coverages of ZD and UI. ZD and UI were measured as missing the 1<sup>st</sup> first dose (Penta1) and 3<sup>rd</sup> dose (Penta3) of pentavalent vaccine, respectively.

We considered two age groups - children aged 4.5-<12 months and 12-23 months. Respondents were asked to show their EPI cards to record the vaccination status. If the card was unavailable during interview, information related to vaccination status was collected verbally from the respondents using standard coverage survey scripts. We also assessed crude vaccination coverage (age appropriate vaccination by card or history) and valid vaccination coverage (relying on card only) for each specific antigen. Comparison between crude and valid coverages enabled us to estimate the percentage of children who received vaccines on time. FVC was reported in the study by calculating the percentage of children aged 12-23 months who took Bacillus Calmette-Guérin (BCG), 3 doses of Penta, 3 doses of Oral Polio Vaccine (OPV), 3 doses of Pneumococcal Conjugate Vaccine (PCV) and 1<sup>st</sup> dose of Measles Rubella (MR). Dropout rates for Penta1-Penta 3 and Penta1-MR1 were calculated as well. A child who received Penta 1 vaccine but did not return for Penta3 was considered as dropout from Penta1 to Penta3. Similarly, a child who received Penta1 but did not return for MR1 was considered a Penta1-MR1 dropout. A vaccine dose was considered invalid if it was administered earlier than the minimum age recommended, or earlier than the minimum interval since the previous dose in the vaccine series.

Several characteristics of respondents and their families such as age, sex, birth order, education, occupation, residence, duration of residence, number of children, monthly family income, monthly family expenditure, asset information, land ownership, house ownership, and wealth quintile were incorporated in the study as covariates as suggested by literature review. Indicators on knowledge, attitudes and practice (KAP) related to child immunization were based on WHO and United Nations Children's Fund (UNICEF) behavioral and social drivers (BeSD) guidelines (16). Similarly, reasons for not receiving vaccines stated by the caregivers of ZD children and suggestions to increase vaccination rate were documented in this study as well.

For bivariate analysis, we used chi-square tests to measure association of the outcome variables- ZD and ZD/UI with each covariate.. Binary logistic regression models adjusted clustering effect by using robust standard errors at the cluster level. This approach adjusts for intra-cluster correlation due to

similarities among households within the same cluster. This was considered for both intervention and comparison areas. Difference-in-Differences (DID) method was applied to estimate the intervention effect on ZD/UI comparing pre-post and intervention-comparison groups. Analysis was conducted using STATA software (version 15).

Details about impact evaluation are available in [Annexure E](#).

## **b. Process evaluation**

### **Data collection for process evaluation**

We conducted a process evaluation to assess whether programme activities were implemented as intended and whether they resulted in certain outputs such as factors influencing the caregivers' decision to vaccinate/not vaccinate children, perceptions (satisfied/not satisfied) of respondents about the services they received from the providers in vaccinating their children and acceptability of the approaches applied for vaccination of their children(17). For the process evaluation, data were collected through in-depth interviews (IDIs) with caregivers of ZD, UI and FVC children, key informant interviews (KIIs) with district and sub-district level managers and focus group discussion (FGD) with frontline service providers.

Participants of IDIs were selected purposively based on their child's immunization status, i.e. caregivers of ZD, UI and FVC children. Participants of KIIs and FGDs of this study were selected purposively based on their roles in the program activities, participation and knowledge about the programme so that they can provide us with a real understanding of the needs, potentials, solutions and recommend feasible ways for improvement of the programme. The list of participants in qualitative components are available in **Annexure F: Table F1**. Data were collected on perceptions of service providers on the interventions, effectiveness of the interventions and respondents' recommendation about modification/strengthening of the interventions.

### **Data analysis for process evaluation**

After transcribing data, we employed the content analysis method for analysis. The data analysis encompassed several steps. First, the transcripts were perused to become familiar with the data. After the rigorous reading, coding was conducted and codes were compiled. Code books were prepared for each data collection tool. Afterwards, the research team reviewed and updated the code books. Third, we formed coding units from code books and identified thematic categories based on coding units. Finally, we identified thematic categories and summarized the data. Details about process evaluation are available in [Annexure F](#).

## **4. Results**

A sample of 12,756 caregivers (n=6,362 in the intervention areas and n=6,394 in the comparison areas) were interviewed in the baseline survey, and 12,974 caregivers (n=6,459 in the intervention areas and n=6,515 in the comparison areas) in the endline survey. The target number of interviews (n=1,150) were achieved in each geo-landscape, except in the urban slum and hilly geo-landscapes upazilas. We have provided details in regards to the number of interviews conducted with the caregivers of children aged 4.5-23 months in the baseline and endline surveys in six intervention and six comparison areas across six geographical landscapes in **Annexure G: Table G1**.

#### 4.1 Background characteristics of the respondents

Several background characteristics of caregivers showed small but statistically significant changes between the baseline and endline surveys, particularly in the comparison areas ([Annexure G: Table G2](#)). At each area, the percentage of caregivers in the upper age groups was lower at baseline compared to endline. Most of the caregivers were female in both the intervention and comparison areas. Caregivers with no education were fewer (10.0% vs 6.4%) between baseline and endline and a similar significant pattern was noticed in the comparison area (baseline:10.2%, endline:7.1%).

Details about the survey coverage and background characteristics of the respondents are available in [Annexure G](#).

#### 4.2 Caregivers' knowledge, perceptions and experience on child vaccination

Mentioned prior, we conducted IDIs with 17 caregivers in six intervention areas to understand their perceptions and experiences on child vaccination. The distribution of the 17 caregivers interviewed were: 6 FVC, 5 UI and 6 ZD children. Their knowledge, perceptions and other aspects related to vaccination are described in [Annexure A: Table A2](#). Findings from the table depict apparent differences among caregivers of FVC, UI and ZD children in terms of their knowledge, perceptions, family influence, role of their partners in child vaccination. Although caregivers of children with FVC had greater awareness on vaccines in contrast to the caregivers of UI and ZD children. Furthermore, family members and fathers of FVC were more supportive about vaccinating their children whereas family members and fathers of UI and ZD children were reluctant in this regard.

#### 4.3 Childhood vaccination

**Table 2** shows the area-specific crude and valid vaccination coverage among children aged 12-23 months at baseline and endline. There were fewer changes in coverages by antigen between the baseline and endline surveys. The crude FVC had declined in intervention areas (82.3% to 81.0%) compared to comparison areas (86.0% to 82.8%) but the decline was lower in intervention areas in contrast to comparison areas. Furthermore, the valid FVC increased in the intervention areas (64.8% to 66.0%) as opposed to having declined in the comparison areas (68.5% to 68.0%).

**Table 2:** Crude and valid vaccination coverage among children aged 12-23 months by antigen and area

| Name of Vaccine  | Crude (Card + History) |         |            |         | Valid (Card Only) |         |            |         |
|------------------|------------------------|---------|------------|---------|-------------------|---------|------------|---------|
|                  | Intervention           |         | Comparison |         | Intervention      |         | Comparison |         |
|                  | Baseline               | Endline | Baseline   | Endline | Baseline          | Endline | Baseline   | Endline |
|                  | n=3809                 | n=4014  | n=3929     | n=3920  | n=3809            | n=4014  | n=3929     | n=3920  |
|                  | %                      | %       | %          | %       | %                 | %       | %          |         |
| BCG              | 98.7                   | 98.8    | 99.1       | 98.8    | 85.3              | 87.0    | 85.9       | 86.5    |
| Penta-1          | 98.4                   | 98.4    | 98.8       | 98.2    | 82.6              | 85.2    | 83.7       | 84.8    |
| Penta-3          | 91.1                   | 90.9    | 93.1       | 91.0    | 78.3              | 79.5    | 80.1       | 78.9    |
| PCV-1            | 98.4                   | 98.2    | 98.7       | 97.9    | 82.7              | 84.7    | 83.7       | 84.6    |
| PCV-3            | 91.1                   | 89.7    | 92.9       | 89.1    | 78.4              | 77.5    | 79.8       | 76.6    |
| OPV-1            | 98.1                   | 98.5    | 98.6       | 98.4    | 82.5              | 84.9    | 83.6       | 84.6    |
| OPV-3            | 90.8                   | 92.2    | 92.9       | 92.8    | 78.9              | 80.3    | 80.0       | 80.9    |
| MR-1             | 83.7                   | 82.8    | 86.6       | 86.0    | 71.3              | 72.8    | 74.5       | 75.1    |
| FVC <sup>1</sup> | 82.3                   | 81.0    | 86.0       | 82.8    | 64.8              | 66.0    | 68.5       | 68.0    |

<sup>1</sup>FVC: A child is considered to be fully vaccinated if s/he has received one dose of BCG, 3 doses of Pentavalent, 3 doses of OPV, 3 doses of PCV, and one dose of MR vaccine

Note: DID estimates were found not to be significant

The percentage of invalid doses for any vaccine including Pentavalent and MR vaccines had reduced at endline compared to baseline in both intervention and comparison areas (**Table 3**). However, the FVC drop-out rates (missed any dose of BCG, Pentavalent, PCV, OPV or MR 1<sup>st</sup> dose) at the baseline and endline surveys were about one-third of all the children in the intervention (35.2% vs 34.0%) and comparison areas (31.5% vs. 32.0%).

**Table 3:** Invalid doses and drop-out rates among children aged 12-23 months in the baseline and endline surveys by area

| Indicator                     | Intervention  |               | Comparison    |               |
|-------------------------------|---------------|---------------|---------------|---------------|
|                               | Baseline      | Endline       | Baseline      | Endline       |
|                               | n=3809        | n=4014        | n=3929        | n=3920        |
|                               | %             | %             | %             | %             |
| <b>Invalid Dose</b>           |               |               |               |               |
| Invalid any dose <sup>1</sup> | 9.3           | 7.2           | 8.8           | 5.9           |
| Invalid Penta1                | 2.6           | 1.7           | 2.0           | 1.2           |
| Invalid Penta3                | 2.4           | 1.6           | 2.5           | 1.4           |
| Invalid MR1                   | 3.2           | 2.1           | 3.0           | 1.1           |
| <b>Drop-out<sup>2</sup></b>   | 35.2          | 34.0          | 31.5          | 32.0          |
| <b>Drop-out rate</b>          | <b>n=3749</b> | <b>n=3950</b> | <b>n=3882</b> | <b>n=3850</b> |
| Penta1-Penta3                 | 7.4           | 7.6           | 5.8           | 7.4           |
| Penta1-MR1                    | 14.9          | 15.8          | 12.3          | 12.5          |

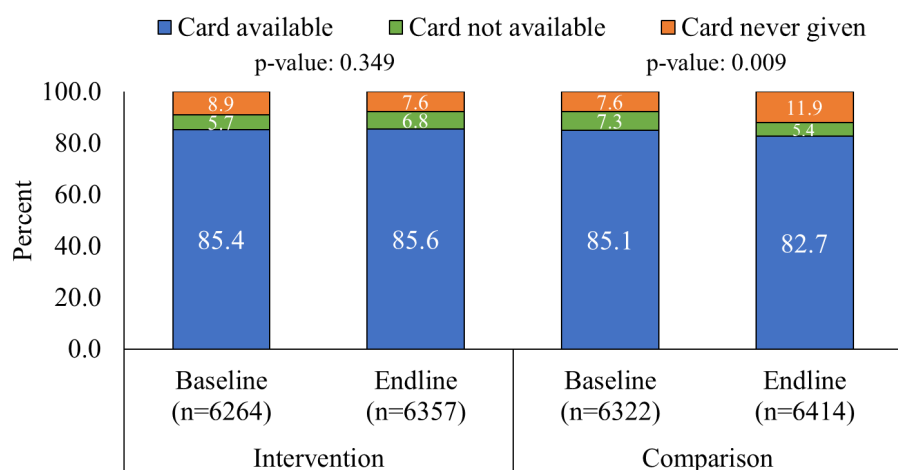
<sup>1</sup> Any invalid dose of BCG, Pentavalent, PCV, OPV or the first dose of MR

<sup>2</sup> Missed any dose (valid) of BCG, Pentavalent, PCV, OPV and the first dose of MR

Note: DID estimates were found to be insignificant

At baseline, the card retention rate was approximately 85% in both the intervention and comparison areas (**Figure 2**). However, at the endline, the retention rate was lower in the comparison area to 82.7% compared to intervention area (85.6%).

**Figure 2:** EPI card retention rates in the baseline and endline in surveys by areas



**Table 4** represents the prevalence of ZD, UI and ZD/UI in the intervention and comparison areas with (DID estimates to depict overall impact of the interventions. The prevalence of ZD/UI reduced significantly in the intervention sites of hilly, plain and urban areas but increased in the respective comparison areas (hilly: -1.3% vs 5.5%; plain: -3.9% vs 2.6%; urban: -1.0% vs 4.3%). The prevalence

of ZD/UI increased in both intervention and comparison sites of char and coastal areas as well but the increase was less pronounced in intervention areas compared to comparison areas (char: 3.4% vs 7.9%; coastal: 9.0% vs 17.1%). Notably, a greater burden of vaccine shortage was observed in char and coastal areas in contrast to other study areas (**Annexure A: [Table A3](#)**).

The DID estimates showed a positive impact of interventions in all areas except those in haor. The unexpected outcome in haor areas may be explained by the significantly higher number of HAs in the comparison sites, nearly double than that of the intervention sites, which likely contributed to better service delivery and coverage.

The overall DID estimate of 3.8% for ZD/UI showed small but significant increase of ZD/UI in intervention areas compared to the comparison areas (1.5% vs 5.3%), indicating a positive impact of the implemented interventions in mitigating the increase in prevalence of ZD/UI over the study period.

**Table 4:** Prevalence of ZD, UI and ZD/UI with difference-in-difference (DID) estimates among children aged 4.5-23 months by area and geo-landscape

| Geo-landscape        | Area         | ZD       |     |         |     |                  | UI       |      |         |      |                  | ZD/UI    |      |         |      |                  |
|----------------------|--------------|----------|-----|---------|-----|------------------|----------|------|---------|------|------------------|----------|------|---------|------|------------------|
|                      |              | Baseline |     | Endline |     | Endline-Baseline | Baseline |      | Endline |      | Endline-Baseline | Baseline |      | Endline |      | Endline-Baseline |
|                      |              | n        | %   | n       | %   |                  | n        | %    | n       | %    |                  | n        | %    |         |      |                  |
| Char                 | Intervention | 1,152    | 1.2 | 1,164   | 1.4 | 0.2              | 1,152    | 7.2  | 1,164   | 10.5 | 3.3              | 1,152    | 8.5  | 1,164   | 11.9 | 3.4              |
|                      | Comparison   | 1,164    | 0.8 | 1,159   | 1.6 | 0.8              | 1,164    | 5.8  | 1,159   | 12.9 | 7.1              | 1,164    | 6.6  | 1,159   | 14.5 | 7.9              |
| <b>DID (char)</b>    |              |          |     |         |     | <b>0.7</b>       |          |      |         |      | <b>3.7</b>       |          |      |         |      | <b>4.5</b>       |
| Coastal              | Intervention | 1,191    | 4.6 | 1,160   | 5.7 | 1.1              | 1,191    | 14.4 | 1,160   | 22.4 | 8.0              | 1,191    | 19.0 | 1,160   | 28.0 | 9.0              |
|                      | Comparison   | 1,190    | 2.8 | 1,177   | 6.4 | 3.6              | 1,190    | 15.7 | 1,177   | 29.1 | 13.4             | 1,190    | 18.5 | 1,177   | 35.6 | 17.1             |
| <b>DID (coastal)</b> |              |          |     |         |     | <b>2.6</b>       |          |      |         |      | <b>5.5</b>       |          |      |         |      | <b>8.0*</b>      |
| Hilly                | Intervention | 1,042    | 1.2 | 945     | 1.4 | 0.2              | 1,042    | 9.4  | 945     | 7.9  | -1.5             | 1,042    | 10.6 | 945     | 9.3  | -1.3             |
|                      | Comparison   | 1,065    | 0.5 | 1,067   | 0.8 | 0.3              | 1,065    | 3.2  | 1,067   | 8.4  | 5.2              | 1,065    | 3.7  | 1,067   | 9.2  | 5.5              |
| <b>DID (hilly)</b>   |              |          |     |         |     | <b>0.1</b>       |          |      |         |      | <b>6.7**</b>     |          |      |         |      | <b>6.8**</b>     |
| Plain                | Intervention | 1,195    | 0.8 | 1,170   | 0.1 | -0.7             | 1,195    | 8.4  | 1,170   | 5.1  | -3.3             | 1,195    | 9.2  | 1,170   | 5.3  | -3.9             |
|                      | Comparison   | 1,172    | 1.4 | 1,171   | 1.6 | 0.2              | 1,172    | 8.2  | 1,171   | 10.5 | 2.3              | 1,172    | 9.5  | 1,171   | 12.1 | 2.6              |
| <b>DID (plain)</b>   |              |          |     |         |     | <b>0.9</b>       |          |      |         |      | <b>5.6***</b>    |          |      |         |      | <b>6.6***</b>    |
| Haor                 | Intervention | 1,189    | 3.2 | 1,184   | 4.0 | 0.8              | 1,189    | 18.1 | 1,184   | 17.3 | -0.8             | 1,189    | 21.2 | 1,184   | 21.3 | 0.1              |
|                      | Comparison   | 1,160    | 2.1 | 1,174   | 2.1 | 0.0              | 1,160    | 19.4 | 1,174   | 13.1 | -6.3             | 1,160    | 21.5 | 1,174   | 15.2 | -6.3             |
| <b>DID (haor)</b>    |              |          |     |         |     | <b>-0.8</b>      |          |      |         |      | <b>-5.5*</b>     |          |      |         |      | <b>-6.4*</b>     |
| Urban                | Intervention | 593      | 2.4 | 836     | 2.2 | -0.2             | 593      | 17.0 | 836     | 16.3 | -0.7             | 593      | 19.4 | 836     | 18.4 | -1.0             |
|                      | Comparison   | 643      | 2.0 | 767     | 4.0 | 2.0              | 643      | 15.1 | 767     | 17.3 | 2.2              | 643      | 17.1 | 767     | 21.4 | 4.3              |
| <b>DID (urban)</b>   |              |          |     |         |     | <b>2.3</b>       |          |      |         |      | <b>3.0</b>       |          |      |         |      | <b>5.3**</b>     |
| All                  | Intervention | 6,362    | 2.3 | 6,459   | 2.5 | 0.2              | 6,362    | 12.1 | 6,459   | 13.3 | 1.2              | 6,362    | 14.3 | 6,459   | 15.8 | 1.5              |
|                      | Comparison   | 6,394    | 1.6 | 6,515   | 2.7 | 1.1              | 6,394    | 11.1 | 6,515   | 15.2 | 4.1              | 6,394    | 12.6 | 6,515   | 17.9 | 5.3              |
| <b>DID (all)</b>     |              |          |     |         |     | <b>0.9</b>       |          |      |         |      | <b>2.9**</b>     |          |      |         |      | <b>3.8**</b>     |

Statistical significance: \*\*\*<0.01, \*\*<0.05 and \*<0.1

**Interpretation:**

Endline-Baseline: +ve sign indicates an increase and -ve sign indicates a decrease in the prevalence of ZD/UI

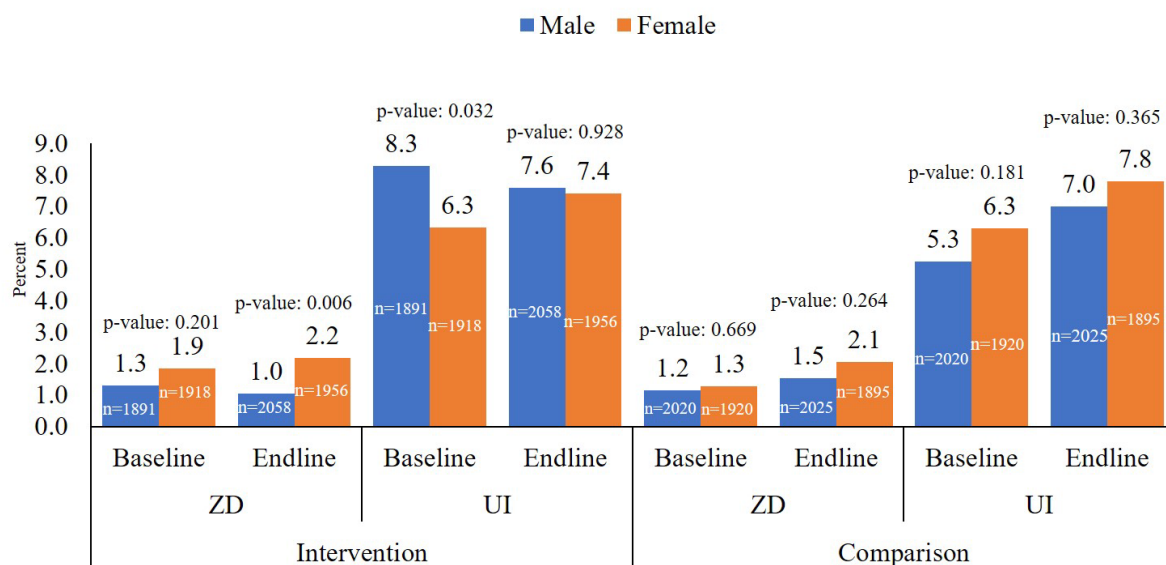
DID: (Endline-Baseline) comparison - (Endline-Baseline) intervention

(+) sign indicates positive effect of interventions and

(-) sign indicates negative/no effect of interventions

**Figure 3** shows the prevalence of ZD and UI children aged 12-23 months in intervention and comparison areas by gender. At the intervention areas, the prevalence of ZD among male and female children was found to be similar (1.3% vs 1.9%) at the baseline but during the endline, the prevalence was found to be significantly higher among female children in contrast to male children (2.2% vs 1.0%). Surprisingly, we observed a reverse situation in regards to UI at the intervention areas in the baseline when the prevalence of UI was found to be greater for male children compared to female children (8.3% vs 6.3%). The gender difference in the prevalence of UI disappeared over the time in the endline (7.6% vs 7.4%). No significant gender differences on prevalence of ZD and UI were detected among the children aged 12-23 months in the comparison areas.

**Figure 3:** Prevalence of ZD and UI among children aged 12-23 months by gender



The most common reason that the caregivers cited for their children being ZD/UI was child illness at the time of vaccination in intervention and comparison areas. At the intervention areas, the second most common reason cited was the intention to vaccinate children in future. The proportion of caregivers reporting vaccine shortage as a reason for their children being ZD/UI in intervention areas increased more than threefold from the baseline to the endline (ZD: 4.1% to 12.9%; UI: 7.0% to 35.0%) period. Other reported reasons mentioned were: caregiver was busy, the fear of side effect after receiving vaccination, restriction from family members and family migration. Similar scenarios were observed in comparison areas as well in regards to children being ZD/UI (**Annexure A: Table A4**).

An uninterrupted supply of vaccines and availability of other logistics are essential for vaccination and contribute greatly in enhancing the vaccination coverage. Yet, vaccine shortages were detected in all the study areas except Rangamati Sadar. Among the study areas, Hatiya and Subarnachar upazilas in Noakhali district were recorded to have the highest number of vaccine stock-out days (Penta: 166 vs. 110; PCV: 163 vs. 146; and IPV: 122 vs. 47 days). The two upazilas of Gaibandha district were the second most affected areas in regards to vaccine shortage throughout the IR period (Penta: 129 vs. 108; PCV: 90 vs. 174; and IPV: 42 vs. 67, OPV: 37 vs. 17 days). This shortage of vaccine had a direct impact on vaccination coverage, ZD, UI and effective implementation of the interventions (**Annexure A: Table A3**).

Findings from qualitative data also showed that vaccine shortage was a prominent barrier against successful implementation of interventions and increasing the number of ZD and UI children. According to the most key informants (n=13), vaccine shortage was the prime challenge that exerted a notable effect on the EPI programme. They said that the shortage of pentavalent and PCV vaccines was noticeable and all 6 intervention areas experienced this predicament. One of the key informants mentioned,

*The pentavalent and PCV stock-out is currently a common issue in our Gaibandha. This issue of vaccine shortage is directly affecting the programme and increasing left out and drop out. If the problem of vaccine shortage cannot be solved, it will not be possible to reap the full benefits of introducing the good interventions.*

In the endline survey, we asked the caregivers of ZD and UI children to specify the type of illness that their children had that deterred them from vaccinating their children on the schedule vaccination day. The most common illness mentioned by the caregivers were: cough and cold (that lasted a week or more) followed by fever (of 102F or above), pneumonia (**Annexure A: Table A5**).

**Table 5** presents incidences of side effects after vaccination in the intervention and comparison areas.,. The incidence of redness or swelling and other side effects had declined at endline both in intervention and comparison areas. Though the incidence of side effects reduced both the areas, it was prominent in intervention areas than comparison areas and that may be due to better knowledge of caregivers after implementation of the interventions.

**Table 5:** Incidences of side effects after vaccination by area

| Side effect after vaccination* | Intervention |         | Comparison |         |
|--------------------------------|--------------|---------|------------|---------|
|                                | Baseline     | Endline | Baseline   | Endline |
|                                | n=6264       | n=6357  | n=6322     | n=6414  |
|                                | %            | %       | %          | %       |
| None                           | 28.4         | 20.8    | 12.2       | 34.4    |
| Fever                          | 71.4         | 79.2    | 87.9       | 65.6    |
| Redness or swelling            | 6.0          | 0.9     | 6.1        | 1.1     |
| Others <sup>1</sup>            | 2.0          | 0.2     | 3.9        | 0.1     |

\*Multiple response  
<sup>1</sup>Allergy, Cold, Diarrhoea, Pox, Pneumonia  
 All the differences from baseline to endline were found statistically significant at 5% level of significance  
 Note: Total of 200 (baseline: 98 & endline: 102) and 173 (baseline: 72 & endline: 101) left-out children were excluded from intervention and comparison area respectively

**Table 6** depicts adjusted odds ratio (AOR) of ZD/UI for each variable from a binary logistic regression model with all the variables and an interaction of area and time. The odds of children being ZD/UI were higher in the endline period compared to the baseline (AOR: 1.53; 95% CI: 1.29–1.80; p < 0.001) due to vaccine shortages throughout IR period (**Annexure A: Table A3**). Although there was no significant association between ZD/UI and study area (AOR: 1.08; 95% CI: 0.91–1.29; p = 0.358), the interaction term between the study area and time period was significant (AOR= 0.79; 95% CI: 0.63–1.01; p = 0.056), indicating a positive effect of the interventions.

Children from haor, coastal and urban areas were more than twice likely to be ZD/UI compared to children living in plain areas. Children under the care of caregivers aged 25-34 years and 35-44 years were less likely (AOR: 0.75; 95% CI: 0.67-0.83; p <0.001 and AOR: 0.70; 95% CI: 0.60-0.83; p <0.001 respectively) to be ZD/UI compared to children under the care of caregivers aged 18-24 years. The odds

of having ZD/UI children decreased with greater education level of caregivers which indicates that caregivers' higher education level plays a role of protective factor for ZD/UI. Notably, children from other religious groups had lower odds of being ZD/UI compared to those from Muslim households (AOR: 0.71; 95% CI: 0.57–0.88;  $p = 0.002$ ). Caregivers with more than three children were more likely to be ZD/UI compared to only-child caregivers (AOR: 1.44; 95% CI: 1.27–1.65;  $p < 0.001$ ).

In the context of household characteristics, children who belonged to the richer households were less likely to be ZD/UI compared to the poorest ones (AOR: 0.62; 95% CI: 0.52–0.73;  $p < 0.001$ ). Additionally, households located more than a kilometer away from the EPI center were more likely to be ZD/UI compared to closest one (AOR: 1.43; 95% CI: 1.10–1.85;  $p = 0.007$ ). Although there was no significant difference in the odds of being ZD/UI between male and female children, those in the older age group (12–23 months) were less likely to be ZD/UI compared to younger children (AOR: 0.25; 95% CI: 0.23–0.27;  $p < 0.001$ ).

**Table 6:** Adjusted odds ratio (AOR) of ZD/UI from binary logistic regression model (n=25,730)

| Background characteristics       | n     | AOR* (95% CI)    | p-value |
|----------------------------------|-------|------------------|---------|
| <b>Study area</b>                |       |                  |         |
| Comparison                       | 12821 | Ref.             | -       |
| Intervention                     | 12909 | 1.08 (0.91-1.29) | 0.358   |
| <b>Time</b>                      |       |                  |         |
| Baseline                         | 12756 | Ref.             | -       |
| Endline                          | 12974 | 1.53 (1.29-1.80) | <0.001  |
| Area × Time                      | -     | 0.79 (0.63-1.01) | 0.056   |
| <b>Geo-landscape</b>             |       |                  |         |
| Plain                            | 4708  | Ref.             | -       |
| Haor                             | 4707  | 2.39 (1.98-2.88) | <0.001  |
| Char                             | 4430  | 1.14 (0.93-1.40) | 0.211   |
| Coastal                          | 4653  | 2.81 (2.33-3.39) | <0.001  |
| Hilly                            | 4393  | 0.91 (0.69-1.19) | 0.518   |
| Urban                            | 2839  | 2.14 (1.80-2.54) | <0.001  |
| <b>Caregiver characteristics</b> |       |                  |         |
| <b>Age (in years)</b>            |       |                  |         |
| 18-24                            | 11601 | Ref.             | -       |
| 25-34                            | 10719 | 0.75 (0.67-0.83) | <0.001  |
| 35-44                            | 2765  | 0.70 (0.60-0.83) | <0.001  |
| 45+                              | 645   | 0.61 (0.45-0.81) | 0.001   |
| <b>Gender</b>                    |       |                  |         |
| Female                           | 24863 | Ref.             | -       |
| Male                             | 867   | 0.93 (0.67-1.30) | 0.682   |
| <b>Education</b>                 |       |                  |         |
| No education <sup>1</sup>        | 2192  | Ref.             | -       |
| Primary incomplete               | 5294  | 0.68 (0.58-0.79) | <0.001  |
| Primary complete                 | 4058  | 0.58 (0.49-0.69) | <0.001  |
| Secondary incomplete             | 8836  | 0.46 (0.39-0.54) | <0.001  |
| Secondary complete or higher     | 5350  | 0.36 (0.30-0.44) | <0.001  |
| <b>Occupation</b>                |       |                  |         |

| <b>Background characteristics</b> | <b>n</b> | <b>AOR* (95% CI)</b> | <b>p-value</b> |
|-----------------------------------|----------|----------------------|----------------|
| Household chores                  | 23744    | Ref.                 | -              |
| Service/ business/worker          | 1849     | 1.24 (0.97-1.58)     | 0.089          |
| Not working/ disabled/ student    | 137      | 0.79 (0.37-1.68)     | 0.538          |
| <b>Religion</b>                   |          |                      |                |
| Islam                             | 22130    | Ref.                 | -              |
| Others <sup>2</sup>               | 3600     | 0.71 (0.57-0.88)     | 0.002          |
| <b>Parity</b>                     |          |                      |                |
| 1                                 | 9251     | Ref.                 | -              |
| 2                                 | 8450     | 1.09 (0.98-1.21)     | 0.110          |
| 3+                                | 8029     | 1.44 (1.27-1.65)     | <0.001         |
| <b>Household characteristics</b>  |          |                      |                |
| <b>Wealth quintile</b>            |          |                      |                |
| Lowest                            | 3120     | Ref.                 | -              |
| Second                            | 4782     | 0.97 (0.85-1.11)     | 0.628          |
| Middle                            | 6434     | 0.93 (0.81-1.06)     | 0.275          |
| Fourth                            | 6241     | 0.67 (0.58-0.77)     | <0.001         |
| Highest                           | 5153     | 0.62 (0.52-0.73)     | <0.001         |
| <b>Distance to EPI centre</b>     |          |                      |                |
| <=1 kilometer                     | 23730    | Ref.                 | -              |
| >1 kilometer                      | 2000     | 1.43 (1.10-1.85)     | 0.007          |
| <b>Child characteristics</b>      |          |                      |                |
| <b>Child's gender</b>             |          |                      |                |
| Male                              | 13172    | Ref.                 | -              |
| Female                            | 12558    | 0.99 (0.92-1.07)     | 0.838          |
| <b>Child's age</b>                |          |                      |                |
| 4.5 -< 12 months                  | 10058    | Ref.                 | -              |
| 12-23 months                      | 15672    | 0.25 (0.23-0.27)     | <0.001         |

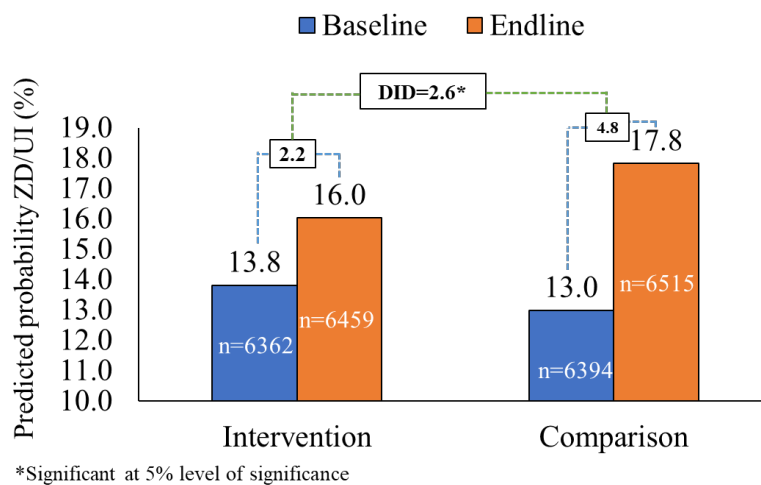
\* Adjusted for cluster effects; <sup>1</sup>Merged with informal education; <sup>2</sup>Hinduism, Christianity, Buddhism;

<sup>3</sup>Estimated from the predicted probabilities of ZD/UI obtained from the model for each study area by project year combination, in line with the difference-in-difference approach to estimate intervention impact

Note: Marital status of caregivers and relationship with child are excluded for high correlation with age of caregivers and gender of caregivers respectively; Ethnicity is excluded due to the confounding effect of geographic location on ethnicity; Number of family member is excluded due to the confounding effect of wealth index on number of family member; Monthly income and expenditure are excluded for high correlation with wealth quintile

**Figure 4** shows the predicted probabilities (in %) of being ZD/UI in the intervention and comparison areas in the baseline and endline estimated by a binary logistic regression model (**Table 6**). The figure shows that the probability of being ZD/UI in the intervention area was 2.6% lower than in the comparison area at the endline.

**Figure 4:** Predicted probability (%) of ZD/UI estimate from binary logistic regression model in baseline and endline by area



Details on the effect of the implemented interventions are available in [Annexure H](#).

#### 4.4. Behavioral and Social Drivers (BeSD) of Vaccination

We analysed data from baseline and endline surveys to determine the BeSD of vaccination. Results show that more than 90% of the caregivers (of both ZD/UI and non-ZD/UI children) believed that vaccines were moderately important or momentous for a child’s health. A high number of respondents, i.e. more than 90% reported that they believed vaccines to be safe and most of their family members and friends wanted their child to be vaccinated. The number of caregivers who wanted to get their children all the recommended vaccines and were informed about where to get their children vaccinated were greater than 90% as well. These results were observed in both intervention and comparison areas. ([Annexure A: Table A6](#)). Notably, such high rates may reflect social-desirability bias.

The percentage of caregivers of both ZD/UI and non- ZD/UI children, who believed that vaccination cost was moderate or affordable decreased from baseline to endline in intervention areas (ZD/UI: 76.2% vs 71.2%, non ZD/UI: 86.1% vs 84.7%). In contrast, an opposite pattern was observed in the comparison areas from the baseline to endline (ZD/UI: 76.6% vs 85.4%, non ZD/UI: 78.4% vs 92.9%). This calls for further investigation so as to determine the reasons behind such scenarios.

Notably, there was a substantial rise in number of caregivers from baseline to endline who reported that a health worker (HA, paramedic, or vaccinator) had recommended vaccination for their child. The rise was greater in intervention areas. Yet, only 35% of the caregivers with ZD/UI children in the intervention area and about 43% in the comparison area were contacted by health workers (HA, Family Welfare Assistant (FWA), paramedics, vaccinators) about their child being due for vaccination in the endline survey. The situation was far better for caregivers of non-ZD/UI children; more than 60% caregivers reported that they were contacted by a health worker about their child’s vaccination. At the baseline, higher proportion of caregivers with non-ZD/UI children reported that they had never experienced being turned away for child vaccination compared to the caregivers of ZD/UI children from intervention and comparison areas. However, this proportion was lower at endline which could have ensued from vaccine shortage. Notably, there was a decline in number of caregivers of both ZD/UI and non-ZD/UI children who found that child vaccination services were easy to acquire from baseline to endline period. ([Annexure A: Table A3](#)).

#### 4.5. Economic Evaluation

Our economic evaluation assessed the total ZD/UI programme cost from October 2023 to December 2024 was estimated to be BDT 30,507,644 (USD 249,960). Of this amount, 27% was attributable to start-up activities such as training material development, system setup and capacity building, and 73% was attributable to the implementation phase activities. Human resources were the main cost driver, accounting for 63% of total cost, followed by allowances, transportation, venue. The average cost per ZD/UI child reached showed significant variation across intervention areas mostly due to variation in population density and the geographic and resource constraints. The lowest cost per child reached was observed in the HTR coastal area (BDT 2,942 or USD 24), while the highest was observed in the HTR hilly area (BDT 48,542 or USD 398). Overall, the programme resulted in a net reduction in ZD and UI prevalence, decreasing ZD by 0.9 percent and UI by 2.9 percent (**Table 4**). The programme was estimated to have averted 566 DALYs by reducing vaccine-preventable diseases among children under the age of five years. The incremental cost-effectiveness ratio (ICER) was calculated at BDT 53,934 (USD 442) per DALY averted and comparing with Bangladesh's GDP per capita threshold, the programme was identified as highly cost-effective (the full report on economic evaluation is available in [link](#)).

#### 4.6. Challenges in implementing the interventions

Findings from qualitative data showed that the participants appreciated the effects of interventions in reducing ZD and UI children. They also mentioned several challenges that hindered the implementation of interventions. The main challenges mentioned are elaborated below:

*Vaccine shortage:* Vaccine shortage was the main challenge which has great effect on the EPI programme. Our results have also shown the hindering impact that vaccine shortage has such as respondents being turned away from getting their child vaccinated. The key informants also emphasized that the shortage in number of pentavalent and PCV vaccines was frequent and all the six intervention areas faced this challenge.

*Shortage of EPI card:* The shortage of EPI card was another challenge that affected the implementation of interventions. Two service providers had apprised that the EPI card is important for caregivers to have vaccine information related to their child and be aware of the due dates. Since there was frequent shortage of EPI card in the upazilas, the caregivers without the EPI cards would not bring their children to the vaccination centers who then became drop-out.

*Scarcity of human resources:* Some key informants mentioned the dearth in number of health staff. They mentioned that there was a shortage of HAs and porters in all the intervention areas. According to the respondents, about 40% of the HA positions are vacant and EPI sessions cannot be held regularly. Thus, the number of ZD and UI children increased in the upazilas.

*Political unrest:* Bangladesh has experienced tremendous changes due to the recent political unrest and setting up of new government. This situation has exerted adverse impact on our research activities- specially on partner engagement, routine EPI sessions, organizing advocacy meetings/social gatherings/counselling given that there was a ban on movement.

*Frequent changes in administration:* There has been frequent changes/transfer of government officials at all levels after the interim government was set up in Bangladesh. Such transfers have had direct impact on the CLH performance.

## 5. Discussion

Based on evaluation data, the prevalence of ZD/UI significantly reduced in intervention areas of hilly, plain and urban areas, whereas it increased in their respective comparison areas. For char and coastal areas, the prevalence of ZD/UI had increased in both intervention and comparison areas but the increase was less pronounced in intervention areas than comparison areas. The frequent vaccine shortage in char and coastal areas may be the reason behind it. Our DID estimates showed a positive impact of interventions in all areas except in haor. Notably, the unexpected outcomes in haor areas was due to a significantly higher number of HAs being available in the comparison site than that in the intervention site which likely contributed to better service delivery and coverage. Though there are human shortage in study areas, posting of HAs in comparison site of haor area was nearly double than that of the intervention site which indicated the status of inequitable distribution of human resources in health systems.

The data analysis divulged that children from haor, coastal and urban areas were more than twice likely to be ZD/UI compared to children living in plain areas. Similarly, caregivers with greater number of children and their household located more than a kilometer further from the EPI centre were more likely to have ZD/UI children. In contrast, children of caregivers with higher level of education were less likely to be ZD/UI. This depicts the utmost importance of education among caregivers and call for interventions that would enhance education and empowerment of caregivers who were mostly found to be women.

The study found some promising interventions which exerted great impact in increasing vaccine uptake and reducing ZD/UI children. Evening sessions enabled working mothers to vaccinate their children on-schedule in urban slums. To inform and motivate more people to attend these sessions, it is recommended to strengthen BCC activities. E-screening checklist is a very promising intervention for identifying and reaching ZD and UI children which might be recommended to scale up on priority basis/urgent basis. Crash programmes have also been proven to be an effective intervention in reducing ZD and UI children in HTR areas where budget is required for smooth continuation of crash programmes. The intervention E-Tracker has helped commence online registration though further efforts such as making shorter/reducing indicator list of the application and further training of field staff, are required from EPI to make E-Tracker fully functional. Although the intervention community engagement had enhanced increasing vaccine uptake, the key informants emphasized more on active participation of local political leaders with EPI to support the programme. However, the promising interventions should be scaled up on a priority basis to reduce ZD/UI children, especially in haor, coastal and urban areas where more than twice the number of ZD/UI children are residing compared to children from plain areas.

Though the IR has demonstrated the impact of tailored interventions to reduce ZD and UI children, it encountered several confounders and limitations which were largely outside the control of the IR study. The prominent limitations encompass: vaccine, logistics and HR shortages; political unrest and frequent movement/transfer of concerned officials from national to upazila levels. As depicted by both the quantitative and qualitative findings, frequent vaccine shortage during implementation of interventions was the prime challenge and this shortage greatly affected the smooth conduction of EPI programme. At the intervention areas, the increase in the number of caregivers, who reported vaccine shortage as a reason for their children being ZD/UI, was more than threefold from the baseline to the endline. Another limitation was the shortage of EPI cards, the EPI card is momentous for caregivers to be aware of information related to vaccines received by their children and due dates of subsequent doses. However,

due to frequent shortage of EPI card in the upazilas, the caregivers would fail to remember due dates and did not bring their children to the vaccination centers which rendered their children drop-out or left out. Some key informants emphasized upon the scarcity of health staff. They mentioned that there was shortage of HAs and porters in all the intervention areas. According to them, 40% of HA positions are vacant and EPI sessions are not held regularly. Thus, number of ZD and UI children increased in the upazilas. A dearth in number of HAs also imply little to no conduction of Interpersonal Communication (IPC) that supports abating the predicament of ZD/UI. Another colossal limitation was the recent political unrest and setting up of new Government which, hindered our research activities, especially on partner engagement, routine EPI sessions, organizing advocacy meetings/social gatherings/counselling since there was a ban on movement. This also linked with frequent changes in administration, i.e., after taking charge of the interim government in Bangladesh, the frequent changes/transfer of government officials at all levels has had a direct impact on implementation of the interventions.

## 6. Conclusion and recommendations

There were numerous challenges in implementing our proposed interventions. Nevertheless, we detected a positive impact of the interventions in mitigating the increase in number of ZD/UI children at the intervention areas compared to the comparison areas over time. The economic evaluation also depicted that overall, the interventions have great potential in regards to sustainability and future-level scale up opportunities ([Economic evaluation report](#)). Therefore, the successful interventions should be scaled up on a priority basis to reduce the prevalence of ZD/UI children throughout the country. Below we provide some recommendations that may support scaling up the interventions as well as reduce the number of ZD and UI children:

### Recommendations specific to reducing ZD and UI children

**Scale up the promising interventions on priority basis:** Findings showed that some of the interventions such as E-screening checklist, evening sessions, crash programme are quite promising. Concerned district and upazila managers requested icddr,b to support them in scaling up those interventions at all upazilas of the districts. Therefore, steps to scale up the promising interventions should be emphasized upon at policy level, especially in high ZD and UI areas/missed communities on a priority basis.

**Ensure vaccine supply:** Findings show a persistent vaccine shortage (especially in Pentavalent and PCV vaccines) throughout the study duration. This is a major challenge in reducing ZD and UI and requires attention. The EPI needs to take drastic measures and ensure adequate as well as uninterrupted vaccine supply.

**Ensure required human resources:** The dearth in number of HAs and porters is alarming and many such posts remain vacant in some areas leading to higher number of ZD and UI children. It is highly recommended to fill up the vacant positions of HA and porters on emergency basis.

**Provide training or recruit personnel:** The DNCC lacks vaccinators from their own organization and thus, have collaborated with partner NGOs to conduct vaccination sessions. These NGOs have high staff turnover which hinders the smooth conduction of vaccination sessions. Under such circumstances, DNCC should arrange training for new transfers/arrivals or recruit own vaccinators.

**EPI card including digital card:** In some areas such as Hatiya and Saghata where monsoon floods are common, we found the number of vaccination cards to be insufficient. During events of natural disasters, caregivers end up losing vaccination cards which leads them to forgetting about the due vaccination schedule of their children. This has an impact on rendering the children being ZD and UI. Thus, it is recommended to have greater supply of vaccination cards especially for areas susceptible to natural disasters. Findings also show that about 16% caregivers were unable to show the vaccination card. Some caregivers also lose vaccination cards when migrating in search of livelihood. Thus, digitalizing the EPI card is also highly recommended. Digitalizing the EPI card can preserve the child's vaccination information and gain quick access from anywhere.

**Increase IPC and awareness building sessions:** IPC plays a vital role in informing and motivating caregivers to vaccinate their children. According to our study findings, about 25% of the caregivers had no information on common side effects of child immunization. EPI needs to strengthen IPC and thus, introduce new programs such as courtyard meetings, health education sessions, advocacy meetings or other community engagement meetings. Furthermore, EPI can digitalize banners, BCC materials, use different social media such as YouTube and Facebook, use television advertisement, folk song or play to build awareness.

**Strengthen monitoring and supervision:** Lack of monitoring and supervision at field level was observed within the EPI. The reasons encompass: lower number of supervisors available than required, increase in workload on existing supervisors, lack of technical skills and transportation facilities. These issues need to be addressed by policymakers.

**Emphasize on area-specific plans:** Geographical variations and challenges exist throughout Bangladesh. A single general planning that covers the whole country is unsuitable. Different areas need to be considered based on the specific geographical challenges with seasonal variations they face. EPI planning including micro-plan, budget and allowance allocation, and manpower distribution should be tailored according to the area-specific needs.

**Increase coordination and involvement:** Greater coordination between department of health and birth registration is highly recommended and needed. The two departments can collaborate to generate a unique ID or code for every child born which will help the EPI to accurately calculate targeted children of specific areas to provide vaccination. EPI needs to emphasize more on enhancing the coordination.

It is also recommended to increase collaboration with different NGOs. To exemplify, the HAs are unable to cover the whole catchment area due to large distances and scattered households. EPI is recommended to collaborate with local NGOs including CSOs and involve those personnel in conducting EPI activities, especially in hilly areas.

**Further investigation related to illness of children:** Findings show child illness (48%) as the prime cause of children being ZD/UI. It is possible that caregivers are using 'child illness' and the reason because it may be socially acceptable while it may mask other barriers or beliefs. Therefore, it is recommended for EPI to investigate the types of illnesses that dissuade caregivers from vaccinating their children and take initiatives accordingly.

**Increase valid coverage:** Findings show the crude FVC to be 81% whereas the valid coverage equaled 66% in study areas. EPI needs to take initiatives with prime focus on increasing the valid coverage.

**Reduce invalid dose:** Findings show the invalid any dose to be 7.2% which is a substantial hindrance for EPI to reach full valid coverage. EPI needs to emphasize on reducing invalid doses and provide training to vaccinators in this regard.

**Exert special attention upon high prevalent ZD/UI areas and groups:** Study findings depict the prevalence of ZD/UI to be comparatively higher in coastal, haor and urban slums. We also found that prevalence of ZD/UI is high among caregivers who are younger in age, have little education and high parity. EPI is recommended to exert focus upon these areas as well as groups and take specific initiatives.

**Focus upon gender disparity in immunization:** Our study findings have detected high prevalence of ZD among female children aged 12-23 months compared to male children of the similar age. EPI is highly recommended to exert efforts on reducing gender disparity in immunization.

**Conducting rolling-review survey and rapid assessment:** It is recommended for EPI to conduct rapid assessment survey on regular basis to remain updated about the status of ZD/UI children in the country. Using Lot Quality Assurance Sampling (LQAS) and use of District Health Information System 2 (DHIS2) data could be the quick and cost-effective methods. To exemplify, the Gavi-supported ZDLH has effectively identified ZD and UI children using LQAS data and conducting rolling review of DHIS2 data and reaching to those children through conduction of rigorous IR.

Overall, the predicament of ZD/UI in Bangladesh can be improved with practical, cost-effective interventions tailored to the local situation. This IR is an attempt to identifying what works the best and where.

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## Annexures

### Annexure A: Annexure tables

**Table A1:** Selected study (intervention and comparison) areas by type of location and district

| Geo location | District/City Corporation (CC)      | Intervention areas         | Comparison areas |
|--------------|-------------------------------------|----------------------------|------------------|
| Haor         | Sunamganj                           | Dowarabazar                | Jamalganj        |
| Char         | Gaibandha                           | Saghata                    | Fulchhari        |
| Coastal      | Noakhali                            | Hatiya                     | Subarnachar      |
| Hilly        | Rangamati                           | Kawkhali                   | Rangamati Sadar  |
| Plain        | Sherpur                             | Nalitabari                 | Sreebardi        |
| Urban        | Dhaka North City Corporation (DNCC) | Zone-05, Ward-26 & Ward 30 | Zone-05, Ward-33 |

**Table A2:** Knowledge, perceptions and experience of caregivers on child vaccination

| Knowledge, perceptions and experiences | Caregivers   |   |   |
|--|--|---|---|
|  | FVC (n=6)  | UI (n=5)  | ZD (n=6)  |
| Knowledge of caregivers about vaccines | Though most of them (n=5) have some knowledge about VPDs, one don't know anything about importance of vaccination of the children.   | Most of the caregivers of this category (n=4) know that vaccines are important for the wellbeing of children, but they don't know anything about specific benefits of vaccination of a child. | Only one knows that vaccines are important to prevent children from diseases.   |
| Perceptions of the respondents         | All of them think that vaccination is important for good health of children.   | All of them believe vaccination is important for their children, but didn't mention any specific area of importance.  | Two out of six caregivers think that vaccines are not important for the children. Though other four consider vaccines are important for children but not sure about the area of importance. |
| Perceptions of family members          | Five out of six said that their family members are supportive about vaccination of their children and believe vaccination is important for good health of a child. However, one said that her in-law's family is reluctant | One out of five said the elders of her family oppose to vaccinate her child.  | All of them said that their family members didn't say anything about vaccination of their children.   |

| Knowledge, perceptions and experiences                                      | Caregivers   |   |  |
|---|--|---|--|
|   | FVC (n=6)  | UI (n=5)  | ZD (n=6)   |
|   | about vaccination of children.   |   |  |
| Role of husbands on vaccination of children                                 | Though most of the husbands (n=4) are supportive about vaccination of their children, two informed that their husbands are reluctant about it.   | The findings revealed that all the husbands of the caregivers of this category either encouraged or keep themselves silent about vaccination of their children.   | Two out of six said that their husbands restricted them to vaccinate their children.   |
| Previous experience on vaccination  | All of them have previous history of vaccination. Either they took four or all doses of TT vaccine or vaccinated their elder children.   | Three out of five respondents have a previous history of vaccination. One took COVID-19 vaccine while another took a dose of the TT vaccine.  | Five out of six have previous history of vaccination of themselves and their children.   |
| Knowledge about vaccination center  | All of them know nearby vaccination centers.   | All of them know nearby vaccination centers   | One doesn't know the vaccination center at their locality.   |
| Reason of not vaccinating the children                                      | NA   | <ul style="list-style-type: none"> <li>- The child was sick-cough and fever (n=2)</li> <li>- Vaccine shortage (n=2),</li> <li>-Resistance from mother-in-law (n=1)</li> <li>- Afraid of vaccine (n=1) as she heard a child died after vaccination at their locality.</li> </ul> | <ul style="list-style-type: none"> <li>- The children were sick (n=3) (fever, convulsion and pneumonia),</li> <li>- Restriction from husbands (n=2)</li> <li>- Vaccine shortage (n=2)</li> <li>- The mother was out of home at the day of vaccination (n=1)</li> </ul> |
| Perceptions on work of vaccinators  | <ul style="list-style-type: none"> <li>- Vaccinators were cordial and handled their children carefully (n=4)</li> <li>- The vaccinator was in rush during vaccination (n=1)</li> <li>- The vaccinator scolded other caregivers. (n=1)</li> </ul> | <ul style="list-style-type: none"> <li>- The vaccinators were good and well behaved (n=4).</li> <li>- The vaccinator didn't response to her queries (n=1).</li> </ul>   | <ul style="list-style-type: none"> <li>- Vaccinators were cordial to them and talked nicely (n=5).</li> </ul>  |
| Counselling by the vaccinators before and after vaccination of the children | - Four out of six caregivers said that vaccinators informed them that the child may have fever after vaccination, but not to worry about that and advised  | <ul style="list-style-type: none"> <li>- Vaccinators informed them about the next date of vaccination of their children (n=2).</li> <li>- One said that the vaccinator informed her</li> </ul>  | The most of the respondents said that they were informed by the vaccinators about side-effects and necessary measure to be   |

| Knowledge, perceptions and experiences | Caregivers  |   |   |
|--|---|---|---|
|  | FVC (n=6)   | UI (n=5)  | ZD (n=6)                                  |
|  | paracetamol syrup for treatment of fever.<br>- One respondent said that she was informed by the vaccinator about next date of vaccination of her child. | about potential and minor side-effects after vaccination of a child | taken after vaccination of their children |

**Table A3:** Days of vaccine shortage by antigen from Jan'24 to Apr'25 by study areas

| District (geo-landscape) | Upazila/Zone (area) | Name of vaccine (in days*) |     |     |     |    |     |
|--------------------------|---------------------|----------------------------|-----|-----|-----|----|-----|
|                          |                     | Pentavalent                | PCV | IPV | OPV | MR | BCG |
| Noakhali (Coastal)       | Hatiya (Int.)       | 166                        | 163 | 122 | -   | -  | -   |
|                          | Subaranachar (Com.) | 110                        | 146 | 47  | 5   | -  | -   |
| Gaibandha (Char)         | Saghata (Int.)      | 129                        | 90  | 42  | 37  | -  | -   |
|                          | Fulchhari (Com.)    | 108                        | 174 | 67  | 17  | -  | -   |
| Sunamganj (Haor)         | Dowarabazar (Int.)  | 9                          | 122 | -   | 31  | -  | 65  |
|                          | Jamalganj (Com.)    | -                          | 86  | -   | 22  | -  | 21  |
| Sherpur (Plain)          | Nalitabari (Int.)   | 46                         | 106 | 29  | -   | 37 | -   |
|                          | Sreebordi (Com.)    | 46                         | 87  | -   | -   | 34 | -   |
| Rangamati (Hilly)        | Kawkhali (Int.)     | -                          | 40  | -   | -   | -  | 13  |
|                          | Sadar (Com.)        | -                          | -   | -   | -   | -  | -   |
| DNCC (Urban)             | Zone-5              | 23                         | 8   | -   | -   | -  | -   |

\* 290 working days

**Table A4:** Reasons for being ZD and UI among children aged 4.5-23 months in the baseline and endline surveys by area

| Reasons*                          | ZD           |         |            |         | UI           |         |            |         |
|-----------------------------------|--------------|---------|------------|---------|--------------|---------|------------|---------|
|                                   | Intervention |         | Comparison |         | Intervention |         | Comparison |         |
|                                   | Baseline     | Endline | Baseline   | Endline | Baseline     | Endline | Baseline   | Endline |
|                                   | n=143        | n=162   | n=102      | n=177   | n=768        | n=858   | n=706      | n=992   |
|                                   | %            | %       | %          | %       | %            | %       | %          |         |
| The child was sick                | 39.0         | 48.1    | 38.6       | 37.0    | 50.2         | 43.7    | 47.2       | 40.0    |
| Would give vaccine in future      | 18.0         | 41.3    | 15.5       | 29.8    | 16.9         | 45.3    | 19.0       | 35.9    |
| Was very busy                     | 22.0         | 32.5    | 20.2       | 24.7    | 21.8         | 30.8    | 25.4       | 31.5    |
| No permission from family members | 12.7         | 19.7    | 13.4       | 14.1    | 5.5          | 4.4     | 2.5        | 3.3     |
| Fearing side effects              | 36.8         | 19.6    | 27.3       | 28.3    | 18.1         | 6.8     | 14.0       | 5.7     |
| Vaccine shortage in the center    | 4.1          | 12.9    | 5.3        | 28.6    | 7.0          | 35.0    | 15.4       | 36.7    |
| Due to migration                  | 15.5         | 9.2     | 12.8       | 11.7    | 11.3         | 6.9     | 15.3       | 7.7     |
| Did not think it was important    | 11.8         | 5.2     | 10.3       | 12.7    | 2.0          | 0.8     | 3.2        | 0.7     |

| Reasons*  | ZD           |         |            |         | UI           |         |            |         |
|---|--------------|---------|------------|---------|--------------|---------|------------|---------|
|   | Intervention |         | Comparison |         | Intervention |         | Comparison |         |
|   | Baseline     | Endline | Baseline   | Endline | Baseline     | Endline | Baseline   | Endline |
|   | n=143        | n=162   | n=102      | n=177   | n=768        | n=858   | n=706      | n=992   |
|   | %            | %       | %          | %       | %            | %       | %          |         |
| Vaccination center was too far                          | 11.2         | 4.7     | 2.9        | 3.2     | 6.3          | 3.4     | 4.2        | 1.9     |
| The session time was inconvenient                       | 13.8         | 1.9     | 9.5        | 4.5     | 12.5         | 3.1     | 13.1       | 4.9     |
| *Multiple response<br>Note:                             |              |         |            |         |              |         |            |         |
| – Sorted by intervention area endline percentages of ZD |              |         |            |         |              |         |            |         |
| – Rest of the reasons were not shown due low percentage |              |         |            |         |              |         |            |         |

**Table A5:** Percentage of ZD and UI children who were not vaccinated due to illness on vaccination day by type of illness in all selected areas

| Type of illness*   | ZD    |      | UI    |  |
|--|-------|------|-------|--|
|  | n=143 |      | n=772 |  |
|  | %     |      | %     |  |
| Cold & Cough (lasted 7 days or more)   | 55.6  | 53.6 |       |  |
| Fever (102°F or above)   | 49.2  | 47.6 |       |  |
| Pneumonia  | 29.5  | 15.8 |       |  |
| Fever (less than 102 °F)   | 20.8  | 26.4 |       |  |
| Cold & Cough (lasted less than 7 days)   | 16.2  | 20.6 |       |  |
| Diarrhea   | 7.5   | 5.1  |       |  |
| Allergy/skin disease   | 4.7   | 3.7  |       |  |
| Others <sup>1</sup>  | 2.2   | 1.0  |       |  |
| *Multiple response<br><sup>1</sup> Convulsion, heart disease, injury, infection, nausea, malnutrition, pox, surgery<br>Note: |       |      |       |  |
| – Computed from endline survey data  |       |      |       |  |
| – Sorted by ZD percentages   |       |      |       |  |

**Table A6:** Behavioral and social drivers (BeSD) of vaccination among caregivers of ZD/UI and non-ZD/UI children aged 4.5-23 months by area

| Indicators   | ZD/UI        |         |            |         | Non-ZD/UI    |         |            |         |
|--|--------------|---------|------------|---------|--------------|---------|------------|---------|
|  | Intervention |         | Comparison |         | Intervention |         | Comparison |         |
|  | Baseline     | Endline | Baseline   | Endline | Baseline     | Endline | Baseline   | Endline |
|  | n=911        | n=1019  | n=808      | n=1169  | n=5451       | n=5440  | n=5586     | n=5346  |
|  | %            | %       | %          | %       | %            | %       | %          |         |
| Think vaccines are moderately or very important for child's health | 93.7         | 90.7    | 94.4       | 94.5    | 99.6         | 99.8    | 99.3       | 99.8    |
| Family members and friends want their child to be vaccinated       | 93.7         | 95.8    | 96.2       | 96.7    | 98.6         | 99.3    | 99.1       | 99.5    |
| Want their child to get all of the recommended vaccines            | 93.7         | 90.3    | 93.8       | 93.5    | 99.6         | 99.7    | 99.6       | 99.9    |

| Indicators  | ZD/UI        |             |            |             | Non-ZD/UI    |             |             |             |
|---|--------------|-------------|------------|-------------|--------------|-------------|-------------|-------------|
|   | Intervention |             | Comparison |             | Intervention |             | Comparison  |             |
|   | Baseline     | Endline     | Baseline   | Endline     | Baseline     | Endline     | Baseline    | Endline     |
|   | n=911<br>%   | n=1019<br>% | n=808<br>% | n=1169<br>% | n=5451<br>%  | n=5440<br>% | n=5586<br>% | n=5346<br>% |
| Know where to get their child vaccinated  | 97.3         | 99.3        | 99.2       | 98.7        | 99.5         | 99.4        | 99.5        | 99.7        |
| Think vaccination cost is moderately or very easy to pay  | 76.2         | 71.2        | 76.6       | 85.4        | 86.1         | 84.7        | 78.4        | 92.9        |
| Think vaccines are moderately or very safe for child  | 95.2         | 92.2        | 95.5       | 95.8        | 99.6         | 99.9        | 99.1        | 99.8        |
| Have moderate or much faith on the health workers who vaccinate their children  | 88.0         | 90.8        | 89.0       | 92.7        | 97.1         | 98.9        | 97.1        | 98.6        |
| Most parents, whom they know, will get their children vaccinated  | 97.7         | 98.8        | 98.2       | 98.4        | 99.1         | 99.4        | 99.1        | 99.7        |
| Their community leaders want their child to be vaccinated   | 98.7         | 90.7        | 99.5       | 87.1        | 99.3         | 94.6        | 99.3        | 89.8        |
| Health worker (HA, paramedics, vaccinators) recommended for vaccination of their children                                 | 55.4         | 75.4        | 56.8       | 72.5        | 75.4         | 90.9        | 77.9        | 84.0        |
| Had ever been contacted by a health worker (HA, FWA, paramedics, vaccinators) about their child being due for vaccination | 40.5         | 35.0        | 42.4       | 42.8        | 61.6         | 63.9        | 68.8        | 66.0        |
| Did not need permission to take child for vaccination   | 71.1         | 81.6        | 73.9       | 79.6        | 77.6         | 88.0        | 80.1        | 88.5        |
| Had ever personally taken their children to get vaccinated  | 88.9         | 89.7        | 90.0       | 92.9        | 95.7         | 98.4        | 96.0        | 97.8        |
| Had never been turned away for a child vaccination  | 77.1         | 65.6        | 73.4       | 65.8        | 85.2         | 73.2        | 85.6        | 82.0        |
| Thinks it is moderately or very easy to get child vaccination services  | 83.2         | 74.0        | 86.1       | 78.5        | 94.9         | 90.3        | 93.6        | 93.2        |
| <b>Hindrances in getting vaccination services*</b>  |              |             |            |             |              |             |             |             |
| – Nothing   | 66.4         | 71.3        | 64.2       | 75.9        | 82.2         | 87.2        | 77.3        | 90.3        |
| – Getting to the clinic (vaccination center) is hard  | 16.3         | 7.6         | 11.9       | 5.5         | 8.7          | 5.2         | 8.6         | 4.0         |

| Indicators  | ZD/UI        |             |            |             | Non-ZD/UI    |             |             |             |
|---|--------------|-------------|------------|-------------|--------------|-------------|-------------|-------------|
|   | Intervention |             | Comparison |             | Intervention |             | Comparison  |             |
|   | Baseline     | Endline     | Baseline   | Endline     | Baseline     | Endline     | Baseline    | Endline     |
|   | n=911<br>%   | n=1019<br>% | n=808<br>% | n=1169<br>% | n=5451<br>%  | n=5440<br>% | n=5586<br>% | n=5346<br>% |
| – Long waiting time in the clinics                              | 8.6          | 5.9         | 17.3       | 6.3         | 6.5          | 3.0         | 12.5        | 1.8         |
| – Inconvenient opening hours at the clinic (vaccination center) | 12.0         | 2.8         | 11.3       | 2.4         | 4.3          | 0.4         | 3.4         | 0.7         |
| – Sitting problem   | 5.6          | 4.0         | 7.5        | 2.5         | 4.8          | 1.9         | 6.0         | 1.2         |
| – The clinic sometimes turns people away without vaccinating    | 8.4          | 16.0        | 8.2        | 14.2        | 2.7          | 6.1         | 2.9         | 4.3         |
| Moderately or very satisfied with the vaccination services      | 86.2         | 78.8        | 86.3       | 80.1        | 97.6         | 94.1        | 97.0        | 96.2        |

\*Multiple response

Note: Rest of the responses for things that make hard to get vaccination services were not shown due to low percentage

## Annexure B: Report on human centered design (HCD)

Please click on the icon to open the online household survey questionnaire



Bangladesh Zero Dose HCD Report.pdf

## Annexure C: Description of the interventions

- 1. Training of service providers:** Training is a key component for service providers to update their knowledge about their job activities and responsibilities. We provided training to the Government of Bangladesh (GoB) and NGO field staff at our intervention areas. The objectives of this training were to provide orientation to those who are directly or indirectly involved in immunization programme on BCLH, ZD, UI, missed community, and interventions designed for reducing ZD and UI. Topics covered on the training encompassed: BCLH overview: sensitization on ZD, UI, and missed communities; process of identification of ZD, UI and missed communities; providing theoretical and practical training on interventions; how the identified ZD and UI children would be brought under immunization programme; and the responsibilities and duties of associated staff took place.

The training participants were Health Assistants (HAs)/ Vaccinators, Assistant Health Inspectors (AHIs), Health Inspectors (HIs), Medical Technologists (EPI), CHCPs, Sub-Assistant Community Medical Officers (SACMOs), Family Planning Inspectors (FPIs), Family Welfare Visitors (FWVs), Midwives, Nurses, Paramedics and Medical Officers (MOs). All participants from training appreciated the motto of the programme, that was ‘Leaving no-one behind with Immunization’.

- 2. Use of E-screening checklist** (except in DNCC): A major barrier to the effective implementation of EPI vaccination programme was the HR shortage (HAs/Vaccinators). To address this challenge, service providers who were not directly involved in vaccination programme but were engaged in health service delivery had involved in the study to identify ZD/UI children. The screening checklist was used to identify children who missed routine immunization. Caregivers, who visited a health facility for treatment, were asked about the immunization status of their children of eligible age (accompanying children and others at home). If a child was found ZD or UI, the child was referred to an EPI session or other facility where vaccination was available. Service providers recorded information of children in the E-screening checklist app which is linked with concerned HAs/ vaccinators. These apps were developed by icddr,b. Service providers working at the facility level such as CHCP, FWV, SACMO, and Midwives working at community clinic, Family Welfare Center (FWC) and Antenatal Care (ANC) corner of Upazila Health Complex (UHC) and local NGO clinics were using this app and supporting to identify ZD or UI children. An animation on the intervention “use of the e-Screening Checklist”, prepared by the BCLH team, is given in the link: [Link of animation on E-screening checklist](#) .
- 3. Modified EPI session schedule:** With the approval of study area health managers, alternative session schedule was introduced to make EPI sessions more efficient, accessible, and convenient. Modified EPI schedule was implemented as per the requirement of IR areas.
  - a. Evening sessions at urban areas:** In addition to the regular immunization, evening EPI sessions were being conducted to bring children under vaccination programme in urban sites. Evening

sessions were providing opportunities for urban working and other busy women to vaccinate their children. Vaccines and other logistics for the sessions were being sent from the concerned zone-level EPI storage in cold boxes the day before the session. The evening sessions were held at Sunibir Housing in Ward 30, Zone 5 of DNCC. The sessions were conducted every Thursday from 3:00 PM to 7:00 PM. BCLH created a short documentary on “Evening session” to highlight the effectiveness of this intervention. The video can be accessed at the following link: [Link of video on evening session](#).

- b. *Crash programme*: It was quite difficult for one vaccinator to reach out all children in HTR areas with a huge scattered population through a regular vaccination programme. Hence, supplementary immunization activities were being implemented in those areas such as crash programme. In the crash programme, the concerned authority of UHC arranged special day/days and HAs of respective upazilas visit to those areas with vaccines in vaccine carriers including other required logistics and provide vaccines to children. The crash programmes were held at Ghasiar Char, Harani union of Hatiya, Kalampati union of Kawkhali and Haldia union of Saghata, Rupnarayankura union of Nalitabari and Dohalia, Dowarabazar, Norshingpur and Pandargaon union of Dowarabazar.
- c. *Additional EPI session*: At the onset of the study, vaccination services at UHCs were limited, with immunization sessions held only one or two days a week. For instance, Nalitabari UHC initially conducted EPI sessions on just two days per week, while Hatiya UHC had only one designated vaccination day in each week. This limited schedule often resulted in mothers returning home without vaccinating their children while visiting on non-session days, which caused both time and financial burdens. In response, the sub-national committee decided to expand the EPI schedule. As a result, two additional EPI sessions were introduced at Nalitabari and one additional EPI session at Hatiya UHCs to enhance the opportunity of receiving vaccine.

In Kawkhali’s Fatikchhari Union (known as a HTR area), HAs were originally scheduled to visit each ward once a month. Recognizing the need for improved coverage, the sub-national committee approved one additional session per ward, resulting in a total of three extra sessions across the union. However, the consistent implementation of these sessions was challenged by factors such as natural calamities and occasional vaccine shortages, which hindered EPI session in this union.

4. **E-Tracker**: E-Tracker is one such digital-based tracking initiative for immunization in Bangladesh, and it uses the District Health Information System (DHIS)2 platform (18). The E-Tracker opened the possibility of tracking vaccination coverage, dropouts, and vaccination timeliness in a better way for EPI Bangladesh (18). The service provider had a TAB with an application which was used to register children along with other information, such as date of birth, address, gender, mobile phone number, vaccination history etc. The information was sent to server by the provider using TAB. The server generated unique ID automatically for each child for tracking for vaccination. However, within the scope of this study, the E-Tracker was implemented only in the DNCC among the IR sites. This is because the EPI Headquarters had to schedule training programmes for each district prior to the launch of the E-Tracker. Among the IR areas, training of trainers (TOT) were completed for Rangamati and Sherpur districts.
5. **Distribution of BCC materials**: BCC materials play a vital role in increasing awareness, improving knowledge, and promoting timely utilization of EPI services among caregivers and communities. The materials contain visual messages that help to present the content accurately. It

was used in this project, especially during interpersonal communication, advocacy meetings, courtyard meetings, the delivery of health education by CHCP, and group discussions. The sample copy of BCC materials are provided below:

**শিশুদের নিয়মিত টিকাদানের সময়সূচি**

| রোগের নাম   | টিকার নাম  | ডোজের সংখ্যা | ডোজের মধ্যে ন্যূনতম বিরতি | টিকা দেয়ার সঠিক সময়              | টিকাদানের স্থান             |
|---|--|--------------|---------------------------|------------------------------------|-----------------------------|
| শিশুদের যক্ষ্মা   | বিসিজি   | ১            | -                         | জন্মের পর                          | বাম বাহুর উপরের অংশে        |
| ডিফথেরিয়া, হুপিংকাশি, ধনুস্টংকার, হেপাটাইটিস-বি ও হিমোফাইলাস ইনফ্লুয়েঞ্জা-বি জনিত রোগ | পেন্টাভ্যালেন্ট টিকা (ডিপিটি হেপাটাইটিস-বি, হিব) | ৩            | ৪ সপ্তাহ                  | ৬ সপ্তাহ<br>১০ সপ্তাহ<br>১৪ সপ্তাহ | বাম উরুর মধ্যভাগের বহিরাংশে |
| নিউমোকোকাল নিউমোনিয়া   | পিসিডি   | ৩            | ৪ সপ্তাহ                  | ৬ সপ্তাহ<br>১০ সপ্তাহ<br>১৪ সপ্তাহ | ডান উরুর মধ্যভাগের বহিরাংশে |
| পোলিওমাইলাইটিস  | বিওপিডি  | ৩            | ৪ সপ্তাহ                  | ৬ সপ্তাহ<br>১০ সপ্তাহ<br>১৪ সপ্তাহ | মুখে                        |
|   | আইপিডি   | ২            | ৮ সপ্তাহ                  | ৬ সপ্তাহ<br>১৪ সপ্তাহ              | ডান বাহুর উপরের অংশে        |
| হাম ও বুবেলা  | এমআর টিকা  | ২            | -                         | ৯ মাস ও ১৫ মাস বয়স পূর্ণ হলে      | ডান উরুর মধ্যভাগের বহিরাংশে |

• জন্মের ১৪ দিনের মধ্যে বিওপিডি টিকার অতিরিক্ত ১ ডোজ দেয়া যেতে পারে যা OPV- শূণ্য ডোজ হিসেবে গণ্য করা হবে

*প্রচারের কান্ট্রি লার্নিং হাব ফর ইয়ুনাইজেশন ইকুইটি ইন বাংলাদেশ*

**শিশুদের ইপিআই টিকা বিষয়ক আতঙ্কহীনতা সচা**  
কারি মার্নিং হাব ফর ইয়ুনাইজেশন ইকুইটি ইন বাংলাদেশ

যদিও বাচ্চাদের সচেতন করা কঠিন হলে সম্প্রদায়িক টিকাদান কর্মসূচি বা ইপিআই: যা বেশে এবং বিশেষে ব্যাপকভাবে প্রদর্শিত হয়েছে। 'আপনার শিশুকে টিকা দিন' সম্প্রদায়িক টিকাদান কর্মসূচির এই আবেদনে সাড়া দিয়ে শতকরা ৮-১১ পাতালে শিশু সমাজের টিকা গ্রহণ করছে। যখন বেশি টিকা প্রতিরোধযোগ্য সংক্রমক রোগের প্রকোপ কমে গেছে এবং কিছু কিছু রোগ নির্মূল হয়েছে। তবে যেনে এখনো গ্রাম ১৬% শিশু সমাজকে ইপিআই টিকার পূর্ণ কোয়ালিটি টিকা থেকে বঞ্চিত রয়েছে। টিকার কভারেজ বৃদ্ধির জন্য বিভিন্ন মৌসুমি অধিবেশন করা হলেও গত এক দু' বছরে টিকার কভারেজ ১০-১৫ শতাংশের মধ্যেই সীমাবদ্ধ রয়েছে। ২০১০ সালের মধ্যে শিশু টিকার আওতার অর্জন করা সম্ভবিত্ত প্রচেষ্টা এবং সমগ্র সংশ্লিষ্ট অধিদপ্তর। আমরা দৃঢ়ভাবে বিশ্বাস করি আপনার বসিট মুম্বিকা আপনার এলাকার বাদ পড়া শিশুদের টিকাদানে অভিভাবকদের অনুপ্রেরণা যোগাবে। অভিভাবকদের টিকা সম্পর্কে জ্ঞান, উৎসাহ এবং তুল ধরনা দৃঢ় হবে এবং সকল শিশু ইপিআই টিকার আওতার অধীনে আসবে।

**ইপিআই কর্মসূচিতে শিশুদের টিকা নিয়ে প্রতিরোধযোগ্য রোগসমূহ:**

|               |                               |
|---------------|-------------------------------|
| ১। যক্ষ্মা    | ৬। হেপাটাইটিস-বি              |
| ২। কোলিও      | ৭। হিমোফাইলাস ইনফ্লুয়েঞ্জা   |
| ৩। ডিফথেরিয়া | ৮। হাম                        |
| ৪। হুপিংকাশি  | ৯। নিউমোকোকাল জনিত নিউমোনিয়া |
| ৫। ধনুস্টংকার | ১০। বুবেলা                    |

- সমসূচি অনুযায়ী সর্বশেষ টিকা নিলে শিশু উপরে বর্ণিত যারামুক্ত সংক্রমক রোগসমূহ হতে রক্ষা পাবে।
- সমসূচি অনুযায়ী টিকা না নিলে শিশুর মারাত্মক সংক্রমক রোগসমূহের বিরুদ্ধে রোগ প্রতিরোধ ক্ষমতা হেরি নাও হতে পারে।
- বিভিন্ন টিকার নির্দিষ্ট কোয়ালিটি অর্জনের পর পর দেয়া যায়। টিকা দেয়ার পর বিবিজি টিকার স্থানে (বাম বাহুর) বাসায়িকভাবে সন্মান্য থা হবে, এতে অতের কিছু নাই।
- শিশুকে আইপিডি টিকার দুই ডোজ টিকা দিতে হবে। ১ম ডোজ ৬ সপ্তাহ/৪২ দিন হলে এবং ২য় ডোজ ১৪ সপ্তাহ বয়সে দিতে হবে।
- শিশুর বয়স ৬ সপ্তাহ/৪২ দিন পূর্ণ হলে পেন্টাভ্যালেন্ট (ডিপিটি, হেপাটাইটিস-বি, হিব), ওপিডি এবং পিসিডি টিকার ১ম ডোজ দিতে হবে। তারপর কমপক্ষে ৪ সপ্তাহ/২৮ দিনের ব্যবধানে এ সকল টিকার ২য় এবং ৩য় ডোজ দিতে হবে।
- শিশুর বয়স ১০ মাসে পর্যন্ত/২৭০ দিন পূর্ণ হলে শিশুকে এমআর (হাম-বুবেলা) টিকার ১ম ডোজ এবং ১৫মাস বয়স পূর্ণ হলেই এমআর (হাম ও বুবেলা) টিকার ২য় ডোজ দিতে হবে।
- অনুষ্ঠ শিশুকে সাময়িকভাবে টিকা দেয়া যাবে না। তবে শিশু সুস্থ হওয়ার সাথে সাথে টিকা দিতে হবে এবং সমসূচি অনুযায়ী সর্বশেষ টিকা দেয়া শেষ করতে হবে।
- টিকা দিলে সামান্য জ্বর, টিকার স্থানে ব্যথা এবং টিকা দেয়ার স্থান পামড়িকভাবে শক্ত হতে পারে, এতে অতের কিছু নেই।

**ইপিআই কর্মসূচিতে প্রতিরোধযোগ্য রোগসমূহ**

| রোগের নাম                   | ভার্যবল  | প্রতিরোধ  |
|-----------------------------|--|---|
| যক্ষ্মা                     | সময়মতো সঠিক ডিক্রিসনা না করলে অক্রান্ত শিশুর মৃত্যুও হতে পারে   | প্রতিরোধ রোগের পালপাই বিবিজি টিকা দিয়ে শিশুকে রক্ষা রোগ থেকে রক্ষা করা যায়।   |
| পোলিওমাইলাইটিস              | এ রোগে শিশুর এক বা একাধিক অঙ্গ অবশ হয়ে যায়। ফলে অক্রান্ত অঙ্গ দিয়ে শিশু ব্যক্তিকিক কাজ করতে পারে না। পরবর্তীতে অক্রান্ত অঙ্গের মাংসেশী পুষ্টিয়ে যায়। শ্বাস-প্রশ্বাসের পেশী অঙ্গ হলে শ্বাস বন্ধ হতে শিশু মারাও যেতে পারে।                      | দিনে কোয়ালিটি টিকা খাওয়াতে এবং দুই ডোজ আইপিডি টিকা নিলে তা শিশুকে পোলিও রোগ থেকে রক্ষা করে।   |
| ডিফথেরিয়া                  | এ রোগের জীবাণু হৃৎপিণ্ড এবং মস্তিষ্ককে আক্রান্ত করতে পারে এবং শিশুর মৃত্যুও ঘটতে পারে।   |   |
| হুপিংকাশি                   | হুপিংকাশির ফলে শিশু দুর্বল হয়ে যায় এবং অপুষ্টিতে ভোগে। শিশুর নিউমোনিয়া হতে পারে। রক্ত জমাট বেঁধে শিশুর চোখে সমস্যা দেখা দিতে পারে। শিশুর মস্তিষ্কের ব্যতি হতে পারে।   |   |
| ধনুস্টংকার                  | যে সকল কারণে শিশুর মৃত্যু হয় এর মধ্যে ধনুস্টংকার অন্যতম প্রধান একটি কারণ। এই রোগে অক্রান্ত নবজাতক ও শিশুরা বেশিরভাগ ক্ষেত্রেই মারা যায়।  | দিনে কোয়ালিটি টিকা (১ম ডোজ ৬ সপ্তাহে, ২য় ডোজ ১০ সপ্তাহে এবং ৩য় ডোজ ১৪ সপ্তাহে) দিয়ে শিশুকে এ সকল রোগ থেকে রক্ষা করা যায়।                                 |
| হেপাটাইটিস-বি               | হেপাটাইটিস-বি ভাইরাসে আক্রান্ত শিশুদের মধ্যে শতকরা ৯০ ভাগ হেপাটাইটিস-বি ভাইরাসের ধীরেধীরে ব্যক্ত হিলাবে কাজ করে এবং ৯০ ভাগের মধ্যে শতকরা ১৫-২৫ ভাগ লিভার সিরাইসিস ও লিভার ক্যান্সারের কারণে মৃত্যুর মুখে পতিত হয়।                                 |   |
| হিমোফাইলাস ইনফ্লুয়েঞ্জা-বি | সময়মতো সঠিক ডিক্রিসনা না করলে এ রোগে আক্রান্ত শিশু হতে পারে এমনকি শিশুর মৃত্যুও হতে পারে।   |   |
| হাম                         | হাম হলে শিশু নিউমোনিয়া, ডাফথেরিয়া ও পুষ্টিহীনতায় ভুগতে পারে। কান শব্দ পাওয়া হতে পারে। শিশুর রক্তকণা রোগ দেখা দিতে পারে: এমনকি জ্বর হতে যেতে পারে। হামের নানা জটিলতার কারণে শিশু মারাও যেতে পারে।   | শিশুর বয়স ৯ মাস বয়স পূর্ণ হলে এক ডোজ এমআর (হাম-বুবেলা) টিকা এবং ১৫ মাস বয়স পূর্ণ হলে হামের ২য় ডোজ টিকা দিয়ে শিশুকে হাম ও বুবেলা রোগ থেকে রক্ষা করা যায়। |
| বুবেলা                      | ধর্মনী মারেরা ঘরি বুবেলা রোগে আক্রান্ত হয় তাহলে শিশুর শিশু মারাত্মক জটিলতা বা অক্ষমতা হ্রাস নিলে জন্মগ্রহণ করতে পারে। বৈকল্য, বধির, চোখের হ্রাস, হৃৎপিণ্ডের জটিলতা এবং ম-সিসি প্রভৃতি বিধাত ইয়াই। যাকে ক্রেনিটাল বুবেলা সিনড্রম (সিয়ারসেস) বলে। |   |
| নিউমোকোকাল নিউমোনিয়া       | সময়মতো সঠিক ডিক্রিসনা না করলে এ রোগে আক্রান্ত শিশু মৃত্যু হতে পারে। এমনকি শিশুর মৃত্যুও হতে পারে।   | দিনে কোয়ালিটি টিকা দিয়ে শিশুকে এ রোগ থেকে রক্ষা করা যায়।   |

*প্রচারের কান্ট্রি লার্নিং হাব ফর ইয়ুনাইজেশন ইকুইটি ইন বাংলাদেশ*

Area-specific interventions implemented across selected IR areas

- 6. Advocacy with community leaders (Saghata and Kawkhali):** Community participation and social support are inevitable for social mobilization. Prior to commencing study activities, we searched for community leaders and influential individuals such as union parishad chairman, religious leaders, teachers, social workers and NGO workers. Advocacy meetings were held at the study areas with them. The EPI staff of concerned UHC provided them with information on benefits of vaccination of children, consequences of ZD, UI and motivated them to support the EPI programme to reduce ZD and UI children from their communities. At least one advocacy meeting was initially planned to be conducted in each union of Saghata and Kawkhali within the three months. However, due to the involvement of HAs in other activities, such as vaccination campaigns, later on the meetings were organized within six months.
- 7. Strengthen EPI support groups (Dowarabazar):** A community support group was established to support ongoing activities at community clinics. We leveraged assistance from this group to bolster the EPI programme. The functions of the groups were: community awareness and advocacy about immunization to ZD children, necessary orientation to the groups about their function, the importance of immunization for ZD children, the importance of completion of all doses of vaccines. One CHCP was assigned to conduct at least one EPI support group meeting in every three months focusing on ZD and UI children. On an average 15~20 participants attended the EPI support group meetings.
- 8. Involvement of existing NGO community worker (Kawkhali):** In Bangladesh, the number of vacant positions of field staff (HA) is very high. Hence, the workload for the HAs is huge due to lack of manpower. Therefore, we involved existing NGO workers to support HAs in this regard. We included para kormi who were engaged in Chattogram Hill Tracts Rural Development project (funded by the GoB and UNICEF. These para kormi were quite familiar with the local residents and involved in various activities since they have been working in these areas for a long time. They were trained and involved to motivate the local people to get their children for vaccination.
- 9. Health education through CHCP (Hatiya):** CHCP provided counselling or health education at the community clinic on mother's health, neonatal and child health, nutrition (nutrition education and nutrition unit supply), identifying the non-contagious diseases, and referrals, symptom-based treatment for contagious diseases—limited treatment services. We trained the CHCP of study sites to hold education sessions at community clinics with pregnant and recently delivered women to inform them about benefits of vaccines and motivate them to vaccinate their children. These health education sessions took place on a regular basis by the CHCPs at community clinics. There was a total of 41 CHCPs in Hatiya. Each CHCP was assigned to conduct at least two health education sessions in every three months.
- 10. E-supervision checklist (Hatiya):** We have developed an online base e-supervision checklist for EPI supervisors to ensure field visit. The supervisors of HAs used this app when they visit to EPI center for supervision where they record the number of target children, number of vaccinated child (by antigen) and reason of not filling the target of that session. E-supervision checklist data was monitored through the project dashboard, developed by icddr,b. Study investigators from BCLH team and GoB higher authorities at the district and upazila level could see the updated status.
- 11. Courtyard meeting with mother of the newborn, child's caregiver (Nalitabari):** Courtyard meetings were conducted to enhance awareness on child immunization among the caregivers. The participants of these meetings were- the mother of the newborn, grandparent, child's caregiver, or

other elderly family personnel. In this courtyard meeting, vaccinators discuss the benefits of vaccination, vaccine schedule for the child and related topics. At least one courtyard meeting per month was planned to be conducted in each union of Nalitabari focusing on missed communities. On an average 10~12 caregivers participated each courtyard session.

- 12. Community engagement (DNCC):** Community engagement at urban areas plays a vital role in the successful vaccination of children. Recognizing this, efforts had made to foster community support through community engagement meetings with influential local leaders. These meetings aimed to enhance social mobilization at urban areas. Through these meetings, stakeholders collaborated to promote the importance of child vaccination within the community, encouraging participation and ensuring widespread immunization coverage. The meeting was organized by vaccinators, supervisors of DNCC and paramedics, clinic managers of NGO clinics. The participants were Ward Counselor, Imam, Land Lord, Slum Manager, Teacher, NGO worker, Pharmacist etc.
  
- 13. Health education through NGO counsellors (DNCC):** NGO counsellors are responsible at their clinics to counsel clients on reproductive, maternal, newborn, and child health. We engaged those counsellors to conduct health education sessions on child immunization with pregnant women and mothers having children aged less than 2 years. The aim of this session was to educate caregivers on the importance of vaccines and encourage them to vaccinate their children in time. The partner NGOs were- Surjer Hashi Network (SHN), FACES, AITAM Hospital and St. John Vianney Hospital. Prior to implementation of this intervention, these NGO counsellors were trained on child immunization.

#### **Annexure D: Endline household survey questionnaire**

Please click on the icon to open the endline household survey questionnaire



(English) Endline  
HH survey Questionnaire

## **Annexure E: Impact evaluation of the interventions**

We evaluated at the client level which included surveys before and after implementation of interventions in intervention and comparison areas. A four-cell (intervention-nonintervention and pre-post comparison) study design was proposed for assessment of the intervention effects. The indicators compared at before and after implementation including coverage of pentavalent 1st, 2nd and 3rd doses, number of ZD children, and factors influencing the decision to vaccinate/not vaccinate children. The baseline also measured the status of identification of ZD children whereas the endline measured perceptions (satisfied/not satisfied) of respondents about the services they received from the providers in vaccinating their children and the acceptability of the approaches applied for vaccination of their children.

### *Sample selection process for impact evaluation of IR study*

As stated, the study population were the caregivers of children aged 4.5-23 months and the primary outcomes are the prevalence of ZD and UI children.

Although EPI service delivery differs between rural and urban areas, the study design, the sampling design and enumeration of households with children aged 4.5-23 months were similar in both areas.

### **Sample size**

We applied the World Health Organization (WHO) - recommended cluster sampling methodology for this study. The required sample size for each area was 1150 considering 6% prevalence of ZD, 5% significance level, 80% power, a design effect of 1.58 (according to WHO vaccination coverage cluster surveys: reference manual) and 10% non-response rate. Overall, we needed to interview a total of 13,800 (=1150\*12) eligible respondents from the selected 12 areas per household survey. Because the rapid assessment had shown that the number of ZD children in hilly and urban areas might be less than the needed sample size, a 'take all' procedure was used in these areas.

### **Sample selection process for rural areas**

#### *Sampling design and sampling frame*

A stratified two-stage random cluster sampling design was followed to minimize travel time and costs of conducting the survey. An updated list of EPI outreach centers is available in each UHC and was considered as the sampling frame for primary sampling units (PSUs).

#### *Selection of PSUs*

Each upazila (sub-district) has an average of about 200 EPI clusters. In first stage, we systematically selected 75 clusters from each upazila following the procedure of the CES 2019 (1). These 75 clusters were chosen using systematic sampling to cover all unions (the lowest administrative unit) within each upazila.

#### *Selection of Households*

A household enumeration operation was conducted in each selected cluster (catchment area of EPI outreach center) for segmentation before household interview. The clusters having more than 150 households were segmented into segments of 75 households each. Afterwards, a segment from that cluster was randomly chosen and all households within a segment with children aged 4.5-23 months were interviewed. The supervisor on a daily basis observed field workers in order to ensure no households were missed from the interview. If any selected segment/cluster contained fewer than 15

eligible children, we randomly chose another segment and interviewed the nearest eligible respondents until 15~16 interviews were completed. We interviewed up to 18 households in the clusters where the number of eligible children were more than 15 and hence marked that PSU enabling the opportunity to get the required sample size for the respective area.

### Sample selection process in urban area

In urban areas, slum areas from each selected ward of zone-5 of DNCC were purposively chosen for both intervention and comparison areas on the basis of population density, size of the slums, EPI performance and consultation with EPI stakeholders (**Table E1**). A complete household listing operation was conducted in selected study areas. Since the number of eligible households were fewer than required sample size, we followed “take-all” criteria in selecting households in urban slum and hilly areas for interviewing caregivers of children aged 4.5-23 months. As most of mothers in slum areas were unavailable during day time due to work, to minimize non-response, the interview sessions were conducted at two different times- four days a week from 9 am to 3 pm and two days a week from 3 pm to 8 pm.

**Table E1:** Selected slums for urban areas

| Interventions   |   | Comparison  |
|---|---|---|
| Ward 26   | Ward 30   | Ward 33   |
| <ul style="list-style-type: none"> <li>- Railway Colony Slum, Kawran Bazar</li> <li>- Kawran Bazar Christian Area</li> <li>- Kawran Bazar (Fish Market)</li> <li>- Elenbari Slum, Kawran Bazar</li> <li>- Karkhana (Factory) Lane Slum, Kawran Bazar</li> <li>- Tejtury Bazar, Farmgate</li> <li>- Garden Road- 27, Farmgate</li> </ul> | <ul style="list-style-type: none"> <li>- Shekhertech, Mohammadpur</li> <li>- Adabar, Mohammadpur</li> <li>- Sunibir Housing, Mohammadpur</li> </ul> | <ul style="list-style-type: none"> <li>- Dhaka Udyan Housing, Mohammadpur</li> <li>- Chand Udyan (Garden), Mohammadpur</li> <li>- Chandrima Udyan, Mohammadpur</li> <li>- Sonamiarteki Slum, Mohammadpur</li> <li>- Ashi katha Slum, Mohammadpur</li> </ul> |

### Recruitment and training of field staff

According to icddr,b’s HR policy, we recruited field staff (Supervisors and data collectors) to conduct the household surveys. A week-long training was arranged prior to data collection during which the trainees were familiarized with the study objectives, consent process, data collection tools, data collection, and ensuring the quality of data. The training was conducted by study investigators. A field test of the questionnaire was also done during training.

### Data collection for impact evaluation

We designated a team consisting of three data collectors, along with a total of three teams and two supervisors (one assigned to each sub-district) at each of the five IR rural districts. Two teams with one supervisor, were assigned at the DNCC. The supervisors and data collectors were expert in immunization and conducting survey.

We used a survey questionnaire to collect information via in-person interview. The questionnaire was translated to Bengali. The survey questionnaire was pilot tested prior to data collection. The informed consent and script documents were available in paper form. Informed consent for data collection was taken and respondents signed a hard copy before interview. Data were entered into a cloud-based system

called KoboToolbox using TAB. The hardcopy of the household survey questionnaire attached in [Annexure D](#).

### **Monitoring of data collection**

Several steps were taken to ensure data quality. First, the data collectors checked their own completed survey questionnaire to cross check any typing error, missing information or inconsistency in responses. The Field Research Assistants (FRAs) solved identified issues (if any detected) immediately during the review process. The FRAs contacted respondents over the phone to correct/confirm their responses if it was necessary. Afterwards, the Field Research Officers (FROs) rechecked the survey questionnaire for any inconsistencies. Data were later uploaded by FRAs to the KoboToolbox server. Two individuals were designated to ensure regular data quality checks and provide feedback to field staff. The investigators also rechecked collected data from the KoboToolbox server and documented any inconsistency using a Microsoft Excel based reference/inquiry form.

We shared weekly data collection progress among the research teams. The data collection progress and related issues were also discussed in bi-weekly meetings with investigators of the research team. The study investigators also visited the field and check data collection to ensure data quality.

### **Data Analysis for impact evaluation**

Data cleaning and analysis were conducted once data collection ended. We applied separate sampling weights to each of the dataset to adjust for the differences in cluster and household selection probabilities in each upazila. Field supervisors were instructed to fill up a form in KoboToolbox where they provided the number of clusters in each upazila, total number of households, segments and completed interviews in each cluster. Using this information, we calculated base weight and normalized weight at household level for each upazila.

The prime outcomes of the study were ZD and UI. ZD was measured as having missed the first dose of Penta vaccine whereas UI was measured as having missed the third dose of Penta vaccine.

We considered two age-groups - children aged 4.5-<12 months and 12-23 months. The respondents were asked to show their EPI cards for the record of vaccination status. If the card was unavailable during the interview, information related to vaccination status was collected verbally from the respondents. Crude vaccination (age appropriate vaccination by card or history) and valid vaccination coverage (relying on card only) for each specific antigen were also assessed in this study. Comparison between crude and valid coverage enabled us to estimate the percentage of children who get the vaccines on time. FVC was reported in the study by calculating the percentage of children aged 12-23 months who took Bacillus Calmette-Guérin (BCG), 3 doses of Penta, 3 doses of Oral Polio Vaccine (OPV), 3 doses of Pneumococcal Conjugate Vaccine (PCV) and 1<sup>st</sup> dose of Measles Rubella (MR). Dropout rates for Penta1-Penta 3 and Penta1-MR1 were calculated as well. A child who received Penta 1 vaccine but did not return for Penta3 was considered as dropout from Penta1 to Penta3. Similarly, a child who received Penta1 but did not return for MR1 was considered a Penta1-MR1 dropout. A vaccine dose was considered invalid if it was administered earlier than the minimum age recommended, or earlier than the minimum interval since the previous dose in the vaccine series. The drop-out rate was calculated as:

$$\text{Dropout Penta1 – Penta3} = \frac{\text{Coverage of Penta1} - \text{coverage of Penta3}}{\text{Coverage of Penta1}} \times 100\%$$

$$\text{Dropout Penta1} - \text{MR1} = \frac{\text{Coverage of penta1} - \text{coverage of MR1}}{\text{Coverage of MR1}} \times 100\%$$

Several characteristics of respondents and their families such as age, sex, birth order, education, occupation, residence, duration of residence, number of children, monthly family income, monthly family expenditure, asset information, land ownership, house ownership, and wealth quintile were incorporated in the study as covariates as suggested by literature review. Indicators on knowledge, attitudes and practice (KAP) related to child immunization were based on WHO and UNICEF behavioral and social driver (BeSD) guidelines. Similarly, reasons for not receiving vaccines stated by the caregivers of ZD children and suggestions to increase vaccination rate were documented in this study as well.

For bivariate analysis, we used chi-square tests to measure the association of the outcome variables- ZD and ZD/UI with each covariate. Binary logistic regression was used for each outcome (ZD and ZD/UI) to estimate the net effect of the covariates on the outcome variable adjusting for clustering effect. Difference-in-Differences (DID) method was applied to estimate the intervention effect on ZD/UI comparing pre-post and intervention-comparison group. Analysis was conducted using STATA software (version 15).

## Annexure F: Process evaluation of the interventions

We conducted a process evaluation to determine whether programme activities had been implemented as intended and resulted in certain outputs. For the process evaluation, data were collected through in-depth interviews (IDIs) with caregivers of ZD, UI and FVC children, key informant interviews (KIIs) with district and sub-district level managers and focus group discussion (FGD) with frontline service providers.

### Study participants

Participants of IDIs were selected purposively based on their child's immunization status, i.e. caregiver of ZD, UI and FVC children. Participants of KIIs and FGDs of this study were selected purposively based on their roles in the program activities, participation and knowledge about the programme so that they can provide us with a real understanding of the needs, potentials, solutions and recommend feasible ways for improvement of the programme. The list of participants in qualitative components are available in **Table F1**. Data were collected on perceptions of service providers on the interventions, effectiveness of the interventions and respondent's recommendation about modification/strengthening of the interventions.

**Table F1:** Participants of qualitative component

| Tools   | Participants   | Number of interviews/sessions |
|---|--|-------------------------------|
| IDIs<br>(Total 17)  | Caregiver of ZD child (All 6 IR areas)   | 06                            |
|   | Caregiver of UI child (All IR areas except Gaibandha)  | 05                            |
|   | Caregiver of FVC child (All 6 IR areas)  | 06                            |
| KIIs<br>(Total 21)  | Civil Surgeon (Noakhali & Rangamati)   | 02                            |
|   | Assistant Health Officer (AHO), DNCC   | 01                            |
|   | Upazila Health & Family Planning Officer (UH&FPO), Dowerabazar, Kawkhali, Nalitabari & Saghata | 04                            |
|   | Surveillance & Immunization Medical Officer-(SIMO), Gaibandha                                  | 01                            |
|   | Medical Officer-Disease Control (MO-DC), (Hatiya, Noakhali)                                    | 01                            |
|   | District EPI Superintendent (Noakhali)   | 01                            |
|   | Medical Technologist -EPI, (MT-EPI) (Dowerabazar, Hatiya & Nalitabari)                         | 03                            |
|   | EPI Supervisor (DNCC)  | 02                            |
|   | Clinic Manager (DNCC)  | 02                            |
| Health Inspector (HI) (Dowerabazar, Kawkhali, Nalitabari & Saghata) | 04   |                               |
| FGDs<br>(Total 12 sessions)   | FGD with HAss/Vaccinators (06 IR areas)  | 06 sessions                   |
|   | FGD with CHCP/Para Karmi/FWA/ FWV (All IR areas Except DNCC)                                   | 05 sessions                   |
|   | FGD with Assistant Health Inspector (Hatiya, Noakhali)   | 01 sessions                   |

### Data collection for process evaluation

A team of data collectors was comprised of four researchers with Anthropology background and well experienced in qualitative data collection. Intensive training for four days before commencing data collection was provided to the data collectors. They received training on details about the interventions. They also received training on qualitative research methods and data collection techniques.

Semi-structured interview guidelines were developed and used to conduct IDIs, KIIs and FGDs. The interview guidelines were developed by reviewing inception report of BCLH, manuals on interventions and relevant literature. Before commencing final data collection, mock interviews were conducted among the team members. Finally, data collection was started in December 2024 and continued till March 2025. The interviews were conducted at the participants' convenient time and place.

### **Data Analysis for process evaluation**

After transcribing data, content analysis method was employed. The data collection process followed: firstly, the transcripts were read to become familiar with the data. After rigorous reading, coding was done. Secondly, the codes were compiled and code books were prepared for each of used tool. After developing code book, the team reviewed it and updated the code book. Thirdly, coding units were formed from code books and thematic categories were found out based on coding units. Finally, the thematic categories were identified and summarized the data.

### **Ethical assurance for the protection of human rights**

Respondents were interviewed after they provided their written consent. Utmost efforts were made to ensure that all respondents were properly informed about the study and thoroughly understood what their participation involved. This study was approved by the Ethical Review Committee (ERC) of icddr,b.

## Annexure G: Survey coverage and background characteristics

**Table G1** presents the number of interviews conducted with the caregivers of children aged 4.5-23 months in the baseline and endline surveys in six intervention and six comparison areas across six geographical landscapes. A sample of 12,756 caregivers (n=6,362 in the intervention areas and n=6,394 in the comparison areas) were interviewed in the baseline survey, and 12,974 caregivers (n=6,459 in the intervention areas and n=6,515 in the comparison areas) in the endline survey. The target number of interviews (n=1,150) were achieved in each geo-landscape, except in the urban slum and hilly geo-landscapes upazilas.

**Table G1:** Number of completed interviews with the caregivers of children aged 4.5-23 months in the intervention (Int.) and comparison (Com.) areas in the baseline and endline surveys by geo-landscape

| Geo-landscape | District/City Corporation | Upazila / Zone (area)        | Number of interviews |               |
|---------------|---------------------------|------------------------------|----------------------|---------------|
|               |                           |                              | Baseline             | Endline       |
| Haor          | Sunamganj                 | Dowarabazar (Int.)           | 1189                 | 1184          |
|               |                           | Jamalganj (Com.)             | 1160                 | 1174          |
| Char          | Gaibandha                 | Saghata (Int.)               | 1152                 | 1164          |
|               |                           | Fulchhari (Com.)             | 1164                 | 1159          |
| Coastal       | Noakhali                  | Hatiya (Int.)                | 1191                 | 1160          |
|               |                           | Subarnachar (Com.)           | 1190                 | 1177          |
| Hilly         | Rangamati                 | Kawkhali (Int.)              | 1042                 | 945           |
|               |                           | Rangamati sadar (Com.)       | 1065                 | 1067          |
| Plain         | Sherpur                   | Nalitabari (Int.)            | 1195                 | 1170          |
|               |                           | Sreebordi (Com.)             | 1172                 | 1171          |
| Urban         | DNCC                      | Zone-05, ward-26 & 30 (Int.) | 593                  | 836           |
|               |                           | Zone-05, ward- 33 (Com.)     | 643                  | 767           |
| <b>Total</b>  |                           | <b>Intervention</b>          | <b>6,362</b>         | <b>6,459</b>  |
|               |                           | <b>Comparison</b>            | <b>6,394</b>         | <b>6,515</b>  |
|               |                           | <b>All</b>                   | <b>12,756</b>        | <b>12,974</b> |

Several background characteristics of caregivers showed small but statistically significant changes between the baseline and endline surveys, particularly in the comparison area (**Table G2**). The percentage of caregivers in the upper age groups was lower at baseline than endline in each area. As expected, great majority of the caregivers were female in both the intervention and comparison areas. Caregivers with no education were fewer (10.0% vs 6.4%) between baseline and endline and a similar significant pattern was noticed in the comparison area (baseline:10.2%, endline:7.1%).

Household characteristics, especially socio-economic characteristics and proximity, also showed positive changes between baseline and endline. In the intervention area, the proportion of households in higher wealth quintile increased over time (18.5% to 20.1%), while in the comparison area, households in the lowest quintile rose sharply (16.1% to 29.1%), indicating a difference in economic pattern between the study areas. Additionally, an increase in the percentage of the lowest quintile, which can be attributed to the inclusion of coastal, hilly and haor areas (shown in [Additional Table I.1](#)). The average income of these households ranged from Bangladeshi Taka (BDT) 10000 to BDT 19999, whereas average monthly expenditure stood between BDT 10000 to BDT 14999. More than 89% of the respondents said that the nearest EPI centre was located less than a kilometre away from their residents living in both study areas. Additionally, there was significant change in distance between household

and EPI center between baseline and endline in both areas. Around three-fifths of the children in the intervention and comparison areas were 12-23 months old.

**Table G2:** Socio-demographic characteristics of caregivers and their children aged 4.5-23 months by area

| Background characteristics       | Intervention |         |         | Comparison |         |         |
|----------------------------------|--------------|---------|---------|------------|---------|---------|
|                                  | Baseline     | Endline | p-value | Baseline   | Endline | p-value |
|                                  | n=6362       | n=6459  |         | n=6394     | n=6515  |         |
|                                  | %            | %       | %       | %          |         |         |
| <b>Caregiver characteristics</b> |              |         |         |            |         |         |
| <b>Age (in years)</b>            |              |         |         |            |         |         |
| 18-24                            | 45.8         | 45.7    | 0.266   | 44.1       | 44.8    | 0.020   |
| 25-34                            | 40.3         | 41.7    |         | 42.1       | 42.6    |         |
| 35-44                            | 11.1         | 10.4    |         | 10.7       | 10.8    |         |
| 45+                              | 2.8          | 2.3     |         | 3.1        | 1.8     |         |
| <b>Gender</b>                    |              |         |         |            |         |         |
| Male                             | 4.6          | 2.6     | <0.001  | 4.2        | 2.1     | <0.001  |
| Female                           | 95.4         | 97.4    |         | 95.8       | 97.9    |         |
| <b>Education</b>                 |              |         |         |            |         |         |
| No education                     | 10.0         | 6.4     | <0.001  | 10.2       | 7.1     | 0.032   |
| Primary incomplete               | 19.3         | 20.0    |         | 20.8       | 22.2    |         |
| Primary complete                 | 15.6         | 15.3    |         | 15.7       | 16.5    |         |
| Secondary incomplete             | 35.0         | 35.8    |         | 33.1       | 33.4    |         |
| Secondary complete or higher     | 20.0         | 22.4    |         | 20.1       | 20.7    |         |
| Informal education (hafizi)      | 0.1          | 0.1     |         | 0.1        | 0.1     |         |
| <b>Occupation</b>                |              |         |         |            |         |         |
| Household chores                 | 92.3         | 93.9    | 0.012   | 90.4       | 92.5    | 0.001   |
| Service/business/ worker         | 7.1          | 5.9     |         | 8.5        | 7.3     |         |
| Not working/ disabled/ student   | 0.6          | 0.3     |         | 1.0        | 0.3     |         |
| <b>Marital status</b>            |              |         |         |            |         |         |
| Married                          | 98.9         | 99.0    | 0.702   | 98.9       | 99.2    | 0.059   |
| Others <sup>1</sup>              | 1.1          | 1.0     |         | 1.1        | 0.8     |         |
| <b>Religion</b>                  |              |         |         |            |         |         |
| Islam                            | 85.8         | 88.2    | 0.319   | 84.8       | 85.2    | 0.883   |
| Others <sup>2</sup>              | 14.2         | 11.8    |         | 15.2       | 14.8    |         |
| <b>Ethnicity</b>                 |              |         |         |            |         |         |
| Bengali                          | 88.5         | 90.7    | 0.342   | 90.6       | 91.2    | 0.770   |
| Others <sup>3</sup>              | 11.5         | 9.3     |         | 9.4        | 8.8     |         |
| <b>Relationship with child</b>   |              |         |         |            |         |         |
| Mother                           | 93.0         | 94.9    | 0.002   | 92.5       | 95.7    | <0.001  |
| Father                           | 3.5          | 2.4     |         | 3.6        | 1.9     |         |
| Grandmother                      | 2.6          | 2.2     |         | 2.7        | 1.9     |         |
| Others <sup>4</sup>              | 0.9          | 0.5     |         | 1.2        | 0.5     |         |
| <b>Household characteristics</b> |              |         |         |            |         |         |

| Background characteristics   | Intervention |         |         | Comparison |         |         |
|--|--------------|---------|---------|------------|---------|---------|
|  | Baseline     | Endline | p-value | Baseline   | Endline | p-value |
|  | n=6362       | n=6459  |         | n=6394     | n=6515  |         |
| %  | %            | %       | %       |            |         |         |
| <b>Number of family member</b>   |              |         |         |            |         |         |
| <5   | 35.9         | 35.0    | 0.739   | 35.6       | 34.4    | 0.736   |
| 5-10   | 61.4         | 62.5    |         | 61.2       | 62.6    |         |
| >10  | 2.7          | 2.5     |         | 3.2        | 3.0     |         |
| <b>Monthly income</b>  |              |         |         |            |         |         |
| < Tk. 10000  | 11.1         | 2.0     | <0.001  | 8.6        | 1.7     | <0.001  |
| Tk.10000-Tk.14999  | 26.8         | 19.5    |         | 25.6       | 17.3    |         |
| Tk.15000-Tk.19999  | 25.5         | 30.9    |         | 26.3       | 30.1    |         |
| Tk.20000- Tk.25000   | 20.1         | 28.6    |         | 22.9       | 28.4    |         |
| > Tk. 25000  | 16.5         | 19.1    |         | 16.7       | 22.5    |         |
| <b>Monthly expenditure</b>   |              |         |         |            |         |         |
| < Tk. 10000  | 18.1         | 4.9     | <0.001  | 16.4       | 3.5     | <0.001  |
| Tk.10000-Tk.14999  | 33.5         | 26.7    |         | 31.7       | 24.2    |         |
| Tk.15000-Tk.19999  | 24.6         | 32.7    |         | 26.3       | 32.5    |         |
| Tk.20000- Tk.25000   | 16.1         | 25.5    |         | 18.3       | 26.1    |         |
| > Tk. 25000  | 7.6          | 10.3    |         | 7.4        | 13.6    |         |
| <b>Wealth quintile</b>   |              |         |         |            |         |         |
| Lowest   | 29.1         | 32.1    | 0.059   | 16.1       | 29.1    | <0.001  |
| Second   | 15.5         | 10.3    |         | 22.0       | 12.8    |         |
| Middle   | 18.3         | 18.4    |         | 20.6       | 20.8    |         |
| Fourth   | 18.6         | 19.1    |         | 21.3       | 19.2    |         |
| Highest  | 18.5         | 20.1    |         | 20.0       | 18.1    |         |
| <b>Distance to EPI centre</b>  |              |         |         |            |         |         |
| <=1 kilometer  | 89.2         | 94.9    | <0.001  | 94.8       | 90.0    | 0.015   |
| >1 kilometer   | 10.8         | 5.1     |         | 5.2        | 10.0    |         |
| <b>Child characteristics</b>   |              |         |         |            |         |         |
| <b>Child's gender</b>  |              |         |         |            |         |         |
| Male   | 50.6         | 51.7    | 0.227   | 50.7       | 51.8    | 0.288   |
| Female   | 49.4         | 48.3    |         | 49.3       | 48.2    |         |
| <b>Child's age</b>   |              |         |         |            |         |         |
| 4.5 - < 12 months  | 40.1         | 37.9    | 0.035   | 38.5       | 39.8    | 0.199   |
| 12 -23 months  | 59.9         | 62.1    |         | 61.5       | 60.2    |         |
| <b>Parity</b>  |              |         |         |            |         |         |
| 1  | 35.2         | 36.5    | 0.549   | 36.7       | 35.4    | 0.478   |
| 2  | 33.1         | 32.5    |         | 32.7       | 33.0    |         |
| 3+   | 31.7         | 30.9    |         | 30.6       | 31.6    |         |
| <sup>1</sup> Divorced, Separated, Widow, Abandoned, Unmarried<br><sup>2</sup> Hinduism, Christianity, Buddhism<br><sup>3</sup> Chakma, Marma, Tanchangya, Santal<br><sup>4</sup> Aunt, Uncle, Grandfather, Sister, Brother, Great grandmother, Step mother |              |         |         |            |         |         |

## Annexure H: Effects of interventions implemented

### Knowledge and practice of caregivers on the interventions

At endline survey, the caregivers were asked if they knew anything about the interventions implemented in their areas and received any service related to the interventions. The findings revealed that one third of the caregivers (33%) reported that they were aware of at least one of the interventions and received services ([Additional Table I.22](#)).

Findings from qualitative data showed notable effects of the interventions. Below are narratives about some promising interventions.

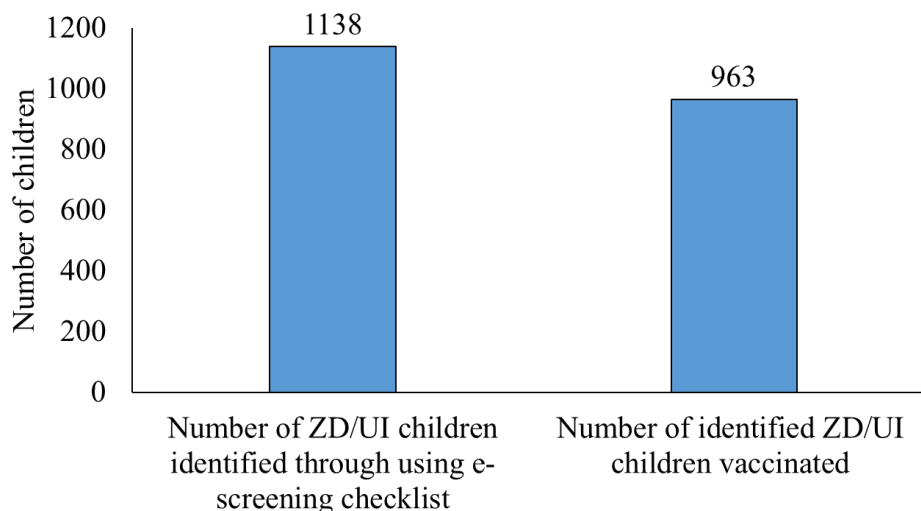
*Training of the service providers:* All the service providers who joined the training and were study participants informed that the training was well planned with all necessary logistics support. They informed that during the training, trainers briefly introduced the CLH project including the aim of the project, definition of ZD, UI and missed communities. The respondents (15 KII and 12 FGD participants) said that they learned from the training about ZD and UI children, how to identify them, different strategies to reach the identified children, and became more careful about their duty. An EPI personnel who participated in the training said,

*“Actually, we learned a lot from the training. We learned many new things there like how to identify ZD and Ui children, how to reach those children.”*

The respondents also mentioned that this training was a new experience for CHCPs, SACMOs, FWAs, and FWVs. Most of them said, they had a comprehensive understanding on EPI including name of vaccines, VPDs, importance of vaccination, vaccine doses, ZD, UI and missed communities. They added that they learned their role in identifying ZD and UI and ensuring vaccination coverage in their areas.

*Use of E-screening checklist:* **Figure H1** presents monitoring data on status of ZD/UI children identified and vaccinated using E-screening checklist during IR period in the intervention areas. The figure shows that a total of 1,138 ZD/UI children were identified through using E-screening checklist application out of which 963 (84.6%) were vaccinated.

**Figure H1:** Number of ZD/UI children identified and vaccinated using E-screening checklist in intervention areas



Most of the key informants (n=10) and FGD participants said that E-screening checklist contributed both in identification and vaccination of ZD and UI children. According to them, when a designated service provider identified a ZD or UI child using E-screening checklist, concerned HA received an auto message with detail information of the child at his/her device. After getting the information of identified child, the HA communicated with the caregiver through phone or visiting their house and took steps to vaccinate the child.

All the KII and FGD participants opined that the E-screening checklist was playing a crucial role in identifying the ZD and UI children. They added that many children remained ZD or UI due to different reasons such as hard to reach areas, migration, shortage of vaccinators, caregivers' unwillingness about vaccination of their children, and lack of knowledge about importance of vaccination of the children. Since the simple screening checklist can use any services providers such as doctors, nurses, paramedics, CHCPs at facility level, it became easy to identify the ZD and UI children. A CHCP shared her experience,

*“A mother came to me for medicine. Her child was sick, missed few doses of vaccines. She didn't know where to vaccinate. .... When she was talking about her child, I asked her whether she vaccinated her child. She said, few doses are left yet. I told her to bring the card and after seeing the card, I did entry that child on E-screening. Later, that child was fully vaccinated.”*

Most of the key informants (n=14) said, earlier many children of this area were ZD or UI. But, when E-screening checklist was introduced at all the facilities and used by service providers working at fixed site facilities such as CHCPs, SACMOs, nurses in identifying ZD and UI children and informing to concerned HAs, the number of ZD and UI children are reducing.

A HA said,

*“Yes, I think it is effective. Because the children who were identified as ZD or UI and we couldn't bring those children under vaccination. Now we used to get information about the status of those children and take steps for bringing them under EPI coverage”.*

*Crash programme and evening session:* **Table H1** presents monitoring data on performance of crash programme and evening sessions. The table shows that a total of 76 crash programmes were conducted at HTR areas during the study period where 1,834 children were vaccinated. In urban intervention areas, 119 evening sessions were held and a total of 1,099 children were vaccinated in the evening sessions held.

**Table H1:** Performance of crash programme and evening session

| <b>Interventions</b> | <b>Number of sessions held</b> | <b>Number of children vaccinated</b>        |
|----------------------|--------------------------------|---|
| Crash programme      | 76                             | 1834 (Avg. 24 children per crash programme) |
| Evening session      | 119                            | 1099 (Avg. 9 children per session)          |

According to key informants (n=11) and FGD participants (n=4), crash programme had demonstrated outstanding success in identifying and reaching ZD and UI children particularly at islands and char areas as the areas are isolated from the mainstream population and migrates frequently from one place to another due to riverbank erosion and emergence of new chars. Bringing out such a population under

the routine EPI is difficult as transportation to these areas is highly depend on weather and climate. Sometimes, the vaccinators can't organize EPI sessions as plan due to sudden change of weather. According to one of the key informants in Hatiya, the children of small islands remain unvaccinated if crash programme is not held. To reach those isolated communities, there is no other way except crash programs. The MT-EPI of Hatiya also said about the effectiveness of the crash programme:

*"It was not possible to provide vaccines to the children in Ghashiar char this year without the support from icddr,b (country learning hub project). High officials always told us to conduct crash programme but they never provide any support for this purpose. The ZD and UI children of those areas are vaccinating only through crash program. And the coverage is now really good. He added that we can provide vaccine 150-200 children in each crash programme in those areas".*

In Dowarabazar, many HA positions remain vacant and crash programme helped them to vaccinate those vacant areas. All the KII participants of Dowarabazar considered the crash programme a very useful initiative. One of the key informants said,

*"We were not able to provide vaccines to our targeted children due to shortage of HAs. We continued conducting crash programme through roster duty among available HAs. When there was shortage of manpower, we organized crash programs in those areas with support from the HAs available in adjacent areas which help in reducing ZD and UI children".*

The other positive side of the crash programme mentioned by the participants was its accessibility among the caregivers. According to the FGD participants and caregivers of an FVC children, the crash programme helped them to vaccinate their children. They added that before implementation of crash programme, their children often missed vaccine doses as they had to cross big rivers to reach Saghata UHC for vaccinating their children. A caregiver in Saghata said,

*"It has been beneficial for us. We don't need to go to Saghata which requires struggling for whole day. We can now do all our work at home and we can vaccinate our children at our locality where crash programme used to hold."*

*Evening session:* Key informants of DNCC said, evening EPI sessions were organized at 4: 00 pm to 8:00 pm targeting working caregivers who cannot vaccinate their children in the morning sessions. Evening sessions were managed by DNCC and partner NGOs of urban primary health care project in the selected outreach centers of DNCC. DNCC organize evening session once in a week in the Islamia Government Primary School of ward # 26. Surjer Hasi Clinic (an NGO clinic) organize another evening session in ward # 30 in every week in front of a large garment factory. The vaccinators of the NGO and DNCC conduct the evening sessions by rotation in addition to their routine EPI sessions.

All the key informants and FGD participants of DNCC opined that the evening session was an effective intervention to reduce ZD and UI children including reducing the drop-out and left out of other vaccines. One of them said, many working women in urban slums work in garment factories or as housemaid; leaving their children with other family members (with elder daughter or mother). So, they often miss to vaccinate their children in routine sessions. The evening session has proven to be extremely helpful and important for them, as it allows both mothers and fathers to bring their children in the EPI centers for vaccination after their work hour. The respondents also pointed out that the coverage is increasing day by day, which couldn't be achieved without evening sessions. To describe the effectiveness of evening session, a vaccinator said,

*“Conducting the evening session has become beneficial for many working people. They were unable to vaccinate their children during daytime from routine EPI sessions. Now they can do it in the evening after completing their day long work; that’s why ZD and UI children are reducing in the intervention areas.”*

Besides, caregivers (n=2) who vaccinated their children from evening session described it as a good option for them. One of them said,

*“In the morning, I need to manage cooking, washing, bathing, and other household chores as my husband goes out for work. I get some leisure time in afternoon. So, the time of evening sessions is convenient for me.”*

Another caregiver said, evening sessions are more convenient for both of the guardians and the children. In the morning, children have their meal and bath time. It is also playtime for children after they have their nap, while evening time is generally free for both the caregivers and children. Considering these, caregivers who attended evening session found it much convenient for vaccinating their children.

As stated earlier, one third of the caregivers (33%) surveyed reported that they knew about any of the interventions implemented. The caregivers who had knowledge about the interventions were asked if they received any services related to the interventions implemented. Based on their responses, we compared the prevalence of ZD/UI children of the caregivers who received and did not receive services related to specific interventions (**Table H2**). The table shows that the percentage of ZD/UI and ZD was significantly higher among the children of caregivers who did not receive the services related to the interventions (ZD/UI: 18.2%, ZD: 3.0%) compared to the caregivers who received services (ZD/UI: 10.8%, ZD: 0.7%). However, the effects of the crash programmes and health education through CHCP were opposite possibly for fewer receivers of services related to the two the interventions (n= 45 and n=21 respectively).

**Table H2:** Prevalence of ZD/UI and ZD children among the caregivers who received and did not receive services related to the interventions implemented

| Implemented interventions     | N        |              | ZD/UI (%) |              |         | ZD (%)   |              |         |
|-------------------------------|----------|--------------|-----------|--------------|---------|----------|--------------|---------|
|                               | Received | Not received | Received  | Not received | p-value | Received | Not received | p-value |
| E-screening checklist         | 167      | 12807        | 8.0       | 17.0         | 0.006   | 1.1      | 2.6          | 0.232   |
| BCC materials                 | 240      | 12734        | 7.4       | 17.0         | <0.001  | 0.0      | 2.7          | 0.176   |
| Crash programme               | 45       | 12929        | 23.7      | 16.8         | 0.289   | 2.7      | 2.6          | 0.978   |
| Advocacy meeting              | 53       | 12921        | 12.5      | 16.9         | 0.508   | 0.0      | 2.6          | 0.409   |
| Additional session            | 387      | 12587        | 15.1      | 16.9         | 0.089   | 1.6      | 2.6          | 0.001   |
| Strengthen EPI support groups | 22       | 12952        | 14.4      | 16.9         | 0.718   | 0.0      | 2.6          | 0.629   |
| Involvement of NGO worker     | 138      | 12836        | 7.4       | 17.0         | 0.129   | 1.5      | 2.6          | 0.559   |
| Health education through CHCP | 21       | 12953        | 20.9      | 16.9         | 0.543   | 0.0      | 2.6          | 0.685   |
| Courtyard meeting             | 747      | 12227        | 3.9       | 17.7         | <0.001  | 0.0      | 2.8          | 0.019   |

| Implemented interventions                | N           |              | ZD/UI (%)   |              |                  | ZD (%)     |              |                  |
|--|-------------|--------------|-------------|--------------|------------------|------------|--------------|------------------|
|  | Received    | Not received | Received    | Not received | p-value          | Received   | Not received | p-value          |
| Community engagement                     | 193         | 12781        | 13.0        | 16.9         | 0.053            | 0.5        | 2.6          | 0.082            |
| Health education through NGO counsellors | 73          | 12901        | 9.6         | 16.9         | 0.033            | 0.0        | 2.6          | 0.515            |
| Evening session                          | 450         | 12524        | 16.4        | 16.9         | 0.793            | 1.1        | 2.7          | <0.001           |
| EPI E-Tracker                            | 904         | 12070        | 13.8        | 17.1         | 0.053            | 0.4        | 2.8          | <0.001           |
| <b>Any intervention</b>                  | <b>2317</b> | <b>10657</b> | <b>10.8</b> | <b>18.2</b>  | <b>&lt;0.001</b> | <b>0.7</b> | <b>3.0</b>   | <b>&lt;0.001</b> |

### Annexure I: Additional tables

Please click on the icon to open the additional tables



Additional  
Tables.xlsx