

Implementation research for reducing zero-dose and under-immunized children in selected areas of Bangladesh: Findings from an economic evaluation

Submitted by:

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List of acronyms

BBS	Bangladesh Bureau of Statistics
BCLH	Bangladesh Country Learning Hub
BCC	Behavioral Change Communication
BDT	Bangladeshi Taka
CHCP	Community Health Care Provider
CPI	Consumer Price Index
CSO	Civil Society Organizations
DALY	Disability-Adjusted Life Year
DGHS	Directorate General of Health Services
DNCC	Dhaka North City Corporation
EPI	Expanded Programme on Immunization
Gavi	Global Alliance for Vaccines and Immunization
GDP	Gross Domestic Product
HE&FRG	Health Economics and Financing Research Group
Hib	Haemophilus influenzae type b
HR	Human Resources
HTR	Hard-to-reach
HSD	Health Services Division
HSPSD	Health Systems and Population Studies Division
ICER	Incremental Cost-Effectiveness Ratio
IHME	Institute for Health Metrics and Evaluation
IRMMA	Identify, Reach, Monitor, Measure, and Advocate
KII	Key Informant Interview
LiST	Lives Saved Tool
LMIC	Low- and Middle-Income Country
MOHFW	Ministry of Health and Family Welfare
NGO	Non-Governmental Organization
PCV	Pneumococcal Conjugate Vaccine
PHC	Primary Health Care
SBCC	Social and Behavior Change Communication
TBA	Traditional Birth Attendant
UI	Under-Immunized
USD	United States Dollar
WHO	World Health Organization
YLD	Years Lived with Disability
YLL	Years of Life Lost
ZD	Zero-Dose
ZDLH	Zero-Dose Learning Hub

Executive Summary

Bangladesh's vaccination coverage rate has ranged between 80-84% over the past 10 years. However, there remains pockets of inequity in immunization coverage where hard-to-reach (HTR) marginalized communities lack access to immunization. There is a growing need to identify the areas with high number of under immunized (UI) and zero-dose (ZD) children in Bangladesh and identify targeted interventions to reach these missed communities. In an attempt to reduce ZD and UI, Gavi set up "Gavi zero-dose learning hubs (ZDLH)" with partners from Mali, Somalia and Bangladesh. As a part of this initiative, Gavi commissioned icddr,b to implement the Bangladesh ZDLH programme.

The objective of the Bangladesh ZDLH was to generate and synthesize learning on the barriers to reach children and support in programme planning; identify and reach ZD children and missed communities; strengthen the evidence based effective approaches to identify and reach ZD children and missed communities; and access and use data to reach ZD children and missed communities. The outcome of the programme was assessed, which included an economic evaluation of the interventions included in the ZDLH programme (referred to as ZD/UI programme from now onwards). The current report presents findings from this economic evaluation.

The objectives of the economic evaluation include:

- To assess the area-specific and overall programme cost (including both start-up and implementation cost) to reach ZD/UI children in the selected six intervention areas
- To assess the cost-effectiveness of the ZD/UI programme in reaching ZD/UI in selected missed communities of Bangladesh.

The study adopted a quasi-experimental design using baseline and endline estimates to assess the outcome of the ZD/UI programme. The programme was implemented in six geographically challenging and socioeconomically marginalized communities— HTR char, haor, hilly, and coastal areas, plain land and urban slum areas—collectively identified as "missed communities" i.e. areas with high prevalence of ZD and UI children. The primary focus was on reaching ZD children, who had not received any routine vaccinations, and UI children, who had not completed their full vaccine schedule.

The programme adopted the Identify, Reach, Monitor, Measure and Advocate (IRMMA) framework to implement a range of tailored interventions, including modified Expanded Programme on Immunization (EPI) sessions such as evening, crash and additional vaccination sessions; the introduction of digital tools like e-screening and e-supervision checklists; capacity-building initiatives; social mobilization and behavior change communication; and community engagement activities etc.

The effectiveness of the ZD/UI programme was assessed in terms of change in ZD/UI children reached using a difference-in-difference analysis with baseline and endline data. Overall, comparing baseline and endline data it was identified that the programme resulted in a net reduction in ZD and UI prevalence, increasing Penta-1 coverage by 0.9 percent, Penta-2 by 0.7 percent and Penta-3 by 2.2 percent .

The cost of the ZD/UI programme was estimated from a programme perspective using an activity-based micro-costing approach that considered both direct (financial) and indirect (opportunity) costs. Both the start-up phase and implementation phase costs were estimated and combined to calculate the total programme cost. The area specific and total number of ZD & UI children reached and average cost per

ZD & UI child reached were estimated. Using the Lives Saved Tool (LiST), the total disability-adjusted life years (DALY) averted for vaccine preventable pneumonia and meningitis disease among under 5 children of the implementation areas was estimated and compared with the national Gross Domestic Product (GDP) per capita threshold to comment on the cost-effectiveness of the ZD/UI programme.

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 resource was the main cost driver, accounting for 63% of total cost, followed by allowances, transportation, venue etc. 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). The programme was estimated to have averted 566 DALYs by reducing vaccine-preventable diseases (Pneumonia and Meningitis) 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 results demonstrated that the programme 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.

Introduction

In lower-income countries, 81% of children now receive routine vaccines and more than 500 new vaccine programmes have been introduced and scaled up (1). However, millions of children are still being left behind. Every year, nearly 10 million of the 72.5 million children that Gavi aims to reach in low-income countries do not receive a single vaccine shot, leaving them vulnerable to some of the world's deadliest diseases (1). Although only one in seven children do not receive any vaccines, these zero-dose (ZD- missing first dose of pentavalent vaccine provided instead of Diphtheria, Tetanus and Pertussis (DTP)) children account for nearly half of all vaccine-preventable deaths (1). The ZD children are more likely to live in extreme poverty, and in “missed communities”, communities deprived of other basic services that face other socio-economic and gender disparities; they experience high child mortality and maternal deaths (2). Gavi, the Vaccine Alliance and the Global Immunization Agenda 2030 have greatly intensified their emphasis on equity, which intends to reach ZD and under-immunized (UI- missing third dose of pentavalent vaccine) children and their communities.

Bangladesh's vaccination coverage rate has ranged between 80-84% over the past 10 years (3). Bangladesh's vast and diverse landscape with pockets of hard-to-reach (HTR), vulnerable and underserved communities and migrant populations in urban areas are the key barriers to achieving the highest possible vaccination rates and understanding the key operational challenges is critical to improving programme efforts. There is a growing need to identify the pockets of ZD children in Bangladesh and dive deeply into the reasons behind the low immunization uptake.

Gavi's new five-year strategy 5.0 to improve equity in vaccination coverage hinges on five key intervention areas within the Identify, Reach, Monitor, Measure, and Advocate (IRMMA) framework. The use of this framework ensures a more systematic approach to reaching ZD children and missed communities. To support this, Gavi set up “Gavi zero-dose learning hubs (ZDLH)” in order to identify and select a partner or consortium of partners to implement the learning hubs in Mali, Nigeria, Somalia and Bangladesh. The ZD country learning hub provides systematic and robust monitoring and learning for the IRMMA interventions by working in conjunction with the government, local academic institutions and civil society organizations (CSOs) in order to maximize data use, learning, partner engagement, assessment of current situation related to ZD, develop and test appropriate mechanisms for reaching to the ZD children. Gavi commissioned icddr,b to conduct the Bangladesh learning hub project.

Objective

The objective of Bangladesh ZDLH was to generate and synthesize learning on the barriers to reach children and support in programme planning; identify and reach ZD children and missed communities; strengthen the evidence based effective approaches to identify and reach ZD children and missed communities; and access and use data to reach ZD children and missed communities.

The ZDLH project encompassed several components and one of the components was conducting ‘implementation research (IR) including economic evaluation’ in selected areas of Bangladesh. The IR was designed with different innovative and evidence-based interventions (detailed in **Table 1**) to reduce ZD and UI children and was implemented in six selected rural HTR areas and urban slum, identified as missed communities i.e. areas with high ZD and UI children (4). The outcome of the programme was assessed and as a part of this assessment, the economic evaluation has been conducted to compare the cost per ZD/UI reached in each of the intervention areas and to compare the cost-effectiveness of the

programme (taking all area-specific interventions as a single package for reaching ZD/UI in missed communities) with no additional intervention to reach ZD/UI children in the control areas.

The major objective of the economic evaluation includes

- To assess the area-specific and overall programme cost (including both start-up and implementation cost) to reach ZD/UI children in the selected six intervention areas
- To assess the cost-effectiveness of the ZD/UI programme in reaching ZD/UI in selected missed communities of Bangladesh.

Method

Study design: The study adopted a quasi-experimental design using baseline and endline estimates to assess the outcome of the ZD/UI programme. The detail description is available in the IR report (5).

Study area and the ZD/UI programme

A list of interventions included in the programme to reach ZD/UI children and study areas are provided in the following table (Table 1).

Table 1: Area-specific list of interventions

Geographical location	Intervention area	Proposed interventions
All Areas		<ul style="list-style-type: none"> • Training of service providers • EPI e-tracker (e-registration, e-messaging, e-monitoring) • Use of e-screening checklist (except Urban slum and street dwellers) • Distribution of Behavioral Change Communication (BCC) materials • Modified EPI session schedule (Evening Session / Mobile Session / Crash Program/ Additional Session) - if needed
Char areas (sandy/silty land surrounded by water)	Saghata, Gaibandha	Advocacy with community leaders
Haor areas (wetlands)	Dowarabazar, Sunamganj	Strengthen EPI support groups (Traditional Birth Attendants (TBAs), Imams, Students, Union parishad members, etc)
Hilly areas	Kawkhali, Rangamati	<ul style="list-style-type: none"> • Advocacy with community leaders • Involvement of existing NGO community worker
Coastal areas	Hatiya, Noakhali	<ul style="list-style-type: none"> • Health education through Community Health Care Provider (CHCP) • e-supervision checklist
Plain land	Nalitabari, Sherpur	Conduct courtyard meetings
Urban areas (slum and street dwellers)	Ward-26 and 30, Zone-5, DNCC	<ul style="list-style-type: none"> • Community engagement (landlord, club/committee member, Imam etc.) • Health education through NGO counsellors

Data collection

We reviewed financial reports and budget documents related to the Gavi, the Vaccine Alliance funded implementation research (IR) project of Bangladesh zero-dose learning hub (ZDLH) to extract information on resources used for the interventions. We also reviewed programme implementation documents and conducted KII with the programme personnel at field level as well as those at central programme office based in Dhaka to map the programme timeline and determine the start-up and implementation phases, its activities, and required resources. Semi-structured questionnaires were prepared following the activity and resource mapping for relevant data collection. Details of data collection tools, source and respondents are provided in **Table 2**. We visited the six intervention areas, conducted key informant interviews (KII) with key programme personnel of the intervention team, and collected data on the activity details, their frequencies, required quantities, share of contribution, and relevant costs. The activities and their associated cost information for the start-up phase have been identified and collected by reviewing relevant documents and interviewing relevant staff from the EPI programme, IR team and respective implementation facilities. For the implementation phase, all implementing activities performed at the Upazila level were identified through visiting the Upazila health complex and by reviewing programme documents.

Table 2: List of tools for cost data collection

Method/ tools	Data source/respondent
Key informant interviews	Medical Officer- Disease Control
	Medical Technologist-EPI
	Head Assistant
	Field Research Officer
	Health Inspector & Assistant Health Inspectors
	Service provider interviews (Health Assistant, Vaccinator)
	Program team personnel (field and central level)
Document review	Expenditure reports
	Statistical documents (Vaccine supplies, vaccine coverage, wastage rate etc.)
Observation	Physical inventory
Semi-structure questionnaires	Training-related information
	Meeting information
	Facility cost-related information

Economic Evaluation

ZD/UI Programme cost estimation

The cost estimation was carried out for the six intervention areas of the project from a programme perspective. An activity-based micro-costing approach was adopted (6). Following this approach, through review of program financial reports, documents and extensive consultation with the implementing members, the different phases of the programme (i.e. start-up and implementation), its activities and sub-activities were mapped and categorized into key activities. The activities and sub-activities were then analyzed to identify and categorize the resources required for the activities. This process included identification of programme activities, identification of associated inputs (e.g. human resources, materials, logistics, office space) for performing each activity and their associated share,

assigning unit costs for each input and multiplication of the associated inputs with their corresponding unit costs.

i.e. Activity cost = \sum Inputs used \times Unit cost of each input.

Programme costs were estimated on both capital and recurrent aspects. The cost for shared recurrent items (e.g. staff and utilities) (7) and capital items (e.g. office space, furniture) were allocated based on their utilization (e.g. time involvement, share of usage) in the programme activities. We annualized the cost of capital items considering the useful lifetime of the good and a 5% discount rate as suggested for LMICs (8,9). For estimating the cost of each activity, we considered both direct and indirect (opportunity cost) costs of activities associated with reaching the ZD and UI children among the missed communities. Direct cost refers to the costs that are incurred directly by the programme activities, such as financial cost of the programme activities. Indirect cost refers to the costs borne through the utilization of resources that are not directly related or intended for the programme activities, such as the opportunity costs of additional time allotted by non-programme personnel (health workers providing existing EPI and primary healthcare services). Shadow prices were implied for items for which information on price or value (e.g. meeting venue cost for government premises, time spent on training, etc.) was not available.

All costs were inflation-adjusted through Consumer Price Index (CPI) for Year 2025. Weighted averages have been used for areas where data availability was limited. For example, a weight was generated combining the proportion of involvement of central management personnel to the programme implementation to apportion the central level combined expenses and exclude research related share. Bangladesh Bank's monthly statistical report's exchange rate and inflation rate has been used for currency exchange rates and CPI calculation (10).

We estimated the programme cost for both start-up and implementation phase. The start-up/initiation activities of this programme were conducted for three months from October'23 to December'23 and were considered as the start-up phase. After one year of the completion of the implementation of the programme in six targeted areas the implementation year 2024 was considered as the implementation phase. Programme cost was the total of start-up and implementation cost.

Start-up cost estimation

The start-up phase encompassed the preparatory activities that were carried out beforehand the implementation of the interventions on the ground. All activities carried out and items (capital and recurrent) acquired in preparation for the intervention rollout were considered for calculating the start-up costs of the ZD programme. The key start-up activities included development of training materials, community mobilization through staff training, development of electronic tools, monitoring training and other relevant administrative, management and monitoring activities.

Implementation cost estimation

Following the start-up phase, the implementation phase was where the core set of activities or programme were implemented. The key activities for the implementation phase included ZD related activities by health workers, social mobilization, training and meetings. The implementation cost was estimated after one full year of programme implementation.

Total programme cost

The total ZD/UI programme cost incurred during the two phases (start-up & implementation phase) constituted the total cost of the programme. The total cost for identifying and vaccinating the ZD and UI

children among the missed communities was estimated by allocating the cost of existing resources considering existing coverage.

Programme outcome estimation

Baseline and endline estimates of ZD/UI coverage were compared between intervention and control areas. A difference-in-difference estimate for ZD/UI coverage was estimated to assess the effectiveness of the programme. The detail description is available in the IR report (5).

The primary outcome for the economic evaluation was incremental cost per: 1) ZD/UI reached and, 2) DALY averted.

The total number of ZD and UI children/cases reached was estimated using the change in the ZD and UI children coverage between the baseline and endline periods (estimated from the coverage survey) and the EPI target population of the intervention areas for year 2024 since population data were unavailable for children below 2 years of age which was the study population's age group.

Cost per outcome and Cost-effectiveness estimation:

Our outcome measures included cost per ZD/UI child reached and cost per DALY averted from reduced pneumonia and meningitis cases resulting from the IR (considering all the interventions across all areas as a single programme). We didn't have primary data on all vaccine preventable disease incidence or prevalence for our area of interest. We therefore, used secondary source of information and a cost effectiveness estimation tool, i.e. LiST for our analysis. The LiST is an evidence-based modeling tool which estimates the number of lives saved from reduction in maternal, newborn, and child deaths through changes in health intervention coverage (13). The LiST tool contained complete data for pneumonia and meningitis for Bangladesh and we used only these two vaccine preventable disease data in our analysis of DALY.

The cost per ZD and UI child reached was estimated using the programme cost required to reach ZD and UI child in the programme area. The cost per case reached was the result of dividing the total programme cost by the total number of ZD/UI cases covered through the programme.

For cost-effectiveness, we estimated the incremental cost-effectiveness ratio (ICER) for increased coverage through the programme. We estimated cost-effectiveness of the complete programme considering all interventions as a package for reducing ZD/UI in selected missed communities in comparison with no additional programme scenario.

Total DALYs averted by the ZD/UI programme was estimated considering the years of lives saved through averting specific vaccine preventable disease incidences and associated mortality by the increased population coverage through the programme. The following formula was used for calculating the DALY;

$$\text{i.e. DALY} = \text{YLD} + \text{YLL}$$

Where YLD = Years of life lived with disability. YLD is the product of number of disease cases (for our analysis disease cases for pneumonia and meningitis) averted, the average duration (years) until remission from the disease or death and the disability weight (used from the Global Burden of Disease database) for the respective disease (11).

YLL= Years of life lost due to specific disease. YLL is the product of the number of deaths averted or lives saved from specific diseases (for our analysis mortality from pneumonia and meningitis) multiplied

by the standard life expectancy (from the country-specific life table of WHO (**Table 4**)) at the age at which death occurs due to the mentioned diseases (12). Thus,

YLD = Disease cases averted × average duration (years) until remission × disability weight,

and

YLL = Number of deaths averted × standard life expectancy at the age of death in years.

As per the WHO Global Burden of Disease (GBD) guideline, no age-weighting and discounting for DALY calculation was done (12). According to the EPI vaccine schedule in Bangladesh Pentavalent and PCV vaccines are provided at the same session. Thus, we assumed Pentavalent and PCV to have similar impact on increasing vaccine coverage due to the programme and estimated the impact for both in calculating DALY. We used the Lives Saved Tool (LiST) to estimate the number of additional vaccine preventable disease cases averted (i.e. Pneumonia and Meningitis) and number of additional under-five child lives saved from selected vaccine preventable diseases (i.e. pneumonia and meningitis) since our primary survey lacked required area specific disease incidence or prevalence data (13). The tool included default number of disease cases averted among under-five children and child lives saved from specific diseases due to an increase in vaccine coverage (13). As the programme was aimed at reducing the prevalence of both the ZD and UI children, it was considered appropriate to consider the dose specific increment in coverage and thus estimate the dose specific additional disease case averted and child lives saved. To do this, we used the LiST separately for each dose by accommodating the evidence based respective dose specific efficacy data into the tool. However, some of the dose specific efficacy data were missing and we used efficacy data from secondary sources (**Table 3**) in those conditions.

Table 3: Dose specific vaccine effectiveness data used in the LIST tool

Dose specific effectiveness	1 st Dose	2 nd Dose	3 rd Dose
Pentavalent vaccine against Hib Pneumonia	59%	92%	93%
Pentavalent vaccine against Hib Meningitis	36%	91%	94%
PCV vaccine against Pneumococcal Pneumonia	37% (14)	63% (14)	80%
PCV vaccine against Pneumococcal Meningitis	37% (14)	63% (14)	84%

Observed increment in vaccine coverage and vaccine efficacy data were used to estimate effective increment in vaccine coverage due to the ZD/UI programme. To estimate the average age at death from specific vaccine preventable disease among under-five children, proportion of mortality data for three different age groups i. neonatal (0-28 days) ii. infant (1 to 12 months) and iii. child (13 to 59 months) for the disease were used to construct a weighted average age at death. For each period, the mid value was assumed as the age at death for that age group. Multiplying this with the proportionate share of death for that age group with respect to the total disease specific death for all the age groups of study population i.e. under five children, the disease specific age at death for that particular age group was calculated (**Table 4**). Finally, combining all the estimated age at death, the disease specific average age at death was estimated. The average age at death was estimated using the following formula:

$$\text{Average age at death} = \sum X_i Y_i$$

Where, X_i = the mid value of the respective age group and, Y_i = the disease specific age weight for the respective age group

We assumed the total under-five population of the study areas as the target population to estimate the impact. We took the under-five population data for the study areas from the Bangladesh Bureau of Statistics (BBS) Census data 2022 and adjusted for growth rate to calculate the study population for the year 2024. Using the LiST tool, the national level impact of increased coverage was obtained as output. This was then used for the area specific estimation. Parameters used in the DALY calculation is presented in **Table 4**.

Table 4: Parameters used for DALY estimation

Parameter Details	Estimates	Source and notes
Country specific life expectancy at birth (for both sex at year 2022)	74.3 years	IHME Global Burden of Disease 2022 estimates (15).
Estimated average age at the time of death for under five children by pneumonia	0.41 years	A weighted average had been estimated based on LiST's age structure and relevant mortality data for respective age groups from literatures (13,16).
Estimated average age at the time of death for under five children by meningitis	0.47 years	A weighted average had been estimated based on LiST's age structure and relevant mortality data for respective age groups from literatures (13,17).
Average duration of illness by pneumonia	10 days	Relevant data for respective age groups from literatures (18).
Average duration of illness by meningitis	10 days	Relevant data for respective age groups from literatures (19).
Disability weight for severe pneumonia	0.1334	IHME Global Burden of Disease 2021 disability weight estimates (11).
Disability weight for meningitis	0.1334	IHME Global Burden of Disease 2021 disability weight estimates (11).
Disability weight for death (YLL)	1	WHO Global Burden of Disease Estimates (12).

The estimated incremental cost-effectiveness ratio (ICER) of the ZD/UI programme was compared with the willingness to pay threshold (in our case, GDP per capita for Bangladesh) to assess whether the ZD/UI programme is cost-effective. We used the rule of thumb of a simple cost-effectiveness analysis approach in global health, where an intervention/programme is deemed cost-effective if the ICER is less than 1 to 3 times the GDP per capita. In particular, a programme is considered cost-effective if the ICER is less than 3 times the GDP per capita and highly cost-effective if the ICER is less than 1 times GDP per capita (20,21).

Definitions

Missed communities: According to the Gavi definition, missed communities are home to clusters of ZD and UI children. These communities often face multiple deprivations and barriers, which prevent them from accessing essential health services like routine immunizations. For operational purposes, ZD children are those who have not received first dose of pentavalent i.e. DTP1 and UI children are defined who have not received the third dose of pentavalent i.e. DTP3. Bangladesh Country Learning Hub (BCLH) used findings from the baseline and [rapid assessment](#) to select missed communities for the study (4).

Life saved from immunization: It is the prevention of death from a vaccine-preventable disease, achieved when a vaccine successfully builds a person's immunity to fight off an infection and prevents that infection from becoming fatal. This can be a direct life saved for an individual, or it can contribute to herd immunity, where high immunization rates in a community protect those who cannot be vaccinated.

Cost per ZD and UI reached: This is the total programme cost divided by the number of ZD/UI covered through the programme.

Cases of ZD and UI averted in the past year: This is the number of ZD and UI that was avoided in the intervention group compared to a control group. We used the net effect of the intervention for our analysis using a different-in-difference estimation of the change in the number of ZD and UI between baseline and endline comparing intervention and control areas. Data from the baseline and endline coverage survey was used.

Results

The implementation cost of the programme was estimated for the start-up and implementation phase. This section presents cost at these two phases separately and then a combined estimate is also presented.

Start-up cost

The preparatory phase i.e. from October 2023 to December 2023 was considered as the start-up phase. The tables below (**Table 5**) outline the costs associated with implementing the activities across the implementation areas for the start-up phase. Training Manual and SBCC Content were developed at the Programme Office in Dhaka and incurred a total cost of BDT 94,520 (USD 774) and BDT 97,850 (USD 802) respectively. Programme implementation training was carried out across the intervention areas and constitutes the highest expenditure accounting for 41% (BDT 3,344,670) of the total budget. Training of Field Monitoring Officers was conducted at the Programme Office in Dhaka and incurred BDT 836,256 in cost, making up 10% of the total cost.

E-screening, e-supervision tool and dashboard development were also conducted at the central level within these three-month periods which incurred a cost of BDT 285,061 (USD 2,336), representing 4% of the total cost. Meetings on programme implementation were mainly held at central Dhaka and costed BDT 769,369 (USD 6,304), which is 10% of the total cost share. Administrative and management activities, mostly conducted at the Programme Office, had a total cost of BDT 2,671,636 (USD 21,890), accounting for 33% of the total cost which is the second highest share of cost. The total start-up cost for all activities amounts to BDT 8,099,361 (USD 66,361) and as expected the Programme Office constituted the highest share of costs (78%) across the regions. Of the total costs, direct cost amounted to BDT 7,892,680 (USD 64,668) and the rest were indirect costs (**Table 17**). From the resource utilizations point of view, capital and human resources utilization was mainly at the central level (**Table 17**). Implementation training across the six areas resulted in significant honorarium and allowance expenses with Dhaka implementation area having the lowest share as this was nearest to central office. Overall, HR cost occupied the highest cost burden followed by honorarium and allowances with a 72% and 14% of the total cost respectively (**Table 17**).

Table 5: Cost of key activities carried out at the start-up phase across the implementation areas

Activity Description	Sherpur, Nalitabari	Gaibandha, Saghata	Sunamganj, Dowarabazar	Rangamati, Kawkhali	Noakhali, Hatiya	Ward 26 & 30, DNCC, Dhaka	Central PM office and others	Total	% of total
	BDT (USD)	BDT (USD)	BDT (USD)	BDT (USD)	BDT (USD)	BDT (USD)	BDT (USD)	BDT (USD)	
1. Training Manual Development	-	-	-	-	-	-	94,520 (774)	94,520 (774)	1%
2. SBCC content development	-	-	-	-	-	-	97,850 (802)	97,850 (802)	1%
3. Programme Implementation training	459,152 (3,762)	295,490 (2,421)	257,968 (2,114)	316,605 (2,594)	316,292 (2,591)	129,608 (1,062)	1,569,554 (12,860)	3,344,670 (27,404)	41%
4. Training of Field Monitoring Officers	-	-	-	-	-	-	836,256 (6,852)	836,256 (6,852)	10%
5. E-screening, E-supervision and Dashboard development	-	-	-	-	-	-	285,061 (2,336)	285,061 (2,336)	4%
6. Meetings on Programme Implementation	-	-	-	-	-	-	769,369 (6,304)	769,369 (6,304)	10%
7. Administrative and management activities	-	-	-	-	-	-	2,671,636 (21,890)	2,671,636 (21,890)	33%
Total cost	459,152 (3,762)	295,490 (2,421)	257,968 (2,114)	316,605 (2,594)	316,292 (2,591)	129,608 (1,062)	6,324,246 (51,817)	8,099,361 (66,361)	100%
(%) of Total	6%	4%	3%	4%	4%	2%	78%	100%	

Implementation cost

Activity-wise implementation cost: The following table (**Table 6**) depicts the implementation phase cost across activities. Administration and monitoring incurred highest cost (83%) estimated at BDT 18,653,711 (USD 152,837). Other major cost drivers were modified EPI evening sessions (3%), use of E-screening (3%), and involvement of existing NGO community workers (3%). The central level expenses resulted in the highest total cost incidence of BDT 11,376,116 (USD 93,209) in this phase. Among the resources, human resource cost was the major driver across the areas with Kawkhali as the highest and Dowarabazar as the lowest among the six intervention areas (**Table 18**). However, HR cost was highest at the central level. Overall, HR occupied 60% of the total cost followed by honorarium and allowances expenses, and transportation expenses each with 8% of the total cost share in this implementation period.

Table 6: Activity based cost of implementation phase across intervention areas for year 2024

Activities	Sherpur, Nalitabari BDT (USD)	Gaibandha, Saghata BDT (USD)	Sunamganj, Dowrabazar BDT (USD)	Rangamati, Kawkhali BDT (USD)	Noakhali, Hatiya BDT (USD)	Ward 26 & 30, DNCC, Dhaka BDT (USD)	Central and others BDT (USD)	Total BDT (USD)	% of total
Skill development training	-	-	131,223 (1,075)	-	-	60,608 (497)	0	191,831 (1,572)	1%
Use of E-screening	33,116 (271)	63,079 (517)	95,485 (782)	122,347 (1,002)	93,605 (767)	-	203,465 (1,667)	611,097 (5,007)	3%
Modified EPI sessions: Crash programme	15,632 (128)	19,023 (156)	59,631 (489)	12,380 (101)	47,347 (388)	-	-	154,011 (1,262)	1%
Modified EPI sessions: Additional sessions	60,959 (499)	-	-	11,458 (94)	63,146 (517)	313,531 (2,569)	-	449,095 (3,680)	2%
Modified EPI sessions: Evening sessions	-	-	-	-	-	748,257 (6,131)	-	748,257 (6,131)	3%
Community awareness through BCC materials	7,931 (65)	7,931 (65)	7,931 (65)	7,931 (65)	7,931 (65)	7,931 (65)	-	47,585 (390)	0.10%
Advocacy with community leaders	-	59,382 (487)	-	31,035 (254)	-	-	-	90,417 (741)	0.40%
Strengthen EPI support groups (TBAs, IMAMs, Students, UP members etc.)	-	-	25,507 (209)	-	-	-	-	25,507 (209)	0.10%
Involvement of existing NGO community worker	-	-	-	642,521 (5,264)	-	-	-	642,521 (5,264)	3%

Activities	Sherpur, Nalitabari BDT (USD)	Gaibandha, Saghata BDT (USD)	Sunamganj, Dowrabazar BDT (USD)	Rangamati, Kawkhali BDT (USD)	Noakhali, Hatiya BDT (USD)	Ward 26 & 30, DNCC, Dhaka BDT (USD)	Central and others BDT (USD)	Total BDT (USD)	% of total
Health education through CHCP	-	-	-	-	103,962 (852)	-	-	103,962 (852)	0.50%
E-supervision checklist	-	-	-	-	78,001 (639)	-	203,465 (1,667)	281,467 (2,306)	1%
Conduct courtyard meeting	44,939 (368)	-	-	-	-	-	-	44,939 (368)	0.20%
Community engagement (Landlord, club/committee member, Imam etc.)	-	-	-	-	-	95,891 (786)	-	95,891 (786)	0.40%
Health education through NGO counsellors	-	-	-	-	-	64,528 (529)	-	64,528 (529)	0.3%
Database maintenance	-	-	-	-	-	-	203,465 (1,667)	203,465 (1,667)	1%
Administration and monitoring	1,392,572 (11,410)	1,560,972 (12,790)	1,046,283 (8,573)	1,891,281 (15,496)	1,145,377 (9,384)	851,507 (6,977)	10,765,720 (88,207)	18,653,711 (152,837)	83%
Total cost	1,555,148 (12,742)	1,710,387 (14,014)	1,366,059 (11,193)	2,718,951 (22,277)	1,539,369 (12,613)	2,142,253 (17,552)	11,376,116 (93,209)	22,408,283 (183,599)	100%

Area-specific total programme cost (considering both start-up and implementation cost):

Area-specific activity-wise total cost:

Nalitabari, Sherpur: Table 7 depicts the distribution of programme costs across activities/interventions for plain land (Nalitabari, Sherpur). Skill development training was the major cost driving of all the interventions accounting for 23% (BDT 459,152 or USD 3,762) of total cost. With a larger utilization of indirect resources, modified EPI sessions all together accounted for 4% of the total cost. Use of E-screening checklist, and courtyard meetings which was also the area specific intervention for plain lands each accounted for 2% of the total cost. Overall, administrative and monitoring was largest cost component (69%) among the activities with BDT 1,392,572 (USD 11,410). The total programme implementation cost amounted to BDT 2,014,300 (USD 16,504).

Table 7: Activity based cost of the programme for plain land (Nalitabari, Sherpur district), 2024

Activities	Direct cost (BDT)	Direct cost (USD)	Indirect cost (BDT)	Indirect cost (USD)	Total cost (BDT)	Total cost (USD)	% share of total cost
Skill development training	444,709	3,644	14,443	118	459,152	3,762	23%
Use of E-screening checklist	24,294	199	8,821	72	33,116	271	2%
Modified EPI sessions: Crash programme	12,015	98	3,617	30	15,632	128	1%
Modified EPI sessions: Additional sessions	8,155	67	52,804	433	60,959	499	3%
Community awareness through BCC materials	7,931	65	-	-	7,931	65	0.4%
Conduct courtyard meeting	-	-	44,939	368	44,939	368	2%
Administration and monitoring	1,318,550	10,803	74,022	606	1,392,572	11,410	69%
Total cost	1,815,653	14,876	198,647	1,628	2,014,300	16,504	100%

Saghata, Gaibandha: The following table (**Table 8**) represents the total programme implementation cost for the HTR char areas across its activities/interventions for the year 2024. Skill development training was the major cost incurring of all the interventions with BDT 295,490 (USD 2,421), which was 17% of the total cost. Majority of the costs were direct expenses. Advocacy with community leaders was the area specific intervention for this area and incurred BDT 59,382 (USD 487) most of which was indirect cost. However, administrative and monitoring activities accounted for the largest cost share with a 78% of the total cost. The total implementation cost amounted to BDT 2,005,877 (USD 16,435) for this area during this one-year implementation period.

Table 8: Activity wise cost of the programme for HTR char areas (Saghata, Gaibandha district) for year 2024

Activities	Direct cost (BDT)	Direct cost (USD)	Indirect cost (BDT)	Indirect cost (USD)	Total cost (BDT)	Total cost (USD)	% share of total cost
Skill development training	288,269	2,362	7,222	59	295,490	2,421	17%
Use of E-screening checklist	29,432	241	33,648	276	63,079	517	4%
Modified EPI sessions: Crash programme	16,332	134	2,690	22	19,023	156	1%
Community awareness through BCC materials	7,931	65	-	-	7,931	65	0.4%
Advocacy with community leaders	27,343	224	32,039	263	59,382	487	3%
Administration and monitoring	1,553,382	12,727	7,590	62	1,560,972	12,790	78%
Total cost	1,922,688	15,753	83,189	682	2,005,877	16,435	100%

Dowarabazar, Sunamganj: The total implementation cost of the HTR haor areas in 2024 is presented in the following table (**Table 9**). Administrative and monitoring activities occupied the largest cost share (64%) for this area also. Skill development training cost (BDT 389,191 or USD 3,189) was 24% of the total cost which was also the largest cost driving of all the interventions for this area. EPI support group strengthening through CHCP was the area specific intervention and amounted to BDT 25,507 (USD 209) for the implementation year. However, it did not incur any direct cost for the programme and cost incidence was from the indirect use of resources. The use of an e-screening checklist accounted for 6% of the total cost most of which was also indirect cost. The total implementation cost for the programme amounted to BDT 1,624,026 (USD 13,306) for this time period.

Table 9: Activity based cost of the programme for HTR haor areas (Dowarabazar, Sunamganj district) for year 2024

Activities	Direct cost (BDT)	Direct cost (USD)	Indirect cost (BDT)	Indirect cost (USD)	Total cost (BDT)	Total cost (USD)	% share of total cost
Skill development training	381,969	3,130	7,222	59	389,191	3,189	24%
Use of E-screening checklist	1,053	9	94,432	774	95,485	782	6%
Modified EPI sessions: Crash programme	58,727	481	904	7	59,631	489	4%
Community awareness through BCC materials	7,931	65	-	-	7,931	65	0.3%
Strengthen EPI support groups (TBAs, IMAMs, Students, UP members etc.)	-	-	25,507	209	25,507	209	2%
Administration and monitoring	1,018,923	8,348	27,360	224	1,046,283	8,573	64%
Total cost	1,468,602	12,033	155,424	1,273	1,624,026	13,306	100%

Kawkhali, Rangamati: The following table (**Table 10**) represents the total cost of implementation for the HTR hilly areas from the start-up period till the end of implementation year 2024. The total cost of implementation amounted to BDT 3,035,557 (USD 24,871) for this time period. Administrative and monitoring activity cost was also the major cost share in this area. Nonetheless, involvement of existing NGO community worker which was one of the area specific interventions observed a significant cost incidence of BDT 642,521 (USD 5,264) for this area. Skill development training cost accounted for 12% of the total cost followed by e-screening checklist utilization cost with 5% of the total cost. Advocacy with community leaders was another area specific intervention and with mostly indirect costs it was 1% of the total cost for this time period.

Table 10: Activity wise cost of the programme for HTR hilly areas (Kawkhali, Rangamati district) for year 2024

Activities	Direct cost (BDT)	Direct cost (USD)	Indirect cost (BDT)	Indirect cost (USD)	Total cost (BDT)	Total cost (USD)	% share of total cost
Skill development training	305,773	2,505	10,833	89	316,605	2,594	12%
Use of E-screening checklist	15,679	128	106,668	874	122,347	1,002	5%
Modified EPI sessions: Crash programme	3,858	32	8,521	70	12,380	101	0.5%
Modified EPI sessions: Additional sessions	5,854	48	5,604	46	11,458	94	0.4%
Community awareness through BCC materials	7,931	65	-	-	7,931	65	0.3%
Advocacy with community leaders	22,968	188	8,067	66	31,035	254	1%
Involvement of existing NGO community worker	-	-	642,521	5,264	642,521	5,264	21%
Administration and monitoring	1,590,253	13,030	301,027	2,466	1,891,281	15,496	62%
Total cost	1,952,316	15,996	1,083,241	8,875	3,035,557	24,871	100%

Hatiya, Noakhali: The total cost of implementing the programme activities/interventions in the HTR coastal areas is given in the following table (**Table 11**). As the table shows, administrative and monitoring activities occupied the major cost share in this area also. Among the interventions, skill development training observed the major cost incidence of BDT 316,292 (USD 2,591) which was 18% of the total cost. The area specific interventions were health education through CHCP and use of e-supervision checklist and they accounted for 6% and 5% of the total cost respectively which were all indirect costs born through the use of existing resources.

Table 11: Activity based cost of the programme for HTR coastal areas (Hatiya, Noakhali district) for year 2024

Activities	Direct cost (BDT)	Direct cost (USD)	Indirect cost (BDT)	Indirect cost (USD)	Total cost (BDT)	Total cost (USD)	% share of total cost
Skill development training	305,460	2,503	10,833	89	316,292	2,591	18%
Use of E-screening checklist	49,278	404	44,327	363	93,605	767	5%
Modified EPI sessions: Crash programme	45,714	375	1,633	13	47,347	388	3%
Modified EPI sessions: Additional sessions	61,742	506	1,404	12	63,146	517	3%
Community awareness through BCC materials	7,931	65	-	-	7,931	65	0.4%
Health education through CHCP	-	-	103,962	852	103,962	852	6%
E-supervision checklist	-	-	78,001	639	78,001	639	4%
Administration and monitoring	1,041,513	8,533	103,864	851	1,145,377	9,384	62%
Total cost	1,511,637	12,385	344,024	2,819	1,855,661	15,204	100%

Urban slum and street dwellers: Table 12 represents the total cost of implementation of the interventions for the slums and street dwellers of urban areas from the start-up period till the end of one implementation year i.e. 2024. The overall total cost was BDT 2,271,861 (USD 18,614) of which the largest share of 37% was occupied by the administrative and monitoring activities. However, evening session conduction also incurred a significant cost of BDT 748,257 (USD 6,131) which was 33% of the total cost. Majority of this was indirect cost. Additional session conduction also had a significant cost incidence with 14% of the total cost which was also with a major share of indirect cost. Community engagement activity and health education through NGO counsellors were the two area specific interventions and accounted for 4% and 3% of the total cost respectively.

Table 12: Activity based cost of the programme for urban slums and street dwellers (ward 26 & 30, DNCC, Dhaka) for year 2024

Activities	Direct cost (BDT)	Direct cost (USD)	Indirect cost (BDT)	Indirect cost (USD)	Total cost (BDT)	Total cost (USD)	% share of total cost
Skill development training	187,809	1,539	2,407	20	190,216	1,559	8%
Modified EPI sessions: Additional sessions	21,940	180	291,591	2,389	313,531	2,569	14%
Modified EPI sessions: Evening sessions	185,414	1,519	562,843	4,612	748,257	6,131	33%
Community awareness through BCC materials	7,931	65	-	-	7,931	65	0.3%
Community engagement (Landlord, club/committee member, Imam etc.)	-	-	95,891	786	95,891	786	4%
Health education through NGO counsellors	-	-	64,528	529	64,528	529	3%
Administration and monitoring	799,035	6,547	52,473	430	851,507	6,977	37%
Total cost	1,202,128	9,849	1,069,733	8,765	2,271,861	18,614	100%

Programme office: The following table (**Table 13**) presents the total cost of the programme office and other central level costs for implementing the interventions across the six intervention areas from the start-up phase till the end of first implementation year i.e. 2024. As the table depicts, the administration and monitoring activities incurred the largest cost of BDT 14,206,726 (USD 116,401) which was 80% of the total cost. Skill development training management and preparatory activities also occupied a significant cost share with 14% of the total cost. With a large share of direct cost, the total central level cost amounted to BDT 17,700,362 (USD 145,025) for this time period.

Table 13: Activity based cost of the programme for programme office and central others for year 2024

Activities	Direct cost (BDT)	Direct cost (USD)	Indirect cost (BDT)	Indirect cost (USD)	Total cost (BDT)	Total cost (USD)	% share of total cost
Skill development training management and other preparatory activities	2,469,143	20,231	31,187	256	2,500,329	20,486	14%
Development and management of E-screening checklist	282,009	2,311	16,477	135	298,486	2,446	2%
Development and management of BCC materials	94,256	772	3,594	29	97,850	802	0.5%
Development and management of E-supervision checklist	282,009	2,311	16,477	135	298,486	2,446	2%
Database management and maintenance	282,009	2,311	16,477	135	298,486	2,446	2%
Administration and monitoring	12,683,046	103,917	1,523,680	12,484	14,206,726	116,401	80%
Total cost	16,092,471	131,851	1,607,891	13,174	17,700,362	145,025	100%

Total programme cost (considering both start-up and implementation cost):

The following table (**Table 14**) represents the overall total cost of programme from the start-up phase till the end of first implementation year i.e. 2024. Overall, administrative and monitoring activities accounted for the largest cost share of BDT 22,094,717 (USD 181,030). However, among the interventions and related activities, skill development training incurred the highest cost share with 15% of total cost followed by the modified EPI sessions cost which in total amounts to 4% of the total cost. E-screening checklist cost and cost of involving existing NGO community worker were also significant with each occupying 2% of the total cost. The total cost of programme implementation amounted to BDT 30,507,644 (USD 249,960) during this time period. Across areas, the highest overall cost was incurred at the central level, followed by HTR hilly area and urban Dhaka's intervention area. From the resource utilizations point of view (**Table 19**), 98% of the total were recurrent costs with HR as the largest cost incurring item across all the areas occupying 63% of the total programme cost, followed by honorariums/allowances (10%), venue/facility (7%), and transportation (7%) costs. Although overall indirect costs were lower than the direct costs, the capital cost items incurred higher indirect costs than the direct ones.

Table 14: Overall total annual activity based cost of the programme (including both start-up and implementation), 2024

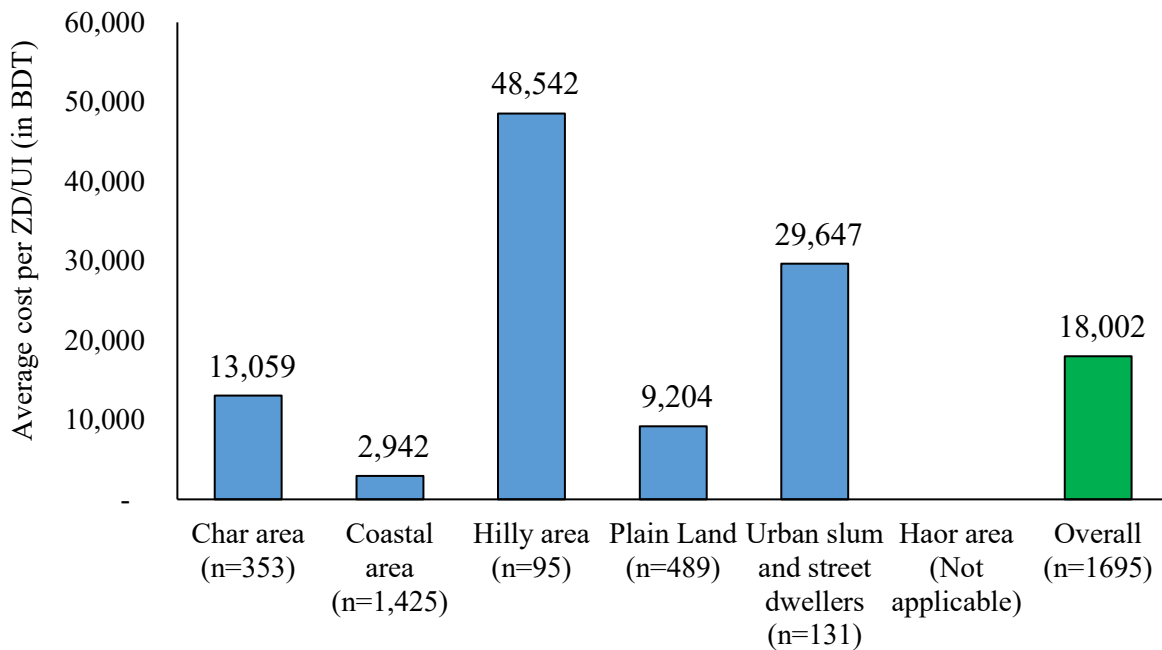
Activities	Direct cost (BDT)	Direct cost (USD)	Indirect cost (BDT)	Indirect cost (USD)	Total cost (BDT)	Total cost (USD)	% share of total cost
Skill development training	4,383,130	35,913	84,146	689	4,467,276	36,602	15%
Use of E-screening checklist	401,745	3,292	304,372	2,494	706,117	5,785	2%
Modified EPI sessions: Crash programme	136,646	1,120	17,365	142	154,011	1,262	1%
Modified EPI sessions: Additional sessions	97,691	800	351,404	2,879	449,095	3,680	1%
Modified EPI sessions: Evening sessions	185,414	1,519	562,843	4,612	748,257	6,131	2%
Community awareness through BCC materials	141,841	1,162	3,594	29	145,435	1,192	0.5%
Advocacy with community leaders	50,310	412	40,106	329	90,417	741	0.3%
Strengthen EPI support groups (TBAs, IMAMs, Students, UP members etc.)	-	-	25,507	209	25,507	209	0.1%
Involvement of existing NGO community worker	-	-	642,521	5,264	642,521	5,264	2%
Health education through CHCP	-	-	103,962	852	103,962	852	0.3%

Activities	Direct cost (BDT)	Direct cost (USD)	Indirect cost (BDT)	Indirect cost (USD)	Total cost (BDT)	Total cost (USD)	% share of total cost
E-supervision checklist	282,009	2,311	94,478	774	376,487	3,085	1%
Conduct courtyard meeting	-	-	44,939	368	44,939	368	0.1%
Community engagement (Landlord, club/committee member, Imam etc.)	-	-	95,891	786	95,891	786	0.3%
Health education through NGO counsellors	-	-	64,528	529	64,528	529	0.2%
Database maintenance	282,009	2,311	16,477	135	298,486	2,446	1%
Administration and monitoring	20,004,701	163,906	2,090,016	17,124	22,094,717	181,030	72%
Total cost	25,965,496	212,745	4,542,148	37,215	30,507,644	249,960	100%

Average implementation cost per ZD/UI child:

Figure 1 presents the average cost per ZD and UI child reached for the six intervention areas in total as well as for each intervention areas separately. After adjusting the central level cost across intervention areas, the area specific cost of the programme and average cost per ZD & UI child reached for the individual intervention areas were estimated. With a comparatively smaller overall population size, HTR hilly area had a very low number of target population and hence a lower number of ZD & UI children reached (n=95), compared to the other areas. The hard-to-reach hilly areas (Kawkhali, Rangamati district) had the highest cost per child reached at BDT 48,542 (USD 398). On the other hand, the HTR coastal area (Hatiya, Noakhali district) had the highest number of children (n=1,425) reached with a relatively higher target population and had the lowest cost per child reached at BDT 2,942 (USD 24). The plain land intervention area (Nalitabari, Sherpur district) also had a higher target population and a relatively higher number of children reached and resulted in the second-lowest cost per child reached at BDT 9,204 (USD 75). However, the haor area observed a net reduction in vaccine coverage and thus the average cost per child reached was not estimated for this area. Using the overall net increase in vaccine coverage, the overall average cost per child reached was estimated at BDT 18,002 (USD 147).

Figure 1: Average cost per ZD/UI reached by intervention area, 2024



The following table (**Table 15**) represents the net effect of the ZD/UI programme. Coverage of first, second and third dose of pentavalent vaccine increased by 0.9%, 0.7% and 2.2% respectively. The net effect observed in the first dose depicts the reduction in ZD prevalence and that of the second and third dose depicts the reduction in respective UI prevalence.

Table 15: Net effect of the ZD/UI programme for selected outcomes

Outcome			Penta-1 (%)		Penta-2 (%)		Penta-3 (%)	
Area	Baseline (n)	Endline (n)	Baseline	Endline	Baseline	Endline	Baseline	Endline
Intervention	6362	6459	97.7	97.5	93.2	92.2	85.7	84.2
Control	6394	6515	98.4	97.3	94.2	91.6	87.4	82.1
Net effect				0.9		0.7		2.2*

Statistical significance: * <0.05

Interpretation: DID = (Endline-Baseline)_{intervention} - (Endline-Baseline)_{comparison}

(+) indicates positive effect of intervention and (-) indicates negative impact of intervention

Cost-effectiveness estimation:

Table 16 represents the estimated total DALY averted by the programme and also the cost-effectiveness of the programme. A total of 566 DALYs were averted and cost per DALY averted was BDT 53,934 (USD 442) which represents the ICER value. The cost per DALY averted was less than one times the GDP per capita at current price for FY 2024-2025 (i.e. BDT 339,211 or USD 2,820) and thus the programme is likely to be highly cost-effective (20,21).

Table 16: Cost and cost-effectiveness of reaching ZD/UI child, 2024

	Outputs	Cost BDT (USD)
DALY averted by ZD & UI programme (compared to no intervention scenario)	566	
Total programme cost		30,507,644 (249,960)
ICER (cost per DALY averted)		53,934 (442)
GDP per Capita for Bangladesh, FY 2024-25		339,211 (2,820)

Discussion

The study assessed the programme cost of selected interventions to reach ZD and UI children across six geographically distinct areas of Bangladesh and carried out an economic evaluation of the programme to comment on their overall cost effectiveness.

The estimated total cost of implementing the interventions in all six areas amounted to BDT 30,507,644 (USD 249,960) over a one-year period where start-up phase cost occupied 27% of the share and implementation phase cost occupied the rest 73% cost. The major share of start-up cost (75%) was concentrated at the central level as expected and activities related to skill development, administration and management were the main cost drivers in this phase.

The ZD/UI programme implementation did not require any major resources in terms of capital items at the implementation areas and were implemented with incremental use of existing resources where necessary. The interventions were, thus, not capital intensive with respect to resource use. The major cost share of the 2% capital cost used in implementation phase, was mostly observed at the central level. Salary, honorarium & allowances, transportation resources etc. were the major cost drivers in the implementation phase. At the intervention areas, implementing agency icddr,b employed one monitoring staff per area and they were the only additional staff engaged in the ZD/UI programme implementation. All other implementation activities were carried out by the existing EPI and other field level staff enhancing the programme's prospect in terms of sustainability.

As a result, a major share of the area specific HR cost for implementation of the interventions was in the form of indirect cost taking account of their additional time commitment. This also explains the variation in cost share across the intervention areas i.e. areas with higher human resource involvement for the intervention incurred higher costs. However, at the central level, the HR cost was mostly the central programme staff costs and thus were direct costs to the programme. The lower use of additional resources at the implementation areas resulted in a lower cost share at the field level and as a result, the major cost incidence was observed at the central level. The administrative and monitoring activities accounted for 83% share of the total cost in the implementation phase.

Further, the higher cost share of honorarium & allowance in programme implementation is noticeable. Emphasis on monitoring and supervision of the intervention involved regular meetings at the sub-national or district as well as national level. This contributed significantly to a higher incidence of honorarium & allowance cost along with costs associated with transportation and food/refreshment.

While comparing programme cost among the six different areas, we observed that the intervention areas of Dhaka district i.e. urban slum and street dwellers, observed the lowest cost mostly due to low transportation and allowance expenses for the sub-national committee meeting compared to the other areas.

Apart from the administrative and skill development activities, use of e-screening checklist and modified EPI sessions were some of the significant cost driving activities. The e-screening checklist was implemented in five of the six intervention areas and modified EPI sessions were implemented in all six areas though in different forms i.e. crash programmes, additional sessions and evening sessions. Though, evening session was implemented in urban slum areas only, it incurred a significant cost compared to the additional sessions and crash programmes. Comparatively higher opportunity cost of venue for sessions

was a key factor behind this increased cost. Also, a wide variation of e-screening cost across implementation areas was observed, which was mostly due to the variation in HR deployment process for the activity.

Among the other area specific interventions, community awareness through involvement of NGO community worker, using e-supervision checklist and health education through Community Health Care Providers ranked higher respectively in terms of cost mostly due to their higher frequency of incidence or increased number of HR involvement. A total of 36 NGO community workers were involved in the HTR hilly areas (Kawkhali, Rangamati district) and approximately 240 health education sessions were conducted in the HTR coastal areas (Hatiya, Noakhali district) during the implementation period. This resulted in significant indirect cost share for these two areas.

Finally, after adjusting the central level costs across the intervention areas, the HTR coastal areas (Hatiya, Noakhali) had the highest number of ZD and UI child reached and thus the lowest cost per child reached (BDT 2,942 or USD 24) whereas, HTR hilly areas (Kawkhali, Rangamati) had the lowest number of ZD and UI child reached and thus the highest average cost per child reached (BDT 48,542 or USD 398). Although, the area specific programme costs had minimum variation, the average cost per ZD and UI child reached varied across the intervention areas mostly due to their difference in target population. Besides, five of the six intervention areas are HTR areas with different geographic, socioeconomic, cultural, political and system constraints, each area faces different types of observed and unobserved implementation challenges. As a result, the observed variation in output may also have been due to several factors influencing the implementation dynamics of the concern areas. This highlights the importance of resource allocation in immunization being responsive to the need of specific target areas to ensure no one is left behind. Despite significant effort, the HTR *haor* area with distinct geographic characteristics along with other systematic challenges experienced a reduction in net coverage change in the post implementation phase. Given this, there is urgent need to identify context specific challenges and design interventions accordingly. Our estimated incremental cost effectiveness ratio (ICER) was BDT 53,934 (USD 442) per DALY averted and comparing with the GDP per capita threshold (i.e. USD 2,820), the overall programme was deemed highly cost-effective. This exhibits great potential in terms of sustainability and future level scale up opportunity for the programme in reducing the ZD and UI prevalence among the missed communities in Bangladesh.

While, studies assessing the cost effectiveness of IRMMA framework or other similar interventions are scarce, a few studies have estimated the cost per additional dose and cost per child reached for programmes to increase immunization coverage and reduce ZD/UI children. A scoping review found a cost range from USD 0.08 per additional dose for a cellular phone contact to encourage return visits in Kenya to USD 67 per dose for cash transfers conditional on children's preventive health visit and mother's health education talk attendance in Nicaragua. The median intervention cost per additional dose was found to be USD 3.72 (22). Another study on the periodic intensification of routine immunization in India estimated an incremental cost of US\$83 per ZD child, with district-level estimates ranging from US\$22 to US\$193.17 and a cost of \$327.63 (\$147.65 to dominated) per DALY averted (23). In Uganda, a costing study found that identifying and reaching ZD and UI children through house-to-house registration and targeted immunisation outreaches costed USD 3.07 per ZD child identified (range: USD 1.33 to 5.75) and USD 14 per ZD child vaccinated (range: USD 8.98 to 85.18) (24).

The contexts, components and reach of the programme and the implementation strategies differ across these studies which doesn't allow direct comparison between the outcomes. However, they offer a useful benchmark for comparing the cost estimates of our current study. Relative to these findings, this study

incurred a higher cost for reaching ZD/UI children and averting DALY. However, this is largely explained by the programme design, the challenging nature of the implementation areas, characterized by hard-to-reach geographic context, varying population sizes and densities and by the fact that the intervention was implemented as a pilot by an external entity rather than within the national EPI system. These factors contributed to additional cost burdens that would not persist under a scaled-up, system-integrated model. Consequently, scaling up this cost-effective intervention within the existing EPI platform is likely to substantially reduce costs, leading to an even lower cost per DALY averted, further strengthening its cost-effectiveness.

Conclusion

Our estimates identified the ZD/UI programme to be potentially cost-effective at the current coverage level. The estimates also indicate that the programme can potentially reach economies of scale during scale-up as the start-up costs and the central level costs are mostly fixed despite the coverage level leading to decreasing marginal cost as coverage increases. The estimates highlight the need to consider context-specific variation in resource requirement and thereby prepare investment plans accordingly to ensure effective coverage for all geographic locations ensuring “no one is left behind”. The interventions entail significant resource requirement for administrative and monitoring activities. More cost-saving options for these activities and a fully functional public healthcare system at PHC level can result in further cost-savings to reach ZD/UI children and enhance the efficiency of the interventions.

The estimates presented in the current report quantifies the specific costs associated with the activities related to reaching ZD/UI children, particularly in HTR areas of the country. The estimates will help identifying funding gaps and developing a rational budget for a strategic investment decision. The required resource input can also be linked to immunization output to monitor programme performance and hence enhance accountability in the system. Investing in ZD/UI elimination interventions have myriad economic benefits as evidenced through earlier studies. Following are few that would strengthen the case for investing in ZD/UI elimination initiatives:

Investing in reducing the rate of ZD/UI can result in:

- a. Increased productivity: Full immunization has positive impact on the cognitive capacity and school attainment of children as shown in earlier studies (25,26). This can potentially result in increased productivity and higher income as adults. Overall, decreased ZD/UI will mean healthier workforce for future and will result in increased productivity in the labor market resulting in higher return on investment in reducing ZD/UI (27).
- b. Reducing inequity in the society: ZD/UI children and their families face myriad socioeconomic deprivations including those in terms of education, wealth, water, sanitation and hygiene, nutrition, and access to other health services (28). Investing in eliminating ZD/UI will benefit in terms of reducing inequities in the society.
- c. Reducing economic inequality: Majority of the ZD/UI children are from lower socioeconomic households. Ensuring full immunization coverage among these households will result in reducing economic inequality in the communities (29).
- d. Reducing financial burden of healthcare: In LMICs, the cost to manage pediatric infectious illness can rapidly escalate in presence of high rates of ZD/UI and can potentially cost up to 75% of a household’s monthly income (30). Investing in reducing ZD/UI can reduce the financial burden on

households and thereby reduce the percentage of households experiencing catastrophic healthcare expenses.

- e. Reduced burden on health systems: Reduced burden of vaccine preventable and other related diseases for under-five children will result in reduced service requirement at the healthcare facilities. This will eventually reduce the burden on healthcare system of the country (31).
- f. Meeting sustainable development goal:
 - i. Reaching ZD/UI child is critical to achieving the sustainable development goals' commitment to "leaving no one behind" (31).
 - ii. Reduced under-five mortality: The potential impact of reaching ZD/UI children goes beyond vaccine-preventable diseases. Studies have shown one-third of all cause under-five mortality takes place in ZD/UI households. Thus, investing in interventions to reach ZD/UI will have potential impact on reducing under-five mortality (31).

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Annex

Table 17: Start-up phase cost across intervention areas with respect to resources

Category	Sherpur, Nalitabari BDT (USD)	Gaibandha, Saghata BDT (USD)	Sunamganj, Dowarabazar BDT (USD)	Rangamati, Kawkhali BDT (USD)	Noakhali, Hatiya BDT (USD)	Ward 26 & 30, DNCC BDT (USD)	Central and others BDT (USD)	Total Direct BDT (USD)	Total Indirect BDT (USD)	Total BDT (USD)	% of total
Capital											
Equipment							65,842 (539)		65,842 (539)	65,842 (539)	1%
Furniture & Others							57,940 (475)		57,940 (475)	57,940 (475)	1%
<i>Total capital cost</i>							123,782 (1,014)		123,782 (1,014)	123,782 (1,014)	2%
Human resource	-	-	-	-	-	-	5,814,149 (47,637)	5,814,149 (47,637)		5,814,149 (47,637)	72%
Honorarium/ Allowances	257,415 (2,109)	163,692 (1,341)	158,757 (1,301)	152,739 (1,251)	203,050 (1,664)	53,200 (436)	108,205 (887)	1,097,058 (8,989)		1,097,058 (8,989)	14%
Transportation Resources	68,956 (565)	43,567 (357)	34,269 (281)	98,651 (808)	4,116 (34)	12,036 (99)	26,590 (218)	288,186 (2,361)		288,186 (2,361)	4%
Materials	25,129 (206)	11,452 (94)	9,912 (81)	9,952 (82)	20,859 (171)	4,682 (38)	63,515 (520)	145,501 (1,192)		145,501 (1,192)	2%
Venue/Facility usage cost	14,443 (118)	7,222 (59)	7,222 (59)	10,833 (89)	10,833 (89)	2,407 (20)	29,940 (245)		82,899 (679)	82,899 (679)	1%
Other Resources	93,208 (764)	69,557 (570)	47,808 (392)	44,432 (364)	77,435 (634)	57,283 (469)	158,065 (1,295)	547,787 (4,488)		547,787 (4,488)	7%
<i>Total recurrent cost</i>	459,152 (3,762)	295,490 (2,421)	257,968 (2,114)	316,605 (2,594)	316,292 (2,591)	129,608 (1,062)	6,200,464 (50,803)	7,892,680 (64,668)	82,899 (679)	7,975,579 (65,347)	98%
Grand total	459,152 (3,762)	295,490 (2,421)	257,968 (2,114)	316,605 (2,594)	316,292 (2,591)	129,608 (1,062)	6,324,246 (51,817)	7,892,680 (64,668)	206,681 (1,693)	8,099,361 (66,361)	100%

Table 18:Implementation phase cost across intervention areas with respect to major resources for year 2024

Category	Sherpur, Nalitabari BDT (USD)	Gaibandha, Saghata BDT (USD)	Sunamganj, Dowarabazar BDT (USD)	Rangamati, Kawkhali BDT (USD)	Noakhali, Hatiya BDT (USD)	Ward 26 & 30, DNCC BDT (USD)	Central and others BDT (USD)	Total Direct BDT (USD)	Total Indirect BDT (USD)	Total BDT (USD)	% of total
Capital											
Equipment	5,758 (47)	5,299 (43)	3,327 (27)	12,274 (101)	22,019 (180)	7,941 (65)	269,107 (2,205)	4,795 (39)	320,931 (2,630)	325,726 (2,669)	1%
Furniture & Others	2,118 (17)	867 (7)	209 (2)	7,004 (57)	3,344 (27)	1,700 (14)	151,304 (1,240)	7,146 (59)	159,400 (1,306)	166,547 (1,365)	1%
<i>Total capital cost</i>	7,876 (65)	6,167 (51)	3,536 (29)	19,278 (158)	25,363 (208)	9,641 (79)	420,412 (3,445)	11,941 (98)	480,332 (3,936)	492,273 (4,033)	2%
Recurrent											
Salary	913,548 (7,485)	824,452 (6,755)	335,145 (2,746)	1,808,857 (14,821)	746,133 (6,113)	656,645 (5,380)	8,259,284 (67,671)	11,854,348 (97,127)	1,689,716 (13,844)	13,544,064 (110,971)	60%
Honorarium/ Allowances	267,461 (2,191)	388,867 (3,186)	434,291 (3,558)	238,445 (1,954)	300,014 (2,458)	211,295 (1,731)	24,275 (199)	1,704,048 (13,962)	160,599 (1,316)	1,864,648 (15,278)	8%
Transportation Resources	100,927 (827)	252,857 (2,072)	286,643 (2,349)	430,621 (3,528)	158,738 (1,301)	121,983 (999)	400,785 (3,284)	1,720,255 (14,095)	32,300 (265)	1,752,554 (14,359)	8%
Materials	85,628 (702)	65,520 (537)	103,175 (845)	66,782 (547)	70,862 (581)	85,499 (701)	209,918 (1,720)	681,761 (5,586)	5,622 (46)	687,383 (5,632)	3%
Venue/Facility usage cost	19,810 (162)	5,530 (45)	5,893 (48)	7,746 (63)	18,383 (151)	821,124 (6,728)	1,042,665 (8,543)		1,921,150 (15,741)	1,921,150 (15,741)	9%
Food/Refreshment	121,380 (995)	118,949 (975)	151,710 (1,243)	114,465 (938)	91,086 (746)	161,076 (1,320)	60,633 (497)	779,490 (6,387)	39,811 (326)	819,300 (6,713)	4%
Overhead							608,905 (4,989)	608,905 (4,989)		608,905 (4,989)	3%
Vaccine	30,547 (250)	38,231 (313)	37,250 (305)	23,704 (194)	120,515 (987)	67,020 (549)		317,267 (2,599)		317,267 (2,599)	1%
Utilities	578 (5)	397 (3)	530 (4)	1,169 (10)	390 (3)	539 (4)	247,347 (2,027)	247,347 (2,027)	3,602 (30)	250,949 (2,056)	1%
Communication	785 (6)	621 (5)	1,278 (10)	1,278 (10)	1,278 (10)	823 (7)	101,893 (835)	105,621 (865)	2,335 (19)	107,956 (885)	0.5%
Other Resources	6,607 (54)	8,797 (72)	6,607 (54)	6,607 (54)	6,607 (54)	6,607 (54)		41,834 (343)		41,834 (343)	0.2%
<i>Total recurrent cost</i>	1,547,272 (12,677)	1,704,220 (13,963)	1,362,522 (11,164)	2,699,673 (22,119)	1,514,006 (12,405)	2,132,613 (17,473)	10,955,704 (89,764)	18,060,875 (147,979)	3,855,135 (31,587)	21,916,010 (179,566)	98%
Grand total	1,555,148 (12,742)	1,710,387 (14,014)	1,366,059 (11,193)	2,718,951 (22,277)	1,539,369 (12,613)	2,142,253 (17,552)	11,376,116 (93,209)	18,072,816 (148,077)	4,335,467 (35,522)	22,408,283 (183,599)	100%

Table 19: Total programme cost across intervention areas with respect to resources for year 2024

Capital	Sherpur, Nalitabari BDT (USD)	Gaibandha, Saghata BDT (USD)	Sunamganj, Dowrabazar BDT (USD)	Rangamati, Kawkhali BDT (USD)	Noakhali, Hatiya BDT (USD)	Ward 26 & 30, DNCC BDT (USD)	Central and others BDT (USD)	Direct BDT (USD)	Indirect BDT (USD)	Total BDT (USD)	% of total
Equipment	5,758 (47)	5,299 (43)	3,327 (27)	12,274 (101)	22,019 (180)	7,941 (65)	334,950 (2,744)	4,795 (39)	386,774 (3,169)	391,569 (3,208)	1%
Furniture & Others	2,118 (17)	867 (7)	209 (2)	7,004 (57)	3,344 (27)	1,700 (14)	209,244 (1,714)	7,146 (59)	217,340 (1,781)	224,486 (1,839)	1%
Total capital cost	7,876 (65)	6,167 (51)	3,536 (29)	19,278 (158)	25,363 (208)	9,641 (79)	544,194 (4,459)	11,941 (98)	604,114 (4,950)	616,055 (5,048)	2%
Salary	913,548 (7,485)	824,452 (6,755)	335,145 (2,746)	1,808,857 (14,821)	746,133 (6,113)	656,645 (5,380)	14,073,432 (115,309)	17,668,496 (144,764)	1,689,716 (13,844)	19,358,212 (158,609)	63%
Honorarium/Per diem/Allowances	524,876 (4,301)	552,559 (4,527)	593,049 (4,859)	391,184 (3,205)	503,064 (4,122)	264,495 (2,167)	132,480 (1,085)	2,801,107 (22,950)	160,599 (1,316)	2,961,706 (24,266)	10%
Transportation Resources	169,883 (1,392)	296,424 (2,429)	320,913 (2,629)	529,271 (4,337)	162,855 (1,334)	134,020 (1,098)	427,375 (3,502)	2,008,441 (16,456)	32,300 (265)	2,040,740 (16,721)	7%
Materials	110,757 (907)	76,972 (631)	113,087 (927)	76,733 (629)	91,721 (752)	90,181 (739)	273,433 (2,240)	827,261 (6,778)	5,622 (46)	832,884 (6,824)	3%
Venue/Facility usage cost	34,253 (281)	12,751 (104)	13,114 (107)	18,579 (152)	29,215 (239)	823,531 (6,747)	1,072,605 (8,788)	0	2,004,049 (16,420)	2,004,049 (16,420)	7%
Food/Refreshment	121,380 (995)	118,949 (975)	151,710 (1,243)	114,465 (938)	91,086 (746)	161,076 (1,320)	60,633 (497)	779,490 (6,387)	39,811 (326)	819,300 (6,713)	3%
Overhead	0	0	0	0	0	0	608,905 (4,989)	608,905 (4,989)	0	608,905 (4,989)	2%
Vaccine	30,547 (250)	38,231 (313)	37,250 (305)	23,704 (194)	120,515 (987)	67,020 (549)	0	317,267 (2,599)	0	317,267 (2,599)	1%
Utilities	578 (5)	397 (3)	530 (4)	1,169 (10)	390 (3)	539 (4)	247,347 (2,027)	247,347 (2,027)	3,602 (30)	250,949 (2,056)	1%
Communication	785 (6)	621 (5)	1,278 (10)	1,278 (10)	1,278 (10)	823 (7)	101,893 (835)	105,621 (865)	2,335 (19)	107,956 (885)	0.40%
Other Resources	99,815 (818)	78,354 (642)	54,415 (446)	51,039 (418)	84,042 (689)	63,890 (523)	158,065 (1,295)	589,620 (4,831)	0	589,620 (4,831)	2%
Total recurrent cost	2,006,424 (16,439)	1,999,711 (16,384)	1,620,490 (13,277)	3,016,278 (24,713)	1,830,299 (14,996)	2,262,220 (18,535)	17,156,168 (140,567)	25,953,555 (212,647)	3,938,035 (32,266)	29,891,589 (244,913)	98%
Grand total	2,014,300 (16,504)	2,005,877 (16,435)	1,624,026 (13,306)	3,035,557 (24,871)	1,855,661 (15,204)	2,271,861 (18,614)	17,700,362 (145,025)	25,965,496 (212,745)	4,542,148 (37,215)	30,507,644 (249,960)	100%