ANALYSIS OF THE COST OF COVID-19 VACCINE DELIVERY AT SELECTED SITES IN BANGLADESH

STUDY REPORT | JANUARY 2024

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This study was conducted in collaboration with the Expanded Program on Immunization (EPI) of the Directorate General of Health Services (DGHS), with the support of the Planning and Research Unit of the Directorate General of Health Services (DGHS), Public Health Wing, Ministry of Health and Family Welfare (MOHFW), as well as various development partners.

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ACRONYMS

AEFI	Adverse Event Following Immunization
BDRCS	Bangladesh Red Crescent Society
C19	COVID-19
CCE	Cold Chain Equipment
COVAX	COVID-19 Vaccines Global Access
DGHS	Directorate General of Health Services
DGDA	Directorate General of Drug Administration
EPI	Expanded Program on Immunization
IFRC	International Federation of Red Cross and Red Crescent Societies
MOF	Ministry of Finance
MOHFW	Ministry of Health and Family Welfare
NDVP	National Deployment and Vaccination Plan
NITAG	National Immunization Technical Advisory Group
OP	Operational Plan
PMO	Prime Minister's Office
UCC	Ultra-cold chain
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WHO	World Health Organization

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EXECUTIVE SUMMARY

RATIONALE

The COVID-19 (C19) pandemic underscored the need for cost evidence on delivering C19 vaccines to inform efficient resource allocation, financial planning, program sustainability, and planning for future outbreaks.
To support the Government of Bangladesh (GOB), ThinkWell conducted a comprehensive study to generate essential cost evidence on the delivery of C19 vaccines in Bangladesh between the launch in February 2021 until November 2022, using a range of delivery strategies, and in the context of constraints in vaccine supply, and evolving target populations. The study estimates delivery costs from a payer perspective, as well as cost incurred by beneficiaries, maps funding flows, and analyzes the operational and financial challenges of the C19 vaccination program.

METHODOLOGY

This was a bottom-up (or ingredients-based) micro-costing study of C19 vaccine delivery through fixed vaccination sites, and temporary sites. Fixed sites included ministry of health (MOH) hospital-based sites, non-MOH government hospitals, and outreach EPI centers, and temporary sites included school-based and mass campaign sites. The study included start-up and recurrent costs incurred by the government and partners for all relevant activities including service delivery, social mobilization, supervision, training, vaccine transport, waste management, and recordkeeping. The study also considered costs incurred by beneficiaries to receive a C19 vaccine dose at fixed sites, such as for transport, food, managing side effects, registering, and printing vaccination certificates, as well as the opportunity cost of their time spent.
Data covered the full financial and economic cost incurred at fixed sites and the Expanded Program on Immunization (EPI) headquarters from April to June 2022, and specific time periods for temporary sites between November 2021 and November 2022, as well as labor data for fixed sites from February 2021 to March 2022.

In addition, monthly labor cost data was collected for all fixed sites from the entire period from the launch of the C19 vaccination program in February 2021 until June 2022. Data was collected from 38 vaccination sites, EPI headquarters, and from the key implementing partners World Health Organization (WHO) and UNICEF, through a partnership between ThinkWell and the Institute of Health Economics (IHE). Beneficiary cost estimates were based on a sample of 110 exit interviews conducted at 6 fixed sites. From all sites and from national level stakeholders, qualitative data was gathered on the operational and financial challenges of the C19 vaccination program, funding flows, and lessons learned.

THE C19 VACCINATION PROGRAM IN BANGLADESH

The C19 vaccination program in Bangladesh was launched in February 2021, targeting 80% of the population. The program began by prioritizing frontline workers, priority groups, and individuals aged 60 and above. Thanks to support from local administrations, public representatives, offices of different ministries, and law enforcement agencies, the C19 vaccination program was quickly accepted by the population. Eligibility widened to include all persons over the age of 12 by October 2021, and by June 2022, 83% of the population had received two doses. In August 2022, vaccination opened up to 5–11-year-old children, and in December 2022, a fourth dose was added. In 2023, vaccination coverage stagnated as C19 infections dropped, but in January 2024, a new vaccination campaign targeting health workers and other priority groups was announced.

Initially, the program only used hospital-based vaccination sites. Over time, outreach and temporary sites were added, but hospital-based delivery remained the primary delivery strategy. The EPI headquarters organized in-person and virtual trainings to roll out the C19 vaccination program.

Vaccination sites could not hire additional staff, and the C19 vaccination program in Bangladesh relied exclusively on its existing health workforce and volunteers. Volunteers from the local community supported vaccination sites in screening, crowd controlling and mobilizing, and record-keeping, for which they received allowances.

The Ministry of Health and Family Welfare, specifically the Directorate General of Health Services and the EPI headquarters, holds primary responsibility for program execution. It plays a central role in ensuring vaccine quality, safety, administration, and overall program oversight. The Prime Minister's Office provides overarching guidance. Collaboration with global entities such as the WHO and UNICEF led to the development of the National Deployment and Vaccination Plan, a strategic framework for effective program execution. Various committees and working groups, both at national and sub-national levels, were established to facilitate planning, coordination, and implementation. Stakeholder collaboration was a key element in ensuring the success of the COVID-19 vaccination program.

Funding for the COVID-19 vaccination program was sourced from government allocations, loans, and donations from international organizations. The program was primarily funded through two mechanisms: the operating and development budget of the GOB, and the development budget consisting of loans and grants from development partners. The World Bank, Asian Development Bank, European Investment Bank, and USAID contributed to cover operational costs, particularly for organizing nationwide mass vaccination campaigns. UNICEF and WHO were major contributors in supporting training, cold chain infrastructure, vaccine transportation, social mobilization, advocacy, and supervision activities. Several other partners, such as Save the Children, BDRCS, and BRAC, provided financial and in-kind support. Despite the significant support from partners, the total financial assistance received by Bangladesh by the end of 2022 was relatively small compared to the scale of the vaccination program and the number of doses delivered.

ENABLERS IN THE IMPLEMENTATION OF THE C19 VACCINATION PROGRAM

- The rollout of the C19 vaccination program was a success due to strong leadership, clear direction, and effective collaboration across all the GOB institutions involved.
- The C19 vaccination program was able to leverage the existing infrastructure of the EPI, and the high level of trust that communities have in the routine EPI program.
- A common sense of urgency meant that the C19 vaccination program could count on a tremendous amount of support from local leaders, institutions, and volunteers.
- Financial and in-kind support along with technical assistance from development partners played a key role in rolling out the C19 vaccination program, and off-budget financing mechanisms ensured funds were available in a timely manner.
- Health facility managers and workers were strongly motivated to ensure the continuous operation of the vaccination program despite resource constraints

CHALLENGES IN THE IMPLEMENTATION OF THE C19 VACCINATION PROGRAM

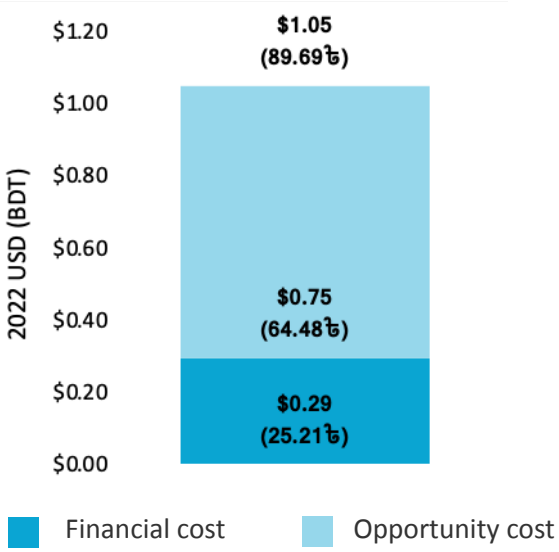
- Staff shortages at temporary vaccination sites placed a high burden on a health workforce that was already stretched pre-pandemic.
- Supply issues complicated implementation and posed challenges for program management and campaign preparations at all levels.
- The transportation of temperature-sensitive vaccines faced challenges due to limited availability of locally accessible air-conditioned vehicles and spaces, especially at site level.
- When the GOB enforced mandatory C19 vaccination, the countrywide vaccination rollout added considerable pressure on vaccination sites.
- Inadequacy of funds caused challenges in several programmatic areas at implementation sites, and reduced morale among health workers.
- The GOB funds that were committed for program activities were not disbursed in a timely manner, which resulted in challenges at implementation level.
- Complex financial management regulations and reporting systems challenged the financing of programmatic activities.

THE COST OF C19 VACCINE DELIVERY

Cost incurred by the health system

The financial delivery cost per C19 vaccine dose, excluding the cost of the vaccine, across all delivery strategies was $0.29 (25.21৳). Across delivery strategies, the financial cost varied from $0.27 (22.81৳) per dose for school-based delivery to $0.44 (37.74৳) per dose for outreach at EPI centers. Delivery strategies through which more C19 vaccine doses were administered on a daily basis incurred a lower cost per dose. Temporary sites required additional resources for logistics but due to the very high volume delivered still achieved lower costs per dose than fixed sites. Volunteer allowances were the key driver of the financial cost per dose, accounting for 31% to 62%. Other financial cost drivers included vaccine injection and safety supplies (13%-18%) and honorarium paid to health staff (5%-15%).

Figure A. Economic delivery cost per dose†



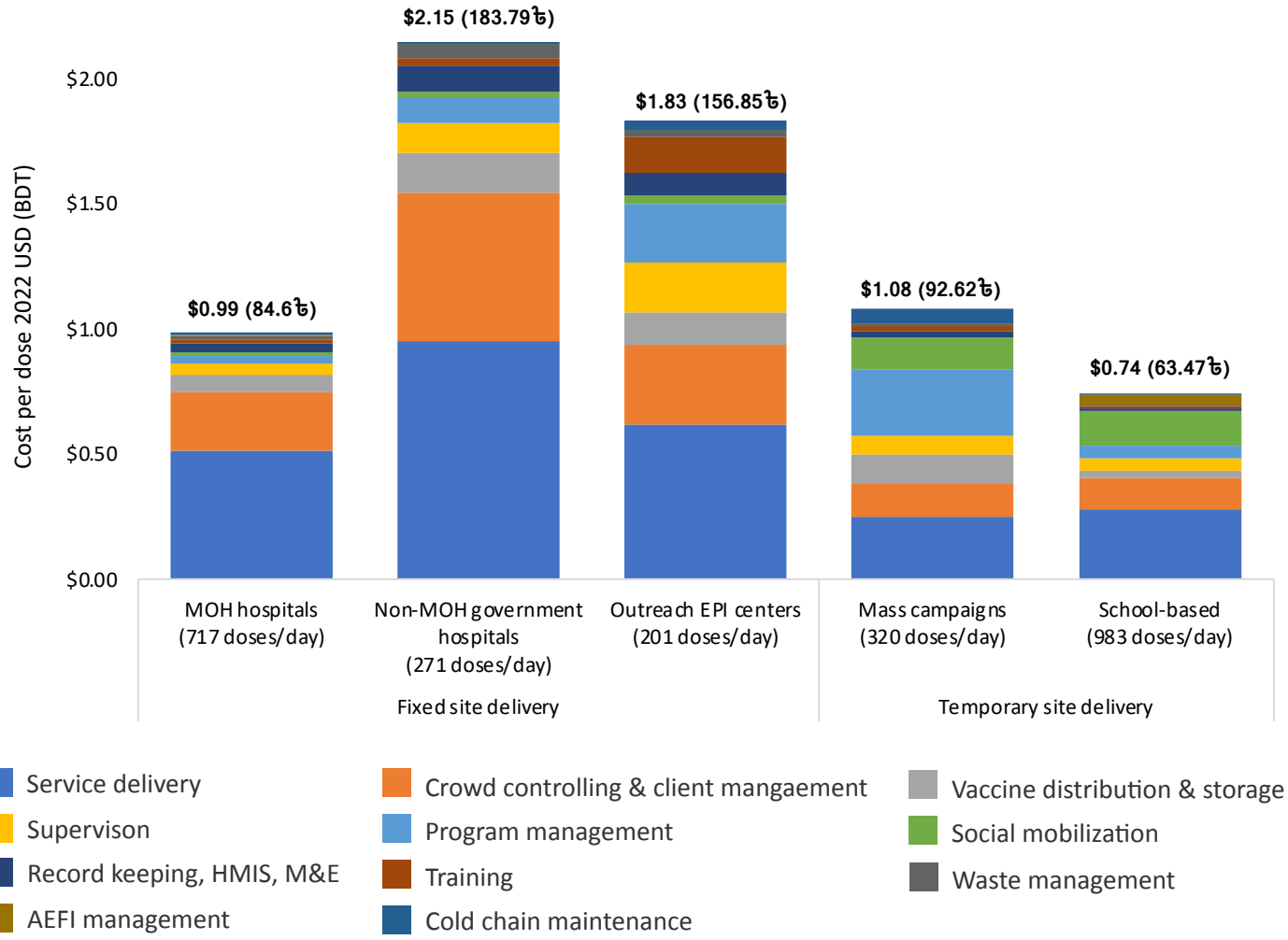
†For USD labels, individual components do not sum to the total due to rounding

Figure B. Economic delivery cost per dose, with opportunity costs disaggregated between salary for existing staff, volunteer labor, and other opportunity costs, for each delivery strategy

The economic delivery cost per C19 vaccine dose across all delivery strategies was $1.05 (89.69৳), which includes the financial and opportunity costs. Opportunity costs accounted for a substantial 73% of the total economic cost of implementing the C19 vaccination program, and consist primarily of the value of health worker salaries. This underscores the heavy reliance on resources shared with the health system. Per dose, opportunity costs were much greater at non-MOH government hospitals ($1.79), and outreach EPI sites ($1.39) when compared to other types of sites ($0.50-$0.75). This is due to the lower volume delivered at these sites, as well as to the much higher share of regular health staff at non-MOH government hospitals —75% of the vaccination team — who are more costly than volunteers.

The very low cost per dose found in this study is due to the high volume delivered per day at the sites included in our sample, low levels of financial support at implementation level, and a high reliance on the existing health workforce.

Figure C. Economic delivery cost per dose, disaggregated by program activity, for each delivery strategy



Service delivery was the costliest activity at fixed sites and at schools-based sites, accounting for 23-52% of the economic cost per dose, while program management (24%) was the main cost driver at mass campaign sites. At fixed sites, crowd controlling and client management was the second largest cost driver (17-28% of the cost), while social mobilization costs were negligible (1-2%). At temporary sites crowd controlling was a less significant cost component, while social mobilization accounted for a larger share of the cost (12-19%), because volunteers spent a larger share of their time on social mobilization activities at temporary sites compared to fixed sites. Program management related costs were the biggest cost driver at mass campaign sites (25% of the economic cost per dose), as almost 40% of labor from health staff was spent on program management activities, as opposed to 16% to 4% at other types of sites.

Cost incurred by beneficiaries

Beneficiaries spent an average of $1.63 (139.68৳) to receive a single dose of C19 at fixed sites. Most of the cost (46%, $0.75 or 64.09৳) was related to transport to and from the vaccination site. An additional $0.37 or 32.05৳ (23%) was spent on vaccine registration from an internet cafe, and $0.35 (92.91৳, 21%) was spent on printing the vaccine certificate. The remaining costs (10%) were for managing side effects ($0.15, 12.73৳), and food and drinks. In addition to incurring direct financial expenses, beneficiaries spent time obtainingthe vaccination at fixed sites—2 hours and 20 minutes on average. Including the opportunity cost of their time, the economic cost incurred by beneficiaries averaged at $4.78 (408.89৳) per dose received.

Figure D. Financial cost incurred by beneficiaries to receive one dose of a C19 vaccine

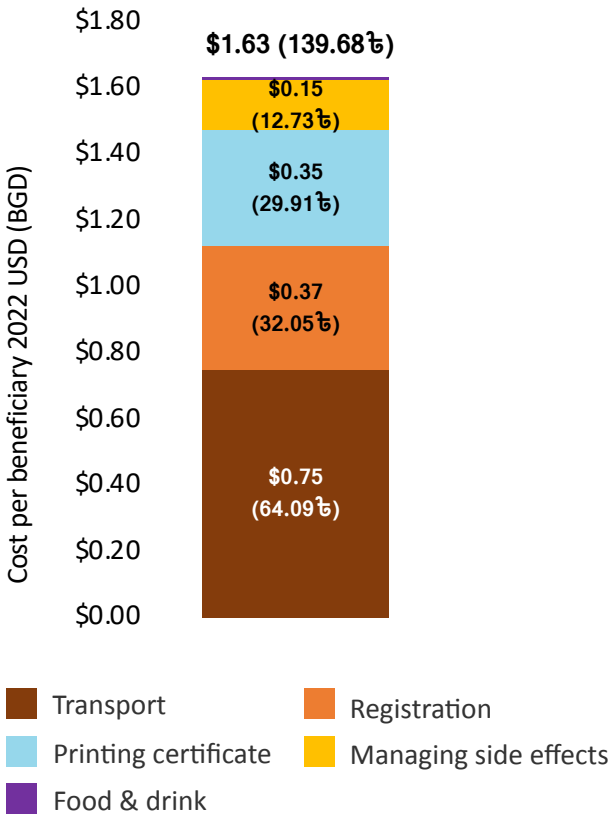


Image: Waiting area for C19 vaccine beneficiaries at a Combined Military Hospital

KEY TAKEAWAYS

- The successful roll-out of the C19 vaccination program was made possible by leveraging resources and infrastructure of the regular EPI program, which is reflected in low financial costs but high opportunity costs, underscoring the value of investing in robust health systems.
- Mass campaign sites and school-based sites were the most cost-efficient and equitable modalities among those evaluated in this study, though a comprehensive delivery strategy mix should consider the equity, cost, and scale of all possible delivery modalities.
- The discontinuation of the vaccinators' honorariums after the first year was perceived as a departure from a commitment to support its health workforce through a particularly challenging time that could have lasting implications for the health system.
- Though government financial management regulations were rigid and restrictive, optimized public financial management processes for development partners ensured timely access to donor funding at lower administrative levels.
- Exceptional political prioritization and strong local commitment were key to the success of the C19 vaccination program in Bangladesh, though routine EPI will likely not be able to count on the same going forward. To ensure the long-term success of vaccination initiatives beyond the emergency-driven dynamics witnessed during the C19 response, it is crucial to strengthen the health system.

RECOMMENDATIONS ON HOW TO USE THIS EVIDENCE

This study aimed to help the GOB make better, data-informed choices for an equitable rollout of C19 vaccines in the country, as well as other immunization programs. To support this aim, below we present a set of recommendations on how policymakers, budget managers, program managers, and researchers can practically use the study's findings:

- Use the cost findings for budgeting and financial planning for the C19 vaccination as well as other immunization programs in Bangladesh.
- Leverage the study results to facilitate an efficient yet equitable delivery strategy mix for COVID-19 or other vaccine delivery in Bangladesh.
- Include the evidence in this study to estimate the full cost of the C19 vaccination program.
- Estimate the cost of incorporating C19 vaccines into the national immunization schedule.
- Model future options for immunization strategies.

I

INTRODUCTION

ThinkWell, in cooperation with the Government of Bangladesh (GOB), conducted a study to estimate the cost of delivering and receiving COVID-19 (C19) vaccines through selected delivery strategies in Bangladesh

The delivery of C19 vaccines presented unprecedented challenges due to the very large volume delivered, the use of multiple delivery strategies, and the need to reach previously untargeted populations. At the same time, costs associated with vaccine delivery remained uncertain.

To address this knowledge gap, ThinkWell conducted a study to estimate the cost of delivering and receiving C19 vaccines in Bangladesh in 2021 and 2022. In addition to the costing analysis, the study also provides an overview of the C19 vaccination program, maps out program funding flows, and documents the enablers, challenges, and lessons learned from implementing the vaccination effort. The evidence generated by this study offers valuable insights on the cost of delivery strategies used for the C19 vaccination program, which can inform strategic planning and budgeting for other vaccination programs, and help optimize the deployment of vaccines in future pandemic scenarios.

This study was conducted in coordination with the Expanded Program on Immunization (EPI) of the Directorate General of Health Services (DGHS) and with the involvement of key stakeholders. The EPI headquarters of the DGHS provided guidance throughout the study. The Planning and Research Unit at DGHS and the Public Health Wing at the Ministry of Health and Family Welfare (MOHFW) approved and supported the study. Throughout the study, ThinkWell also actively collaborated with other relevant stakeholders, such as the United Nations Children's Fund (UNICEF) and the World Health Organization (WHO). The study was conducted over two years, from September 2021 to November 2023. For a detailed timeline with activities, please refer to **Annex 1**.

ESTIMATING THE COST OF DELIVERING COVID-19 VACCINES IN LOW- AND MIDDLE-INCOME COUNTRIES

This study is part of a multi-country research project that utilizes standardized methods to generate cost evidence on the delivery of C19 vaccines in low- and middle-income countries. The project is led by ThinkWell, and supported by the Bill & Melinda Gates Foundation, and covers studies in Vietnam, Bangladesh, and the Philippines in Asia, and Mozambique, Côte d'Ivoire, the Democratic Republic of Congo, and Uganda in Africa.

For more information, please see: https://immunizationeconomics.org/covid19-vaccine-delivery-costing

II

OBJECTIVES AND STUDY METHODS

RATIONALE AND OBJECTIVES

The C19 pandemic underscored the need for cost evidence on delivering C19 vaccines to inform efficient resource allocation, financial planning, program sustainability, and planning for future outbreaks. Nonetheless, uncertainty persisted around the cost of delivering the vaccines, considering the different delivery strategies adopted, constraints in vaccine supply, varying vaccine storage requirements, and evolving prioritization of the target population.

Moreover, the pandemic exacerbated existing resource scarcity by negatively impacting the economy while straining the healthcare system. Consequently, it has become even more crucial to make evidence-based decisions to optimize the use of available health resources. In this context, the government lacks sufficient evidence regarding the costs of delivering C19 vaccines nationwide, which is crucial for the ongoing sustainability of the C19 vaccination program and other vaccination initiatives.

To make well-informed decisions based on evidence, it is imperative to have a comprehensive understanding of the costs involved in C19 vaccine delivery and the operational aspects associated with the delivery strategies implemented. By also capturing information on the expenditures and loss of income associated with C19 vaccination from a beneficiary perspective, the study can help inform the GOB to account for and mitigate these costs when designing future vaccination programs. Moreover, this study will fill an important gap in the global literature regarding the financial costs incurred and time spent by beneficiaries in low- and middle-income countries to obtain vaccinations.[1]

The primary objective of this study is to estimate the cost of delivering and receiving C19 vaccines in Bangladesh through various delivery strategies adopted by the GOB.

The specific objectives of the study are to:

1. Estimate the cost of C19 vaccine service delivery through the five most used vaccine delivery strategies in 2021 and 2022;
2. Estimate the costs incurred by beneficiaries to receive the C19 vaccine;
3. Identify key funding sources and map the flow of funds for the C19 vaccination program; and
4. Describe how the vaccination program was implemented and identify operational and financial challenges and lessons learned.

STUDY DESIGN

ThinkWell estimated the start-up and recurrent costs of all activities required to deliver C19 vaccines in Bangladesh between 2021 and 2022. This study estimated vaccine delivery costs, defined as the costs associated with delivering immunizations to target populations, including vaccine administration and safety supplies. The cost of the C19 vaccines were excluded at the recommendation of the ethical review board, as these data were considered sensitive by the GOB. This covers the cost of all major programmatic activities such as service delivery, social mobilization, supervision, training, waste management, and recordkeeping (the full list of program activities is outlined in **Annex 2**). The study included both recurrent costs as well as one-off start-up costs incurred during the 30 days before the start of vaccination activities until the conclusion of the study period in June 2022. Start-up costs encompass inputs and activities directly related to initiating the new C19 vaccination program such as the development and maintenance of the government vaccine registration website (Surokkha App), training of health workers, and additional cold chain investments. We captured costs specific to the C19 vaccination program, as well as those shared across the broader immunization program and health system.

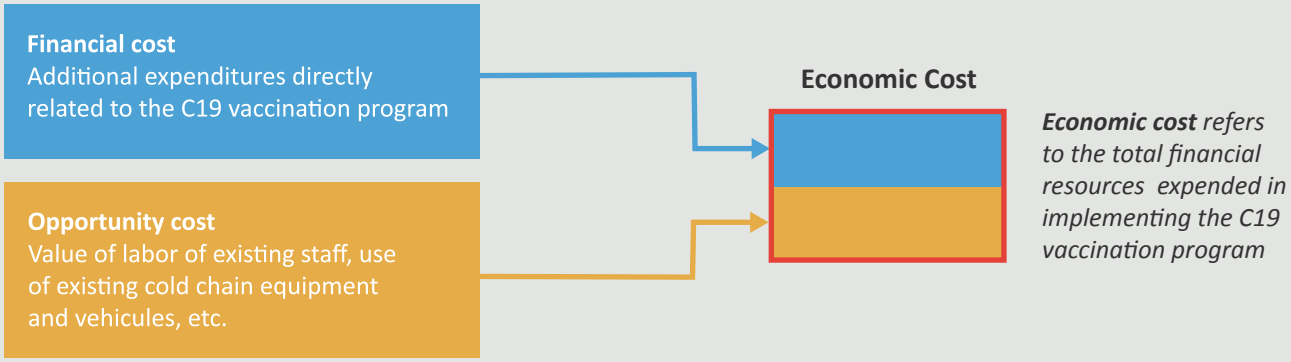
We employed standard ingredients-based costing methods to estimate the cost of delivering and receiving C19 vaccines in Bangladesh in 2021 and 2022, the primary objective of this study. This is an ingredients-based (or bottom-up) costing study, which followed common immunization costing approaches tailored to the C19 vaccination program to collect data on resource use at all levels of the health system.[2] Through standardized questionnaires, the study team collected data on resource use from all levels of the health system, as well as from beneficiaries. Quantities used were then multiplied by the respective prices of the inputs to estimate the total costs incurred by the program. Financial expenditure reports and budgets were used to fill data gaps when needed.

The study estimates the costs from the payer and beneficiary's perspective, considering expenses borne by the GOB, development partners, and vaccinated persons. At national level, this includes the national-level costs incurred by the EPI headquarters, the entity primarily responsible for implementing the C19 vaccination program, as well as costs incurred by the two essential partner organizations, UNICEF and WHO. At lower levels, the study captured costs incurred at the selected vaccination sites. At the implementation level, all contributions were channeled through vaccination sites; therefore, there was no need for data collection from district and upazila offices. Contributions that were not channeled through the MOHFW, such support by the police force in securing vaccine transportation and storage, were not included in the study. However, excluded contributions were likely very small, and their omission is not expected to significantly impact service delivery costs.

BOX 1
Financial, opportunity, and economic costs

This study includes both financial and opportunity costs, which together make up economic costs. Financial delivery costs are additional monetary outlays for the C19 vaccination program for resources such as honorarium, per diems, additional health workers recruited specifically for the C19 vaccination program, fuel, and personal protective equipment and other supplies. The opportunity cost of vaccine delivery represents the value of utilizing existing resources for the C19 vaccination program, such as routine government health workers, cold chain equipment, and vehicles. The full list of resource types considered for C19 vaccine delivery can be found in **Annex 2**. Finally, the economic cost represents the sum of the financial and opportunity costs, providing a comprehensive view of the total value of the resource used to implement the C19 vaccination progr Value of labor of existing staff, use of existing cold chain equipment

Figure 1. Explanation of the types of costs estimated in the study.



In addition to the cost incurred by the health system to delivery C19 vaccines, through exit interviews, we estimated the financial and opportunity costs incurred by beneficiaries to receive one dose of vaccine. This addresses specific objective 2, as illustrated in Table 2. Financial costs incurred to receive the vaccine include fees spent on registration from internet cafes, transport to and from the vaccination site—including, if relevant, accommodation and food expenses, expenses incurred to manage side effects, and the cost of printing vaccination certificates. For beneficiaries, opportunity costs include the value of their time spent on registration, transport, and time spent receiving the vaccine, and possibly managing side effects. We conducted exit interviews with vaccinated persons to estimate the cost that beneficiaries incurred to receive C19 vaccines at hospital-based vaccination sites. These exit interviews captured a range of information, including demographic characteristics, income details, direct financial expenses incurred by the vaccine recipients, and the time spent obtaining the C19 vaccine.

The study covers the period from the start of the rollout in February 2021 until October 2022, with cost estimates reflecting different time periods based on when each delivery strategy was active. For fixed sites and the national-level EPI headquarters, in-depth cost data were collected for April and June 2022. For temporary vaccination sites like school-based delivery and mass vaccination campaigns, data was collected based on their most recent implementation: late 2021 to early 2022 for school-based delivery sites and September-October 2022 for mass vaccination campaign sites. To capture how the program ramped up and resource use and delivery volume evolved from the start of the rollout, the study team also gathered data on the number of doses delivered and the time spent by health workers (as labor is typically a key cost driver in vaccination programs) from February 2021 through June 2022 or for the period relevant to temporary vaccination sites.

In consultation with EPI headquarters, we selected five delivery strategies for inclusion in this study (Table 1). The selected strategies were chosen as most important in terms of the delivery volume delivered through them, and the portion of the target population intended to be covered by the C19 vaccination program in Bangladesh through each of the strategies. For example, the study excluded the 'special campaign' delivery strategies, that were only implemented on a very limited scale to reach specific target populations that were relatively small, such as the floating population, transport workers, qawmi madrasa students, prisoners, sex workers, etc. Further detail regarding these and other delivery strategies and how these were implemented can be found in Section III of this report.

Table 1. C19 vaccine delivery strategies included in the study

Delivery strategy	Main characteristics
Fixed sites	
MOH hospitals	Vaccination sites set up within health facilities—including medical college hospitals, specialized hospital, district hospitals and upazila health complexes—were established at city corporations, districts and upazilas across the country to reach the target population.
Non-MOH government hospitals	Vaccination sites located at existing hospitals and clinics within high-level government offices such as for defense forces hospital, police hospitals, hospital managed by ministry of public administration, where C19 vaccination was offered on a regular basis to government offices staff and their dependents.
Outreach EPI centers	Vaccination offered at regular EPI centers in urban and rural areas with the aim of bringing vaccination sites closer to eligible recipients. EPI centers are facilities similar to health posts or other fixed locations established as part of an Expanded Program on Immunization (EPI) to extend immunization services beyond fixed health facilities, such as at community centers or counselors offices. These centers are designed to reach communities with primary healthcare services who may not access regular health facilities.
Temporary sites	
Mass campaign	Temporary vaccination sites established in urban and rural areas to bring vaccination sites closer to eligible recipients and reach wider coverage.
School-based	Vaccination sites occasionally set up in some specific locations such as schools and community centers, managed by city corporations, districts, and upazila levels to reach students enrolled in schools.

The costing study was complemented by a qualitative assessment of funding sources and flows, the vaccine supply chain, operational and financial enablers and challenges, as well as lessons learned in implementing the C19 vaccination program. To address specific objectives 3 and 4, we conducted key informant interviews (KIIs), and consultation workshops with stakeholders involved in the rollout of the C19 vaccination program at both implementation and national level. The consultation workshops were meant to explore and understand local organizations' and partners' involvement and support (financial and in-kind) in the C19 vaccination program rollout.

The interviews and workshops aimed to enhance comprehension of the C19 vaccination program's execution, identify enablers, challenges and key insights gained, and map the program's sources and allocation of funds. We visualized how funding flows from financing sources (entities that allocate funds), to financing agents (which receive funds from financing sources and serve as intermediaries to transfer the funds to users), and eventually reach the users of funds that carry out the program (also referred to as cost centers).

Table 2. Summary of methodology employed to address each study objective

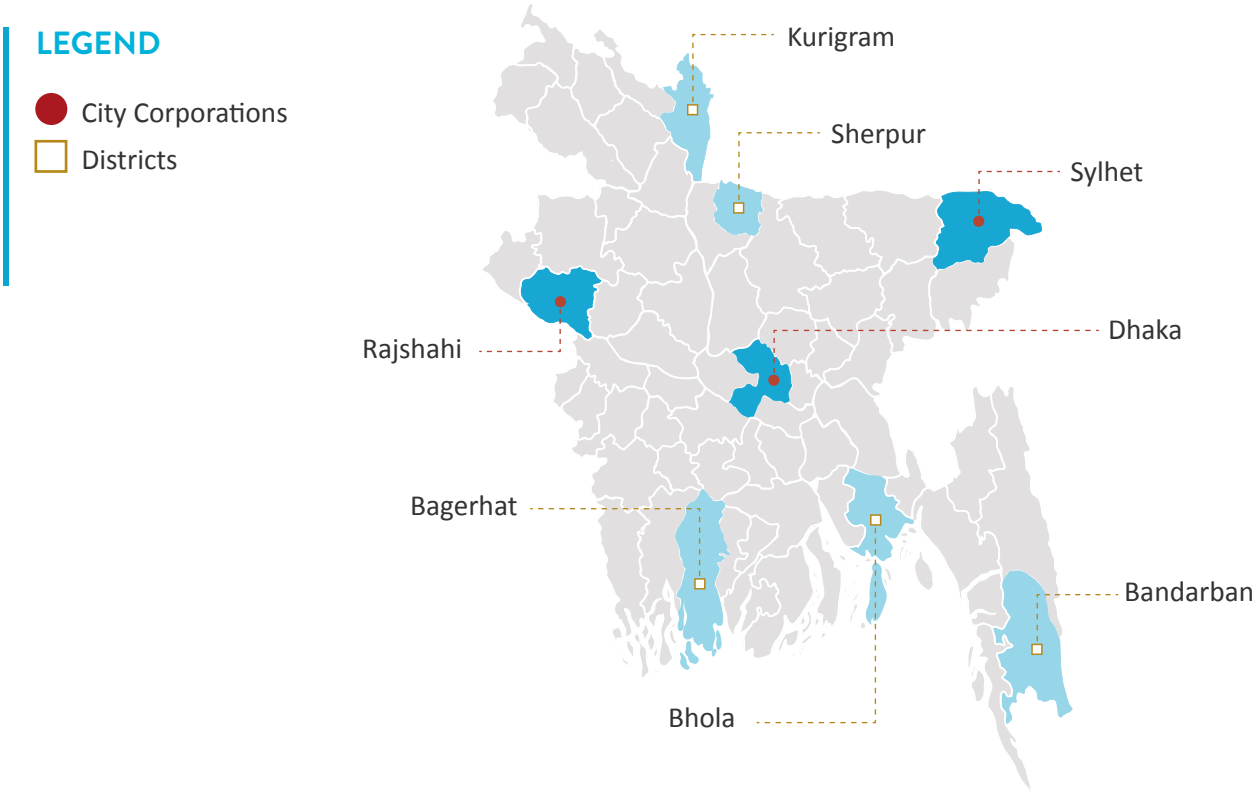
Study objective	Methods
1. Estimate the cost of C19 vaccine service delivery through the five most used vaccine delivery strategies in 2021 and 2022	Bottom-up, ingredients-based costing study with retrospective data collection at 14 MOH hospitals, 5 non-MOH government hospitals, 7 outreach EPI centers, 6 mass campaign sites and 6 school-based vaccination sites
2. Estimate the costs incurred by beneficiaries to receive the C19 vaccine	Bottom-up, ingredients-based costing study based on data collected from exit interviews with 110 beneficiaries at MOH hospitals and at non-MOH government hospitals
3. Identify key funding sources and map the flow of funds for the C19 vaccination program	Qualitative assessment based on 53 key informant interviews and 5 consultation workshops with stakeholders involved in the rollout of the C19 vaccination program at implementation and national level
4. Describe how the vaccination program was implemented and identify operational and financial challenges and lessons learned.	Qualitative assessment based on 53 key informant interviews and 5 consultation workshops with stakeholders involved in the rollout of the C19 vaccination program at implementation and national level

SAMPLING

The study followed a three-stage purposive sampling approach to select vaccination sites spread across all eight divisions of the country. In consultation with the EPI headquarters, we selected four city corporations and five districts. In the second step, four upazilas from four selected districts were selected. The city corporations, districts, and upazilas that were selected are shown in Figure 2. The vaccination sites were selected from different administrative levels: city corporations, districts, and upazila (which are administrative sub-units of the district).

Fixed vaccination sites were selected in consultation with the national level EPI headquarters, and temporary sites were selected in consultation with the city corporation office (in the city corporation area), civil surgeon office (at the district level), and upazila health office/ complex (at the upazila and below level). School-based vaccination sites were selected from city corporation and district levels as these sites were mostly implemented in these areas.

Figure 2. Selected city corporations and districts of the study.



Vaccination sites were selected to cover diverse settings, including hard-to-reach areas, hilly areas, char areas (riverine sand and silt landmasses known as char), and islands. As primary data collection was particularly challenging in the context of the C19 pandemic, the majority of the vaccination sites were selected to ensure that data collectors could easily reach them, and that reasonably high-quality financial and administrative records could be collected from these sites. The temporary sites were selected based on the quality of data availability at the data collection points, which were typically the Upazila Health and Family Planning Officers (UHFPO) office. As a result, the sample included many larger hospitals, such as the district hospitals, upazila health complexes, medical college hospitals, and specialized hospitals, though also four hard-to-reach sites from Monpura upazila of Bhola district and Rowmari upazila of Kurigram district. Coverage data was not available at the time of sample selection, thus performance could not be taken into account when selecting sites.

The final sample covered a total of 26 fixed vaccination sites and 12 temporary vaccination sites, as well as the national-level EPI headquarters and the two main partners (Table 3). Of the 38 vaccination sites, 17 were in city corporations, 13 were in districts, and 8 were in upazilas. All non-MOH government hospitals were government institutions. Three of the five selected non-MOH government hospitals were managed by the defense forces, and the remaining two were health facilities for government employees. The list of selected vaccination sites of this study is in **Annex 3**. The beneficiary exit interviews were conducted at six hospital-based vaccination sites in urban areas, selected for convenience. Furthermore, the consultation workshops were organized in a subset of the city corporations, districts, and upazilas. The national-level EPI headquarters and the two main national-level development partner organizations—UNICEF and WHO—were also included in the sample.

Table 3. Study sample

City Corporation/ District/Upazila		Consultation workshop	Cost data collection sites (* = sites where exit interviews were held)				
			Fixed vaccination sites			Temporary vaccination sites	
			MOH hospitals	Non-MOH gov. hospitals	Outreach EPI centers	Mass campaign	School-based
City	Dhaka South		2*	1*	1		1
	Dhaka North	✓	1*	1*		1	1
	Sylhet		1	1	1		1
	Rajshahi	✓	1	1		1	1
District	Kurigram		1			1	1
	Sherpur		1		1		1
	Bagerhat	✓	1*	1	1		
	Bhola		1*			1	
	Bandarban		1		1		
Upazila	Rowmari, Kurigram		1		1		
	Jhenaigati, Sherpur	✓	1			1	
	Fakirhat, Bagerhat		1			1	
	Monpura, Bhola	✓	1		1		
Vaccination sites in urban areas			10	4	2	2	6
Vaccination sites in rural areas			4	1	5	4	0
Total number of vaccination sites, by strategy		**n.a.**	**14**	**5**	**7**	**6**	**6**
Total number of vaccination sites, overall		**5**	**38**				
National level (EPI headquarters, UNICEF, and WHO)		3					
Total number of data collection sites		**41**					

DATA COLLECTION

Data for this study were collected retrospectively using standardized data collection tools at selected vaccination sites and nationally between September 2022 and March 2023. This study's data was collected through a partnership between ThinkWell and the Institute of Health Economics (IHE) at the University of Dhaka. A team of 14 researchers underwent a two-day training session before being deployed to collect data from the chosen vaccination sites and at the national level. The cost data collection tools in Microsoft Excel that were developed for the multi-country project were customized for Bangladesh to facilitate the collection of cost data on C19 vaccine service delivery. Specific guidelines were developed for interviews at vaccination sites, national levels, and with development partners. A checklist for the consultation workshops and a structured questionnaire for beneficiary exit interviews were also developed. These tools were tested in August 2022 at three vaccination sites (Mugda Medical College Hospital, Keraniganj Upazila Health Complex, and mass campaign site at Korail Slum, selected in consultation with the EPI headquarters) and refined based on observations that were discussed with the EPI headquarters, resulting in their finalization for data collection.

We collected cost data from 38 vaccination sites and EPI headquarters, and from 110 beneficiaries, through in-person interviews, document reviews, and inventory records. Delivery cost data was collected in consultation with staff members, including EPI officials, focal persons, health facility managers, Medical Technologist-EPI (MT-EPIs), and accounts officers at national and vaccination site levels. The study team also reviewed financial expenditure reports, record and register books, as well as other relevant documents. Acquisition details for vehicles, cold chain equipment, and other C19 vaccination program equipment were obtained from inventory records from the vaccination sites where they had own cold chain and from the upazila health office and city corporation where the cold chain was located, as well as from the national level EPI headquarters. The cost of vaccine distribution from the EPI's storage facility and other storage sites to district and city corporation level was collected at the national level based on the vehicle registers. Vaccine shipments from the airport to the storage sites were a service offered by the pharmaceutical industries, and the cost for this was not captured. In cases without written records, such as health staff time allocation, the study team conducted detailed interviews with the staff. Vaccine administration and safety supplies prices were sourced from UNICEF, and cold chain equipment costs were obtained from the WHO Performance, Quality, and Safety (PQS) devices catalogue[3] at national level. Exit interviews were only conducted at hospital-based sites, and to identify potential interviewees among vaccine recipients, study team collaborated with the selected sites, and obtained informed consent from all participants in the exit interviews.

We conducted 53 qualitative interviews at the national and vaccination site level during the cost data collection visits. For the qualitative assessment, study team conducted a KII at each of the 38 sampled vaccination sites and 15 interviews at the national level involving government officials and development partners. Interviews with key informants at the national level (e.g., EPI Officials, DGHS, Public Health Wing of MOHFW, development partners) and vaccination sites (e.g., health facility manager, focal person, MT-EPI) were conducted to identify enablers, processes and challenges encountered in the implementation of the program and document lessons learned at the service delivery and national level. Five consultation workshops were organized, bringing together all the relevant stakeholders who supported implementing the C19 vaccination program. Please see **Annex 4** for the list of informants who participated in this study, as well as the specific locations of the consultation workshops. The interviews and workshops were conducted in Bangla and recorded, with subsequent transcription. In cases where respondents declined recording, the interviewer took comprehensive notes. The study team then reviewed, synthesized, and translated the transcripts into English.

A meticulous validation and cleaning procedure followed the data collection process. After data collection, four researchers carefully reviewed all cost data sheets to ensure completeness and identify and verify any potential outliers. For instance, they scrutinized data such as hours worked by health staff, purchase costs and acquisition of cold chain equipment and vehicles, and quantity of vaccination supplies used. If the reviewer identified any issues, the corresponding data sheet was forwarded to the data collector team for clarification and correction. In cases where further verification was necessary, direct phone calls were made to the respondent at the relevant vaccination sites. If specific data remained unobtainable despite these efforts, assumptions were made to impute the missing information from the same site or other sites. Please refer to **Annex 5** for a detailed account of the imputation process.

DATA ANALYSIS

Delivery costs were estimated and allocated to resource types, program activities, delivery strategies, and cost types (financial or opportunity cost). For resources that were shared across the health system, such as cold storage or paid labor, a proportion was allocated to the C19 vaccination program as per respondent's estimates. Similarly, costs were allocated across C19 program activities based on what activity respondents reported they were used for. When respondents could not allocate resources across C19 program activities, the allocation rules detailed in **Annex 5** were employed. The opportunity cost associated with the time spent by vaccine recipients in the vaccination process was calculated by considering their income levels, and the value of the time spent by homemakers was based on the national minimum wage. Microsoft Excel was used to perform this study's cost data analysis.

The overall cost per dose delivered was estimated by calculating the volume-weighted average cost per dose at implementation level and adding it to the cost per dose at national level to estimate the overall cost per dose delivered. The volume-weighted cost per dose at vaccination sites was calculated by dividing the total cost incurred at the sites by the total number of C19 vaccine doses administered at those sites, using the formula:

$$unit\_cost_{vw} = \frac{\sum_{i=1}^{n} C_i}{\sum_{i=1}^{n} Q_i}$$

where *Ci* represents the total cost of vaccine delivery at location *i*, *Qi* is the total quantity of doses delivered at location *i*, and *n* is the sample size for that level. The data collected at the national level represents the enumeration of the population at that level rather than a sample. Therefore, the unit cost at national level was calculated using a simple average, with total costs at national level divided by the total number of doses delivered in the same period. Then, the overall delivery cost per dose was obtained by summing the volume-weighted average cost per dose for vaccination sites with the national level cost per dose. The unit cost of receiving a one dose of C19 vaccine was estimated by applying a simple average across the cost incurred by all exit interviewees.

All costs are presented in 2022 US dollars (USD, $) and in Bangladeshi Taka (BDT, ৳). Costs incurred in 2021 were inflated to 2022 using the inflation rate (average consumer prices) published by the International Monetary Fund (IMF).[4] Costs were then converted from BDT to USD using a conversion rate of 1 USD = 85.540939 BDT.[5] Depreciation of capital items was calculated based on the year of acquisition, acquisition cost, and useful life assumptions defined by existing guidance on immunization costing,[6], [7] using a discount rate of 3%. When comparing our findings to those of other studies, we first converted the other studies' findings into 2022 USD. First, ThinkWell converted their unit costs back to BDT using the exchange rate for the study year, using the conversion rate reported in the study or the World Bank's conversion rate[8] if not reported. Then, we adjusted for inflation using the IMF inflation rate for the relevant year, and finally converted back to USD using a conversion rate of 1 USD = 85.540939 BDT.

Thematic analysis was performed to process the qualitative findings from interviews and consultation workshops. Initially, two team members reviewed a subset of transcripts individually and developed a thematic analysis template comprising of main themes and sub-themes. Subsequently, all transcripts were meticulously examined multiple times to establish a deep understanding of the data and facilitate the thematic analysis process. The themes and sub-themes are presented in Table 1, located in **Annex 6**.

STAKEHOLDER ENGAGEMENT AND APPROVALS

The study was conducted under the leadership and guidance of EPI headquarters, as EPI is the secretariat for implementing the C19 vaccination program. The study's scope, methodology, and data collection tools were thoroughly reviewed and endorsed through consultation workshops held in January and June 2022, involving the EPI headquarters and other relevant stakeholders from government and development partners. In September 2022, a virtual sensitization meeting was conducted with the health facility managers/focal persons of selected vaccination sites. The Director and Line Director of MNC&AH, DGHS, chaired the meeting. The meeting aimed to highlight the importance of the study and ensure preparedness and support from the vaccination sites to the research team before commencing data collection. Before initiating the data collection process, the EPI headquarters issued a letter of support to facilitate and aid the study's data collection efforts.

The Institutional Review Board of the Institute of Health Economics (IHE-IRB), Federal-wide Assurance (FWA) No. FWA00026031 granted the study ethical approval. ThinkWell obtained administrative approval from the Planning and Research Unit, DGHS, and acknowledgement from the Public Health Wing, MOHFW. Please refer to **Annex 1** for a timeline of the study's activities and approval steps.

A final validation workshop was organized to validate the findings of the study with EPI, DGHS, MOHFW, and other relevant stakeholders. It was aimed to share the findings and review the draft report of the study. Subsequently, incorporating feedback from the workshop, the study report underwent revisions and reached its final version. The report will be shared at a dissemination meeting in Bangladesh with all relevant immunization stakeholders.

LIMITATIONS

The cost estimates provided in this study were derived from a small sample size that might not be nationally representative. Data were gathered from 38 vaccination sites distributed across all eight divisions of Bangladesh, covering only 4 of its 12 city corporations and 5 out of the country's 64 districts, so the average might not be nationally representative. In addition, as we purposively sampled sites with strong recordkeeping capacity, our sample includes a disproportionate number of large hospitals. Therefore, our findings might not be representative of vaccination sites with lower recordkeeping capacity, and the unit cost averages might be low compared with sites that delivered fewer C19 vaccine doses. However, as many large hospitals were included, our sample accounts for 4% of all doses delivered in the country in the period between April and June 2022, therefore capturing a significant share of the doses delivered in that period. Moreover, though purposively selected, the sample was chosen to capture a variety of delivery strategies and settings, and we feel confident that the range of delivery costs captured in this study across all sites represents what can be found throughout the country.

Data collection for our study focused on short implementation periods that might not have been representative for other moments of the C19 vaccination roll-out. In-depth cost data was collected for April to June 2022 for fixed sites, late 2021 to early 2022 for school-based delivery sites, and September-October 2022 for mass vaccination campaign sites. The cost findings are therefore likely not representative of other distinctive phases of the roll-out, such as the early part of the roll-out in 2021 that was characterized by supply constraints and targeting specific priority populations. However, for the entire duration from the launch of the C19 vaccination program until the end of June 2022, we did collect labor costs and start-up investments. This means that large start-up investments were not missed, and the evolution of labor cost over time, although not offering a complete picture of the delivery cost, does shed light on how the burden on the health system of the C19 vaccination program evolved over time.

The study only included costs incurred by other actors besides MOHFW and its partners, which means that it excludes some costs incurred by other institutions. This includes the involvement of the police force, who play a crucial role in providing security and escort services to safeguard vaccines against theft, damage, and other risks during transportation and storage. Contributions from actors such as the Ministry of Education, Ministry of Local Government, Rural Development and Co-Operatives, Police forces, Public Administration and Directorate of Drug Administration were also not included in this study. Local government institutes assisted in social mobilization, promotion, and, in certain instances, vaccine transportation support for implementing the C19 vaccination program. The study team did not obtain the exact costs associated with these activities, though these were expected to be relatively small.

The cost estimation did not consider the value of existing building space required for delivering and storing C19 vaccines, as previous immunization costing studies have shown building costs to be negligible. The delivery of the C19 vaccine has been carried out exclusively using the existing infrastructure, and no significant additional investments in building space were made. The study did not capture the cost as from earlier immunization costing studies, we knew that the share of the rent or depreciation that could be allocated to the C19 vaccination program would be very minimal. The study included the most essential infrastructure pieces (cold chain, vehicles, etc.), and even those capital costs were relatively minor. The omission of the existing building costs did not significantly impact the study's findings.

The total number of vaccination sites sharing the same cold storage facilities was unknown; therefore, cold storage costs at the implementation level are likely overestimated. Cold storage facilities for C19 vaccines were often shared among multiple vaccination sites. The shared cold storage facilities were usually located at the city corporation, district, upazila, and municipality levels. In our sample, 32 out of 38 vaccination sites used shared cold storage facilities for storing C19 vaccines. However, the study team could not obtain the list of vaccination sites relying on the cold storage facilities used by the vaccination sites in our sample. Since most storage facilities used by vaccination sites in the sample likely served more sites than those included in this study, the team allocated all the costs incurred by each storage facility to the vaccination sites in the sample that relied on those sites, thus likely overestimating cold storage costs at the implementation level.

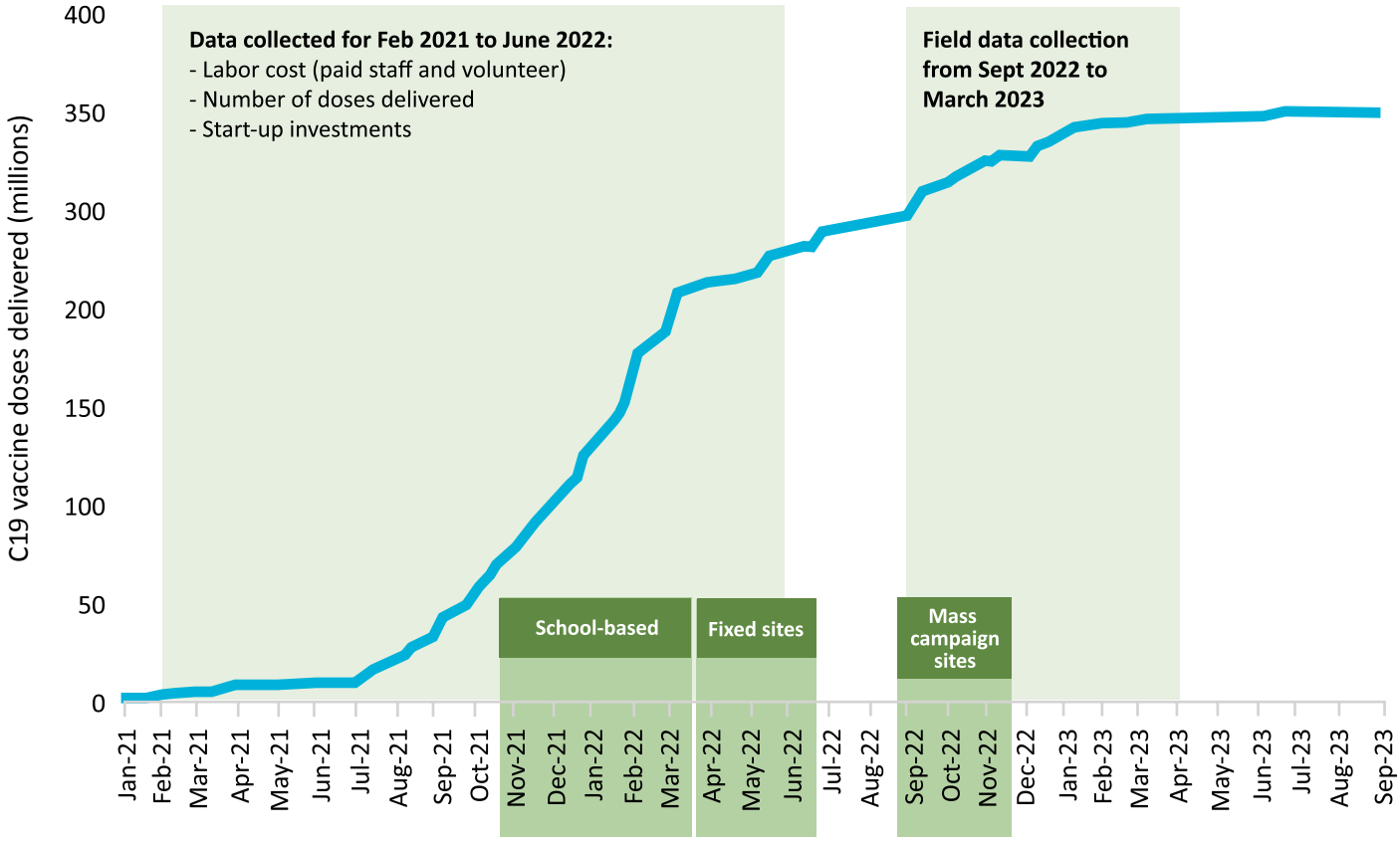
III

THE C19 VACCINATION PROGRAM IN BANGLADESH

OVERVIEW OF THE C19 VACCINE ROLL-OUT

The GOB launched the C19 vaccination program in January 2021 through a phased approach to vaccinate 80% of the population (over 138 million). The vaccination program began by targeting frontline workers, priority groups, and individuals aged 60 and above, and the C19 vaccination initiative commenced at MOH hospitals vaccination sites. Over time, it expanded its reach by adding non-MOH government hospitals, outreach, temporary and campaign-based vaccination sites. In August 2021, the eligibility age was progressively reduced, first to 18, and later, the vaccination program was extended to encompass children aged 12-17 years in October 2021. The government required individuals to be vaccinated to be able to access services from government departments, enter restaurants, use banking services, take domestic flights, and receive surgical care in health facilities, which boosted the overall vaccination rate. Furthermore, in December 2021, the MOHFW introduced the administration of a third dose of the C19 vaccine. By June 2022, 87% of the population of Bangladesh had received at least one dose of C19 vaccine, and 83% had received two doses.[9] In August 2022, vaccination opened up to 5–11-year-old children, and in December 2022, a fourth dose was added.[10] In 2023, vaccination coverage stagnated as C19 infections dropped, but in January 2024, a new vaccination campaign targeting health workers and other priority groups was announced.

Figure 3. C19 vaccine doses administered in Bangladesh from February 2021 to September 2023.[10]

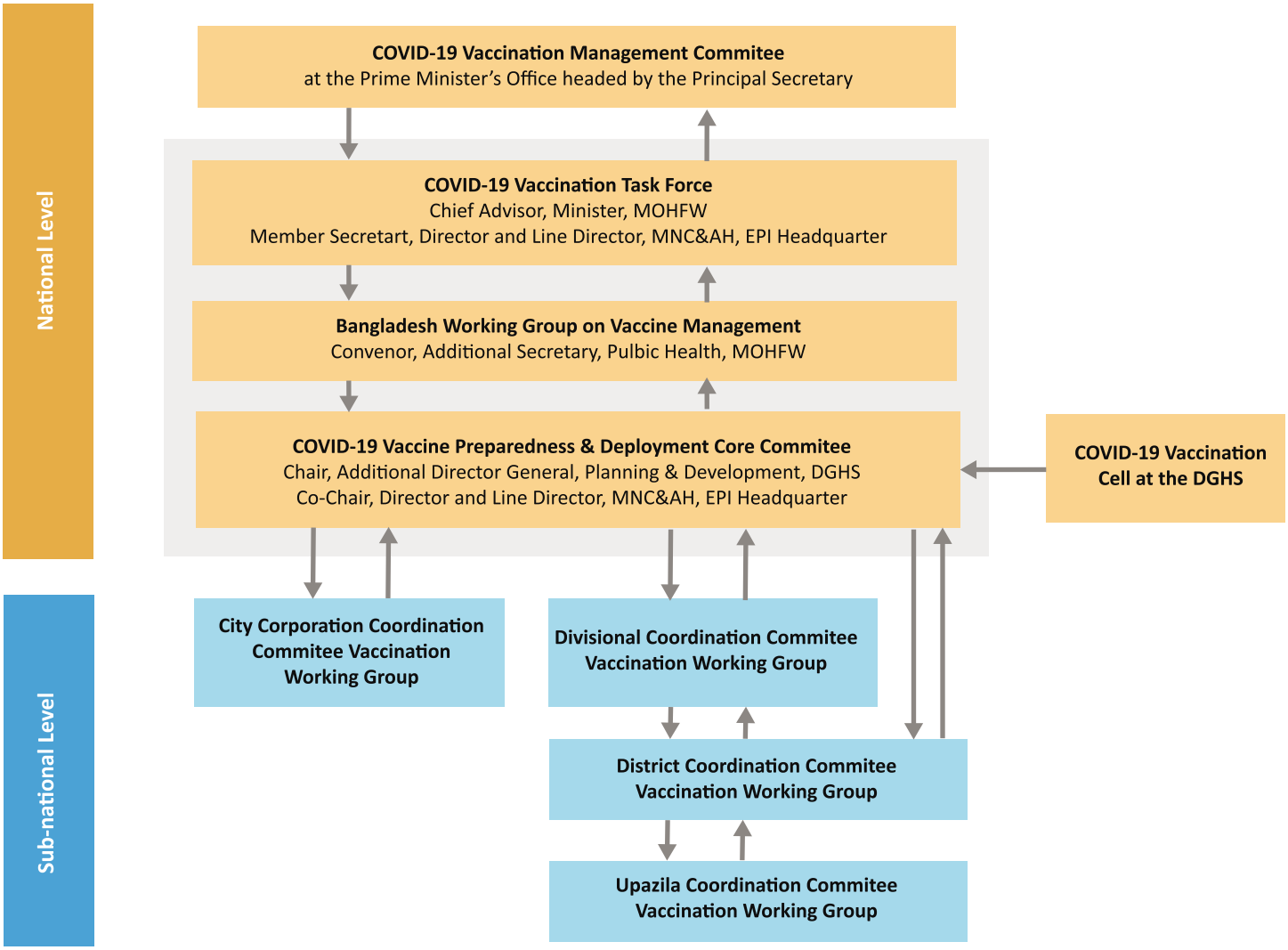


MANAGEMENT OF THE C19 VACCINATION PROGRAM

The MOHFW of Bangladesh, along with its directorate, the DGHS, specifically the EPI headquarters, has the primary responsibility for executing the C19 vaccination program under overall guidance from the Prime Minister's Office (PMO). The EPI headquarters serves as the central hub, taking on the pivotal responsibility of ensuring the quality and safety of vaccines, vaccine administration, and overseeing the execution of vaccination programs and campaigns, including those for C19 vaccines, within the country. GOB collaborated with the WHO and UNICEF to develop the National Deployment and Vaccination Plan (NDVP), a strategic framework for effectively executing the C19 vaccination program. The NDVP outlines the government's strategy for procuring, deploying, implementing, and monitoring C19 vaccines.[11] The NDVP is aligned with various drug-related policies[12],[13] and gazette orders[14] and incorporates recommendations from the National Immunization Technical Advisory Group (NITAG).

The GOB has established various committees and working groups at national and sub-national levels to facilitate effective planning, management, coordination, and implementation of the C19 vaccination program. A National Management Committee under the PMO had been formed to expedite decision-making for the program. The C19 Vaccine Preparedness and Deployment Core Committee oversees procurement, coordination, preparatory activities for vaccine deployment, and vaccination program implementation under the leadership of the Additional Director General and Director and Line Director, MNC&AH, EPI headquarters of DGHS, and with NITAG guidance. Figure 4 illustrates the structure of these committees and groups.

Figure 4. Committees and working groups established for the implementation of the C19 vaccination program.[9,15,16]



EPI headquarters collaborated with many stakeholders to ensure the success of the C19 vaccination program. These stakeholders encompassed a diverse range of entities, including the Ministry of Local Government, Rural Development, and Co-operatives (MOLGRDC); Ministry of Education; DGHS; Directorate General of Drug Administration (DGDA); Institute of Epidemiology, Disease Control and Research (IEDCR), Bangladesh Madrasah Education Board; Islamic Foundation; Bangladesh Tea Workers' Union; Bangladesh Police; security forces, religious leaders; community leaders; tribal community leaders; private sector organizations; voluntary organizations; and development partners.

C19 VACCINE PROCUREMENT AND APPROVAL

Bangladesh took early action to acquire C19 vaccines for the country through COVAX as well as several other agreements. The government signed up for the COVID-19 Vaccines Global Access (COVAX)[17] initiative with technical support from UNICEF and WHO. In addition, the government imported vaccines through a tripartite agreement with Beximco Pharmaceuticals Ltd. and Serum Institute of India to ensure the early arrival of vaccines. MOHFW also signed separate agreements with vaccine producers worldwide, actively maintaining communication with the vaccine-producing countries from the beginning. To procure the C19 vaccines, the government swiftly mobilized domestic and external resources. Please refer to **Annex 7** for details regarding the quantity of vaccines received from various sources. Securing vaccine supply during the initial six months of the C19 vaccination program was challenging. During this period, the quantity of first dose administrations was reduced by half to reserve enough for second doses to ensure optimal effectiveness per WHO guidelines.

The GOB took prompt action in approving new C19 vaccines immediately after they received WHO prequalification to expedite the availability of vaccines in the country. To ensure timely implementation, the NDVP established efficient systems and procedures for vaccine approval. Bangladesh has a robust regulatory environment that facilitated C19 vaccine deployment. The DGDA, under the MOHFW, oversees vaccine approval. Two pathways were used to expedite the C19 vaccine approval process. The first involves issuing a No-Objection Certificate, mainly for COVAX or WHO-prequalified vaccines for non-commercial use. The second pathway is registration or Emergency Use Authorization for commercially sourced vaccines. DGDA has an efficient information management, a standardized plan for vaccine monitoring, pharmacovigilance, and post-market surveillance. Continuous coordination between MOHFW, DGDA, and other ministries streamlined vaccine approvals. MOHFW launched the vaccination program in February 2021 (piloted in January 2021) with the AstraZeneca vaccine, and gradually, other C19 vaccines became available for use in the program (see Figure 5). A total of seven C19 vaccines received approval from the DGDA, MOHFW, with six of them being utilized (Box 2).

BOX 2
C19 vaccines approved for use in Bangladesh.[16]

- AstraZeneca (0.5 ml, 8 weeks interval)
- Sinopharm (0.5 ml, 4 weeks interval)
- Pfizer (0.3 ml, 4 weeks interval)
- Moderna (0.5 ml, 4 weeks interval)
- Sinovac (0.5 ml, 4 weeks interval)
- Johnson & Johnson (J&J) (0.5 ml, single dose)
- Sputnik V (not deployed)

C19 VACCINE STORAGE AND DISTRIBUTION

Vaccine storage and distribution practices largely followed common EPI processes (Figure 6), with financial support from partners, and leveraging private companies' services. Upon entering the country, C19 vaccines were usually stored at the EPI headquarters, which serves as the primary storage facility for the national vaccine distribution network. Once the vaccines arrive in the country, they are collected by the EPI headquarters, and undergo inspection by the DGDA. Temperature monitoring, storage, transport, and delivery of vaccine vials are carried out using WHO's PQS certified equipment. The distribution process starts at the national storage facility, from where the vaccines are dispatched to district and city corporation depots, which act as the lowest distribution points. From there, the vaccines are further sent to service delivery points like upazila health complexes, municipalities, government health facilities, hospitals, and other vaccination sites.

Several partners provided financial support for the storage and distribution of C19 vaccines from national to district level, leveraging private companies' services though sites indicated that vaccine transport support remained insufficient. For the first six months, Beximco Pharmaceuticals Ltd. provided in-kind support in distributing the vaccines following instructions of the EPI Headquarters. Afterwards, vaccine distribution was facilitated through rented freezer trucks and vans, sponsored by UNICEF, WHO, Save the Children, and the International Federation of Red Cross and Red Crescent Societies (IFRC). In addition, the police force played a crucial role in ensuring the vaccines' safety and security, by providing protection and escort services to prevent theft, damage, and other potential risks. However, at implementation level, sites indicated that the government's allocations for vaccine transportation and fuel were insufficient. The calculated unit costs for many of the line items were made based on routine EPI costs, which have not changed with time, although the prices have increased a lot, especially the fuel prices.

Figure 5. Dates of approval and launch of C19 vaccines in Bangladesh.

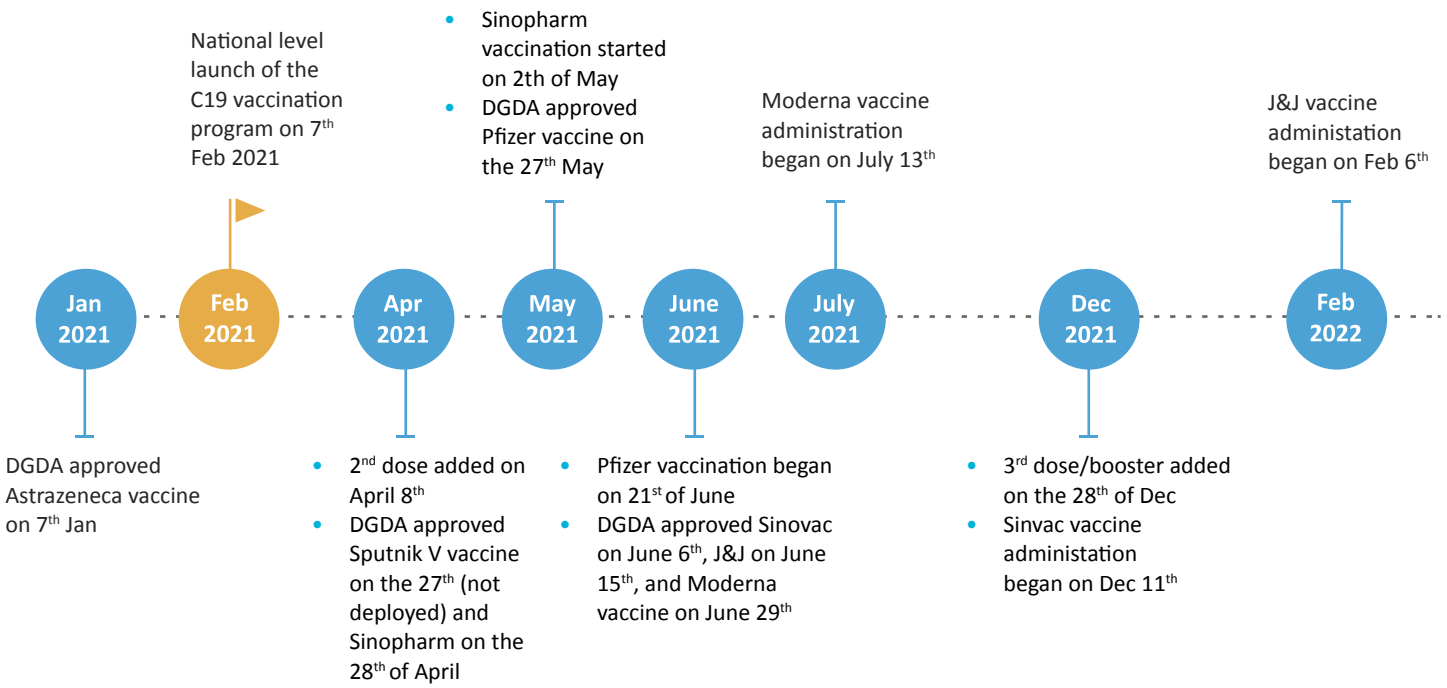
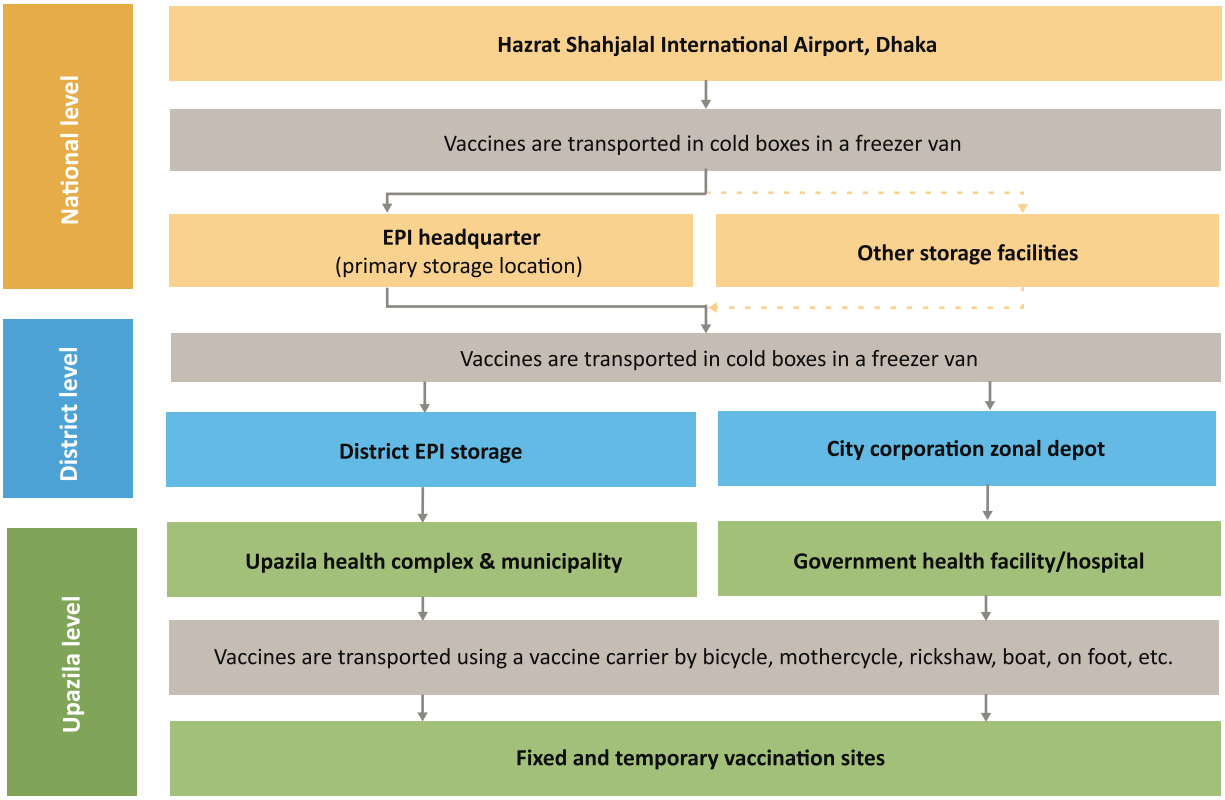


Figure 6. C19 vaccine supply chain in Bangladesh.



As the EPI headquarters lacked cold chain space, and some vaccines required ultra-cold chain (UCC) storage, national cold chain capacity was significantly increased in 2021 to implement the C19 vaccination program. Cold rooms and freezer rooms were sourced from various providers, including Beximco Pharmaceuticals Ltd., Incepta Pharmaceuticals Ltd., and Radiant Pharmaceuticals Limited (primarily for the Pfizer vaccine). Some were rented, such as those at the Bangladesh Agricultural Development Corporation Cold Store at Hazrat Shahjalal International Airport in Dhaka, the Bangladesh Agricultural Development Corporation Seed Testing Laboratory in Gabtoli, Dhaka, Bonton Foods Limited in Dhaka, and N M Enterprise in Savar, Dhaka. Some cold chain equipment was purchased with funding from GAVI COVAX, and UNICEF, WHO and Save the Children provided support for cold chain rentals.

However, at sub-national level, cold chain capacity remained insufficient, which resulted in operational challenges. The lack of UCC capacity at the implementation level meant that vaccines had to be administered quickly after defrosting to maintain their efficacy. As not all these service delivery points have sufficient freezers and ice-lined refrigerators, they are sometimes shared among multiple vaccination sites. Site-level managers coordinated locally with storage sites to collect the C19 vaccines from the lowest distribution points on a rolling basis each month. For instance, Fakirhat Upazila Health Complex cold storage was used by one MOH hospitals and 32 temporary vaccination sites. Some of the vaccination sites arranged additional air conditioners from their own funds or with donations from the community to facilitate the storage of temperature-sensitive vaccines. Any available vehicle with air-conditioned services like an ambulance, Civil Surgeon, or UHFPO's personal official cars was used for vaccine transportation.

REGISTRATION

The government developed a website to manage the registration process through which beneficiaries could sign up for an appointment to receive the C19 vaccine. In partnership with the PMO, the Information, Communication, and Technology (ICT) Division created an open-source eHealth Individual Case Management and Analysis System (ICMAS). This system, also known as the Surokkha App, for both web and mobile platforms, streamlines registration, automates tracking via SMS, keeps track of dropouts, and provides vaccination certificates. The client uses their national ID, birth registration, and passport number to register themselves through this system. Those unable to do online registration had the option of on-site registration with assistance from volunteers at the vaccination site. They could receive the vaccine on the same day and were given a handwritten vaccine card as their official C19 vaccination record.

C19 VACCINE DELIVERY STRATEGIES

The GOB adopted multiple strategies to ensure effective vaccine delivery; MOH hospitals were the primary strategy. The routine EPI's micro-planning approach was leveraged, aimed at ensuring coverage of all geographic locations. The government achieved high coverage by employing various delivery strategies throughout the country, including MOH hospitals, non-MOH government hospitals, outreach EPI centers, temporary sites, mass vaccination campaigns, and special campaigns (see Table 4). Throughout the rollout of the C19 vaccination program, delivery strategies were reviewed and updated multiple times to adapt to the availability of vaccines and the country's socio-economic recovery needs. In the initial phase of the vaccination program, vaccines were exclusively delivered through facility- and non-MOH government hospitals, so that the program could leverage well-trained nurses as vaccinators and establish trust within the community regarding the safety of C19 vaccines. As vaccine availability increased, the MOHFW subsequently introduced other delivery strategies to expand C19 vaccination coverage among the population.

Table 4. C19 vaccine delivery strategies in Bangladesh.

Delivery strategy	Description	Implementation period and frequency
MOH hospitals (fixed sites)	Bangladesh's primary and most used strategy implemented through government hospitals, medical college hospitals, district hospitals, and upazila health complexes.	Started in January 2021, continuous implementation
Non-MOH government hospitals (fixed sites)	Used on a small scale to ensure vaccination coverage for government officials and their dependents through designated government health staff hospitals, staff clinics, etc. of the respective offices.	Started in February 2021, continuous implementation
Outreach EPI centers (fixed sites)	Introduced to boost vaccination rates in both rural and urban areas, primarily implemented through the regular EPI centers, which are health post that provide immunization and other primary health care services. C19 vaccination sessions and routine EPI sessions were typically organized on alternating days of a week.	Started in July 2021, continuous implementation
Mass campaign sites (temporary sites)	Mass campaign sites were implemented nationwide during pre-scheduled campaign days as directed by the EPI headquarters. These sites were coordinated by city corporations (in city corporation areas), civil surgeon offices (at the district level), and upazila health offices/complexes (at the upazila and lower levels).	Implemented for short periods of time (1 to 7 days) between August 2021 and July 2023
School-based vaccine delivery sites (temporary sites)	In collaboration with the Ministry of Education, city corporations, civil surgeon offices, and upazila health offices/complexes vaccinated children aged 12-17 in educational institutions (e.g., schools, madrasahs, etc.). Some schools based sites organized brief vaccination sessions only for their students, while much longer sessions were arranged at larger institutions to vaccinate students from other schools.	Sessions conducted between October 2021 and October 2023
Special campaign sites (temporary sites)	This strategy aimed to provide vaccinations to underserved populations. The EPI headquarters implemented targeted initiatives, focusing on specific target groups like the floating population, transport workers, qawmi madrasa students, prisoners, sex workers, etc., operated exclusively during pre-scheduled campaign days by establishing vaccination booths at temporary locations.	Implemented as short, one-off campaigns between July 2021 and December 2022
Pediatric vaccination sites (temporary sites)	This strategy aimed to vaccinate children aged 5-11 in schools. Vaccination sites were managed by city corporations, civil surgeon offices, and upazila health offices/complexes.	Sessions conducted between August 2022 and July 2023

STAFFING OF THE C19 VACCINATION PROGRAM

A team of two vaccinators and three volunteers was assembled to facilitate efficient C19 vaccine delivery. Initially, the MOHFW designated nurses as the primary vaccinators to roll out the C19 vaccination program at MOH hospitals and non-MOH government hospitals. The decision to start the C19 vaccination program with trained healthcare professionals like nurses aimed to foster trust and alleviate fear within the community. However, given the HR constraints, other cadres such as Paramedics, Health Assistants, Assistant Health Inspector, Health Inspector, Family Welfare Visitors, Family Welfare Assistants, Family Planning Inspector, Sub-assistant Community Medical Officers (SACMO), and Midwives worked as vaccinators at temporary sites, and nursing students were also trained as vaccinators. Six different C19 vaccines were used in Bangladesh, which meant that health workers had to adapt to different storage requirements and vaccine administration protocols and adhere to specific vaccine compatibility guidelines when administering the second dose.

Volunteers from the local community supported vaccination sites in various ways, for which they received allowances. Volunteers could be responsible for screening, crowd controlling and mobilizing, taking care of the older people and comorbidities target group, client management, and record-keeping with finger marking. The volunteers were sourced from the local community, and included individuals with prior experience in vaccination campaigns, such as members of Ansar, Village Defense Police, Social Welfare Department Workers, Social Workers, Watchmen (Choukidar), NGO workers, Multipurpose Health Volunteers, Students, as well as volunteers from Bangladesh Scouts and Bangladesh Red Crescent Society (BDRCS). Allowances for volunteers typically amounted to 350৳ per day (approximately $4.09). At temporary vaccination sites (mass campaigns sites and schools), volunteer allowances were given for every vaccination day, while at fixed vaccination sites allowances were only given for a portion of the vaccination days worked. During the fiscal year 2021-22, volunteers working at fixed sites only received the daily allowance for about 58% of the vaccination days.

TRAINING

The EPI headquarters organized in-person and virtual training to roll out the C19 vaccination program. EPI headquarters developed operational guidelines for administering specific vaccine types, which were disseminated through the health system levels through training. National master training, national training of the trainers, and other training sessions were organized covering various topics related to C19 vaccination (e.g., vaccine administration, AEFI management, cold chain management, session organization, data management, volunteers, etc.) with technical assistance from WHO and UNICEF. To facilitate this training initiative, materials developed by WHO were adapted, translated, and supplemented with vaccine-specific guidelines and manuals. As per the routine EPI program's approach, a phased training was conducted for each newly approved and introduced C19 vaccine. The training was organized at the national and below levels, and by January 2022, over 250,000 individuals had received training.[16]

SOCIAL MOBILIZATION

Thanks to support from local administrations, public representatives, offices of different ministries, and law enforcement agencies, the MOHFW-led C19 vaccination program quickly was accepted by the people. The national-level media campaign for C19 vaccination provided regular updates on the number of C19 vaccinations, and through social media, television, and radio, people were informed on the availability of vaccines. The C19 Vaccine Preparedness and Deployment Core Committee also worked with local administrative bodies to manage any locally spread rumor regarding C19 vaccinations. Local administrative bodies like Upazila Nirbahi Officers, Upazila Education Officers, Upazila Family Planning Officers, Upazila Parishad, and Union Parishad got engaged in social mobilization to increase awareness of the importance of receiving C19 vaccinations among local communities. Although guidance dictated conducting mass announcements in the catchment area for several days, funding was only sufficient to rent the announcement systems for one day. Therefore, local leaders like Upazila Council Chairman, Union Council Chairman and Ward Councilors provided in-kind support to conduct social mobilization activities, especially mass announcements. Mosques and temples opened their doors for use as vaccination booths for temperature-sensitive vaccines, and the religious leaders took a significant role in sensitizing the mass population during prayer congregations. The local voluntary and youth-based organizations came forward to support social mobilization, in addition to crowd control, and managing vaccination booths.

WASTE MANAGEMENT

Vaccination sites reported that waste management followed routine practices. Sites reported that there was no additional funding available for waste management for the C19 vaccination program. Mainly at hospital-based sites, waste management for the C19 vaccination program was managed as per usual practices.

However, some sites had to handle waste from adjacent temporary sites and incurred extra labor costs to transport it to the fixed sites for disposal. Vaccination sites had to manage this as a part of their regular activities and available funding, which was often insufficient.

Image: C19 vaccinators and volunteers waiting at a booth

IV

FINANCING AND IN-KIND CONTRIBUTIONS FOR THE C19 VACCINATION PROGRAM

FUNDING FOR THE C19 VACCINATION PROGRAM

In addition to government funding, significant loans and donations from the World Bank, Asian Development Bank, European Investment Bank, and USAID facilitated the procurement of C19 vaccines. In 2021, the World Bank provided a loan of $500 million, which enabled the vaccination of around 11% of the population and operation costs for 31% of the population. The Asian Development Bank granted a loan of $940 million, facilitating the vaccination of approximately 11.6% of the population.[18] The European Investment Bank provided $283 million (€250 million) for safe and effective vaccines and country-wide vaccination against C19.[19] Furthermore, the United States Agency for International Development (USAID) donated more than 115 million C19 vaccines (primarily via COVAX) to Bangladesh.[20] The government has also received bilateral donations that support the implementation of the C19 vaccination program in the country.

Up until the end of 2022, development partners had contributed approximately $23 million the operational cost of the rollout of the C19 vaccination program (see Table 5). Table 5 summarizes the amounts and areas of support of the government and key partners. Development partners primarily filled the gaps in organizing nationwide mass vaccination campaigns. Their support played a crucial role, as financial regulations constrained the utilization of government funding on short notice in organizing the campaigns. UNICEF and WHO were the main contributors, primarily at the national level. They financed training, rental of cold chain facilities, transporting vaccines, social mobilization, advocacy, organizing mass vaccination campaigns, and supervision activities, and donated immunization supplies and cold chain equipment. With funding from COVAX, UNICEF also supported the EPI headquarters to expand the cold chain infrastructure at national and subnational levels.

Apart from the primary implementing partners WHO and UNICEF, several others provided financial and in-kind support. Save the Children facilitated the training of more than 102,000 personnel, rented cold chain facilities, transported vaccines, printed training modules and vaccination cards, conducted social mobilization, and organized mass vaccination campaigns. BDRCS provided in-kind support by coordinating a substantial team of over 2,600 doctors, 6,100 vaccinators, and 8,700 volunteers to support the C19 vaccine rollout nationwide. They also supported vaccine transportation, and donated 18 freezer vans. BRAC offered support by managing vaccination centers in Dhaka, informing the public about vaccination, myth-busting, C19 vaccination registration, and directing people to vaccination services. Though given the scale of the C19 vaccination program, the total amount of financial support that Bangladesh has received by the end of 2022 was very little. For comparison, by the end of 2022, Bangladesh had delivered 335 million C19 vaccine doses, while for an MR follow-up campaign that aimed to deliver 32 million doses in 2021, the country received $17 million in operational support from Gavi.

In addition to financial support, technical assistance from UNICEF, WHO, and other development partners was instrumental in implementing the C19 vaccination program. UNICEF and WHO supported crafting of national guidelines, organizing meetings and workshops, determining the target population and delivery strategy, and facilitating bilateral vaccine donations. Furthermore, both partners stationed personnel at the EPI headquarters to provide ongoing technical support in the execution of the program. WHO's Surveillance and Immunization Medical Officer (SIMO) network has ensured the safety and quality of C19 vaccines. UNICEF has also helped develop the national C19 vaccination dashboard. PATH supported in organizing mass vaccination campaigns in hard-to-reach areas. CARE assisted in organizing training at multiple levels, facilitated volunteers, and organized home visits in promoting awareness for C19 vaccination program in a particular area of the country. They supported connecting the government with garment factory owners, which enabled healthcare staff to receive vaccination training, eliminating the need for women employed in these factories to take time off. Johns Hopkins Center for Communication Programs supported the government for C19 prevention and vaccination promotion in the country. They also offered logistical assistance, printed vaccination cards, and shared vaccination campaign information through community and national radio partners. Positive stories were also featured on official government Facebook pages.

The C19 vaccination program also benefited from the support of other government agencies, and local-level support from private citizens and organizations. This support is primarily made on an ad-hoc basis to address the specific requirements of the vaccination effort. These contributions encompassed a range of essential needs, including but not limited to the transportation of vaccines, social mobilization, food and drinks for local health staff and volunteers, and supply of personal protective equipment for vaccination sites.

Voluntary and youth-based organizations contributed by offering support in managing crowds, vaccination booths, and social mobilization. Local political figures, religious leaders, and influential community members united to raise awareness and promoted C19 vaccination among individuals. Law enforcement agencies worked to maintain the safety and security of the vaccines and vaccination teams, as well maintaining queues and incoming people for vaccination.

Table 5. Overview of the financial contribution for C19 vaccination program operational costs until December 2022.

Funding Source	GOB	GOB	UNICEF	WHO	IFRC	Save the Children (USAID funding)	BRAC (USAID funding)
Year	**FY 2020-21**	**FY 2021-22**	**2021 & 2022**	**2021 &2022**	**2022**	**2022**	**2022**
Amount of support (2022 USD)	$181.43 million	$9.59 million	$12.49 million	$6.77 million	$3.06 million	$700,000	$30,000
Amount of support (৳)	15,519,387,000	820,000,000	1,068,023,000	579,301,000	262,144,000	59,867,000	2,683,000
Service delivery	✓	✓	✓	✓	✓	✓	✓
Training	✓	✓	✓				
Vaccine collection, distribution, and storage	✓	✓	✓	✓	✓	✓	✓
Social mobilization and advocacy	✓	✓	✓	✓			
Program management	✓	✓	✓	✓			
Supervision	✓	✓	✓	✓	✓	✓	
Recording keeping, HMIS, M&E	✓	✓	✓	✓			✓
AEFI management	✓	✓					
Other activities/ unknown	✓	✓			✓ (donated 18 freezer vans)		

Source: EPI headquarters, DGHS, UNICEF, WHO, December 2022.

BUDGETING AND DISBURSEMENT OF FUNDS

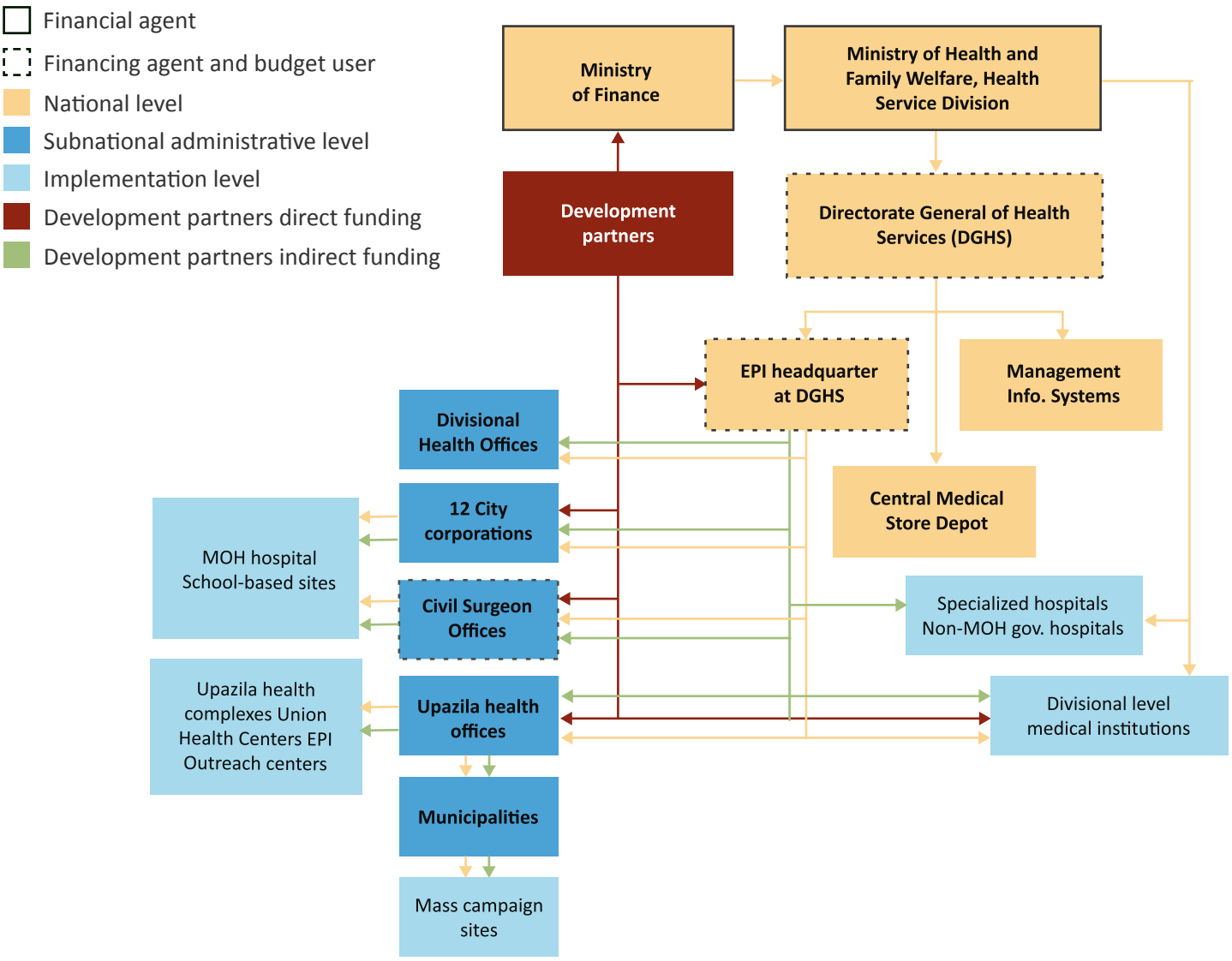
The C19 vaccination program was primarily funded through two mechanisms: (1) the operating and development budget of the GOB, and (2) the development budget consisting of loans and grants from development partners. The Ministry of Finance (MOF) and development partners financed the MOHFW and EPI headquarters to implement the C19 vaccination program. The health budget in Bangladesh is characterized by an operating and a development budget, which are financed from different sources. The operating budget is a fixed, recurrent budget that relies on domestic funding, whereas the development budget is variable, funded by both domestic and external sources, as defined by the Annual Development Plan (ADP). The development budget is typically allocated to operational plans or projects for specific program and policy priorities. In contrast, the operating budget is provided to the cost centers to cover salaries and other regular recurring costs. The funding process for the C19 vaccination program comprised multiple phases: budget planning, negotiation, allocation, disbursement, and budget utilization.

Preparing the budget for the C19 vaccination program involved several approval steps by the EPI, DGHS, MOHFW, and MOF. The EPI program prepares a yearly budget based on the approved five-year operational plan, through a microplanning exercise with district and upazila-level health facilities. Unlike the routine EPI program, the C19 vaccination program is a unique program planned and estimated annually in consultation with relevant government departments and development partners. First, the Line Director of Maternal, Newborn, Child, and Adolescent Health (MNC&AH), member secretary of the C19 vaccination task force, at the EPI headquarters prepared the initial budget, which was then sent to the Finance Unit of the DGHS. The Director of Finance at DGHS and the Director General of DGHS both had to grant their approval for the budget. Once these approvals were secured, the budget was forwarded to the MOHFW, where the Budget Wing thoroughly reviewed the budget before sending it to the MOF. This review phase included inter-ministerial coordination and negotiations to ensure the submitted budget was acceptable. If necessary, revisions were made to the budget at this stage. In the FY 2021-22, the budget request to cover service delivery for the C19 vaccination program was initially estimated at 524 crores ৳ ($61.26 million). However, it is worth noting that only 82 crores ৳ ($9.59 million) was approved towards the conclusion of the financial year. One notable adjustment pertained to removing the honorarium for vaccinators, which were included and granted for the fiscal year before that.

The budget distribution of the C19 vaccination program sometimes differed from the regular process, with development funds sometimes being directly transferred to cost centers (Figure 7). Once the budget received approval from MOF, the MOF distributed funds to the MOHFW for implementing the C19 vaccination program at lower levels. Within the MOHFW, the Health Services Division gave funds to the DGHS, which in turn distributed government funds to cost centers at both the national and local levels. A cost center is a government department or unit that is responsible for incurring expenses related to specific activities or functions at the city corporation, district, and upazila levels to facilitate the implementation of the C19 vaccination program. While the government predominantly adhered to the standard distribution process for the C19 vaccination program, there were instances in which the Line Director, MNC&AH accumulated funds from development partners and sent the funds directly to the cost centers to ensure prompt and efficient service delivery at the field level, for example to organize C19 mass vaccination campaigns.

The C19 vaccination program funds were used by various national and local level users and cost centers (Figure 7). At the national headquarters, fund users included DGHS, EPI headquarters, Management Information Systems (MIS), and Central Medical Store Depot (CMSD). At lower administrative levels, users included the divisional health offices, civil surgeon offices, medical institutions/hospitals, non-MOH government hospitals at divisional and district levels, city corporations, and upazila health offices/complexes. Civil surgeon offices, upazila health offices, and city corporations managed funding for school-based sites and mass vaccination campaigns. The union health center, which is the lowest rural administrative unit, public health facilities within municipalities, and EPI outreach centers received funds through the upazila health offices/complexes. The upazila health offices/complexes had the authority to oversee the utilization of funds for these facilities for the C19 vaccination program.

Figure 7. Fund flow for the C19 vaccination program.



OFF-BUDGET FINANCING OF SERVICE DELIVERY

Financial regulations presented obstacles to quickly access the GOB funding needed to organize mass vaccination campaigns, so development partners stepped in to fill the void. The mobilization of GOB funding within short notice was restricted due to financial regulations, which constrained the utilization of government resources. Therefore, the EPI headquarters mobilized funding from UNICEF, WHO, Save the Children and other development partners to organize these extensive nationwide vaccination campaigns. It is crucial to underscore that the contributions from development partners, channeled through the EPI headquarters, were undertaken with the consent of the MOHFW and DGHS. The EPI headquarters was the main financing agent for covering the off-budget service delivery costs of the C19 vaccination program, disbursed these funds to various cost centers and civil surgeon offices for further administration at the district and upazila levels. In certain instances, the development partner directly allocated funds to specific cost centers at national, city corporation, district, and upazila level (see Figure 7).

V

QUALITATIVE FINDINGS

This section is based on the findings of the qualitative interviews and consultation workshops conducted between September and March 2023 at national and below levels.

It is meant to offer a comprehensive understanding of the enablers and challenges involved in the financing and implementation of the C19 vaccination program at implementation level as well as at national level. For more information regarding the methods, see the earlier section on Data analysis.

ENABLERS IN IMPLEMENTING THE C19 VACCINATION PROGRAM

- **The program succeeded due to strong political commitment and collaborative approach.**
  The rollout of the C19 vaccination program was a success due to strong leadership, clear direction, and effective collaboration across all the GOB institutions involved. The Prime Minister felt the urgency to initiate the C19 vaccination program as the COVID-19 situation was impacting the economy of the country and provided direct oversight. Local level respondents consistently mentioned the continuous support and guidance received from EPI headquarters and DGHS throughout the implementation of the C19 vaccination program, including through regular supervision visits to vaccination sites. GOB's obligation to be vaccinated for accessing numerous services further boosted immunization rates in the country.

- **Leveraging the existing infrastructure of and the communities' trust in the routine EPI program facilitated the implementation of the C19 vaccination program.**
  The EPI in Bangladesh is a successful program and has a high coverage rate. Respondents felt that acceptability of the EPI routine vaccines among the mass population made the introduction of C19 vaccines easier for the vaccination sites as they were able to leverage the trust that the population has in the routine EPI program, as well as leverage EPI staff and other resources, using the same modalities. The national-level EPI program comprises highly skilled and experienced personnel in immunization, and their leadership and management capabilities also facilitated the implementation of the C19 vaccination program.

- **A common sense of urgency meant that the C19 vaccination program could count on a tremendous amount of local and volunteer support.**
  The disruptions caused by COVID-19 to both lives and the economy led to the collective realization that a potent vaccination program was essential for restoring normalcy. This catalyzed an extraordinary level of local and voluntary support for the C19 vaccination program, surpassing the typical engagement seen in other vaccination campaigns or new vaccine introductions. The rapid acceptance of the MOHFW-led COVID-19 vaccination program can be attributed to the support received from various government institutions and local leaders, including the Upazila Council Chairman, Union Council Chairman, and Ward Councilors.

- **Financial and in-kind support along with technical assistance from development partners played a key role in rolling out the C19 vaccination program, and off-budget financing mechanisms ensured funds were available in a timely manner.**
  Development partners offered the GOB prompt financial and technical assistance for vaccine procurement, cold chain rentals, vaccine transportation, training, and organizing mass vaccination campaigns. The overall support for implementing the C19 vaccination program was more comprehensive than is commonly provided to the routine EPI program in Bangladesh. Thanks to the flexibility of off-budget financing directly to lower-level administrative units, timely funding was available for crucial upfront investments such as to set up mass vaccination campaigns.

- **Health facility managers and workers were strongly motivated to ensure the continuous operation of the vaccination program despite their resource constraints.**
  Given the financial constraints, site-level managers had to plan carefully, and efficiently manage their existing resources. Due to the sense of urgency to turn the program into a success, site managers and health workers were especially motivated to find alternative solutions where gaps persisted. When funding for social mobilization, waste management, and vaccine transportation was insufficient, funds were drawn from routine health, EPI budgets or regular hospital budgets to fill gaps for the C19 vaccination program. Additionally, health facility managers had to make use of their personal official vehicles and establish partnerships with local government institutions to ensure the transportation of vaccines and the execution of social mobilization activities at the local level.

CHALLENGES IN IMPLEMENTING THE C19 VACCINATION PROGRAM

Most of the financial and operational challenges that were identified related to the vaccination site level.

At the national level, challenges that were expressed by key informants mostly related to financial issues.

- **Staff shortages at temporary vaccination sites placed a high burden on a health workforce that was already stretched pre-pandemic.**
  All respondents mentioned a severe shortage of field-level health workers at temporary vaccination sites. Vaccination sites could not hire any additional staff for the C19 vaccination program due to the public health system's centralized, complex, and time-consuming recruitment process. Bangladesh was already on the WHO health workforce support and safeguard list before the C19 pandemic, due to its critical shortage of HRH, and it remains on this list in 2023.[21,22] Therefore, the limited workforce available had to manage a high workload. There was particularly a shortage of health assistants, crowd controllers, and especially porters in charge of vaccine transport. To fill in gaps, MT-EPIs, volunteers, and UHFPOs transported the vaccines to the sites from the storage facility, supported the management of incoming crowds, and oversaw the vaccination activities. The routine EPI program also had no cold chain technicians in about half of the country's districts. As a result, cold chain maintenance has been a challenge for the C19 vaccination program.

- **Supply issues complicated implementation and posed challenges for program management and campaign preparations at all levels.**
  Supply uncertainty at the start, and limited expiry dates of donated vaccines posed challenges for program management and campaign preparations, such as reshuffling of stocks between districts, and having to organize vaccination campaigns at short notice. Respondents at vaccination sites reported difficulties in meeting preparation deadlines. In addition, guidance or plans were sometimes changed at the last minute, such as using a different vaccine type, which posed challenges to vaccine collection, storage, program management, health workers, and volunteer planning. Sites also faced difficulties in achieving the targeted number of vaccinations within a limited timeframe, leading to some campaigns being extended by several days to meet their goals.

- **The transportation of temperature-sensitive vaccines faced challenges due to limited availability of locally accessible air-conditioned vehicles and spaces, especially at site level.**
  There were instances where the need for air conditioning support to maintain the required temperature for these vaccines were limited due to a scarcity of readily available resources such as suitable vehicles or air-conditioned rooms with appropriate cooling facilities. The site managers had to come up with alternative solutions to mitigate this. Alternative vehicles were arranged for the temperature-sensitive vaccines, for example, the Civil Surgeon or UHFPO's car, or if available, airconditioned ambulances of the health facilities were used to transport C19 vaccines to the sites. Vaccinations booths were set up at mosques or other public places where air conditioning was available.

- **When the GOB enforced mandatory C19 vaccination, the countrywide vaccination rollout added considerable pressure on vaccination sites.** The additional influx of individuals surpassed the daily targets set for each booth, creating challenges in accommodating the heightened demand. Moreover, many vaccination sites had to grapple with on-site registration, a manual process that introduced additional workload and operational pressures. At outreach EPI centers, technical obstacles compounded, primarily due to the low literacy levels of villagers. Online registration proved challenging as villagers lacked knowledge about their mobile numbers and National Identification (NID) cards, complicating the process. This not only posed difficulties for real-time registration but also created complications in obtaining vaccination certificates later, illustrating the multifaceted challenges faced by vaccination sites in ensuring a smooth and efficient process.

- **Inadequacy of funds caused challenges in several programmatic areas at implementation sites, and reduced morale among health workers.** Despite the resources mobilized by governments and partners, vaccination sites reported receiving inadequate funding from the national level for activities such as social mobilization, waste management, and vaccine transportation, especially around the campaigns. Vaccination sites had to arrange alternative funding sources or had to look for in-kind contributions locally when the disbursed funds for C19 vaccination program activities were exhausted. Additionally, the discontinuation of honorarium for vaccinators after the first year of the C19 vaccination program's implementation reduced morale among the health workers, as they felt that they were not appropriately compensated for their time and efforts.

- **The GOB funds that were committed for program activities were not disbursed in a timely manner, which resulted in challenges at implementation level.** Respondents at national and vaccination site levels reported the persistent issue of delays in disbursements of GOB funds for C19 program activities. Such issues predate the C19 pandemic, though given the scale of funding required for implementation of the C19 vaccination program, posed an even greater challenge during this time. Although fund disbursements should occur quarterly, during the fiscal years 2020-21 and 2021-22, funds were not made available until the end of the fourth quarter. Vaccination sites faced challenges as they had to submit bills to access the funds promptly. However, many struggled to prepare the necessary documentation within the given timeframe. The problem was compounded by an overload system and inadequate communication with the treasurer's office, hindering the timely crosschecking of bills. Consequently, numerous sites faced difficulties in withdrawing the allocated funding promptly.

- **Complex financial management regulations and reporting systems challenged the financing of programmatic activities.** Despite the program's magnitude and implementation speed, the C19 vaccination program was restricted to the rigid financial management regulations of the routine EPI program. As for routine EPI, the funds that were allocated for the C19 vaccination program were reimbursable, while many large expenditures had to be paid in advance. Funding was not channeled directly to the upazila and below sites but followed the development budget fund flow process, meaning funds had to be collected from the Civil Surgeon's office from the Line Director at DGHS after submitting bills of expenditures, which is usually a cumbersome and time-consuming process. It was also not possible to reallocate funds across program activities or budget line items even in the case of an emergency. Additionally, there was unclarity around the budget ceiling for C19 program activities. Respondents reported that if the budget had been known and advances had been made available, this would have significantly facilitated program management.

VI

DESCRIPTIVE STATISTICS

SERVICE DELIVERY PROVIDERS

Fixed vaccination sites were active for several months and offered C19 vaccines 3 to 6 days a week, temporary mass sites were active for 2-6 days at a time, while the period of activity for school-based delivery varied significantly. All non-MOH government hospitals and most MOH hospitals sites in our sample (13 out of 14) began delivering C19 vaccines in February 2021, while the remaining MOH hospitals site became active in May 2021, and all but one were still active at the end of the data collection period in June 2022. Sampled sites delivering vaccines through outreach EPI centers started delivering C19 vaccines between July and October 2021. MOH hospitals and non-MOH government hospitals held C19 vaccination sessions 6 days a week, while outreach sites at EPI centers offered C19 vaccines 3 days a week. Of the 26 fixed delivery sites in our sample, six interrupted operations for at least one month and at most two months in the period between February 2021 and July 2022. Temporary mass campaign sites were active for 2 to 6 vaccination days, while school-based sites varied much more significantly. Two (out of 6) sampled school-based sites were active for just one day, while two more were active continuously for 6 days a week over a period of 5 to 7.5 months. The wide variation is due to the fact that while some school-based sites only vaccinated their own students, larger educational institutions that were better suited to host a vaccination site also vaccinated students from other schools and therefore were active for significantly longer.

Fixed sites delivered 201 to 717 doses per day, while temporary sites administered 320 to 983 doses (Table 6). Delivery volume was highest (983 doses per day/site) for school-based delivery, where all students could be vaccinated within a short time span. MOH hospitals vaccination sites also delivered very high volumes (717 per day), likely because the majority of the MOH hospitals sites in our sample are large secondary and tertiary level hospitals. Delivery volumes at mass campaign sites were much lower (320 per day), because for four out of the six campaign sites in our sample, data represent September-October 2022, when coverage was already relatively high and delivery volumes were reducing. Delivery to employees and dependents at non-MOH government hospitals averaged 271 doses per day. The daily administration of vaccine doses was lowest (201 doses per site/day) at the regular outreach sites at EPI centers.

The time spent on vaccine administration per dose delivered was highest at EPI outreach centers (18 minutes per dose) and lowest at schools (4 minutes per dose). However, for other delivery strategies, the time spent per dose delivered was relatively similar (5-9 minutes per dose), despite widely varying delivery volumes. MOH hospitals sites had the largest vaccination teams, consisting of 43 members (25 regular staff and 18 volunteers), followed closely by non-MOH government hospitals, which relied the most on regular staff (26 out of a team of 33) among all the types of sites in our sample. Although there was some national level recruitment by WHO and UNICEF, none of the sites in the sample recruited additional health workers for the C19 vaccination program.

Urban vaccination sites generally administered more than twice as many vaccine doses per day as rural sites, with a vaccination team comprised of twice as many vaccination team members, and the administration time per dose was half as long (Table 6). On average, there were 29 members on each vaccination team at the sampled vaccination sites, of which 18 were regular staff and 12 volunteers. Urban vaccination sites administered significantly more vaccine doses—an average of 699 doses compared to 275 doses per day per site—than vaccination sites in rural areas. On average, urban vaccination sites in our sample had more staff (34 vaccination team members compared to 18 at rural vaccination sites), and a greater share were regular staff (21 compared to 11 at rural sites). In rural areas, it took almost twice as long to administer each vaccine dose compared to urban sites, with 11 minutes versus 6 minutes. Including time spent on other C19 vaccination program activities, the total time per dose spent at rural sites amounted to 32 minutes of labor, whereas urban sites only needed 17 minutes.

Table 6. Average staffing and service delivery at the sampled vaccination sites (April – June 2022).

	Overall	Urban	Rural	Fixed Sites			Temporary Sites	
				MOH hospitals	Non-MOH gov. hospitals	Outreach EPI centers	Mass campaign sites	School-based
Number of vaccination sites	38	24	14	14	5	7	6	6
Number of vaccination days	-	-	-	6 days/week continuously		3 days/week continuously	2-6 days in total	1-181 days in total
Doses delivered per day	543	699	275	717	271	201	320	983
Vaccination team members*	29	34	18	43	33	15	10	29
Of which regular staff	18	21	11	25	26	9	6	15
Of which volunteers	12	14	7	18	7	6	4	14
Person minutes (all activities)	22	17	32	13	22	55	17	12
Person minutes (vaccination)	8	6	11	5	9	18	6	4

*Average number of regular staff and volunteers not always add up to the total number of vaccination team members due to rounding

BENEFICIARIES

We conducted exit interviews with 110 beneficiaries, including 89 individuals accessing vaccination at health facilities and 21 at non-MOH government hospitals vaccination sites, all in urban areas (Table 7). The number of people interviewed included 68 males and 42 females. All respondents indicated their profession, and we therefore have data on the approximate personal income level for all respondents. More than half our sample reported earning less than the minimum wage ($94 or 8000৳ per month).[23], [24] though of the 51 respondents that reported not having any personal income, a large share were homemakers and students, for whom personal income is not an accurate reflection of household wealth. Unfortunately, our data on household income are incomplete, and cover only MOH hospitals delivery, as none of the respondents at non-MOH government hospitals disclosed household income. The average income of a household in Bangladesh was $379 or 32,422৳ in 2022[25], which means that at MOH hospitals sites, most earned less than that, and although we cannot confirm this from our data, we expect that respondents at the non-MOH government hospitals may have been wealthier on average.

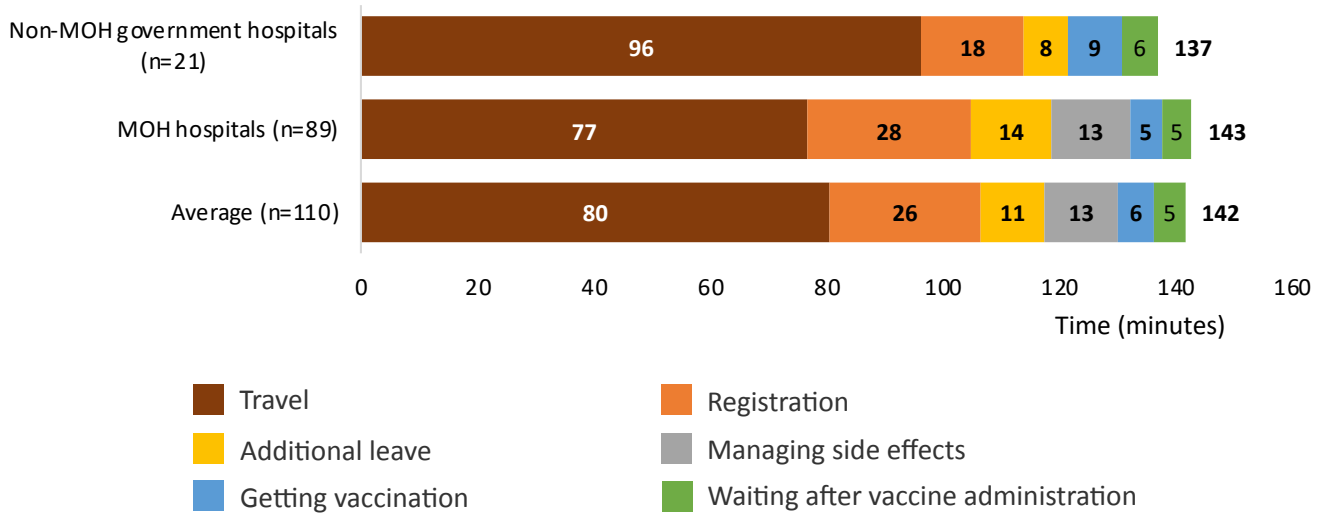
Image: C19 vaccines and related supplies at a booth

Table 7. Demographics of beneficiaries in the exit interviews (n=110)

Gender						
	Male	**68**				
	Female	**42**				
	Total	110				
Occupation						
	Government service	4	**Technician**	**1**	**Farmer**	2
	Private service	26	**Factory worker**	11		
	Homemaker	32	**Skilled worker**	9		
	Student	21	**Unemployed**	4		
Personal income						
		All	**$0**	**$50-$99**	**$100-149**	**$150-249**	**$249+**
	MOH hospitals delivery	**89** (100%)	40 (45%)	5 (6%)	17 (19%)	19 (21%)	8 (9%)
	Non-MOH gov. hospitals delivery	**21** (100%)	11 (52%)	0	2 (10%)	4 (19%)	4 (19%)
	Total	**110**	51	5	19	23	12
Household income									
		All	$0	$50-$149	$150-$249	$250-$349	$350-$449	$450+	N/A
	MOH hospitals delivery	**89**	2	13	38	9	12	14	1
	Non-MOH gov. hospitals delivery	**21**	None of the respondents at non-MOH government hospitals disclosed family income						

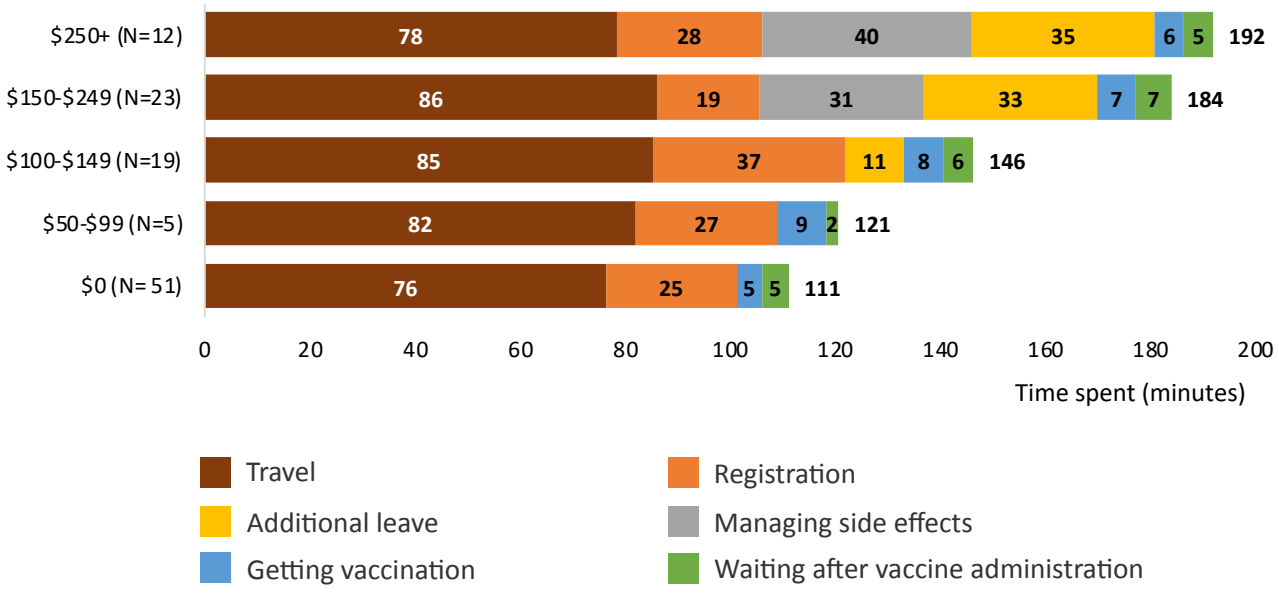
Beneficiaries spent on average 2 hours and 22 minutes to receive a C19 vaccine dose (Figure 8), with most of this time spent on travelling to and from the site (80 minutes on average). Travel time was greater for those receiving vaccines at non-MOH government hospitals (96 minutes compared with 77 minutes at MOH hospitals sites), likely because staff and their dependents might have traveled further to these offices to get vaccinated, than the distance to their nearest facility. Registration took an average of 26 minutes, and took less time for those registering at non-MOH government hospitals (18 minutes vs 28 minutes at MOH hospitals sites). Only MOH hospitals respondents spent time managing AEFIs (13 minutes on average). At both types of sites, actual vaccination was quick, with an average of 6 minutes, and waiting time was only 5 minutes. The additional leave—defined as time off from work that beneficiaries had to take in excess of the time needed to complete all activities related to getting vaccinated—averaged to only 11 minutes on average, due to the large number of individuals in our sample that did not have a paid job (52%) and therefore did not have to take any leave to get vaccinated. The overall time spent getting vaccinated found in our study is low compared to the limited literature available on this topic. A study on the time and costs of seeking measles vaccination in Guinea-Bissau found that the average time spent accessing vaccination was 3.55 hours.[26] However, this study was done in a rural setting where the vaccination site was likely to be further away.

Figure 8. Average time spent by a beneficiary receiving one dose of COVID-19 vaccine



There was no relationship between respondents' personal or household income, and the time they spent on getting vaccinated (Figure 9). Time spent on travel, the most time-consuming activity, was similar across income groups. Those in the highest income brackets had to take additional leave from work to receive the vaccination, whilst the lowest earners and those with no personal monthly income did not require any time off from work in addition to the time needed to complete all activities to get vaccinated. Higher income groupings also spent more time on managing side effects. On the other hand, lower income groups spent more time on registration, likely because of more limited access to internet access, and other smaller categories was similar across income groups. Overall, differences in overall time spent across income groups were not significant, and no correlation between income (personal or household) and time spent was observed.

Figure 9. Time spent by a beneficiary receiving one dose of COVID-19 vaccine by income level



Note: for some bars the individual components do not sum up to the total due to rounding

VII

THE COST OF DELIVERING AND RECEIVING C19 VACCINES

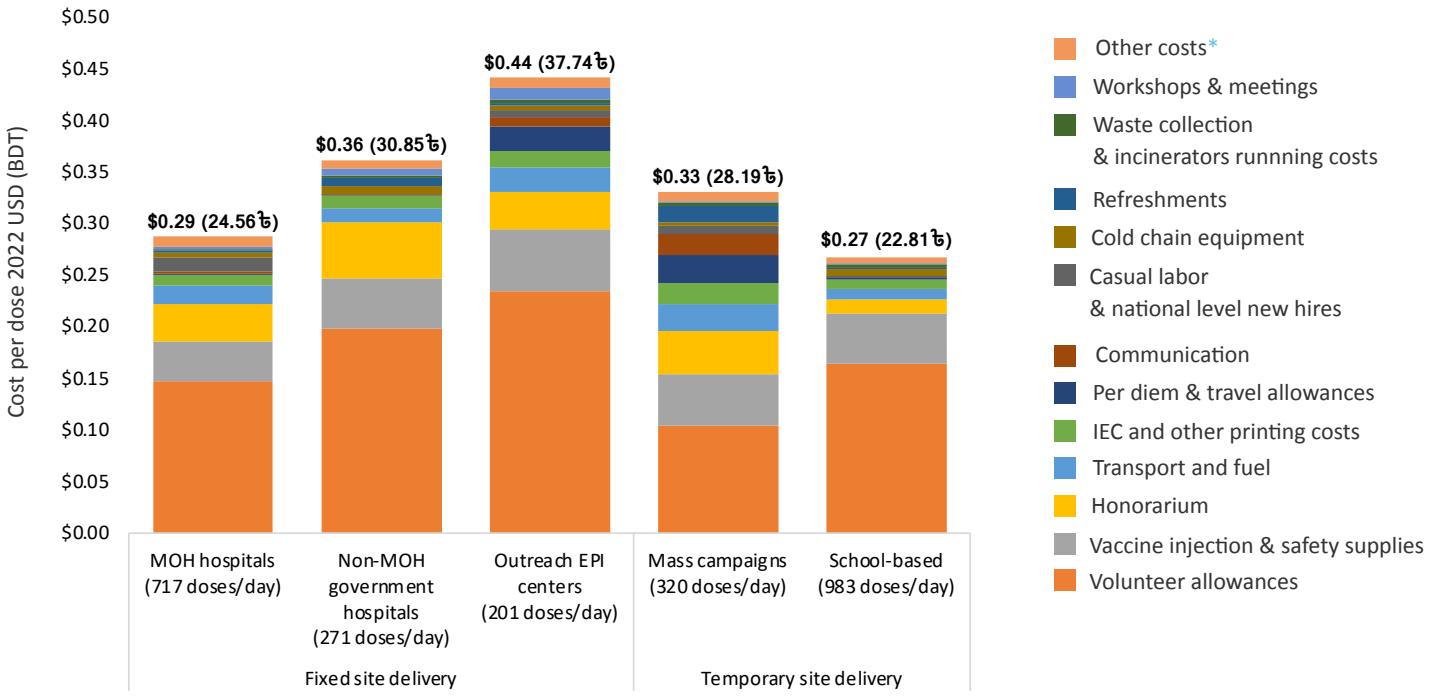
COST INCURRED BY THE HEALTH SYSTEM

The financial cost of delivering C19 vaccines in Bangladesh varied from $0.27 to $0.44 per dose, depending on daily delivery volume

The financial delivery cost varied from $0.27 (22.81৳) per dose for school-based delivery to $0.44 (37.74৳) per dose for outreach EPI centers (Figure 10). The school-based vaccination sites delivered very high volumes, an average of 983 doses per day per site, resulting in the lowest cost per dose among all delivery strategies. The cost per dose achieved at MOH hospitals sites, the primary delivery strategy used for the C19 vaccination program in Bangladesh, followed closely at $0.29 (24.57৳) per dose, with slightly fewer doses delivered per day (717). The cost and volume at non-MOH government hospitals and mass campaign sites were similar.

Mass campaign sites delivered more doses per day (320) at a slightly lower cost per dose ($0.33), compared with non-MOH government hospitals (271 doses per day at $0.36 per dose). The temporary sites set up for mass campaigns required additional resources for logistics, such as for transport, per diem, and communication, that were not needed at fixed sites, though due to the high delivery volumes they achieved, these costs were limited on a per dose basis. Outreach vaccination activities at EPI centers recorded the highest financial cost per dose ($0.44) due to having to lowest daily delivery volume among all strategies (201 doses per day per site).

Figure 10. Financial delivery cost per dose, disaggregated by resource type, for each delivery strategy



* Includes resource types with costs lower than $0.007 for all delivery strategies, namely: cold chain repairs and energy costs, stationery and other supplies, vehicle maintenance, vehicles, and costs related to the development of the registration app.

Financial delivery costs were primarily driven by allowances paid to volunteers, which accounted for 31% to 61% of the cost per dose across delivery strategies (Figure 10).

The amount per dose that the allowances represent is higher for outreach EPI centers due to lower daily delivery volumes. At most sites, the second most substantial cost component was vaccine injection and safety supplies, ranging from $0.04-$0.06 (or 13% to 18%) per dose across the types of sites. Honorarium, which is a financial incentive given to existing health staff for working on the C19 vaccination program, was also a significant cost driver. It varied from $0.01-$0.05 across strategies, representing 5% to 15% of the financial cost per dose.

BOX 3
Types of financial incentives or reimbursements given to vaccination team members:

Financial incentives or reimbursements given to vaccination teams for the C19 vaccination program followed the existing government policy. These amounts are paid on a per day basis and are not part of the regular salary and include:

i) **Travel allowance:** covers the travel cost to attend the training, workshop, or other events held in a location that is different from staff's regular workplace.

ii) **Per diem:** sometimes also called Daily Substance Allowance (DSA), covers meals and incidental costs of participants attending a training, workshop, or other events in a location that is different from staff's regular workplace.

iii) **Honorarium:** is given to the facilitator or focal person of a training, workshop, or other event or to staff for providing a service outside of their usual job description—for example to vaccinators of the COVID-19 vaccination program.

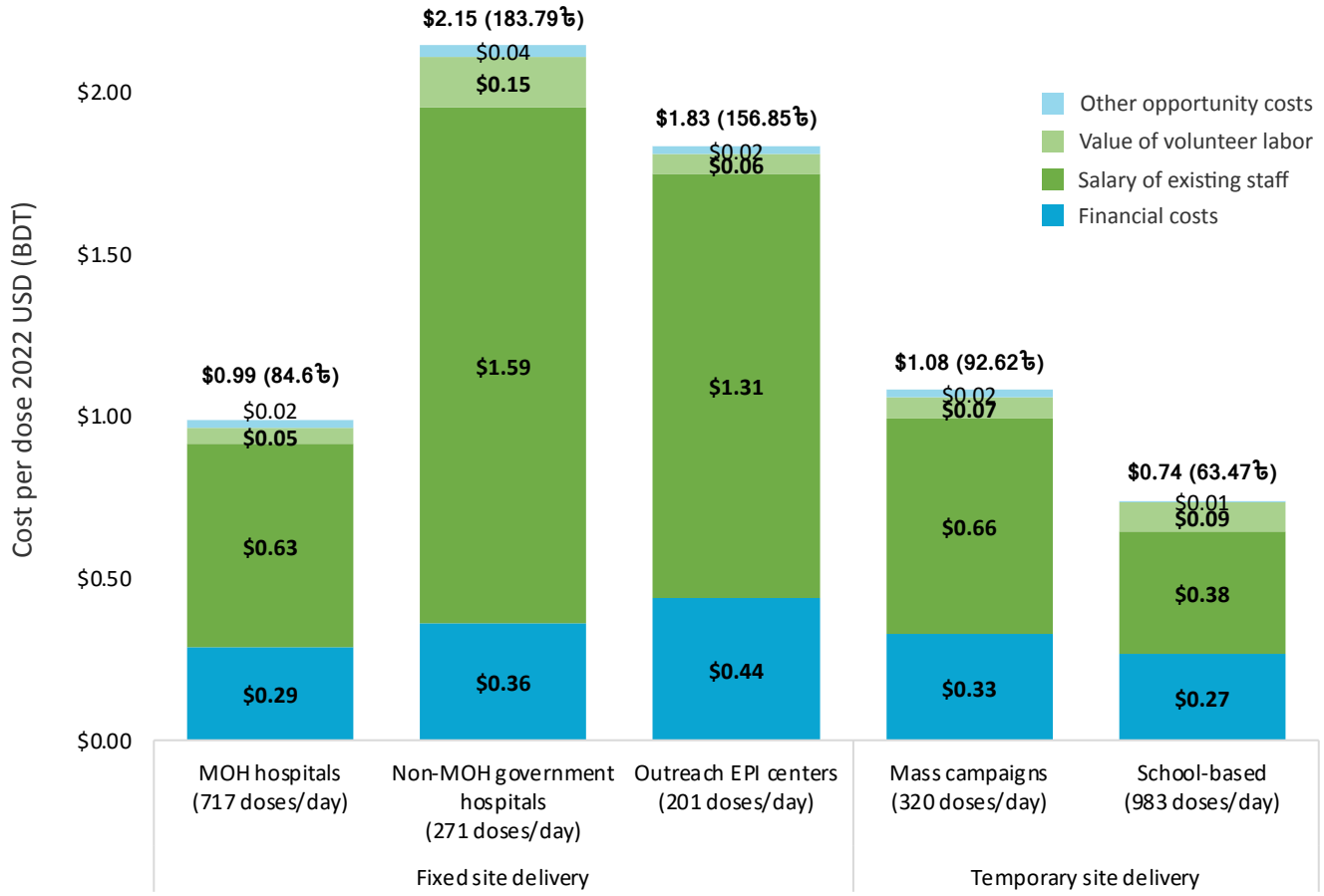
iv) **Volunteer allowance**: refers to a non-regular allowance provided to volunteers specifically to cover transportation and meal expenses incurred during COVID-19 vaccination days.

Image: Study team collecting data at a vaccination site

The opportunity cost of labor was high, especially at non-MOH government hospitals and for outreach EPI centers

During Phase I, labor costs accounted for 64% of the economic cost per dose, consisting entirely of salaries for existing staff. Opportunity costs accounted for the great majority of the economic cost per dose during Phase I (over 73%). This was largely due to paid labor, which during Phase I represented a much larger share of the economic cost per dose (64%, compared to 37% in the December 2021 to February 2022 period) and amounted to $2.27. No financial labor costs were recorded, as no additional health staff were hired for the C19 vaccination program. During Phase I, sampled sites deployed a similar amount of vaccination team members when compared to the higher-volume period of December 2021 to February 2022 (an average of 10 vs. 11 vaccination team members) but delivered far fewer doses per vaccination day (an average of 64 vs. 225 doses per day).

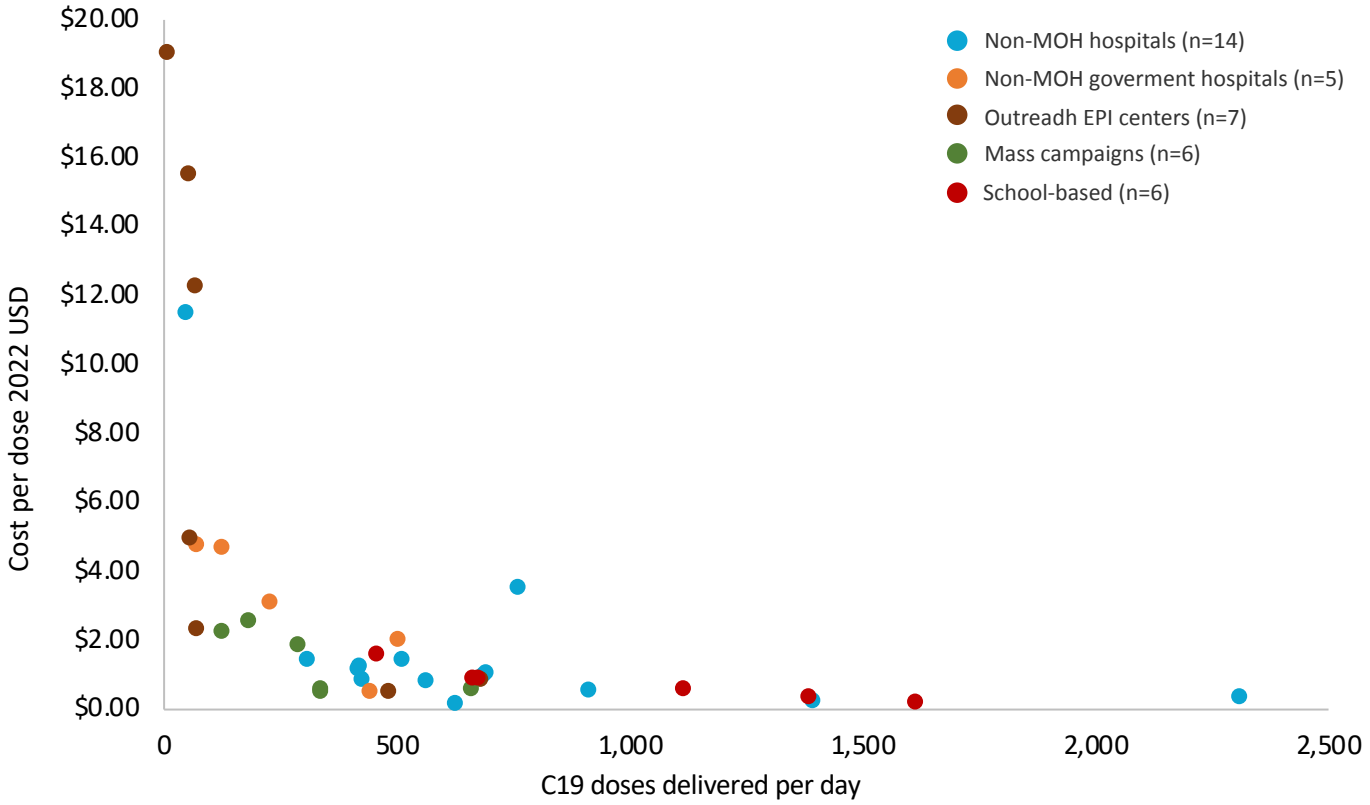
Figure 11. Economic delivery cost per dose, with opportunity costs disaggregated between salary for existing staff, volunteer labor, and other opportunity costs, for each delivery strategy.



Generally, the economic cost per dose across sites was driven by the volume they delivered, though there is variation in cost at similar delivery volumes.

Figure 12 shows an inverse relationship between the economic cost per dose at sampled sites and the volume of C19 vaccine doses delivered per day per site. This means that sites that delivered more doses per day generally incurred a lower economic cost per dose. A similar trend was observed when looking at the financial cost per dose. However, the correlation found in this study is not as strong as is commonly found in immunization delivery costing studies, likely for two reasons. First, our study incorporated many different delivery strategies, and even for a strategy such as MOH hospitals delivery, the implementation of the C19 vaccination program likely varied much more across sites than regular routine immunization would have. Second, at very high delivery volumes economies of scale diminish because the share of fixed costs apportioned to each individual dose approaches zero due to being spread over a very large number of doses delivered. Consequently, the marginal cost of an additional dose delivered approaches a constant because it is almost exclusively made up of variable costs, such as vaccine injection safety supplies.

Figure 12. Relationship between the economic delivery cost per dose and volume delivered per day, for each delivery strategy



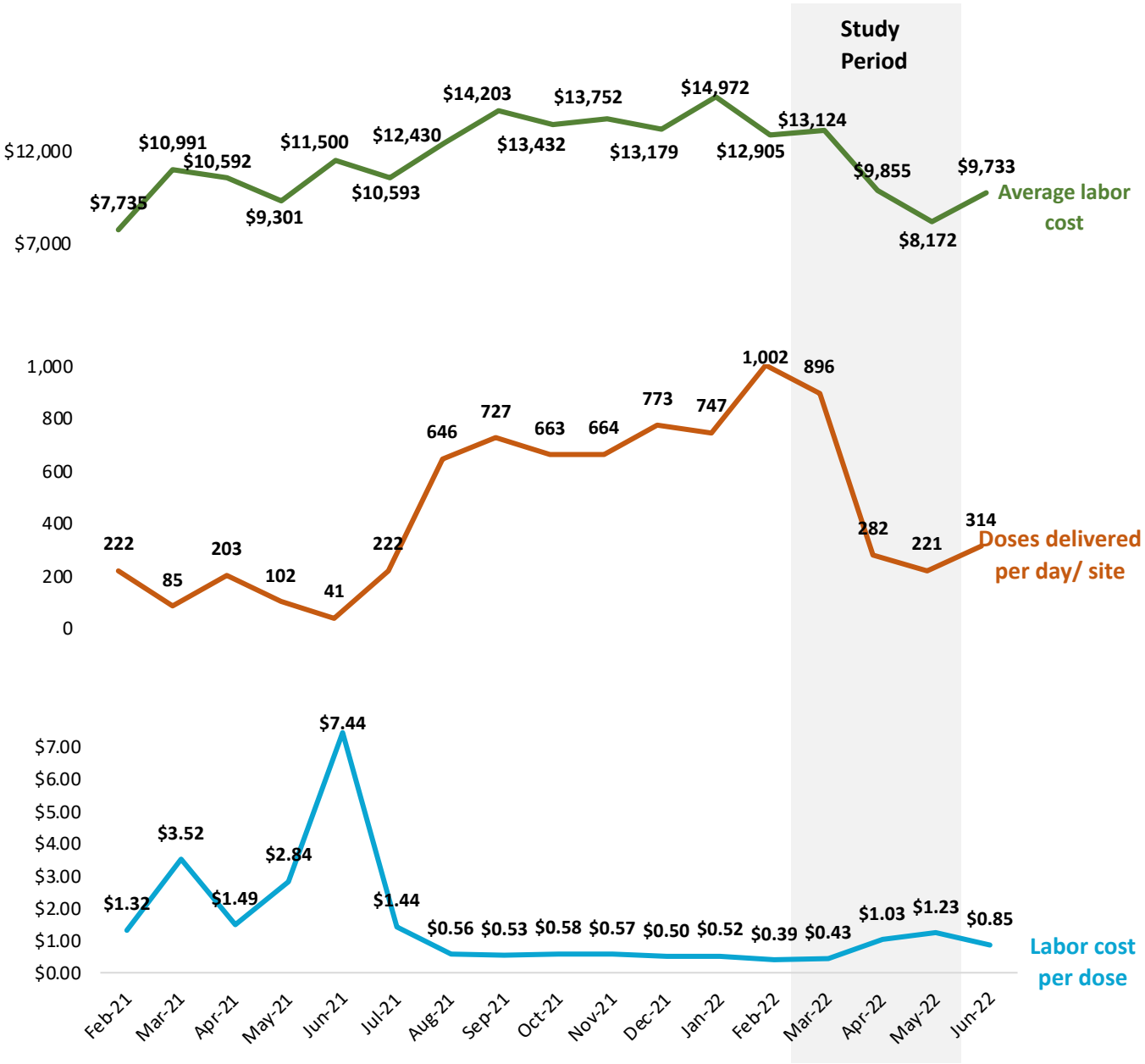
Over time, labor cost per dose was inversely correlated to volume delivered per day

Labor costs per dose at fixed sites were high and fluctuated significantly during the first months of the roll-out, and later decreased significantly when vaccine delivery volume picked up. Figure 13 shows the average total labor costs, doses delivered per day per site and labor costs per dose at MOH hospitals, non-MOH government hospitals and outreach sites, from the start of the vaccination program in February 2021 until the end of the study period in June 2022. Average total labor costs nearly doubled from $7,735 per vaccination day per site in February 2021 to $14,972 at its peak in January 2022. However, during the same period, daily delivery volumes fluctuated much more significantly, from 222 doses per day in February 2021, to more than four times as much in February 2022 (1,002 doses per day). Labor costs per dose were significantly higher in the early period of the roll out when volume delivered was much lower, reaching a peak of $7.44 in June 2021, when an average of only 41 doses per day were delivered at sampled sites, due to a shortage of vaccines.

Over time, the labor cost per dose decreased and stabilized as volume delivered per day increased, suggesting economies of scale are reached at first, and are later exhausted. As supply constraints eased after July 2021, and the volume delivered increased, the labor cost per dose decreased considerably, suggesting economies of scale were achieved, with the lowest cost per dose recorded in February 2022 ($0.39), when volume reached a peak of over 1,002 doses delivered per day. However, during the higher volume period between August 2021 to March 2022, when vaccine volumes varied from 646 to 1,002 doses, labor costs per dose remained relatively stable between $0.39 and $0.58.

This suggests that at very high delivery volume, economies of scale diminish as fixed costs per dose approach zero as they are spread across very large delivery volume, and what remains are nearly constant marginal costs. When delivery volume dropped in May-June 2022, average total labor costs decreased along with delivery volume, resulting in a more modest increase in the labor cost per dose. This trend was also observed when looking separately at each fixed delivery strategy.

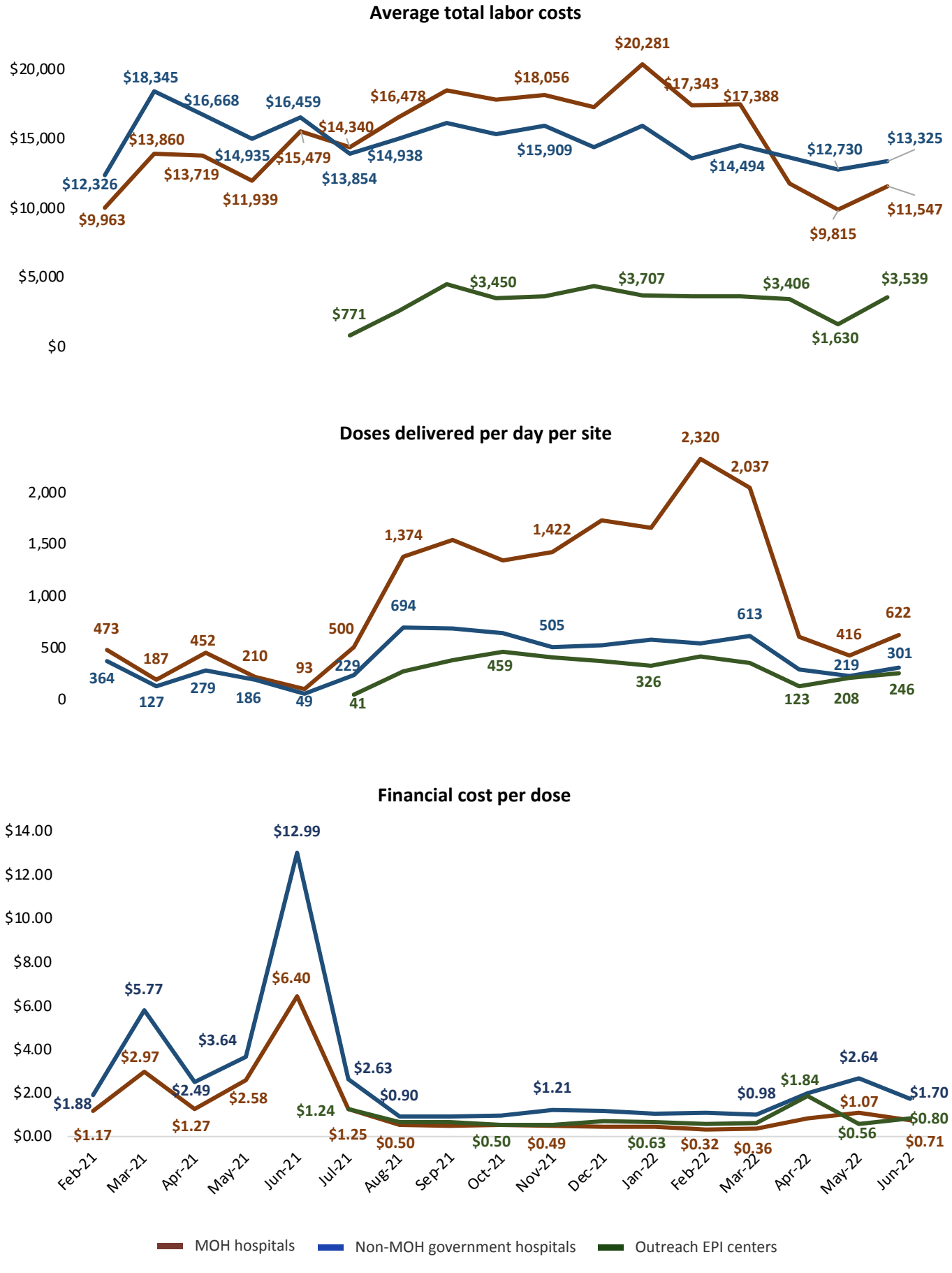
Figure 13. Labor cost per dose in 2022 USD (bottom), average C19 vaccine doses delivered per vaccination day (middle) and average total labor costs in 2022 USD (top), at sampled fixed sites, from February 2021 to June 2022



At non-MOH government hospitals were consistently higher than at other fixed sites, with a peak of $12.99 per dose in June 2021 (Figure 14). This is because average monthly total labor costs at non-MOH government hospitals were almost as high as at MOH hospitals sites (an average of $14,864, compared to $15,017 at facilities over the entire period), but MOH hospitals sites delivered much higher vaccine volumes, particularly in the period between July 2021 to June 2022.

Moreover, three out of the five non-MOH government hospitals vaccination sites in our sample were managed by defense forces and only staffed regular health workers without leveraging volunteers, resulting in higher labor costs. Outreach sites had much lower average monthly total labor costs ($3,223 on average during the active months), and also delivered lower volumes, resulting in a lower labor cost per dose more similar to MOH hospitals.

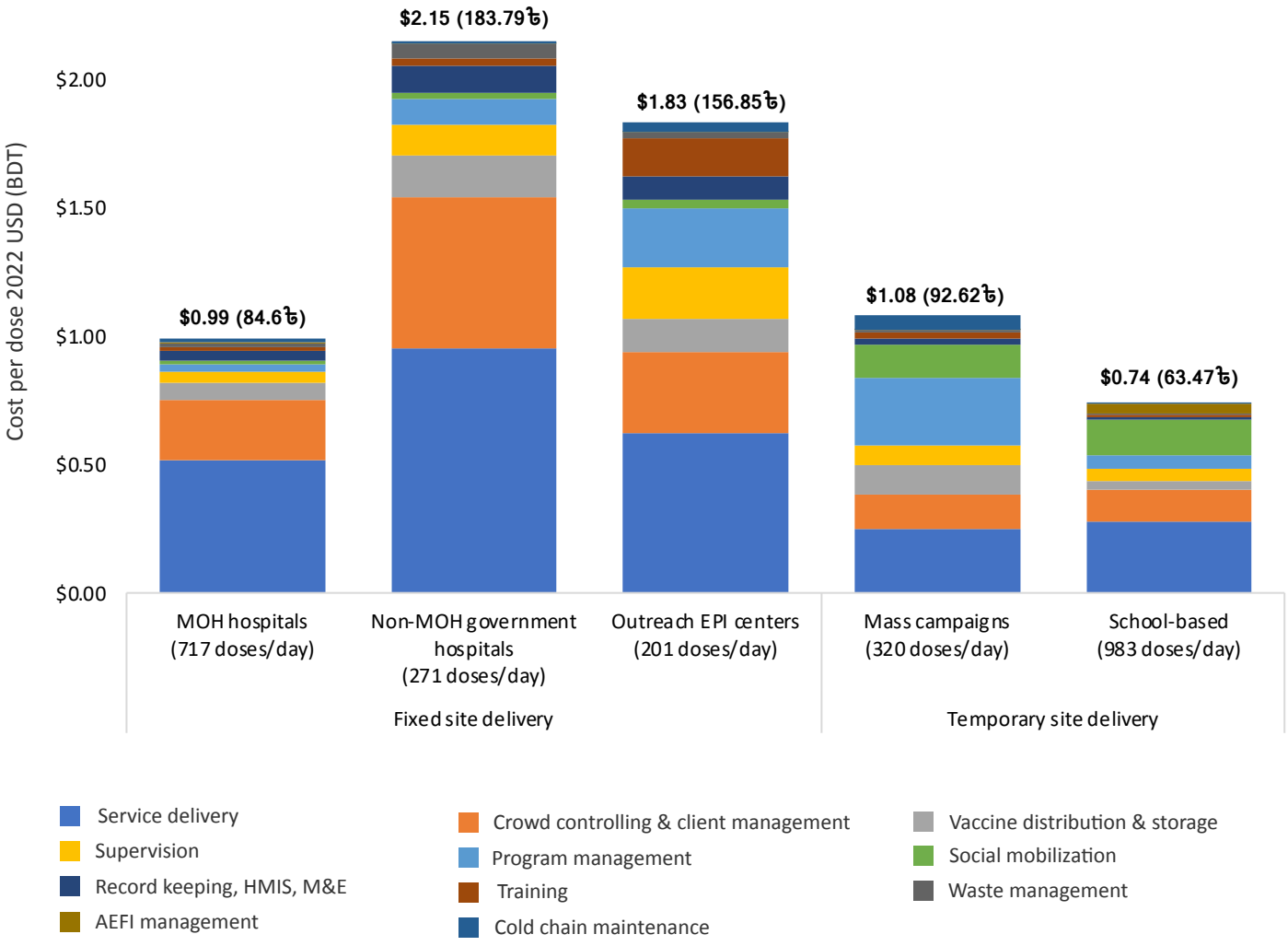
Figure 14. Labor cost per dose in 2022 USD (bottom), average C19 vaccine doses delivered per vaccination day (middle) and average total labor costs in 2022 USD (top), by delivery strategy, from February 2021 to June 2022



Service delivery was the largest cost activity at most sites

Service delivery was the largest cost activity at fixed sites and at schools, accounting for 23-52% of the economic cost per dose, while program management was the main cost driver at mass campaign sites (Figure 15). Service delivery costs include staff time, supplies, volunteer allowances, and all other inputs needed to prepare the vaccination site, administer vaccines, and clean up after each vaccination session. Service delivery made up a larger share of the economic cost per dose at MOH hospitals (52%) and non-MOH government hospitals (44%) than at mass campaign sites (23%). Crowd controlling and client management was the second largest cost driver at all fixed sites—accounting for 28% of the cost at non-MOH government hospitals and 24% at MOH hospitals—as these sites were more likely to also use regular staff, as opposed to volunteers only, for this activity. Social mobilization costs were negligible at fixed sites (1-2% of the cost). At temporary sites the cost structure differed slightly: crowd controlling was a less significant cost component, while social mobilization accounted for a larger share of the cost (12-19%). This is due to volunteers spending a larger share of their time on social mobilization activities at temporary sites compared to fixed sites. Program management related costs were the biggest cost driver at mass campaign sites (25% of the economic cost per dose), as almost 40% of labor from health staff was spent on program management activities, as opposed to 16% to 4% at other types of sites.

Figure 15. Economic delivery cost per dose, disaggregated by program activity, for each delivery strategy



Start-up investments at national level consisted primarily of cold chain expansions

Both at national and implementation level, investments in new cold chain equipment made up the majority of the start-up costs. Start-up costs consist of the initial investments and activities that were implemented specifically to prepare for the C19 vaccination program in the 30 days before the start of vaccination activities until the end of the study period (June 2022). Investments ahead of the C19 vaccination program were relatively limited. At national level, total financial start-up cost was $6.59 million, including costs incurred by the GOB and donors (Table 8), with 70% for cold chain equipment. At implementation level, financial start-up costs amounted to an average of $2,242 per site (Table 9).

Capital investments made up the largest share of this, with 18% of sampled sites reporting that new equipment was procured specifically for the C19 vaccination program, though the average vehicle cost of $467 reflects only a single site in our sample that had purchased a vehicle specifically for the C19 vaccination program. Honorarium given to regular staff to attend training specific to the C19 vaccination program, as well as planning workshops, meetings, and trainings implemented to prepare for the rollout of the vaccine were other drivers of the start-up costs.

Table 8. Total start-up cost at the national level for all delivery strategies (2022 USD)

	Financial costs
Cold chain equipment	$ 4,680,554
Printing of training and social mobilization materials	$ 1,052,585
Vehicles	$ 579,839
Development of registration app	$ 233,806
Training	$ 29,098
Vehicle maintenance	$ 9,535
Paid labor (salaries)	$ 3,918
Total	**$ 6,589,335**

Table 9. Volume-weighted average start-up cost at the vaccination sites level (2022 USD)

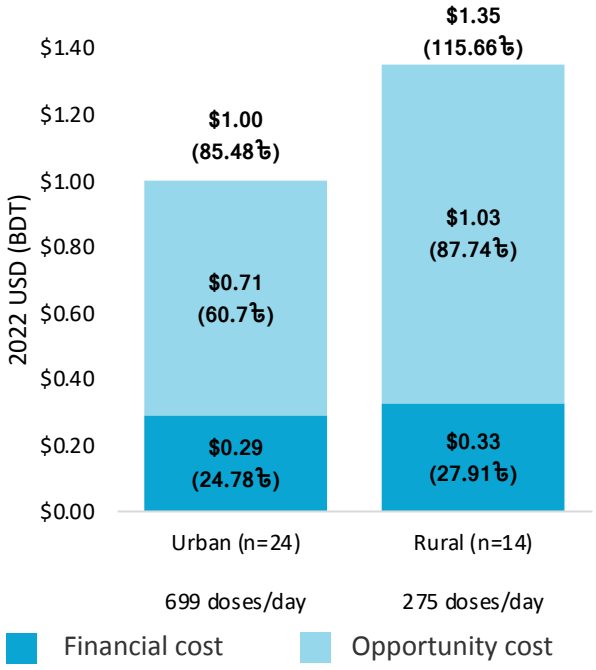
Resource type	Financial costs
Cold chain equipment	$ 634
Vehicles	$ 467
Honorarium for regular staff	$ 539
Per diem and travel allowances	$ 149
Volunteer allowances	$ 20
Planning workshops and trainings	$ 407
IEC and other printing costs	$ 25
Total	**$ 2,242**

Delivery costs were higher at rural vaccination sites, largely due to higher labor costs

The economic delivery cost was higher in rural areas (Figure 16), averaging $1.35 across delivery strategies, compared to $1.00 in urban areas, where far fewer doses were delivered per day (275 vs. 699 at urban sites). The financial cost per dose was also higher in rural areas, though the difference was less significant ($0.33 at rural areas compared to $0.29 in urban areas), and the difference in economic cost was driven by much larger opportunity costs in rural areas, largely due to higher labor costs. The economic cost at rural sites ranged from $1.03 at rural MOH hospitals to $4.84 at the only rural non-MOH government hospitals included in our sample, while costs at urban sites ranged between $0.74 at school-based sites to $2.01 at urban non-MOH government hospitals.

When looking at differences between rural and urban sites across delivery strategies, urban sites consistently reported lower economic costs per dose when compared to rural sites implementing the same delivery strategy. However, when looking at financial costs only, for some delivery strategies rural sites reported lower costs than urban sites. For instance, MOH hospitals and non-MOH government hospitals rural sites reported lower costs when compared to urban sites implementing the same strategies—$0.27 at rural sites vs. $0.29 at urban site for MOH hospitals delivery, and $0.16 at the sole rural non-MOH government hospitals in our sample, compared to $0.37 at urban non-MOH government hospitals. Financial costs were similar but slightly higher at rural mass sites ($0.34 compared to $0.31 at urban mass sites) and significantly higher at rural outreach sites ($0.53 compared to $0.29 at urban outreach sites).

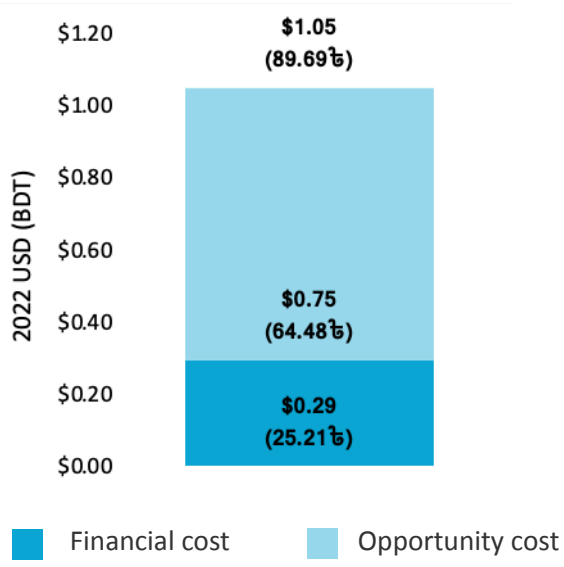
Figure 16. Economic delivery cost per dose in rural and urban areas



On average, the delivery cost per dose was lower than for other vaccination programs in Bangladesh, as well as compared to C19 vaccination in other countries

The average economic cost per dose across all delivery strategies was $1.05, which is lower than the cost of OCV campaigns that have been costed in the past ($1.23-1.28 per dose).[i] A study estimating economic costs for an oral cholera vaccine (OCV) campaign targeting only children aged 1 to 14 years old in urban communities in Dhaka South City Corporation found the delivery cost per dose was $1.23 (in 2022 USD)[27], while a feasibility study on an OCV campaign in an urban area in Dhaka found the delivery cost per dose to be $1.28 (in 2022 USD)[28]. These costs are higher than those found by our study, likely due to a larger volume delivered during the C19 vaccination program, though the other studies do not report any information about daily volume delivered by sites. Our findings are also lower than modeled estimates for the economic cost per dose for routine immunization in Bangladesh, which was estimated to be $2.49 ($0.79-$6.16).[29]

Figure 17. Economic delivery cost per dose†



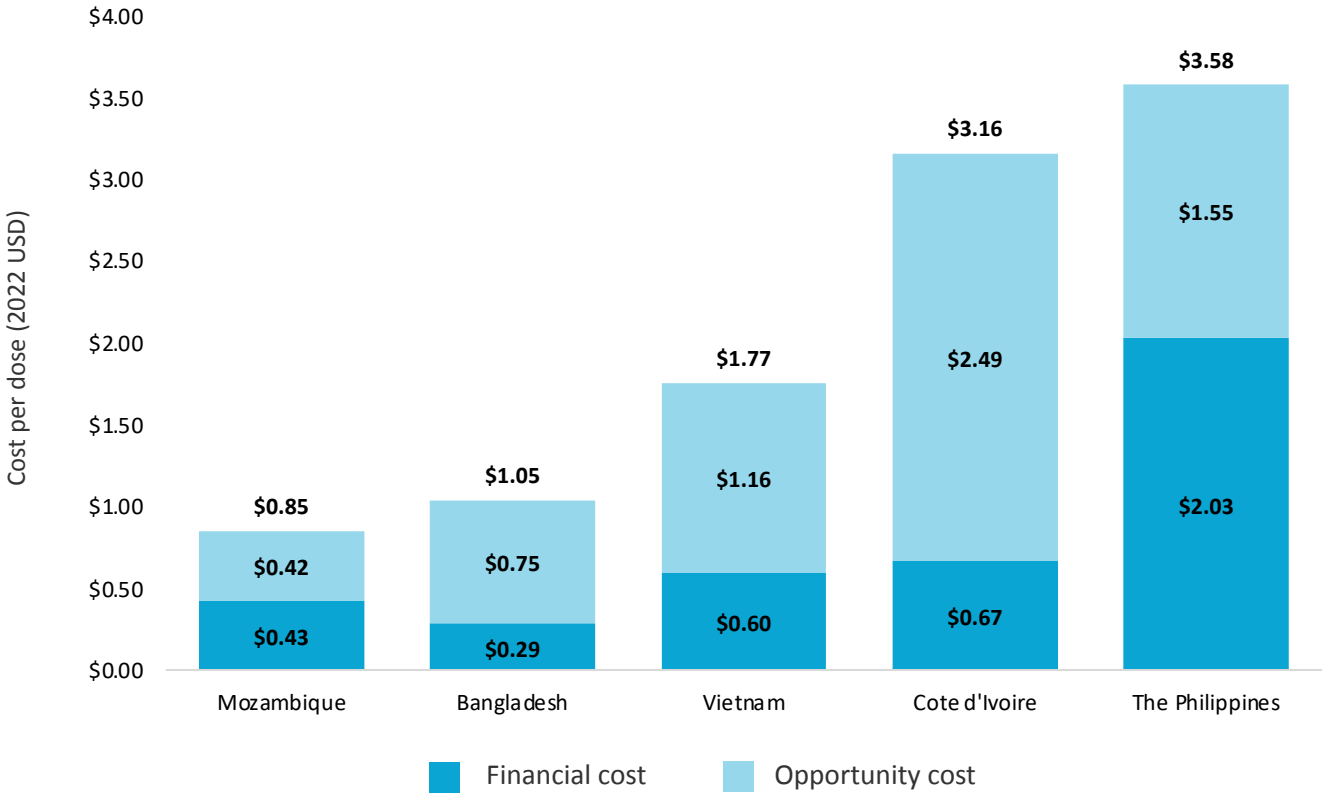
†For USD labels, individual components do not sum to the total due to rounding

[i] All results from other studies are presented in this section are in 2022 USD. To inflate costs from the year originally reported to 2022, we used the annual inflation rate of the Consumer Price Index (CPI) from the IMF.

The financial cost per dose found in this study is also lower than found in other countries for the delivery of C19 vaccines (Figure 18). [30,31,32,33]
The financial cost per dose for the delivery of C19 vaccines in other countries was found to range from $0.43 in Mozambique, $0.60 in Vietnam, $0.67 in Côte d'Ivoire to $2.03 in the Philippines, all higher than the average found in Bangladesh. The very low financial cost per dose in Bangladesh is primarily due to the high volume delivered per day. This is partially because our sample included particularly high-volume vaccination sites, though even the costliest strategy in Bangladesh, outreach EPI centers, reached a low financial ($0.44) and economic ($1.83) cost per dose compared to the average across all delivery strategies in other countries. Another reason for the low costs observed in Bangladesh is the limited financial support at implementation level, when compared with the other lower middle-income countries. When adding opportunity costs, which are largely composed of salaries of existing staff and the value of volunteers' labor, the economic cost per dose in Bangladesh is also lower than found in most other countries ($1.77 in Vietnam, $3.16 in Côte d'Ivoire, and $3.58 in the Philippines), except Mozambique ($0.85) where health worker's salaries are substantially lower.

The financial delivery cost per dose found in this study ($0.29, 25.21৳) is also lower than the estimated cost projected by the COVAX Readiness and Delivery Working Group for Delivery Costing. The COVAX model estimated that the cost of delivering vaccines in Bangladesh would range from $0.63 to $2.42 per dose, depending on the proportion of doses delivered through outreach (between 15-50%), and the number of additional health workers recruited for the C19 vaccination program.[34] While the country delivered a substantial share of all doses through temporary vaccination sites, per diems and travel costs, key cost drivers assumed by the COVAX model, were relatively limited. Moreover, the COVAX model assumed that countries could redeploy anywhere between 0-10% of the current workforce for the C19 vaccination program, and that all additional needs would be covered through additional hiring of health staff. However, in reality, no additional recruitment done to launch the C19 vaccination program in Bangladesh, where critical health workforce shortages predated the C19 pandemic.[21] Instead, a substantial number of volunteers were mobilized to fill gaps, though many sites reported persisting staffing shortages.

Figure 18. Economic cost per dose for C19 vaccine delivery in Mozambique, Bangladesh, Vietnam, Côte d'Ivoire, and the Philippines

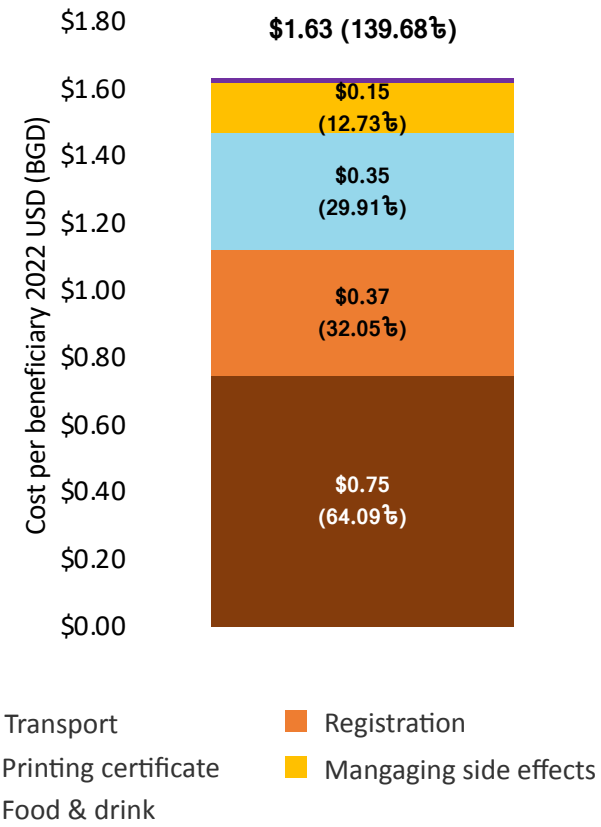


COST INCURRED BY BENEFICIARIES

Beneficiaries incurred on average $1.63 (139.68৳) per dose to receive a dose of a COVID-19 vaccine from a hospital-based site

All 110 beneficiaries that were interviewed at a selection of the hospitals in our sample indicated they had incurred financial expenditures to receive a dose of C19 vaccine, mainly for transport (Figure 19). On average, beneficiaries spent $1.63 to receive a dose, and transportation to reach the sites was the biggest driver of that cost ($0.75 per C19 vaccine dose received). These results should be interpreted with some caution, as our exit interviews were conducted a specific types of sites. Our sample covered especially reputable medical colleges, district hospitals, and general hospitals, in which beneficiaries might have placed high trust, as well as two sites catering exclusively to government employees and their dependents. Therefore, beneficiaries might have preferred to travel further to reach these specific sites, which may have further from their residence than the closest available C19 vaccination site.

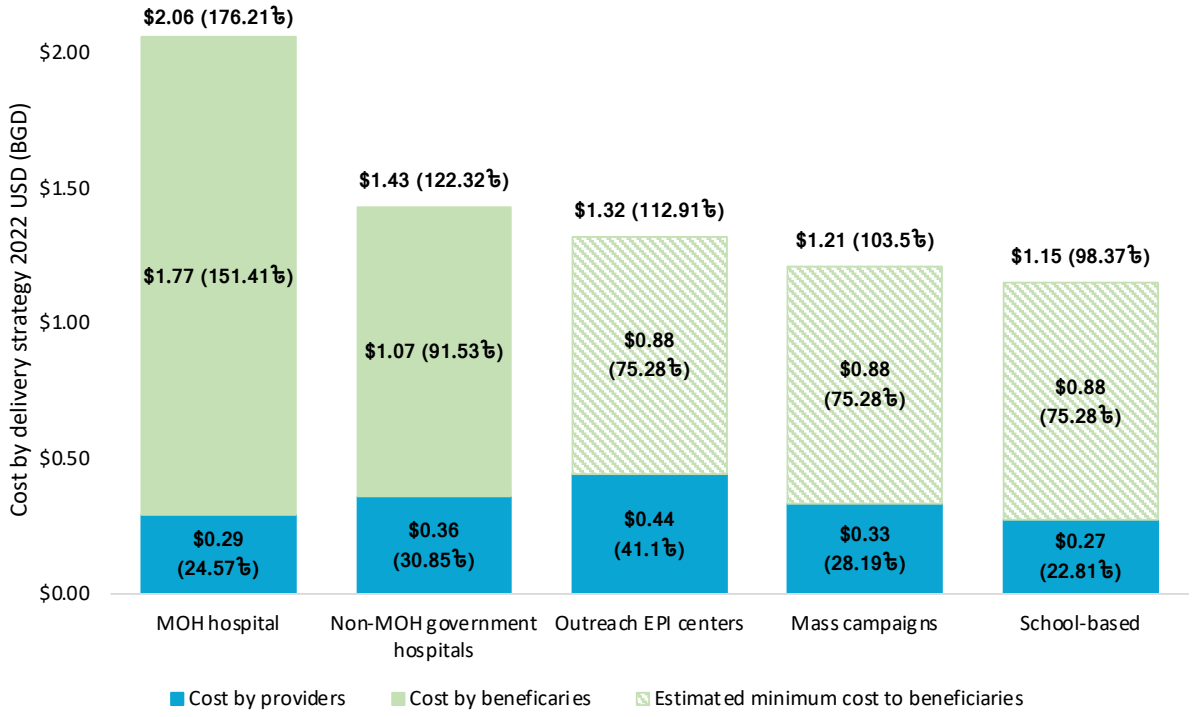
Figure 19. Financial cost incurred by beneficiaries to receive one dose of a C19 vaccine



Money spent on registration ranked as the second biggest cost driver for beneficiaries ($0.37 per dose), as they were required to register for C19 vaccination, either at the vaccination sites or online. To avoid long waiting times at the site, many preferred registering through the online platform. While registration per se was free, individuals who lacked access to the internet needed to go to a computer shop (internet café) to complete the online registration, thereby incurring a fee. The printing of vaccination certificates ranked as the third highest cost driver ($0.35 per dose). The certificates were provided digitally free of charge, and individuals were required to show it for domestic travel, restaurant visits, and accessing various public services. Consequently, a significant number of respondents chose to print their certificates, resulting in 96% of them incurring printing costs. Other costs incurred included managing side effects (e.g., medication for fever, headache) and food and drinks purchased whilst traveling or waiting for the vaccine.

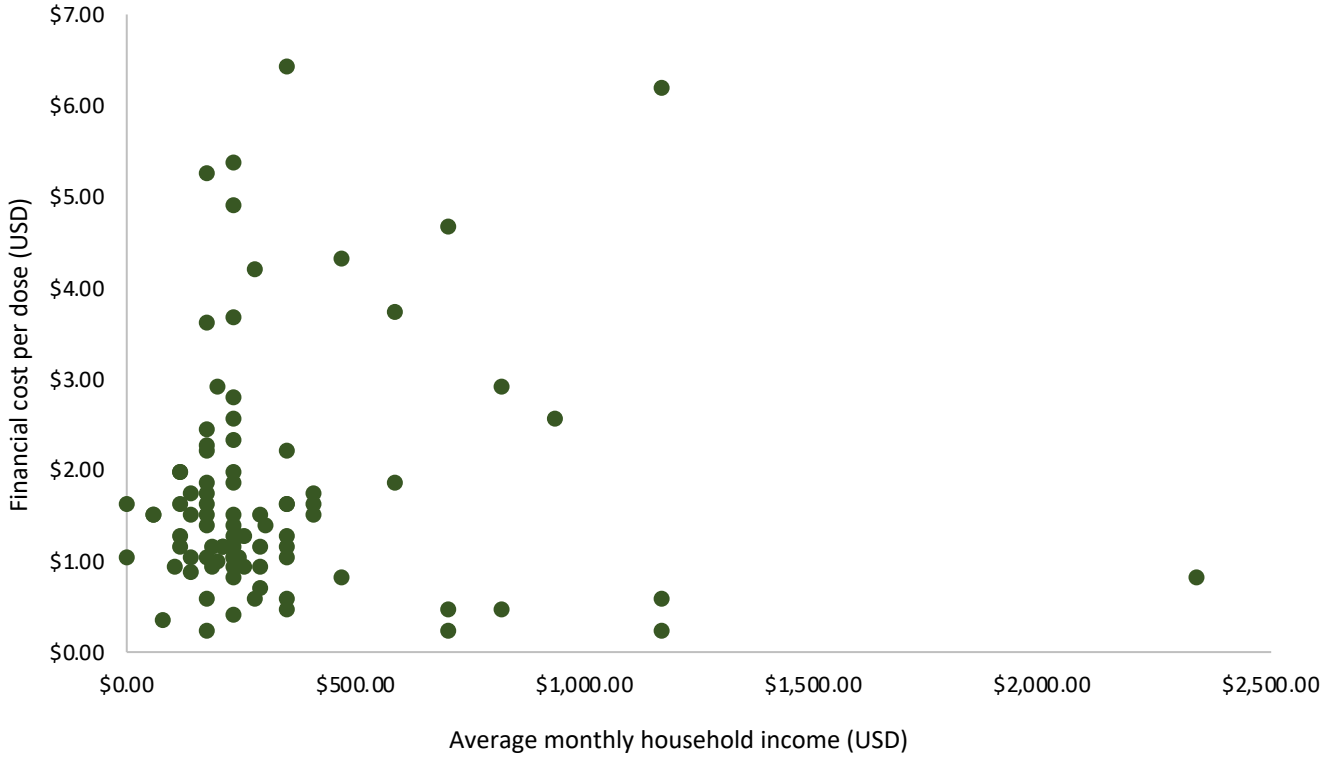
Beneficiaries visiting non-MOH government hospitals spent $1.07 per C19 vaccine dose received, and those visiting facilities spent $1.77, as seen in Figure 20. Together with the costs incurred by providers, this means the total financial cost to the health system and beneficiaries was $1.43-$2.06 per dose delivered across fixed sites. This study only assessed the cost incurred by beneficiaries reaching fixed sites, while transport costs for beneficiaries to reach outreach or mass vaccination sites might have been lower. And in addition, due to the nature of the sampled sites (high-trust or work-related), beneficiaries may have travelled further than their nearest C19 vaccination sites, which means that the transport costs found in this study might be an overestimation of the average to a person in Bangladesh receiving a C19 vaccine dose. However, registration and printing costs are likely to have been similar for other delivery modalities, meaning that beneficiaries that got vaccinated at other sites are expected to have incurred at least an average of $0.88 per dose as well.

Figure 20. Financial cost incurred by providers and beneficiaries for various delivery strategies



The financial cost incurred by beneficiaries to get vaccinated was not correlated with income level (Figure 21). Among respondents that reported having a personal income, the financial cost per dose amounted on average to 1% of respondents' personal monthly income. There was no clear correlation between the financial costs incurred to get vaccinated and household income, and the same was observed when looking at personal income reported, as well as when assessing individual delivery strategies. We also did not observe patterns for individual cost components (such as travel or printing costs). However, it is important to emphasize that our analysis is heavily limited by sampling bias. Exit interviews by nature exclude all respondents who were unwilling or unable to reach vaccination sites, and therefore our analysis might have excluded poorer and vulnerable individuals. Moreover, we did not consult respondents at sites that were specifically designed to reach those with fewer means, such as outreach EPI centers, and the cost to reach those sites might have been lower. Therefore, the costs found in this study might be an overestimation of the cost incurred by beneficiaries at other types of sites.

Figure 21. Financial cost per beneficiary and household income level, MOH hospitals only, n=89



The opportunity cost of beneficiaries' time spent on obtaining a dose of C19 vaccine, reflecting potentially lost income, was $3.14 per dose

Combining financial expenses ($.163) and the value of time spent ($3.14), the average economic cost incurred by beneficiaries to get vaccinated at fixed sites was $4.78 per dose (Figure 22). In addition to incurring direct financial expenses, beneficiaries spent time in obtaining the vaccination—2 hours and 20 minutes on average. This was valued at the beneficiary's income level, to represent the potential lost income, and is also referred to as beneficiaries' opportunity cost. The potential lost income usually represented about 1% of beneficiaries' monthly (personal or household) income. For only 4 (out of 89) respondents, the opportunity costs amounted to more than 4% of their household's income.

Figure 22. Average economic cost per beneficiary by delivery type

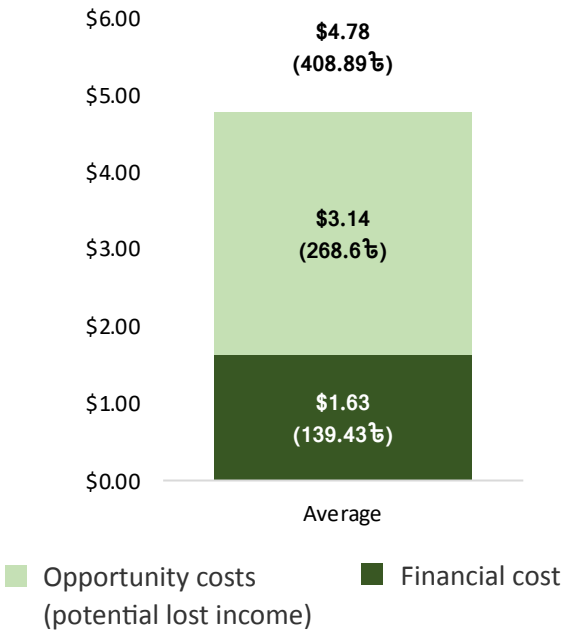


Image: Vaccinators checking beneficiaries' vaccine cards before C19 vaccination

VIII

KEY TAKEAWAYS

The successful roll-out of the C19 vaccination program was made possible by leveraging resources and infrastructure of the regular EPI program, which is reflected in low financial costs but high opportunity costs, underscoring the value of investing in robust health systems.

The success of the C19 vaccination program in achieving widespread coverage can be credited to Bangladesh's robust EPI program. The rollout greatly relied on the EPI's resources and infrastructure, which helped streamline efficient distribution and delivery of C19 vaccines. Moreover, the population's high level of trust in the routine EPI program facilitated acceptance of the C19 vaccines, resulting in minimal social mobilization costs. The successful roll-out emphasizes the need to continue to invest in robust primary healthcare that is resilient to shocks, such as the C19 pandemic.

Mass campaign sites and school-based sites were the most cost-efficient and equitable modalities among those evaluated in this study, though a comprehensive delivery strategy mix should consider the equity, cost, and scale of all possible delivery modalities.

Mass campaign sites and school-based sites brought services close to communities and managed to deliver high volumes at low cost levels, making them both cost-efficient and equitable. Outreach EPI centers were also an equitable delivery strategy—even more so than mass campaigns and school-based sites as they aimed to reach vulnerable populations—though the health system's cost per dose to deliver vaccines at EPI centers was the highest found in this study. Conversely, the cost to delivery vaccines at MOH hospitals was low for the health system, but beneficiaries incurred significant costs to reach these fixed sites. We found that beneficiaries incurred far lower costs to reach non-MOH government hospitals, but there the financial cost per dose to the health system was significantly higher, and as these sites targeted a relatively wealthy niche population, this delivery strategy was neither cost-efficient nor equitable.

The discontinuation of the vaccinators' honorariums after the first year was perceived as a departure from a commitment to support its health workforce through a particularly challenging time that could have lasting implications for the health system.

During the first year of the pandemic, health workers were given additional compensation (honorariums) for the additional workload that they had to cope with due to the C19 vaccination program. The government's decision to discontinue this after the first year resulted in low morale among an already overburdened health workforce**.** This poses a risk to the dedication of health workers, and some indicated this experience impacted their commitment levels. To maintain a motivated and resilient health workforce in ongoing programs, especially given the persistent health worker shortages in Bangladesh (pre-, during, as well as post-pandemic) it is essential that health workers are adequately compensated.

Since no additional health workers were hired to carry out C19 vaccination, the pressure to achieve high vaccination coverage within a short period of time might have impacted the provision of other health services.

None of the study's health facilities reported hiring new staff, and each location deployed an average of 5 health workers for C19 vaccination every day. Due to its critical shortage of human resources for health (HRH), Mozambique was on the WHO health workforce support and safeguard list before the C19 pandemic, and remains on this list in 2023.[17,18], Therefore, the absence of staff at health facilities likely had a negative impact on the delivery of other health services. While our findings do not quantify the impact of the C19 vaccination program on the provision of other health services, evidence shows that coverage rates for routine immunization vaccines continued to drop during the study period.[19]

Though government financial management regulations were rigid and restrictive, optimized public financial management processes for development partners ensured timely access to donor funding at lower administrative levels.

No exceptions were made to the regular routine EPI program's financial management regulations, and vaccination sites were not allowed to reallocate government funding across activities or line items. However, existing flexibilities around donor funding allowed development partners to quickly disburse funds to lower administrative levels to respond to emerging needs. This ensured lower administrative levels to have timely access to funding, which was crucial to finance large mass campaigns, particularly as these required large upfront payments. The combination of flexible on- and off-budget disbursement mechanisms for development partners, coupled with regular government funding greatly facilitated a rapid roll-out of the C19 vaccination program.

Exceptional political prioritization and strong local commitment were key to the success of the C19 vaccination program in Bangladesh, though routine EPI will likely not be able to count on the same going forward.

The support of top-level government officials was crucial in efficiently deploying C19 vaccines nationwide, and a sense of urgency catalyzed unwavering dedication from local communities and health workers. However, maintaining this commitment to routine immunization programs poses challenges, requiring sustained attention, funding, and logistical support distinct from pandemic emergency responses. To ensure the long-term success of vaccination initiatives, it is crucial to implement sustainable strategies, allocate necessary resources, and provide systemic assistance, strengthening the health system beyond the emergency-driven dynamics witnessed during the C19 response.

Image: Used COVID-19 vaccine vials at an upazila health complex

IX

RECOMMENDATIONS ON HOW TO USE THIS EVIDENCE

- **This study aimed to help the GOB make better, data-informed choices for an equitable rollout of C19 vaccines in the country, as well as other immunization programs.**
  To support this aim, below we present a set of recommendations on how policymakers, budget managers, program managers, and researchers in Bangladesh can practically use the study's findings. In addition, the evidence and learnings can be leveraged by other countries as well.

- **Use the cost findings for budgeting and financial planning for the C19 vaccination as well as other immunization programs in Bangladesh.**
  The study findings offer a complete picture of the resource use for the C19 vaccination program, regardless of the funding sources. As the study provides evidence both on the full financial and economic cost, the evidence can be useful for budgeting as well as feed into cost projections needed for longer-term strategic plans. The study's results can support the EPI and immunization partners to ensure sufficient resources for C19 vaccine delivery. Given the limited literature on vaccine delivery costs in Bangladesh, these findings can also contribute to informed resource allocation decisions for other vaccination programs that leverage similar delivery strategies, which is essential for meeting national and global vaccination targets.

- **Leverage the study results to facilitate an efficient yet equitable delivery strategy mix for COVID-19 or other vaccine delivery in Bangladesh.**
  The evidence in this study shows that Bangladesh managed to deliver C19 vaccines at relatively low costs compared to other countries, due to the high delivery volumes that many sites managed to deliver on a daily basis. To keep delivery costs contained in the future, policymakers are encouraged to find ways to strategically optimize C19 vaccine delivery to keep up high daily delivery volumes. However, this might be challenging in settings where volumes are lower and populations more geographically dispersed, especially considering the narrower target group that the C19 vaccination program is currently targeting. As the study offers insights into the key cost drivers of high- as well as low-volume vaccine delivery strategies, as well as the cost incurred by beneficiaries to reach hospital-based vaccination sites, they can serve as a valuable resource in guiding decision-making around the most appropriate delivery strategy mix to deliver C19 and other vaccines in various settings, balancing efficiency and equity.

- **Include the evidence in this study to estimate the full cost of the C19 vaccination program.**
  This study provides evidence on the cost involved in delivering C19 vaccines, including program management, social mobilization, vaccine transport, service delivery, training, recordkeeping, and waste management. However, to estimate the full cost of the C19 vaccination program, the cost of vaccines and international shipment would need to be included as well. If such an analysis were undertaken, the delivery cost generated by this study could feed into such an analysis of the overall cost of the program.

- **Estimate the cost of incorporating C19 vaccines into the national immunization schedule.**
  The cost findings could be used to feed into further studies to analyze the total cost of incorporating C19 vaccines into the national routine immunization schedule, providing insights into the long-term financial implications. The findings can be used to model return on investment for different schedules of C19 vaccine delivery or can be used for cost-benefit economic analysis.

- **Model future options for immunization strategies.**
  The cost evidence presented in this study also offers valuable insights that can guide the planning and execution of new vaccination drives during C19 infection surges, such as the January 2024 announcement to vaccinate priority groups.
  Our cost evidence could be used to model out potential options to estimate the cost of reaching specific target populations with a mix of delivery strategies, understanding how the cost of a specific strategy changes with varying delivery volumes, and determining the optimal mobilization of health workers for efficient delivery at different types of vaccination sites.

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ANNEXES

ANNEX 1. STUDY TIMELINE AND ACTIVITIES

Timeline	Activities
Sep – Dec 2021	• Meeting(s) with EPI Headquarters to understand the scope of the study • Developed research protocol and data collection tools • Obtained IRB approval for the study
Jan – Mar 2022	• Obtained administrative approval from Planning and Research Unit, DGHS • Consultation workshop with EPI to define the scope and methodology of the study • Selected district, city corporation, and vaccination sites in consultation with EPI headquarters
Apr – Jun 2022	• Consultation workshop with EPI and other stakeholders for the endorsement of study methodology and data collection tools • Onboarded partner institute (IHE, DU) for the study's data collection • Obtained acknowledgement from Public Health Wing, MOHFW (through EPI, DGHS)
Jul – Sep 2022	• Organized training on data collection tools • Tools piloting, sharing feedback with EPI headquarters, and finalization of the tools • Virtual sensitization meeting with managers of selected vaccination sites chaired by the Director and Line Director, MNC&AH, DGHS
Oct 2022 – Mar 2023	• Cost data collection, KII, and exit interviews at selected vaccination sites • Consultation workshops at the selected District/Upazila/City Corporation • Cost data collection from EPI headquarters • Interviews at the national level
Apr – Jun 2023	• Data cleaning and management • Data analysis • Preliminary findings sharing
Jul – Dec 2023	• Submission of draft report • Validation of study findings • Finalization of the report

ANNEX 2. PROGRAM ACTIVITIES AND RESOURCE TYPES DEFINITIONS

Program activity	Definition
Program management	C19 vaccination program management, including development of guidelines, program meetings, development of vaccination implementation plan for each round, budgeting for the program.
Vaccine collection, distribution and storage	Storing vaccines in national level cold storages, distributing vaccines down to the district and upazila level cold storages, MOH hospitals, and to temporary sites where relevant. Vaccine distribution from the airport to the national cold store was not included as that was provided in-kind by Beximco and Incepta Pharmaceuticals.
Cold chain maintenance	Maintaining and repairing the cold chain for the purpose of the C19 vaccine roll-out.
Training	Attending and/or providing C19 vaccination-related training, including topics such as administering vaccines, storage and logistics, record keeping, pharmacovigilance, social mobilization, planning, supervision, etc.
Social mobilization and advocacy	Mainly advocacy activities, such as: developing and distributing advocating materials, via mass media, social media, leaflets, and miking.
Supervision	Supervising subordinate or peer health or community workers.
Service delivery	Including the administration of the vaccine to people at the vaccination sites, preparation and cleaning up before and after the vaccination event.
Waste management	Time and resources spent on disposing sharps and infectious non-sharp wastes.
AEFI management	Managing and following up on post-vaccination events following C19 vaccine administration; developing reports on AEFI events occurred.
Record-keeping, HMIS, monitoring and evaluation	Data entry and analysis, reporting, monitoring.

Table 10. Definition of resource types for C19 vaccine delivery.

Resource types	Description	Financial vs. opportunity cost	Start-up vs. operating
Recurrent costs			
Salary/paid labor	Paid salary for new staff that were hired specifically for C19 vaccination program. Based on the financial records of the study site(s).	Financial cost	Operating, unless related to start-up activities
	Paid salary for health staff and government officers. The paid personnel costs were derived from the total working time of each staff and their annual salary in 2021.	Opportunity cost	Operating, unless related to start-up activities
Volunteer labor	Value of volunteer labor for those staff who are not receiving salary from the government/ MOHFW. This cost was calculated based on each volunteer's working time and valued at minimum wage (as specified by the government).	Opportunity cost	Operating, unless related to start-up activities
Honorarium	Honorarium paid to the facilitator/resource person of the training, workshop, or other events. This is also paid to staff for providing a particular service (e.g., vaccinator of the COVID-19 vaccination program, volunteer of the COVID-19 vaccination program, etc.).	Financial cost	Operating
Per diem and travel allowances	Per diem and travel allowances paid to regular staff for participation to activities related to the C19 vaccination program.	Financial cost	Operating
Vaccine injection and safety supplies	Cost of auto-disabled syringes, diluent, reconstituting syringes, safety boxes and other supplies used for administration of C19 vaccines.	Financial cost	Operating
Stationery and other supplies	Cost for stationery and other supplies required for the program.	Financial cost	Operating
Transport and fuel (in-country transportation)	Fuel costs specifically for C19 vaccination program activities that required travelling (supervision, trainings, vaccine distribution, etc.)	Financial cost	Operating
	A proportion of total cost for gasoline at the study site which was used for C19 vaccination program activities.	Opportunity cost	Operating
Vehicle maintenance	Cost for vehicles maintenance specifically done for C19 vaccination program.	Financial cost	Start-up
	Routine and non-routine vehicle maintenance done during the data collection period.	Opportunity cost	Operating
Cold chain equipment repairs and energy costs	Cost for CCE maintenance specifically done for C19 vaccination program.	Financial cost	Start-up
	Routine and non-routine cold chain maintenance/repairs done during the data collection period. The energy cost for the CCE is the energy bill of the storage room (if available).	Opportunity cost	Operating
ISBCC/SBCC/IEC and other printing costs	Cost incurred specifically for C19 vaccination program as reported in financial reports (if available), or estimations based on discussion with the respondent at vaccination sites.	Financial cost	Operating
	Share of the cost in relation to C19 vaccination activities.	Opportunity cost	Operating, unless related to start-up activities

Resource types	Description	Financial vs. opportunity cost	Start-up vs. operating
Recurrent costs			
Workshops and meetings	Cost incurred specifically for C19 vaccination workshops and meetings (line of budget, if available).	Financial cost	Start-up
	Cost incurred for general workshops and meetings which was also used for C19 vaccination program.	Opportunity cost	Start-up
Waste disposal fuel	Costs for fuel used in incinerators for C19 vaccination program specifically.	Financial cost	Operating
	Share of routine waste disposal incinerator fuel costs that was used in relation to C19 vaccine waste management.	Opportunity cost	Operating
Other recurrent cost	Other financial outlays that are not included in the categories above, including direct financial support for development of guidelines and policies, waste disposal (for a third party) at district level, sugar drinks for vaccine recipients, etc.	Financial cost	Operating, unless related to start-up activities
Capital costs			
Cold chain equipment	New cold chain equipment acquired and used for C19 vaccination program.	Financial cost	Start-up
	Depreciation costs of existing cold chain equipment used for C19 vaccine storage at study sites.	Opportunity cost	Operating
Vehicles	New vehicle(s) acquired and used for C19 vaccination program.	Financial cost	Start-up
	Depreciation costs of existing vehicle(s) used for C19 vaccination activities (trainings, supervision, vaccine collection/distribution) at study sites.	Opportunity cost	Operating
Incinerators	New incinerator(s) acquired and used for C19 vaccination program.	Financial cost	Start-up
	Depreciation costs of existing incinerator(s) used for C19 vaccination waste disposal at study sites.	Opportunity cost	Operating

ANNEX 3. SELECTED VACCINATION SITES

Area	District/Upazila/City Corporation	Vaccination Sites
District	Kurigram	1. Kurigram District Hospital 2. Mass campaign outreach site 3. School-based vaccine delivery site
	Sherpur	4. Sherpur District Hospital 5. Regular outreach site 6. School-based vaccine delivery site
	Bagerhat	7. Bagerhat District Hospital 8. BNS Mongla 9. Regular outreach site
	Bhola	10. Bhola District Hospital 11. Mass campaign outreach site
	Bandarban	12. Bandarban District Hospital 13. Regular outreach site
Upazila	Rowmari, Kurigram	14. Upazila Health Complex, Rowmari 15. Regular outreach site
	Jhenaigati, Sherpur	16. Upazila Health Complex, Jhenaigati 17. Mass campaign outreach site
	Fakirhat, Bagerhat	18. Upazila Health Complex, Fakirhat 19. Mass campaign outreach site
	Monpura, Bhola	20. Upazila Health Complex, Monpura 21. Regular outreach site
City Corporation	Dhaka South	22. Dhaka Medical College Hospital 23. Institute of Child and Mother Health 24. Government Employee Hospital 25. Regular outreach site 26. School-based vaccine delivery site
	Dhaka North	27. Kurmitola General Hospital 28. BNS Haji Mohshin 29. Mass campaign outreach site 30. School-based vaccine delivery site
	Sylhet	31. Sylhet MAG Osmani Medical College Hospital 32. Combined Military Hospital (CMH) 33. Regular outreach site 34. School-based vaccine delivery site
	Rajshahi	35. Rajshahi Medical College Hospital 36. Police Hospital, Rajshahi 37. Mass campaign outreach site 38. School-based vaccine delivery site

ANNEX 4. LIST OF INFORMANTS AND CONSULTATION WORKSHOPS

Key informants

Site Level
38 selected vaccination sites with Health Facility Manager/Focal Person of the C19 Vaccination Program/MT-EPI
National Level
1. Director and Line Director, MNC&AH, DGHS
2. Deputy Director, EPI and Surveillance, DGHS
3. Deputy Program Manager, Field Services, EPI, DGHS
4. Deputy Program Manager, EPI and Surveillance, EPI, DGHS
5. Accounts Officer, EPI, DGHS
6. Cold Chain Engineer, EPI, DGHS
7. Principal Scientific Officer, Institute of Epidemiology, Disease Control and Research (IEDCR)
8. Deputy Director, Finance, Directorate General of Health Services
9. Deputy Secretary, Public Health Wing, Ministry of Health and Family Welfare
10. Team Lead, Public Health, Asian Development Bank
11. Senior Economist (Health), World Bank
12. Health Officer, United Nations Children's Fund
13. National Professional Officer, World Health Organization
14. Project Director (In Charge), Save the Children
15. In Charge, International Relations and Operation Coordinator (COVID-19), Disaster Response, Bangladesh Red Crescent Society

Consultation workshops

District/Upazila/City Corporation	Number of participants
1. Bagerhat	14
2. Jhenaigati, Sherpur	16
3. Monpura, Bhola	14
4. Rajshahi North City Corporation	17
5. Dhaka North City Corporation	10

ANNEX 5. IMPUTATION METHODS AND ALLOCATION RULES

If after communication with the respondent certain data remained unattainable, assumptions were utilized to estimate the missing data. These assumptions were made based on information from the same site or other related sites. A comprehensive overview of these assumptions can be found in the table below.

Missing data	# sites	Methods
Vaccine administration and safety supplies prices for locally procured items	1	Used supply prices reported at the national level
Vaccine administration and safety supplies quantities missing for at least one supply	7	Imputed based on the average quantity used at other vaccination sites per dose delivered. Supplies for which the quantity was missing included: safety boxes, markers, disinfectants
Doses delivered at one site	1	Imputed based on the average doses delivered at other sites implementing the same delivery strategy, considering the number of vaccination booths, and working days
Fuel costs for burn pit	2	Imputed based on the average burn pit fuel cost per dose at other sites
Fuel cost for vaccine transport	2	Imputed based on the average fuel cost per day of vehicle use at other sites, calculated only including the same type of vehicle

For resources for which respondents could not specify for which activity the resource was used for, or resources that were shared across several vaccination sites, we employed the cost allocation rules described in the table below.

Resources	# sites	Allocation methods
Honorarium for volunteers	5	At 5 sites, the honorarium given to volunteers was reported as a lump sum, without specifying for what activities the honorarium was given. We allocated this resource proportionately across the activities that volunteers worked on at the vaccination site where the allocation was required, based on the hours worked.
Shared cold storage facilities	28	28 facilities in the sampled relied on just 17 cold storage facilities. Each of these 17 facilities usually served an additional 1-2 sites that were included in our sample, as well as an unknown number of additional vaccination sites that were not included in our sample. We allocated cold storage costs proportionally based on the number of doses delivered across all sites included in our sample that relied on each cold storage facility.

ANNEX 6. THEME AND SUB-THEME

Key Informant Interview (KII)

Themes	Sub-themes
Program management	Overview, Enablers, Challenges, Lessons Learned
Vaccine collection, storage, and distribution	Overview, Enablers, Challenges, Lessons Learned
Cold chain maintenance	Overview, Enablers, Challenges, Lessons Learned
Training	Overview, Enablers, Challenges, Lessons Learned
Vaccine administration	Overview, Enablers, Challenges, Lessons Learned
Social mobilization	Overview, Enablers, Challenges, Lessons Learned
Waste management	Overview, Enablers, Challenges, Lessons Learned
HRH for the vaccination program	Overview, Enablers, Challenges, Lessons Learned
Financing for the COVID-19 vaccination program	Overview, Enablers, Challenges, Lessons Learned
Financial constraints	N/A
Recommendation	N/A

Consultation Workshop

Themes
Participants opinion on status of the COVID-19 vaccination program
Organization/partner involved in COVID-19 vaccine delivery and their roles in the rollout of the COVID-19 vaccination program
Factors that were considered to decide the role and contribution of each organization/partner supported in the rollout of the COVID-19 vaccination program
Contribution (both cash and in-kind) to the rollout of the COVID-19 vaccination program or program-related activities (e.g., Training, Social mobilization and advocacy, Supervision, Waste management, Surveillance/AEFI management, Record-keeping, etc.
Specific examples of how local support was instrumental in implementing the COVID-19 vaccination program in this city corporation
Any regular meetings for overall coordination among the organization/ partner, including who participates, how often they are held, and what topics that are usually discussed
Critical financing and programmatic gaps that hamper the implementation of the COVID-19 vaccination program and how the gaps are mitigated
Recommendations for the betterment of any similar program in future, based on lessons learned from the COVID-19 vaccine delivery program

ANNEX 7. C19 VACCINE QUANTITY

Vaccine	COVAX (Donation)	COVAX (Cost sharing)	Bilateral purchase	Bilateral donation	Total (by vaccine)
AstraZeneca	27,077,450	-	15,006,000	14,087,660	**56,171,110**
Sinopharm	5,155,200	29,722,800	77,000,000	2,300,000	**114,178,000**
Pfizer	118,141,550	-	-	-	**118,141,550**
Moderna	15,792,460	-	-	-	**15,792,460**
Sinovac	-	57,465,040	-	3,000,000	**60,465,040**
Johnson & Johnson (J&J)	679,750	-	-	-	**679,750**
Total (by source)	**166,846,410**	**87,187,840**	**92,006,000**	**19,387,660**	**365,427,910**

Source: EPI headquarters, WHO

ANNEX 8. DETAILED COST FINDINGS

Table 11. Financial, opportunity and economic cost per dose by program activity and resource type, disaggregated by delivery strategy, in 2022 USD

		Delivery strategy															All delivery strategies		
		MOH hospitals			Non-MOH gov. hospitals			Outreach EPI centers			Mass campaign			School-based					
	*Note: True zero values in grey	Fin	Opp	Eco	Fin	Opp	Eco	Fin	Opp	Eco	Fin	Opp	Eco	Fin	Opp	Eco	Fin	Opp	Eco
Program activities	AEFI management	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.00	0.01	0.01
	Program management	0.00	0.03	0.03	0.01	0.09	0.10	0.00	0.23	0.23	0.01	0.25	0.26	0.00	0.05	0.05	0.00	0.05	0.05
	Cold chain maintenance	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.04	0.04	0.02	0.04	0.06	0.00	0.00	0.00	0.00	0.01	0.01
	Record keeping, HMIS, M&E	0.02	0.02	0.04	0.02	0.08	0.10	0.02	0.08	0.09	0.01	0.02	0.02	0.00	0.01	0.01	0.01	0.02	0.04
	Service delivery	0.04	0.47	0.52	0.08	0.87	0.95	0.09	0.53	0.62	0.10	0.14	0.25	0.06	0.22	0.28	0.05	0.43	0.48
	Social mobilization	0.01	0.00	0.01	0.01	0.01	0.03	0.02	0.02	0.03	0.08	0.04	0.13	0.09	0.05	0.14	0.03	0.02	0.05
	Supervision	0.00	0.04	0.04	0.00	0.12	0.12	0.00	0.20	0.20	0.00	0.07	0.07	0.00	0.04	0.05	0.00	0.06	0.06
	Training	0.01	0.01	0.01	0.02	0.01	0.03	0.02	0.13	0.15	0.00	0.02	0.02	0.00	0.01	0.01	0.01	0.01	0.02
	Vaccine distribution & storage	0.03	0.04	0.07	0.03	0.13	0.16	0.04	0.09	0.13	0.04	0.07	0.11	0.02	0.01	0.03	0.03	0.04	0.07
	Waste management	0.01	0.01	0.01	0.02	0.04	0.06	0.01	0.01	0.02	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.01
	Crowd controlling & client management	0.16	0.07	0.23	0.18	0.42	0.59	0.25	0.07	0.32	0.06	0.08	0.14	0.09	0.04	0.13	0.15	0.09	0.23
Resource types	Cold chain equipment	0.00	0.01	0.02	0.01	0.01	0.02	0.00	0.02	0.02	0.00	0.01	0.02	0.01	0.00	0.01	0.01	0.01	0.02
	Cold chain repairs and energy costs	0.00	0.01	0.01	0.00	0.02	0.02	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.00	0.01	0.00	0.01	0.01
	Communication	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00
	IEC and other printing costs	0.01	0.00	0.01	0.01	0.00	0.01	0.02	0.00	0.02	0.02	0.00	0.02	0.01	0.00	0.01	0.01	0.00	0.01
	Incinerators	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Waste collection & incineration cost	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Refreshments	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00
	Honorarium	0.04	0.00	0.04	0.05	0.00	0.05	0.04	0.00	0.04	0.04	0.00	0.04	0.01	0.00	0.01	0.03	0.00	0.03
	Paid labor - salary for existing staff	0.00	0.63	0.63	0.00	1.59	1.59	0.00	1.31	1.31	0.00	0.66	0.66	0.00	0.38	0.38	0.00	0.66	0.66
	Paid labor - new hires	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.00		0.00	0.01	0.00	0.01
	Per diem and allowances	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.02	0.03	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00
	Stationery and other supplies	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Transport and fuel	0.02	0.00	0.02	0.01	0.00	0.01	0.02	0.00	0.02	0.03	0.00	0.03	0.01	0.00	0.01	0.02	0.00	0.02
	Vaccine injection and safety supplies	0.04	0.00	0.04	0.05	0.00	0.05	0.06	0.00	0.06	0.05	0.00	0.05	0.05	0.00	0.05	0.04	0.00	0.04
	Vehicle maintenance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Vehicles	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Volunteer labor and allowances	0.15	0.05	0.20	0.20	0.15	0.35	0.23	0.06	0.29	0.10	0.07	0.17	0.16	0.09	0.25	0.16	0.07	0.23
	Workshops and meetings	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Registration app	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OVERALL		**0.29**	**0.70**	**0.99**	**0.36**	**1.79**	**2.15**	**0.44**	**1.39**	**1.83**	**0.33**	**0.75**	**1.08**	**0.27**	**0.48**	**0.74**	**0.29**	**0.75**	**1.05**

THINK
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