THE COST OF DELIVERING COVID-19 VACCINES IN THE DEMOCRATIC REPUBLIC OF THE CONGO

STUDY REPORT | APRIL 2024

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ACRONYMS

AEFI	Adverse Event Following Immunization
ALIMA	Alliance for International Medical Action
CoVDP	C19 Vaccine Delivery Partnership
CCE	Cold Chain Equipment
CDF	Congolese Franc
C19	COVID-19
COVAX	COVID-19 Vaccines Global Access
DPS	Provincial Health Division (Division Provincial de la Santé)
DRC	Democratic Republic of the Congo
EPI	Expanded Program on Immunization (Programme Elargi de Vaccination)
KSPH	Kinshasa School of Public Health
MR	Measles and Rubella vaccine
MoPH	Ministry of Public Health (Ministère de la Santé Publique, Hygiène et Prévention
M-RITE	MOMENTUM Routine Immunization Transformation and Equity
M&E	Monitoring and evaluation
NITAG	National Immunization Technical Advisory Group
NVDP	National Vaccination Deployment Plan
OCV	Oral Cholera vaccine
RECO	Relais Communautaire (Community health worker)
SANRU	Soins de Santé primaires en milieu Rurale

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EXECUTIVE SUMMARY

RATIONALE

The delivery of COVID-19 (C19) vaccines posed unprecedented challenges in terms of supply constraints and reaching new target populations. Meanwhile, what it costs to deliver these vaccines remains highly uncertain. To address this knowledge gap and support the Democratic Republic of Congo (DRC) in planning and budgeting for the future of its C19 vaccination program, the Kinshasa School of Public Health and ThinkWell conducted a study to estimate the cost of delivering C19 vaccines through routine and campaign delivery in the DRC.

METHODOLOGY

This was a retrospective, bottom-up costing study that estimated the financial and economic costs of delivering C19 vaccines in the DRC through routine and campaign delivery. The study covers different periods during which sites were active between November 2021 and June 2022. The study was conducted from the payer perspective, including costs incurred by health service providers, the Expanded Program on Immunization (EPI) at the Ministry of Public Health, Hygiene and Prevention, and development partners, at all levels of the health system. Data were collected retrospectively from a sample of 26 health facilities in the provinces of Kinshasa, Haut-Katanga, and Kongo Central, as well as all relevant health zone, provincial, national level offices, and four development partners.

Costs were disaggregated by program activity and resource type to analyze cost drivers. Volume-weighted average unit costs were estimated for each administrative level and then aggregated to obtain the overall volume-weighted delivery cost per dose. The costing study was complemented by a qualitative assessment to analyze the operational and financial challenges that government officials and health staff encountered during the implementation of the C19 vaccination program, and to map funding flows.

IMPLEMENTATION OF THE C19 VACCINATION PROGRAM IN THE DRC

On April 19th, 2021, the DRC launched the C19 vaccination program, initially only in the 15 provinces most affected by C19, and targeting priority groups that together represented 20% of the country's population. From the onset, the DRC's C19 vaccination program suffered from slow vaccine uptake, primarily due to vaccine hesitancy. To avoid wasting doses, the DRC redeployed 1.3M of the 1.7M vaccine doses that had received through COVAX to other African countries and expanded the target population to everyone aged 18 and older. In September 2021, the country endorsed the use of mass campaigns to increase coverage. By February 2022, seven provinces had implemented at least one mass vaccination campaign. Nevertheless, at the time of data collection in August 2022, only 4% of the country's population had received at least one dose of a C19 vaccine. By June 2023, about 17% of the population had been vaccinated with single dose.

The DRC's EPI managed the C19 vaccination rollout. A mix of delivery strategies were leveraged to deliver C19 vaccines to the Congolese population, including fixed sites, temporary vaccination posts, vaccinodromes, and mobile vaccination teams. Vaccination teams were largely made up from the existing workforce, and health workers received little additional compensation for the C19 vaccination effort. The C19 cold chain predominantly relied on existing equipment, and by the time of this study, only a few additional cold chain items had been procured.

ENABLING FACTORS IN THE IMPLEMENTATION OF THE C19 VACCINATION PROGRAM

- Extraordinary commitment and financial contributions from the health workforce and volunteers made the C19 vaccine roll-out possible.
- A resource-efficient and time-saving cascade training model upskilled the workforce to introduce the C19 vaccine.
- Donor support enabled the deployment of mobile teams and campaigns to increase coverage.

CHALLENGES FACTORS IN THE IMPLEMENTATION OF THE C19 VACCINATION PROGRAM

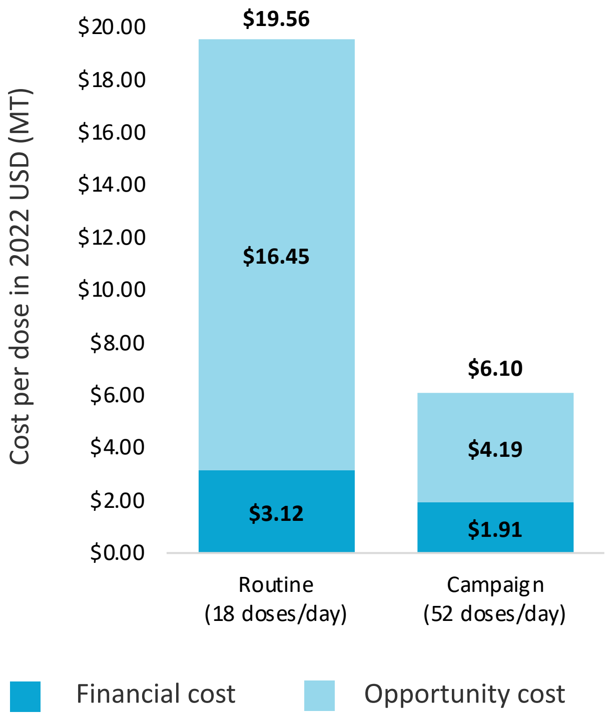
- Additional funding for the C19 vaccination program was insufficient and plagued by disbursement delays, hindering vaccination activities from being carried out.
- While the C19 vaccination program relied heavily on partner support, allocation processes were not streamlined, sometimes resulting in an inequitable distribution of funding.
- Due to funding shortages, the number of vaccination sites was insufficient to cover the population.
- Lack of budget for additional hires resulted in staff shortages and reliance on volunteers to fill gaps.
- Health worker demotivation soared when even their regular salary payments were delayed.
- The lack of cold chain equipment, particularly in rural areas, resulted in an increased need to transport vaccines to and from other sites.
- Lack of funding for transportation resulted in inefficiencies, delayed vaccine deliveries, and health workers having to contribute from their own pockets.
- Vaccine hesitancy and stock-outs meant that C19 vaccinations were sometimes halted for several months.

COST OF DELIVERING C19 VACCINES

The economic cost of delivering a C19 vaccine dose varied from $4.19 during campaigns to $16.45 during routine. The financial cost was 1.7 times higher for routine ($3.12) than for campaigns ($1.91), and the difference for the opportunity costs was even greater, with it being almost 4 times as much for routine delivery. Delivery volumes were larger during campaigns—52 doses per site per day compared with 18 doses per site per day during routine—though still much lower than is often achieved through childhood immunization campaigns.

Nevertheless, the difference in the cost per dose demonstrates that campaigns were able to achieve economies of scale compared with routine delivery

Economic cost per dose for routine and campaign



Service delivery and program management were the key cost drivers. The financial costs were primarily driven by per diem and allowances, estimated at $1.18 for routine delivery and $0.64 for campaigns. Paid labor was the main cost driver of the economic cost per dose, at $2.08 per dose for campaigns, and $8.78 for routine. Overall, the cost structure did not vary significantly between routine and campaign delivery, except for the higher cost per dose for training during campaigns ($0.37 or 6%), compared to routine ($0.21 or 1%).

Across provinces, the economic cost per dose varied widely from $8.24 in Haut-Katanga to $25.14 in Kinshasa for routine, and from $3.71 in Haut-Katanga to $8.68 in Kongo Central for campaign delivery. Both financial and economic costs were greater in rural areas (Kongo Central) when compared to urban areas (Kinshasa and Haut-Katanga), though the difference was more marked for campaign delivery.

The average financial cost of delivering a C19 vaccine dose across campaigns and routine was $2.18, and including opportunity costs, the economic cost of delivery was $10.75 per dose. The cost estimates found in this study were high compared with the cost of C19 vaccine delivery found in other countries, as well as compared with the cost of childhood routine immunization and campaigns.

KEY TAKEAWAYS

- Insufficient funding led to inadequate service coverage and inefficient practices, hindering the uptake of the C19 vaccination program which already struggled with very high vaccine hesitancy.
- Despite the lack of funding, the cost per dose delivered was high due to the very low volume delivered.
- C19 vaccination campaigns were more cost-efficient than routine delivery, reaching more people at a lower cost per dose.
- Committed health workers made the program possible, but without an underlying robust health system and sufficient additional funding, high vaccination coverage remained unattainable.

Image: Banner announcing a C19 vaccination campaign in Kinshasa province

I

INTRODUCTION

To support the government in planning and budgeting for the COVID-19 (C19) vaccination program as well for the delivery of other vaccines, the Kinshasa School of Public Health and ThinkWell conducted a study to estimate the cost of delivering COVID-19 vaccines in the Democratic Republic of the Congo (DRC). The delivery of C19 vaccines posed unprecedented challenges in terms of supply constraints and reaching new target populations. Meanwhile, what it costs to deliver these vaccines remains highly uncertain. To address this knowledge gap and support the DRC's planning and budgeting for the future of its C19 vaccination program, the Kinshasa School of Public Health (KSPH) and ThinkWell conducted a study to estimate the cost of delivering C19 vaccines through continuous and campaign delivery in the DRC in 2022. This study estimates the cost of delivering C19 vaccines through routine and campaign delivery in different geographic areas—Kinshasa, Haut-Katanga, and Kongo Central—and at different levels of delivery volume. It also illustrates the vaccination delivery process, maps key program funding flows, and explores challenges and lessons learned from implementation of the vaccination effort.

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

This study is part of a multi-country 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 Côte d'Ivoire, the Democratic Republic of Congo, Mozambique, Uganda, Vietnam, Bangladesh, and the Philippines.

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 the delivery of C19 vaccines to inform an efficient allocation of available resources for health in the DRC. The C19 pandemic placed a tremendous burden on the health system, and its negative impact on the economy exacerbated pre-existing resource scarcity. For this reason, evidence-based decision making became even more important to ensure optimal use of available resources for health. However, the actual cost of delivering C19 vaccines, or even immunization services in general, in the DRC is unknown. This study provides cost evidence to enable policymakers in the DRC to make crucial data-informed allocation decisions regarding their immunization program.

The primary objective of this study is to estimate the cost of delivering C19 vaccines in the DRC. Specifically, the objectives of the study are to:

- Estimate the average cost per dose of delivering C19 vaccines in the DRC;
- Estimate the cost of delivery through campaigns and routine, in different geographic areas, and at different levels of delivery volume;
- Map out funding flows for the C19 vaccination program;
- Describe how the vaccination effort was implemented, and identify operational and financial challenges and lessons learned.

STUDY DESIGN

This was a retrospective, bottom-up costing study that estimated the financial and economic costs of delivering C19 vaccines in the DRC through routine and campaign delivery. This study estimated vaccine delivery costs, defined as the costs associated with delivering immunizations to target populations, including vaccine administration and safety supplies, but exclusive of vaccine costs. We collected costs incurred in 2022 in relation to the C19 vaccination program using a bottom-up (or ingredients-based) costing approach, complemented with a review of financial expenditure reports and budgets. Program-related activities (defined in Table 5 in **Annex 1**) at each administrative level were costed by measuring the quantity of the inputs or resource types (defined in Table 6 in **Annex 1**) used to implement these activities, which were then multiplied by the unit cost of each of these inputs. We captured both the additional resources used to implement the C19 vaccination program—such as new cold chain equipment (CCE) investments, per diems, supplies and fuel—as well as an estimation of the use of existing resources—such as the cost of using existing capital items and a share of routine government health worker salaries. The study estimates financial costs, which are financial expenses with linear depreciation of capital items, as well as opportunity costs, which represent the value of using existing resources for activities related to the C19 vaccination program. The economic costs are the sum of the financial and opportunity costs. For an explanation of why our study includes opportunity costs, refer to **Box 2**.

BOX 2
Why include opportunity costs?

Opportunity costs represent the monetary value associated with the use of existing resources—such as existing cold chain equipment or existing health staff—to provide C19 vaccines. Utilizing these resources for C19 vaccination does not require additional expenditures. However, when a share of these existing resources is allocated towards a new program, less of these resources is available to other health services. If opportunity costs are significant, other health services may be negatively affected. For instance, when a nurse, previously dedicated to well-child checkups, spends the entire day administering C19 vaccines outside the health facility, the health facility may have to offer fewer well-child checkups per day. Therefore, this study included opportunity costs, alongside financial costs, to illustrate the total cost to the health system of administering C19 vaccines.

The study estimates delivery costs for routine vaccine delivery and campaigns, covering different periods during which sites were active between November 2021 and June 2022. The month of June 2022 was selected to estimate the cost of routine delivery, as at the time of data collection, this was the most recent month for which data on doses delivered were available. At sites that were temporarily inactive during the month of June 2022, data were collected for the most recent month during which the health facility delivered any doses of C19 vaccines (February to May 2022). The most recent campaigns captured by the study took place in either April or May 2022 in all facilities except one, which did not participate in that round of campaigns and thus reported data about a campaign held in November 2021. Our study also captured costs related to vaccine distribution and storage, planning, social mobilization, training, and other start-up activities that took place before the first vaccines were delivered.

The study was conducted from the payer perspective, including costs incurred by the health service providers, the immunization program at the Ministry of Public Health, Hygiene and Prevention (MoPH), and development partners, at all levels of the health system. At the national level, we included costs incurred by the Expanded Program on Immunization (Programme Elargi de Vaccination, EPI), as well as from key donor and partner organizations, including the United Nations International Children's Fund (UNICEF), the Alliance for International Medical Action (ALIMA), Soins de Santé primaires en milieu Rurale (SANRU) and the MOMENTUM Routine Immunization Transformation and Equity (M-RITE) project. The study team also attempted to collect data from the World Health Organization (WHO), but representatives for the country office did not accept our invite to participate in this study. At provincial level, we included costs incurred at the provincial EPI antennas within each Provincial Health Division (Division Provincial de la Santé, DPS), as well as costs incurred at health zone level, and at health facilities.

The costing study was complemented by a qualitative assessment to analyze the operational and financial challenges that government officials and health staff encountered during the implementation of the C19 vaccination program, and to map funding flows. We conducted qualitative interviews with officials at the national, provincial, health zone and with facility staff at implementation level. The aim of the interviews was to obtain a better understanding of the implementation of the C19 vaccination program, and identify challenges and lessons learned, as well as to map funding sources and flows for the C19 vaccination program at all administrative levels and, where possible, identify how specific program activities were funded.

Ethical approval for the study was obtained in April 2022 through the Ethical Committee of the School of Public Health of the University of Kinshasa.

STUDY SAMPLE

Our sample includes 26 health facilities in the provinces of Kinshasa, Haut-Katanga, and Kongo Central, as well as all relevant health zone, provincial, national level offices, and 4 development partner organizations, as shown in Table 1. We selected three provinces purposively in collaboration with the EPI among the 15 provinces (out of 26 in total) where the C19 program had first been rolled out in April 2021. We aimed to include a variety of geographic settings, while also considering the logistics of reaching the provinces in the context of the C19 pandemic. The province of Kinshasa was included as the nation's capital and most populous city, and bordering Kongo Central was included to add rural health facilities to the sample. Haut-Katanga, located in the south-east of the country, was included to increase the geographic diversity of the sample.

In collaboration with the national EPI, 4 to 7 health zones were selected in each province, and within each health zone, 1 to 3 facilities were sampled. Vaccinodromes were excluded from our sampling frame as they were exclusively donor-funded, and were the subject of another costing study at the time of sampling. Key partner organizations involved in the implementation of the C19 vaccination program were identified by respondents at health facilities, health zones, provincial EPI antennas and at the national level EPI office, in order to be included in the study. The final sample included 20 urban (of which 9 public and 11 private) and 6 rural health facilities (3 public and 3 private).

Table 1. Study sample

Level	EPI administrative and implementation sites				Donors and partners
National	1				0
	Kinshasa	Kongo Central	Haut-Katanga	Total	
Provincial (antennes)	3	1	1	**5**	2
Health zone	7	4	4	**15**	2
Health facility	14	6	6	**26** Urban n=20 Rural n=6	0

DATA COLLECTION

In-person interviews at all vaccination sites and government entities were conducted between July and August 2022, and development partners were interviewed between September 2022 and May 2023. The cost data was collected using a Microsoft Excel tool developed by the research team. In July 2022, data collectors participated in a five-day training, which consisted of two days of formal training, two days of pilot testing the data collection tools at health facilities and health zones, and one day of debrief. Subsequently, a team of eight data collectors was deployed under the leadership of a supervisor to conduct in-person interviews at all administrative and implementation sites as well as with donor and partner organizations. During the same visits, data collectors also administered an open-ended semi-structured questionnaire to collect qualitative data from the person most knowledgeable about the implementation of the C19 vaccine program, namely the Chief Medical Officer (médecin chef) at provincial EPI antennas and at health zones, and the Chief nurse (infirmier titulaire) or Chief Medical Officer (responsable du site) at health facilities. At national level the National Coordinator for the C19 vaccination program was interviewed and data on doses delivered were obtained from the EPI data manager.

Key informant interviews with health staff were the primary source of data collection for the cost analysis and the qualitative assessment, supplemented by written records. Information on resource use and time spent was gathered from detailed interviews with staff and written records at all levels. Financial reports were used to collect costs related to fuel and transport, printing, and per diem. Where information could not be collected from sites directly, financial and programmatic reports at higher administrative levels or publicly available sources were used. To estimate the labor cost for health staff, we used the publicly available salary scale for civil servants which was in effect during the study period. Replacement prices for cold chain equipment were obtained from the UNICEF supply catalogue.[1] Prices for vaccination supplies were obtained from the MoPH where possible, or from publicly available local pharmacy catalogues. Data on doses delivered for all sites were obtained both from local registers at health facilities and higher administrative levels as well as from the central EPI data management office.

In-person interviews were followed by a review process to ensure data quality. After data collection, the data collection supervisor reviewed all data sheets to check for completeness. Subsequently each sheet was reviewed by two researchers to identify and verify potential outliers (e.g. on data such as hours worked by health staff, quantity of immunization supplies used, etc.) and to further ensure the completeness of the data. If any issues were identified or if data were missing, the data sheets were reviewed by the data collector who filled in that data sheet, and if needed further verification or additional data collection was conducted directly with the respondent from the relevant study site. The qualitative interviews were recorded and transcribed in French. The transcripts were reviewed, synthesized, and translated into English by the research team.

Due to weak reporting systems, there was a large amount of missing or inconsistent data at all levels, requiring an extensive follow-up phase. The follow-up process lasted several months and included multiple rounds of review. If after the extensive follow-up, process non-essential data still could not be obtained, assumptions were made to impute the data from the same site or from other sites, as detailed in **Annex 2**. Some essential data could not be imputed, such as the number of doses delivered, and had to be collected from the national EPI office instead. Obtaining cost data on contributions from donors, which played a key role in the rollout of the C19 vaccine in the DRC, also lengthened the data collection and cleaning phase as key information such when and where the donor contribution was spent was initially missing.

DATA ANALYSIS

Delivery costs were estimated and allocated to resource types, program activities, and cost types (financial or opportunity cost). When respondents could not directly allocate resources to the C19 vaccination program and across C19 program activities, allocation rules were applied. Resources that were shared across the health system were allocated to the C19 vaccination program and across C19 vaccination program activities based on time spent (for labor) or based on the proportion of space occupied (for cold chain), as reported by respondents. Costs related to some resources were allocated across C19 program activities based on what activities respondents reported they were used for, such as fuel or vehicles. When respondents could only provide lump sum amounts, assumptions were made to allocate the resources across the most likely activity that these amounts were used for.

All costs are presented in 2022 US dollars (USD, $). Costs were converted from Congolese Francs (CDF) to US Dollars (USD) using a conversion of 1 USD = 1,996 CDF.[2] The depreciation of capital items was calculated based on replacement prices and useful life of the item, using a 3% discount rate. Costs incurred in 2021 were adjusted for inflation, using IMF's inflation rate (consumer prices annual percentage change).[3] When comparing our findings to those of other studies, we converted the other studies' findings into 2022 USD. First, we converted their unit costs to the original currency using the conversion rate reported in the study, or if not reported, the World Bank's conversion rate for original currency in the study year.[4] Then, we adjusted for inflation using the IMF's inflation rate, and finally converted the amount to USD using the World Bank's exchange rate for 2022.

The overall cost per dose delivered was estimated by calculating the volume-weighted average cost per dose at each level, and then summing these to estimate the overall cost per dose delivered. All analysis was conducted in Microsoft Excel. The volume-weighted cost per dose for study sites at vaccination sites and subnational administrative levels (health zone, provincial) was estimated by dividing the total cost incurred at sites at that level by the total number of vaccine doses administered at site at the same level, according to the following formula:

$$unit\_cost\_level\_A_{vw} = \frac{\sum_{i=1}^{n} C_i}{\sum_{i=1}^{n} Q_i}$$

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 costs obtained for each administrative level.

We also conducted a sensitivity analysis to estimate the effect of the variability between two sets of data on the number of C19 vaccine doses delivered. We collected data on the number of doses both at vaccination sites and subnational administrative offices as well as from the EPI national office. Upon examination, both datasets contained discrepancies and inconsistencies. As the dataset obtained at the sites and subnational administrative levels included many more discrepancies than the dataset from the EPI national office, we opted to conduct our analysis using the latter. However, we also conducted a sensitivity analysis to estimate the cost per dose delivered using the dataset from our data collection and to confirm whether key conclusions from our analysis still hold true.

LIMITATIONS

Cost estimates in this study were derived from a small, purposively sampled selection of vaccination sites which may not be nationally representative. Our study includes a total of 26 immunization sites, located in 3 provinces, which is a small sample from the total of 26 provinces in the country. Therefore, the overall sample size is relatively small, which limits the generalizability of the results. Moreover, the sample does not include some of the hardest-to-reach places and conflict areas where delivery costs were likely higher. However, the sample was designed to explicitly include sites located in urban and rural areas to capture the expected variability across different settings and was validated by EPI officials at national level.

The evidence from our study reflects how the C19 vaccination program operated until June 2022, and may not be generalizable to other periods of implementation. The DRC C19 vaccination program had challenges getting off the ground and achieving high coverage. Program implementation fluctuated over time, with various sites stopping and restarting implementation throughout the period of our study. The results captured in our study provide a snapshot of the cost of the program at a given point in time, and it is likely that this is not representative of how sites operated since then.

Weak reporting systems, data quality issues, and missing data likely increased uncertainty around our cost results. During data collection we encountered a significant amount of missing or inconsistent data. While an extensive follow up was conducted to fill data gaps, some data still could not be obtained, and assumptions were made to impute the missing data. Moreover, despite efforts to triangulate data by collecting them at different administrative levels, some inconsistencies remained, most importantly on the number of doses delivered by vaccination sites and at subnational administrative levels. Therefore, the significant data quality and availability issues encountered by our study team likely increased uncertainty around our cost results

Partner contributions are underestimated as one key partner did not participate in the study. Four partners were identified as having contributed significantly to the C19 vaccination program in the three provinces sampled by this study or at national level. However, WHO did not respond to repeated requests to participate in the study and therefore all contributions by that partner could not be included in our cost estimates. This means that our cost estimates are underestimated, though the magnitude of the underestimation likely represents a small percentage of the cost per dose found in this study.

Due to limited information on how they were deployed, findings on mobile teams should be interpreted with caution. It was challenging to obtain detailed and comprehensive information on how mobile teams operated, which means that some activities may have inadvertently been excluded. Moreover, the cost per dose for mobile teams' delivery presented in this study represents the incremental donor contribution, and not full resource requirement needed to implement this strategy, while estimates for routine and campaigns represent the full cost of implementation.

III

THE C19 VACCINATION PROGRAM IN THE DRC

OVERVIEW OF THE C19 VACCINATION PROGRAM

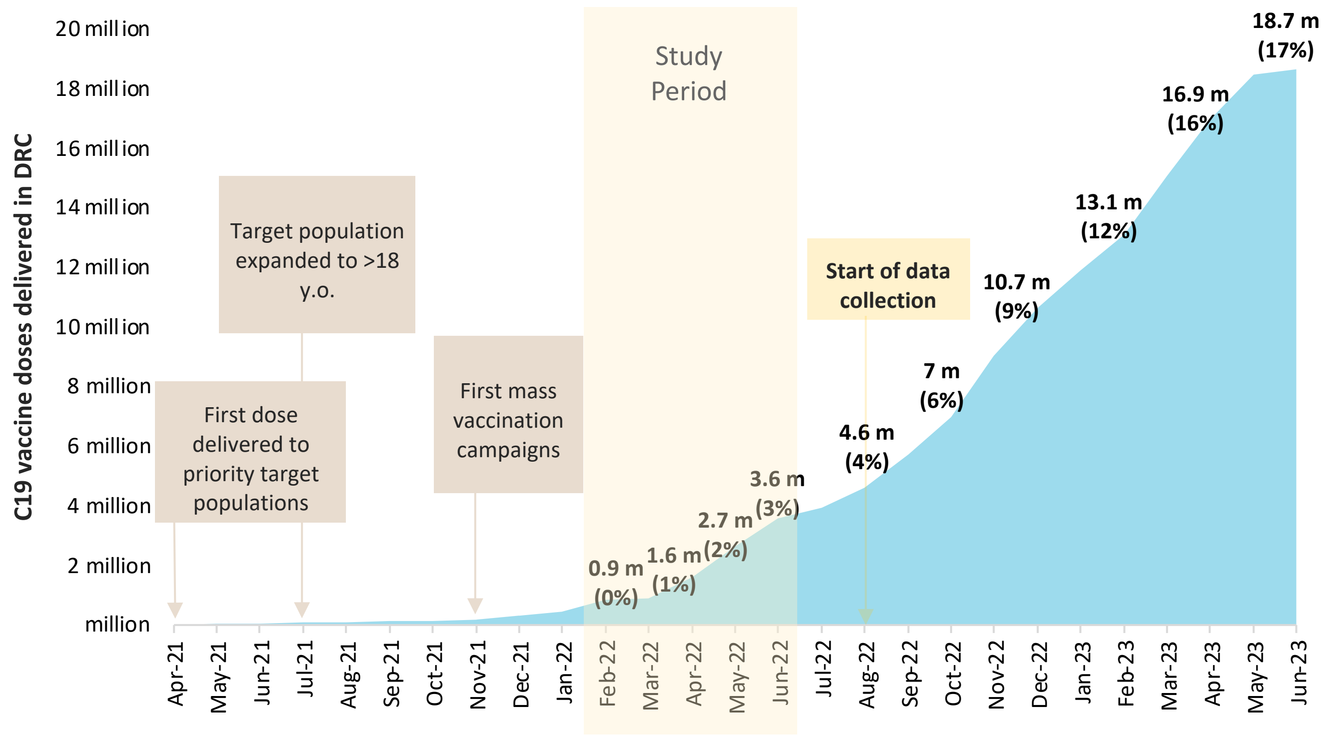
On April 19th, 2021, the DRC launched the C19 vaccination program, initially only in the 15 provinces most affected by C19, and targeting priority groups that together represented 20% of the country's population. In February 2021, the DRC's National Immunization Technical Advisory Group (NITAG) issued its recommendations for the use of the first C19 vaccine in the country, and identified vaccination strategies and priority target populations for vaccination.[5] Following these recommendations, the National Vaccine Deployment Plan and identified three priority target groups to be vaccinated in the initial phase of the vaccination effort, estimated to represent 20% of the country's population. Through the COVAX mechanism, the DRC received the first doses of C19 vaccines in early March 2021 (AstraZeneca/Covishield/Vaxzevria), and the first vaccines were administered on April 19th, 2021.

The DRC's C19 vaccination program suffered from slow vaccine uptake, primarily due to vaccine hesitancy. Vaccine hesitancy was very high partly due reports of thrombosis events in vaccinated persons having received the AstraZeneca vaccine in Europe.[5] Reportedly, only about 1 in 4 health workers stated they would accept a C19 vaccine if offered.[6] Therefore, even though the C19 vaccines had already arrived in the country, the rollout was postponed for one month to strengthen capacity for vaccine safety investigations. However, vaccine uptake continued to be a challenge. To avoid wasting doses, the DRC redeployed 1.3M of the 1.7M vaccine doses that had been received through COVAX to other African countries.[5] The country also expanded the target population to everyone aged 18 and older, a total of approximately 54 million people.[7] On July 10th, 2021 vaccinations were halted due to a shortage of C19 vaccines, following the discovery that 200,000 doses of the AstraZeneca vaccine were expired. By then, only 79,000 people had received at least one dose of the vaccine, and only 2,500 people were fully vaccinated with two doses.

To increase C19 vaccination coverage, the country approved the use of additional vaccines, and endorsed the use of mass campaigns in September 2021. In August 2021 the NITAG approved use of Moderna, Sinovac, and Johnson & Johnson vaccine, paving the way for an increase in supply.[7] The country restarted vaccinations through routine delivery, and in September 2021, the country's National Vaccination Deployment Plan (NVDP) was updated to recommend use of mass vaccination campaigns to reach 90% of the target population, and continued use of routine to reach the remaining 10%. The first campaigns were implemented in November 2021, and by February 2022 seven provinces had implemented at least one mass vaccination campaign.

At the time of our study, C19 vaccination had started to ramp up, though only 3% of the total population had received at least one dose of the vaccine. Despite the progress achieved through the vaccination campaigns, the DRC's coverage still lagged behind other countries in the region, and in January 2022, the DRC was added to the C19 Vaccine Delivery Partnership's (CoVDP) list of priority countries, making it eligible for immediate additional support from partners.[8] While maintaining an overall target population of everyone aged 18 and older (53.9 million people), in March 2022, the EPI adopted a new short-term goal of vaccinating 20% of the target population (approximately 10.7 million people) by June 2022 with the plan of conducting one campaign every six weeks in all provinces. As shown in Figure 1, by the time of data collection at vaccination sites in August 2022, 4% of the country's population at received at least one dose of the vaccine, and by June 2023, about 17% of the population had been vaccinated (with one dose).[9]

Figure 1. C19 vaccine doses delivered (% of population vaccinated with at least one dose) in the DRC in 2021-2023[8,6]



MANAGEMENT OF THE C19 VACCINATION PROGRAM

The DRC's EPI managed the C19 vaccination rollout at central, provincial, and health zone level. The central level EPI, led by the National Director, formulated the overall campaign strategy, developed operational guidelines, carried out the macroplanning and managed resource mobilization efforts. The EPI is housed within the MoPH, and larger policy decisions were made and signed off by the MoPH. At provincial level, the EPI antennas adapted the national vaccination strategy to their context through the creation of an operational action plan. Furthermore, they organized and supervised the activities at the health zones, reviewed, consolidated, and reported on data for each zone, and managed surveillance efforts.

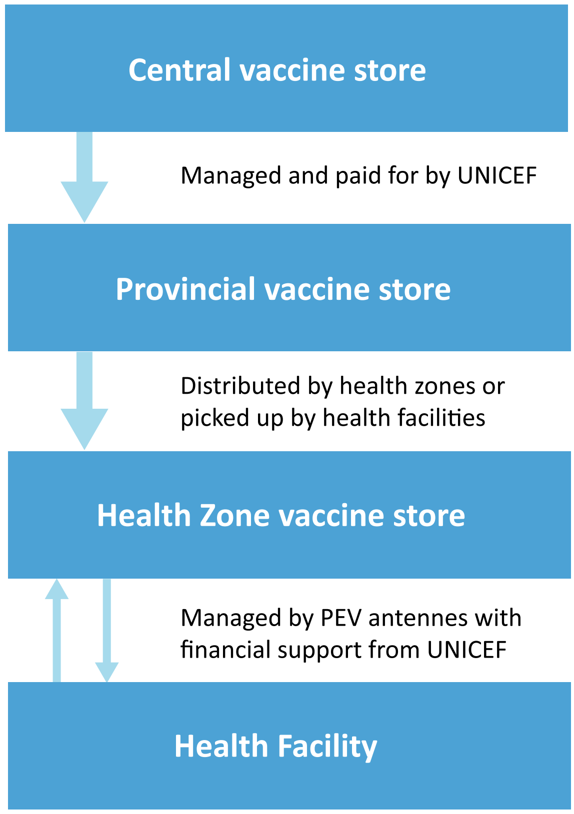
At district level, the health zones functioned as operational units, conducting microplanning to determine local needs which were then forwarded and approved by the provincial EPI antennas, who directly oversaw vaccination activities at health facilities. All administrative levels (central, provincial, health zone) were engaged in monitoring and evaluation (M&E) efforts. Meetings on several aspects of the C19 vaccination program—including service delivery, supply chain, communication, finance, monitoring and evaluation—were convened at all administrative levels and had large partner involvement.

C19 VACCINE STORAGE AND DISTRIBUTION

The C19 cold chain predominantly relied on existing cold chain equipment, and by the time of this study, only a few additional cold chain items had been procured. Vaccines were imported into the country to the national vaccine store and then transported using cold boxes through a hierarchy of vaccine stores—from central to province to health zone—before arriving at the vaccination sites, as illustrated in Figure 2. Sites without refrigerators used isothermal boxes, ice packs, and coolers to maintain the cold chain, and vaccines were returned to the health zones at the end of the day. For the most part, the program relied on existing cold chain equipment (CCE), and many sites did not have powered cold chain. In principle, health zones or sites could raise the need for additional equipment, so that the EPI could make requests to partners to procure additional CCE, though by the time of the study, only one out of the 26 sites in our sample had received additional equipment.

At lower administrative levels vaccine transport was organized in varying ways, depending on availability of resources. Each administrative level developed a plan for the distribution of vaccines and supplies. The plan considered the size of the target population, estimated demand, the geographic distribution of vaccination sites, and availability of powered CCE at the sites. From the central to the provincial level, UNICEF contracted a private agency to transport the vaccines. At lower levels of the health system, transport was organized in varying ways. Some health zones reported renting vehicles with partner funding to deliver vaccines to health facilities. Of the facilities included in our sample, none reported owning or renting a vehicle, and vaccines were either picked up from the health zones on foot or by using health staffs' personal vehicles, and the required fuel for this was not covered by government nor partner funding. At one site it was reported that partners delivered vaccines to the health facility. In general, sites that were further away from health zones and that had powered cold chain were given enough vaccines for the entire campaign period to minimize travel.

Figure 2. Vaccine distribution flow



TRAINING AND SUPERVISION

A training of trainers model approach was utilized to equip the health workers with necessary knowledge and skills, after which a supportive supervision model was deployed. The central EPI developed operational guidelines on the administration of specific vaccine types, cold chain maintenance, waste management, communication, data management, and other logistics. They also developed training tools to disseminate the operational guidelines through the health system levels. Trainers were trained at provincial level, who in turn trained staff at either at the health zone level or at referral hospitals. Trainings at provincial level were conducted online, to minimize travel during the pandemic, and at the health zone level, trainings were carried out in person. Training sessions were funded by partners, though refreshments and travel costs were sometimes paid for by health zones or by staff themselves. After the formal training was conducted, the formative training model was switched to a supportive supervision model. Supervision of health zones was scheduled to be carried out on a monthly basis, and health zones were meant to carry out supervision to health areas on a weekly basis to enable corrective actions, though due to lack of transportation supervision visits were not always carried out according to plan.

SOCIAL MOBILIZATION

The Central Communication Taskforce spearheaded the nationwide communications strategy, with the aim of building community's trust in C19 vaccination. This included the development of the messaging and materials, promoting vaccination through national media outlets, and ensuring national cohesion of the strategy. Provincial-level communication taskforces planned and monitored communications activities at the health zone level, and engaged relevant political-administrative authorities, as well as local TV and radio stations. Health zones organized local coordination meetings to involve community champions in implementation planning to generate trust and promote local buy in. Community health volunteers, known as Relais Communautaires (RECOs) disseminated health messages, shared information on nearby vaccination efforts, and mobilized community members days ahead of the campaign. RECOs distributed communication materials, engaged in door-to-door vaccine promotion, and utilized megaphones in markets and busy streets. In addition to going out into the community, RECOs were tasked with educating patients and visitors in larger hospitals.

SERVICE DELIVERY AND WASTE MANAGEMENT

Existing vaccine delivery strategies and new modalities were utilized to deliver vaccines to the Congolese population. C19 vaccines were delivered through four delivery strategies:

- Fixed sites (*sites fixes*): Health facilities and hospitals already offered routine immunization services, though for C19 vaccinations they increased the frequency of their vaccination efforts, most operating on a daily basis;
- Vaccinodromes (fixed-advanced sites or *fixe-avancés*): Partner-funded and initially exclusively partner-implemented vaccinodromes were non-facility based semi-permanent structures designed to deliver a large number of doses per day. They were exclusively located in Kinshasa;
- Temporary vaccination posts (advanced sites or *sites avancés*): Locations in the community for temporary vaccination sites were identified by health zones, usually in busy areas such as markets, and were then approved at the provincial level. They were not as commonly used for C19 vaccination as in some other countries (only 6 out of 26 sites in our sample), and often were only operational during vaccination campaigns;
- Mobile vaccination teams (*équipes mobiles*): These teams moved around precarious neighborhoods, high concentration areas, markets, and bus stations. The locations were identified by health zones and were then approved at the provincial level. Some were also deployed to large public or private companies to vaccinate employees. Mobile teams were only deployed upon availability of donor funding, mostly during campaigns.

Nationwide vaccination campaigns leveraging all delivery strategies were organized to boost low vaccination coverage. During campaigns, routine delivery sites remained active and were supplemented by additional temporary posts. Campaign logistics were managed by the EPI with financial and technical support from partners. To implement the campaigns, regular meetings at each level of health system were convened; the central and provincial levels focused on strategy development, including defining who should be targeted, and health zones focused on executing what was planned at the higher levels and defining specifics such as target numbers. At the health zone level, preparatory meetings were held ahead of the campaign, daily meetings were convened during the campaign, and an evaluation meeting then followed after.

C19 vaccination-related waste, such as vials and syringes, was managed through existing waste management systems. Each health zone has a Waste Manager to oversee operations, and staff at the vaccination sites would manage the waste bins. Sites without incinerators would use those of health zones or neighboring vaccination sites. Either sites would bring their own waste, or the health zone would pick up waste depending on transport availability. Within our sample, no health facility reported additional funding for waste management activities for the C19 vaccination program.

STAFFING

Vaccination teams were largely made up from the existing workforce, and health workers received little additional compensation for the C19 vaccination effort. The composition of teams and the roles and responsibilities were standardized by the national level. Team members were predominantly existing staff, redeployed from routine EPI or other areas. Based on the microplans and staffing criteria set at national level, the number and types of staff needed per vaccination site were determined. If health zones identified additional human resource needs, health zones were asked to cover each other's shortages or to source funding for local recruitment. However, only one of the facilities in our sample reported hiring additional paid staff. Per diem or financial incentives for vaccination team members were patchy, covering only a portion of the weeks worked on C19 vaccination, and at some sites health workers did not receive any. Per diems were usually disbursed directly to vaccination team members through mobile money and were exclusively paid for by donors or partners.

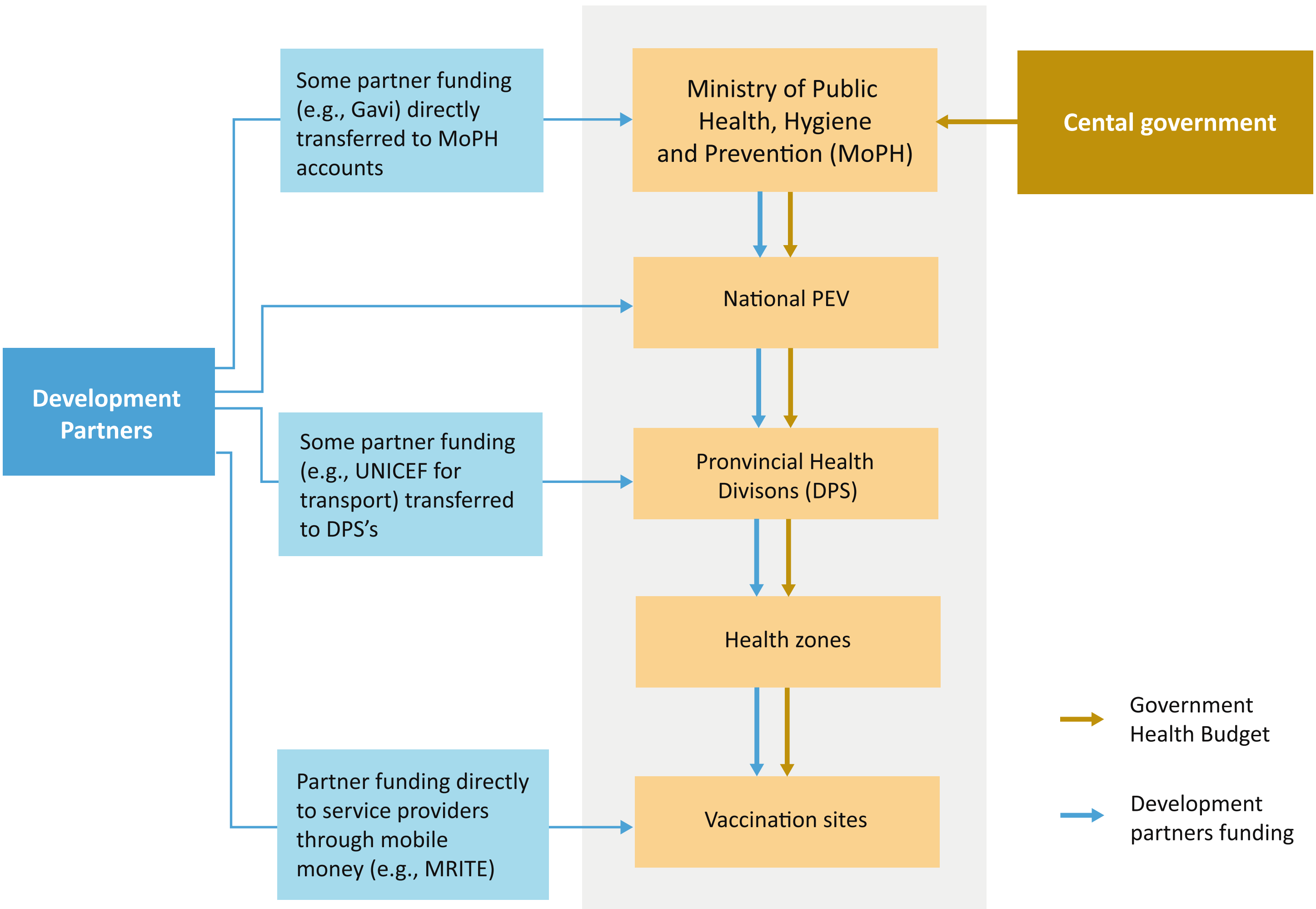
FINANCING AND IN-KIND DONATIONS FOR THE C19 VACCINATION PROGRAM

C19 vaccination rollout was heavily reliant on partner support, though disbursement processes were not streamlined, sometimes resulting in an inequitable distribution of funding. Central EPI staff mobilized partner funding for the C19 vaccine roll-out. As a general rule, government and partner funding was channeled through the hierarchy of administrative levels down to vaccination sites (see Figure 3). However, this process was not always followed and provinces and health zones also had the autonomy to fundraise independently. For instance, while funding from Gavi was deposited to the central MoPH accounts, UNICEF's funding for communication went straight to provinces. Within each province, multiple partners supported groups of health zones, and sometimes this support was not streamlined resulting in an inequitable distribution of funding, with some health zones receiving support from more than one partner and others not receiving any support.

Finally, some partner support bypassed all administrative levels, as payments for per diem or stipends were sent directly to service providers via mobile money.

Vaccination sites grappled with disbursement delays, unpredictable funding, and funding promised but never received. Partners committed over 41 million USD to support the DRC's C19 vaccination effort, but by the end of 2021 only 23 million USD had been disbursed.[10] Most of the funding required for the C19 vaccine program was fundraised and allocated at central level. There were significant delays in the disbursement of these funds to the lower levels. By the time of our study, a large part of the funding that should have reached lower levels had only partially been disbursed or had not been disbursed yet. Bottlenecks that hindered the flow of funds down the hierarchy included a $10,000 dollar limits on bank withdrawals, technical issues with mobile money transfers, and complex disbursement processes for partner funding.

Figure 3. C19 vaccination program funding flow (financial and in-kind donations)



IV

ENABLING FACTORS AND CHALLENGES

ENABLING FACTORS FOR THE SUCCESS OF THE C19 VACCINATION PROGRAM

- **Extraordinary commitment and financial contributions from the health workforce and volunteers made the C19 vaccine roll-out possible.** Healthcare personnel and volunteers demonstrated their firm commitment to protect the population from C19 through their unwavering dedication to roll out the C19 vaccine in the DRC, despite significant resource constraints. Health workers reported working long hours or on weekends, and financially contributing to vaccination activities. For instance, staff reported paying for their own fuel to bring vaccines to the temporary sites in the community. Moreover, at the sites that did not have powered cold chain, campaigns were made possible by staff paying for transportation of vaccines between health zones and vaccination sites at the beginning and end of each vaccination day. Staff also financially contributed to pay for refreshments, supplies, and communication equipment.
- **A resource-efficient and time-saving cascade training model upskilled the workforce to introduce the C19 vaccine.** In the context of financial limitations and travel restrictions due to the C19 pandemic, the DRC employed a trainer of trainers model to disseminate guidance and practitioner skills related to C19 vaccination to the large health workforce spread around the country. Further, to comply with social distancing recommendations, virtual technologies were deployed to facilitate trainings of provincial level staff. This reduced training costs while also facilitating a quicker roll-out of the training sessions across the country.

CHALLENGES IN IMPLEMENTING THE C19 VACCINATION PROGRAM

- **Staff shortages meant health workers were overburdened, and sites relied on volunteers to fill gaps.** There was no budget to recruit additional health workers to manage the additional workload of the C19 vaccination program, and most health zones and sites relied exclusively on existing staff. While health zones were given the autonomy to seek out external funding to recruit additional staff at the local level, most did not manage to secure additional funding for this. Health zones greatly relied on volunteers to fill gaps, though it was challenging to mobilize them in sufficient numbers as they received little to no compensation.
- **Lack of funding for transportation resulted in inefficiencies, delayed vaccine deliveries, and health workers having to contribute from their own pockets.**No additional funding was provided for the transportation of vaccines or bringing vaccination teams to temporary sites and none of the sampled health facilities reported having access to a vehicle. This resulted in vaccination teams having to either fund transportation with their own money or travel to temporary sites on foot, thereby increasing travel time and decreasing the time they could spend administering vaccines. Because vaccine transportation down to the lower levels was underfunded, it was organized opportunistically, resulting in delays in deliveries and sometimes stockouts. A lack of transport at the lower levels of the health system also prevented routine monitoring and the full realization of the supportive supervision model.

- **Budget disbursements were often delayed or sometimes not executed at all, hindering immunization and social mobilization activities from being carried out.** Insufficient funding ahead of activities meant that health zones either had to pre-finance certain activities or if they were not able to do that, they had to postpone or pause campaigns and supporting activities. Some health zones indicated that they were only able to cover a part of the campaign catchment area due to the lack of funding. Health zones were often short of masks, cotton pads, plastic tables, chairs, and other supplies. While social mobilization activities were intensified in the beginning, health zones lacked the means to sustain these activities over time. RECOs were a core part of the strategy in promoting C19 vaccination within the community and disseminating key information on vaccination efforts, however there were not enough volunteers to meet the needs due to limited funding to pay their stipends. This was coupled with a lack of funding for megaphones, batteries, and other materials. At the start of the rollout, members of the health workforce reported financing activities or materials out of pocket, however this eventually stopped due to demotivation and low morale among staff and volunteers.

- **Health worker demotivation soared when even their regular salary payments were delayed.** Not only did health workers receive little additional incentives to implement the program, they reported delays in receiving their regular salary, obtaining only partial payment, or not being paid at all. Similar problems also applied to the per diem for staff and volunteers that was meant to be paid out by partners. While morale amongst the health workforce was high in the initial phase of the roll-out, issues around pay significantly decreased motivation amongst staff. This reduced the willingness of staff to go to great lengths to support the program, and staff reported that they stopped paying for vaccination activities with their own money. One health zone reported that facilities in its catchment area refused to share data on vaccine doses delivered to protest the lack of payments.

- **Vaccine hesitancy and stock-outs meant that C19 vaccinations were sometimes halted for several months.** At the beginning of the rollout, the program suffered from severe vaccine hesitancy, particularly surrounding the AstraZeneca vaccine, which led to slow uptake and expired stocks. As a result, there was a nation-wide pause in C19 vaccination in July 2021. Additionally, even when vaccine supply improved at national level as more vaccine products were approved for use in the country, both the health zone and site level reported not having vaccines delivered on time and the quantity delivered not being sufficient. Between October 2021 and June 2022, 7 health facilities out of 26 included in our study reported they had to halt vaccination due to vaccine stockouts.

- **There was a lack of cold chain equipment, particularly in rural areas, resulting in additional time and resources spent on transporting vaccines.** More than a third of sampled health facilities did not have any powered cold chain to store the C19 vaccines on site. Some CCE needs at health zone and site level were filled by donors, but many gaps remained. Therefore, vaccines were picked up every morning and returned to the health zone at the end of each vaccination day or stored at neighboring facilities. Further, a lack of solar power refrigerators at health zone level meant that vaccines had to be returned to provinces in instances of power outages. These extra logistical challenges led to increased fuel costs, and additional health worker time for an already under-resourced program.

- **Due to funding shortages, the number of vaccination sites was insufficient to cover the population.** Health zones reported a disconnect between the national and province-level macroplans, and lower-level microplans. Health zones planned a certain number of vaccination sites needed to reach the target population, but the number would subsequently be altered by the higher administrative levels, due to funding shortages. This led to too few vaccination sites and sites that were poorly geographically distributed, with one health zone in our sample reportedly covering 80km with only two vaccination sites.

V

STAFFING AND SERVICE DELIVERY AT SAMPLED SITES

Sampled sites in the DRC delivered very few C19 vaccines per day, on average 18 during routine periods, and 52 per day during campaigns (Table 2). The average vaccination team was similar for routine and campaign delivery as well as across provinces, and comprised of paid and unpaid health workers, as well as volunteers. This reflects the lack of resources available to fill health worker shortages. Three of the 26 sites in the sample reported hiring new staff for the C19 vaccination program, though the newly hired staff were paid at only one of these sites. Health workers were more likely to have received per diems during campaigns (35%) than during routine (23%).

This difference was particularly pronounced in Haut-Katanga, where 83% of the sites were able to provide per diems to staff during the campaigns, but none during the routine period. Nevertheless, Haut-Katanga delivered many more doses per day during the routine period than other provinces (48 per site per day compared with 6-9 elsewhere). Vaccination teams were usually comprised of 6-7 members, and composition was similar across geographies and delivery modalities, with slightly smaller teams in Kongo Central for campaign delivery. Vaccination teams spent an average of 7 hours working on C19 vaccination activities per day.

Table 2. Staffing and service delivery at sampled sites, for routine and campaign delivery

	All	Urban			Rural
		All	Kinshasa	Haut-Katanga	Kongo Central
Number of sites	26	20	14	6	6
Average doses delivered per day/site					
Routine	18	21	9	48	6
Campaign	52	61	57	68	21
Average vaccination team staff					
Total - Routine	7	7	7	6	7
Paid health staff - Routine	5	5	6	4	5
Unpaid health staff - Routine	2	2	2	2	1
Unpaid volunteers - Routine	1	1	1	0.3	2
Total - Campaign	6	7	7	6	5
Paid health staff - Campaign	5	5	6	4	5
Unpaid health staff - Campaign	1	1	1	2	0
Unpaid volunteers - Campaign	0.2	0.3	0.3	0.2	0
Average working hours per day					
Routine	7	8	8	7	6
Campaign	7	7	7	7	8
% of sites were staff received per diem					
Routine	23%	30%	43%	0%	0%
Campaign	35%	45%	29%	83%	0%
% sites supported by partners					
Routine and campaign	46%	60%	50%	83%	0%

Out of 15 health zones included in our study, 9 reported deploying mobile teams during the study period, exclusively funded by development partners. Across these 9 health zones, mobile teams were supported by 4 different partner organizations. Most of them were deployed for campaigns, while two were deployed in support of routine delivery. Deployment modalities varied significantly, with the duration ranging from 2 to 10 days, the number of teams deployed ranging from 1 to 8, and the doses delivered per day by each team ranging between 11 and 133.

All health zones except one reported recruiting temporary workers to mobile teams, including three health zones that did not leverage existing health staff at all (only newly recruited vaccination team members or NGO employees). All health zones except one reported that mobile vaccination team members received a per diem or daily stipend, ranging from $7 to $18 per staff member per day. Most of the health zones that deployed mobile teams trained vaccination team members specifically for this deployment (8 out of 9), and three of them reported also incurring financial costs related to these trainings.

V

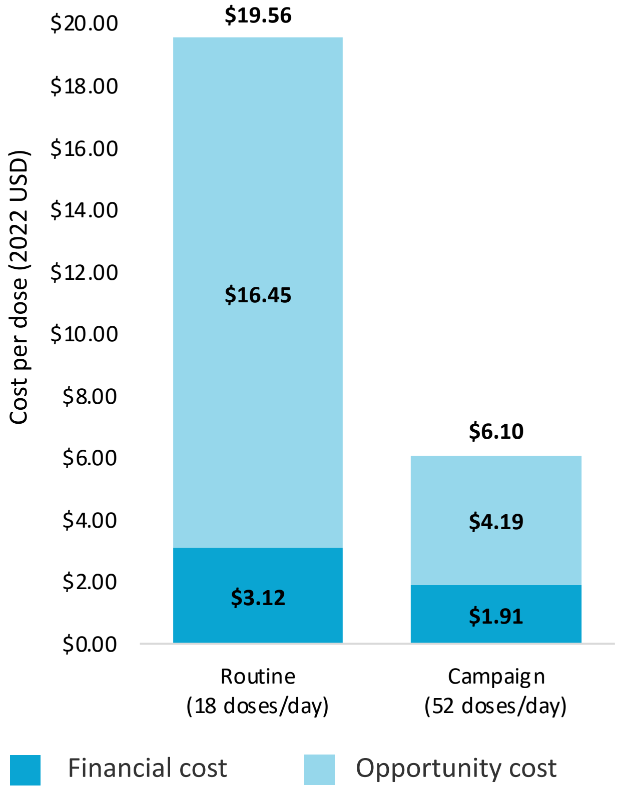
THE COST OF DELIVERING C19 VACCINES

ROUTINE, CAMPAIGNS AND MOBILE TEAMS

C19 vaccine delivery was more cost-efficient during campaigns than routine, as more doses were delivered per day

The economic cost of delivering a C19 vaccine dose varied from $6.10 during campaigns to $19.56 during routine. The economic cost per dose cost includes the opportunity cost of delivery. This represents the value of existing resources that were used to implement the C19 vaccination program, which primarily consists of the value of health workers' salaries. While the financial cost for routine delivery was 1.7 times higher in routine ($3.12) than for campaigns ($1.91) as shown in Figure 4, the difference was much greater for opportunity costs, which were almost 4 times as much for routine delivery. The relatively smaller difference in the financial cost per dose is likely explained by slightly higher spending levels for campaign delivery. During campaigns, vaccination team members were more likely to receive per diem from donors or partner organizations, and some health facilities used temporary sites in addition to fixed site delivery, therefore recording higher transport costs. Delivery volumes were larger during campaigns (52 doses per site per day) than during routine (18 doses per site per day), though they were still much lower than is often achieved through childhood immunization campaigns. Nevertheless, the difference in the cost per dose demonstrates that campaigns were able to achieve economies of scale compared with routine delivery.

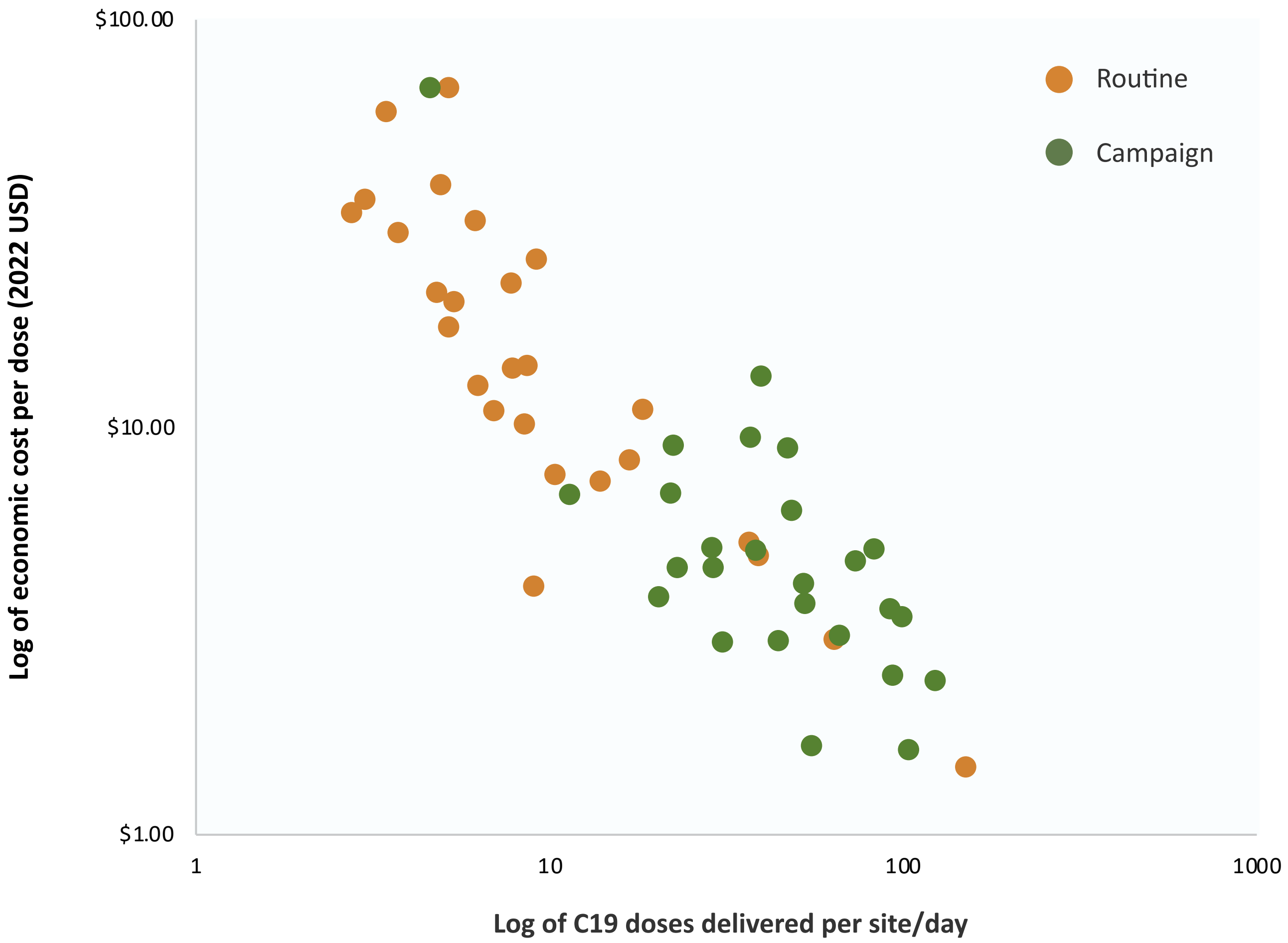
Figure 4. Economic cost per dose for routine and campaign delivery



Across our sample, sites that delivered more doses per day reported a lower cost per dose, showing an inverse relationship between cost per dose and volume delivered. Figure 5 shows the economic cost per dose and daily volume delivered at sampled sites, both on a logarithmic scale. The economic cost per dose was lower at sites that delivered more doses per day, indicating an inverse power-law relationship between the economic cost per dose and volume delivered.

A similar trend was observed when looking at the relationship between the financial cost per dose and volume delivered per day at sampled sites. An inverse relationship between the cost per dose and volume delivered is commonly found in immunization delivery costing studies, because at higher levels of delivery volume fixed costs are spread across a higher number of doses, thus driving down fixed costs per dose.

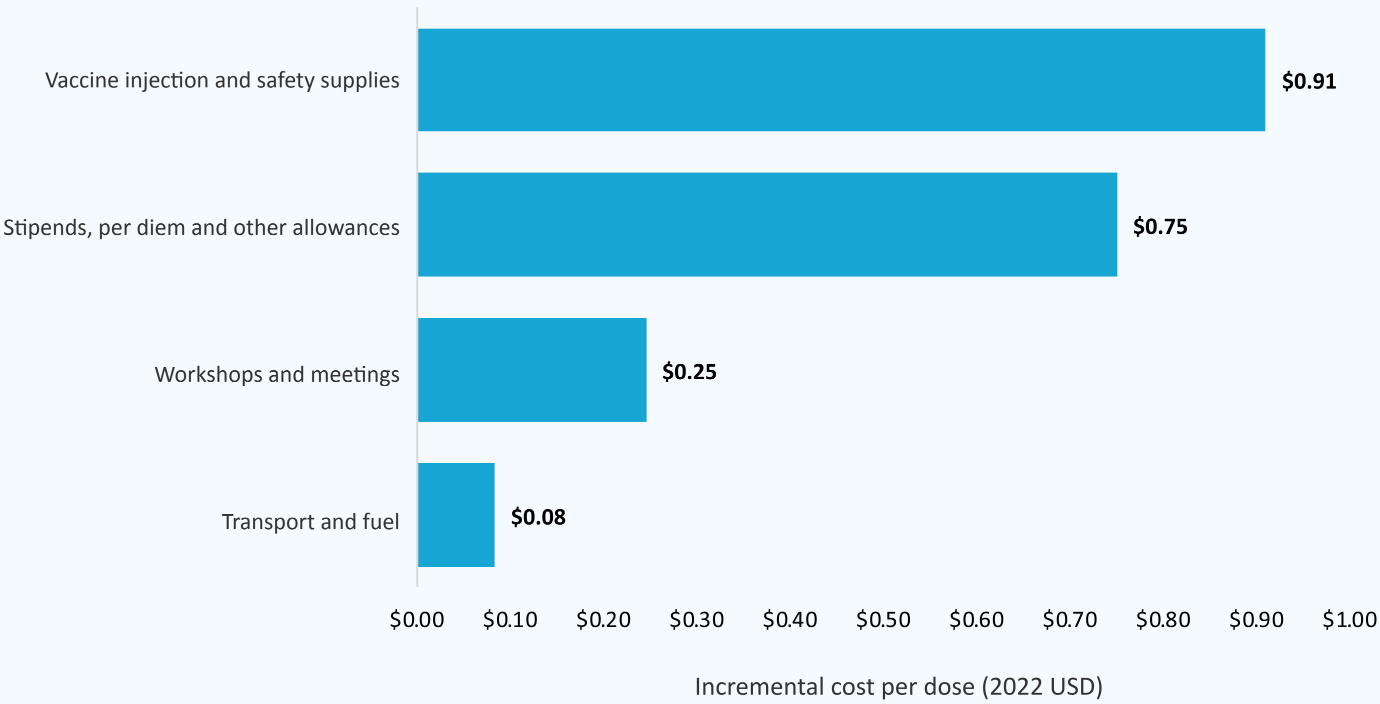
Figure 5. Relationship between the economic delivery cost per dose and volume delivered per day, for routine and campaign delivery



Fully donor-funded, with incremental financial cost of $1.99 per dose, mobile teams delivered more doses per day compared to facilities

Mobile teams were infrequent efforts that were only implemented when donor funding was available, and for an incremental financial cost of $1.99 per dose, they delivered an average of 69 doses per day per team. Mobile teams were deployed mostly to support campaign delivery, though a few teams in our sample were deployed during routine delivery. Mobile vaccination team members were temporary workers—some of them recruited from regular health workers—and in all teams except one, all members received a daily stipend or per diem. Mobile teams relied on health zones for vaccine distribution and storage, program management, waste management, and social mobilization. The incremental cost of delivery through mobile teams was driven by vaccine injection and safety supplies ($0.91 or 46%) and stipends and per diem for vaccination team members ($0.75 or 38%) as shown in Figure 6. Other expenses were related to training vaccination team members ($0.25 or 14%) and transport and fuel ($0.08 or 4%). On average, each mobile team delivered 69 doses per day, making them more effective at reaching the target population when compared to health facilities, which delivered 52 doses per day during campaigns, and 18 per day in routine. With an incremental financial cost per dose estimated at $1.99, it may appear that mobile teams were more cost-efficient at delivering C19 vaccines than routine teams (financial cost per dose of $3.12) and on par with campaign delivery ($1.91). However, this estimate only includes incremental financial contributions by donors for vaccine administration and training of mobile teams, and therefore underestimates the full financial cost of mobile team delivery.

Figure 6. Incremental financial cost per dose for mobile team delivery

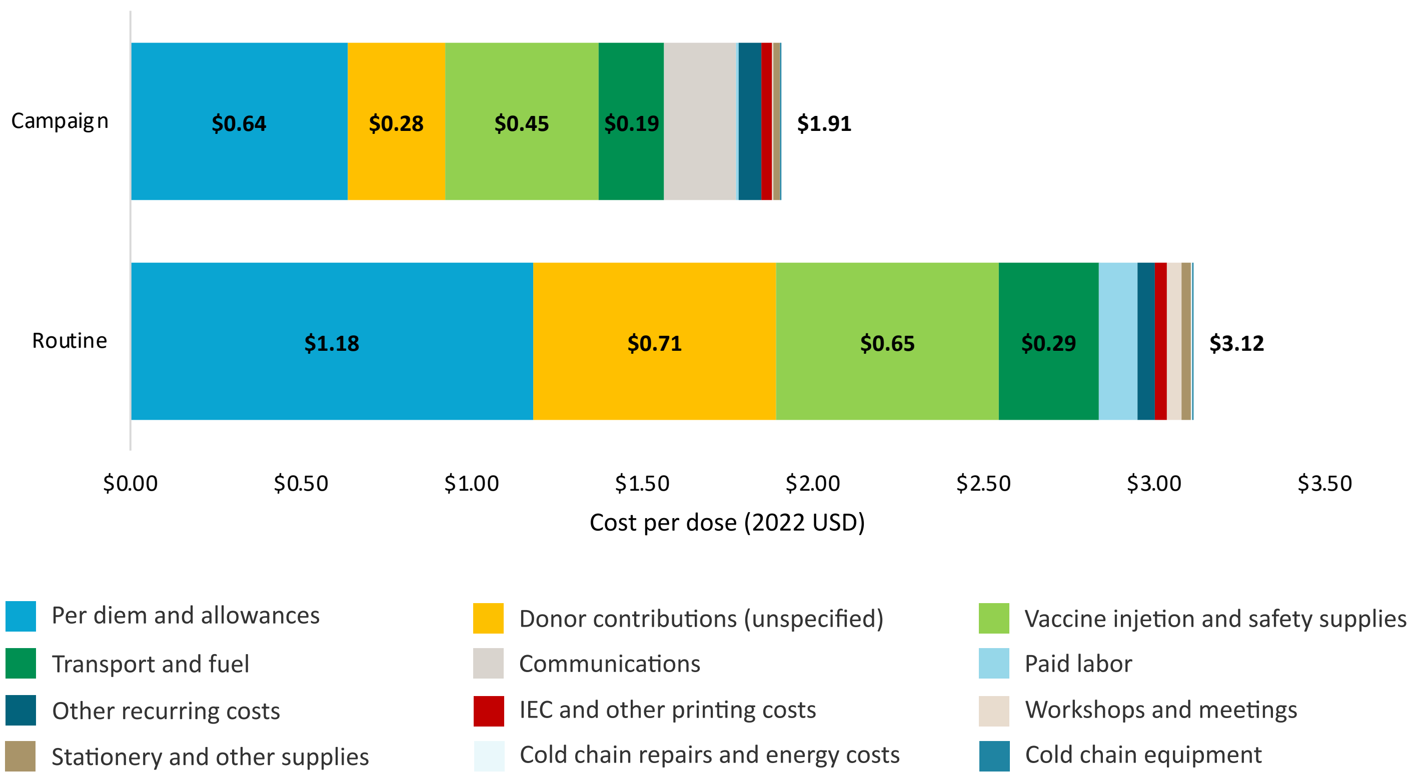


Per diem and allowances were the main financial cost driver, accounting for 33%-38% of the financial cost per dose

Per diem and allowances were the key financial cost driver, estimated at $1.18 for routine delivery and $0.64 for campaigns. Vaccine injection and safety supplies were also a key cost component in both campaign ($0.45) and routine delivery ($0.65). Donor contributions spent on unspecified resource types (shown in Figure 7 as "Unknown resource type") were the second largest cost driver of routine delivery at $0.71 per dose.

The cost structure of the financial cost per dose did not differ significantly between routine and campaign delivery, with the exceptions of communication costs which accounted for $0.21 per dose in campaigns and only $0.003 during routine, and paid labor which was $0.11 per dose for routine delivery and $0.01 during campaigns, with the difference driven by partner-funded additional recruitment at provincial level.

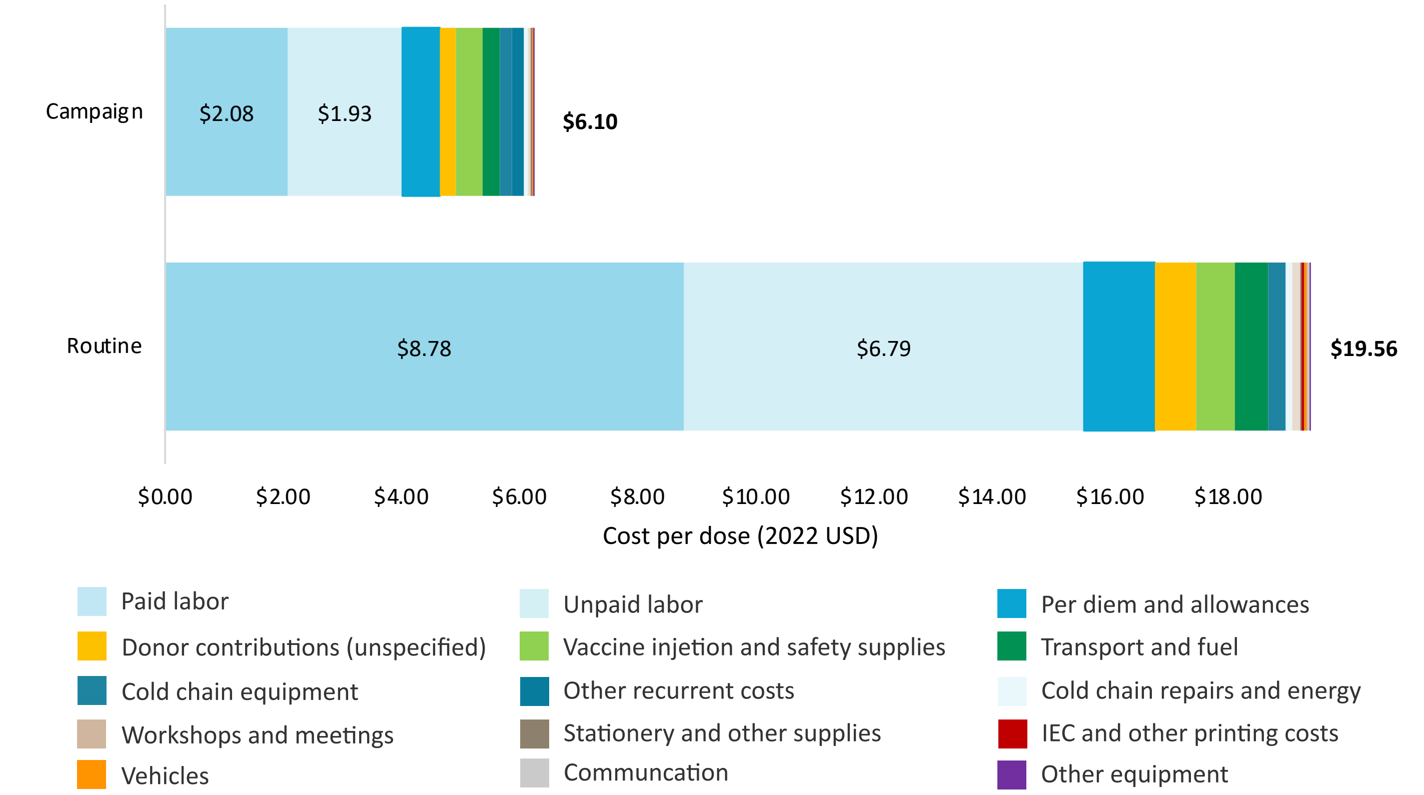
Figure 7. Financial cost per dose, by resource type



Labor-related costs represent the great majority of the economic cost per dose, 80% in routine and 66% in campaigns

Paid labor was the main cost driver of the economic cost per dose, at $2.08 per dose for campaigns, and $8.78 for routine. Paid labor includes a share of the salaries paid to health workers proportional to the time they dedicated to C19 vaccination activities during the study period. The second largest cost driver shown in Figure 8 was the value of unpaid labor, which amounted to $1.93 per dose during campaigns and $6.79 for routine. Unpaid labor includes the value of volunteers' time, as well as the value of labor of health workers that do not receive a salary, and the value of unpaid overtime labor from health workers that do receive a regular salary.

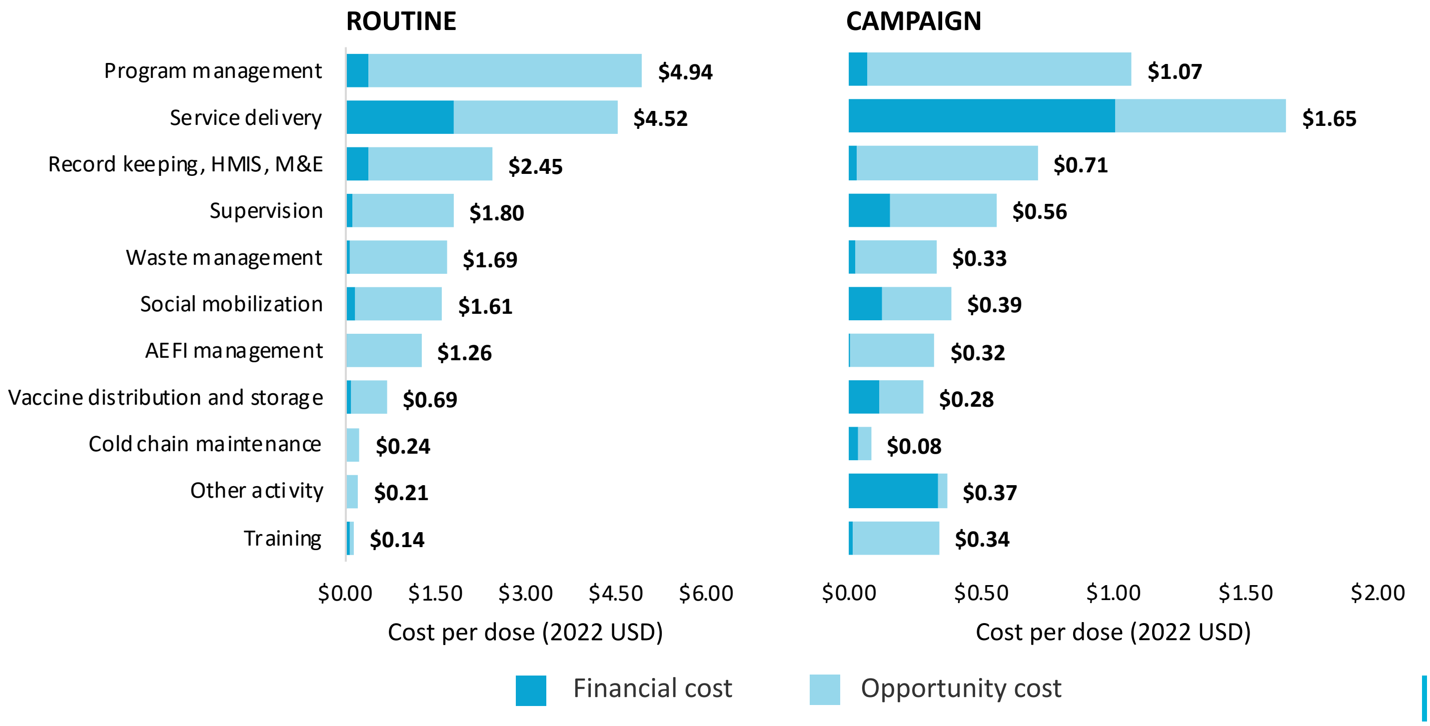
Figure 8. Economic cost per dose, by resource type



Most of the costs were for service delivery, due to supplies, per diem for vaccination teams, and program management

Most financial costs were spent on service delivery ($1.01 during campaigns and $1.80 during routine), though in terms of the economic cost, program management was a key driver as well (Figure 9). Record keeping was the third largest economic cost driver for both routine and campaign. Although social mobilization is often a cost driver of new vaccine introductions, and the program started off in the context of extreme vaccine hesitancy, the financial cost of social mobilization was only $0.12-0.16 per dose across campaign and routine delivery. Overall, the cost structure did not vary significantly between routine and campaign delivery, except for the much higher cost per dose for training during campaigns ($0.34 or 6%), compared to routine ($0.14 or 1%).

Figure 9. Economic cost per dose, by program activity for routine (left) and campaign (right)



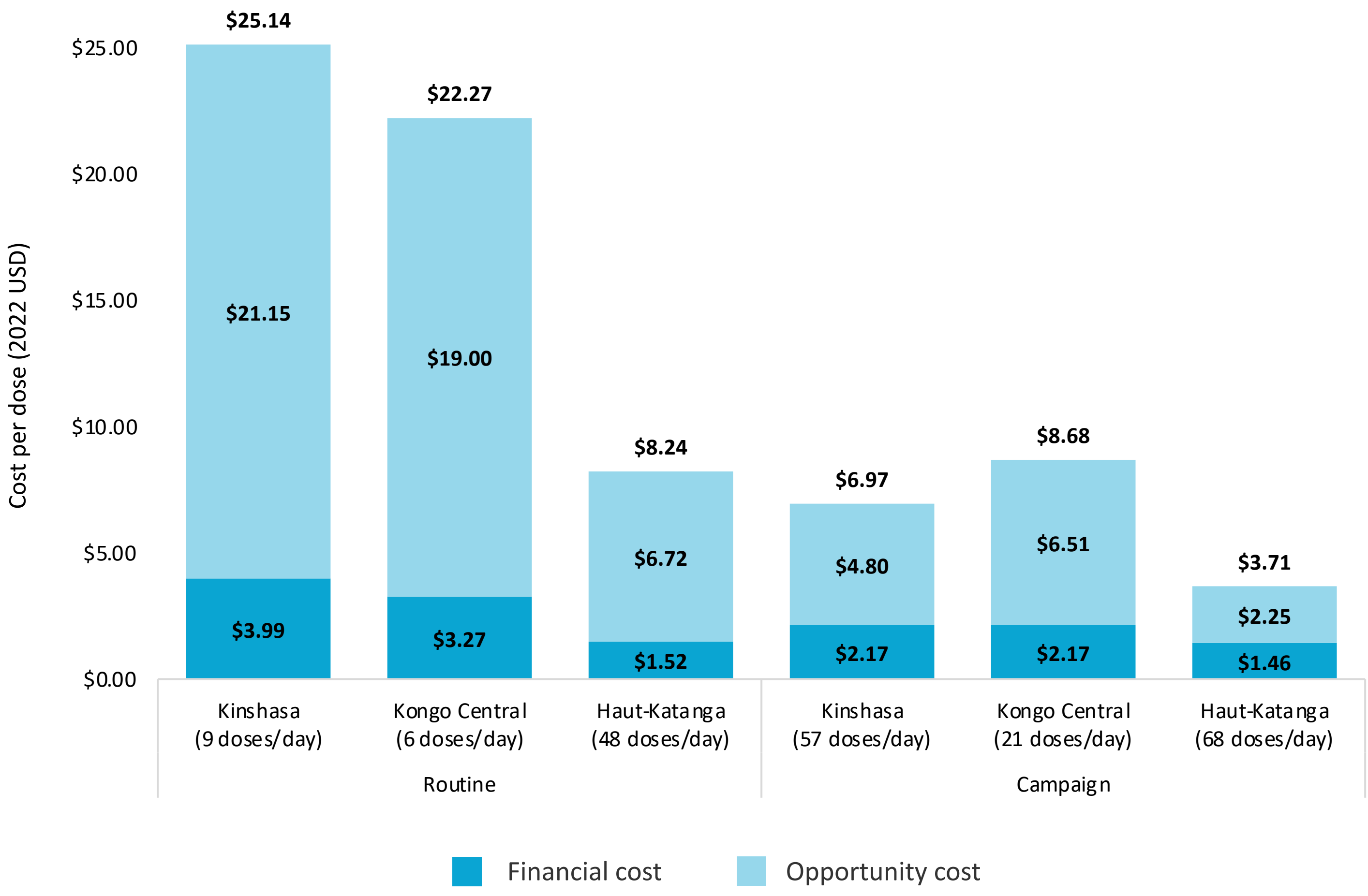
DIFFERENCES ACROSS GEOGRAPHIES

The cost per dose was lowest in the province of Haut-Katanga, where sites delivered more doses per day

The economic cost per dose varied widely between $8.24 in Haut-Katanga and $25.14 in Kinshasa and for routine, and between $3.71 in Haut-Katanga and $8.68 in Kongo Central for campaign delivery (Figure 10). There was less variation in the financial delivery cost per dose, which ranged between $1.52 in Haut-Katanga and $3.99 in Kinshasa for routine delivery, and between $1.46 in Haut-Katanga and $2.17 in Kinshasa and Kongo Central for campaigns. The economic costs per dose delivered in Kinshasa and Kongo Central during routine were exceptionally high, due to the very low number of C19 vaccine doses delivered per day.

Generally, the cost per dose across provinces was inversely correlated with volume delivered, though with some minor exceptions. For example, Kinshasa reported slightly higher costs per dose ($25.14) than Kongo Central ($22.27) despite delivering slightly more doses per day (9 vs. 6). This might be because vaccination teams worked on average longer hours in Kinshasa (8 hours per day), compared to Kongo Central (6 hours per day). Moreover, staff in Kinshasa received per diem while vaccination teams in Kongo Central did not, leading to a higher financial cost per dose in Kinshasa.

Figure 10. Economic cost per dose for routine and campaign delivery, by province

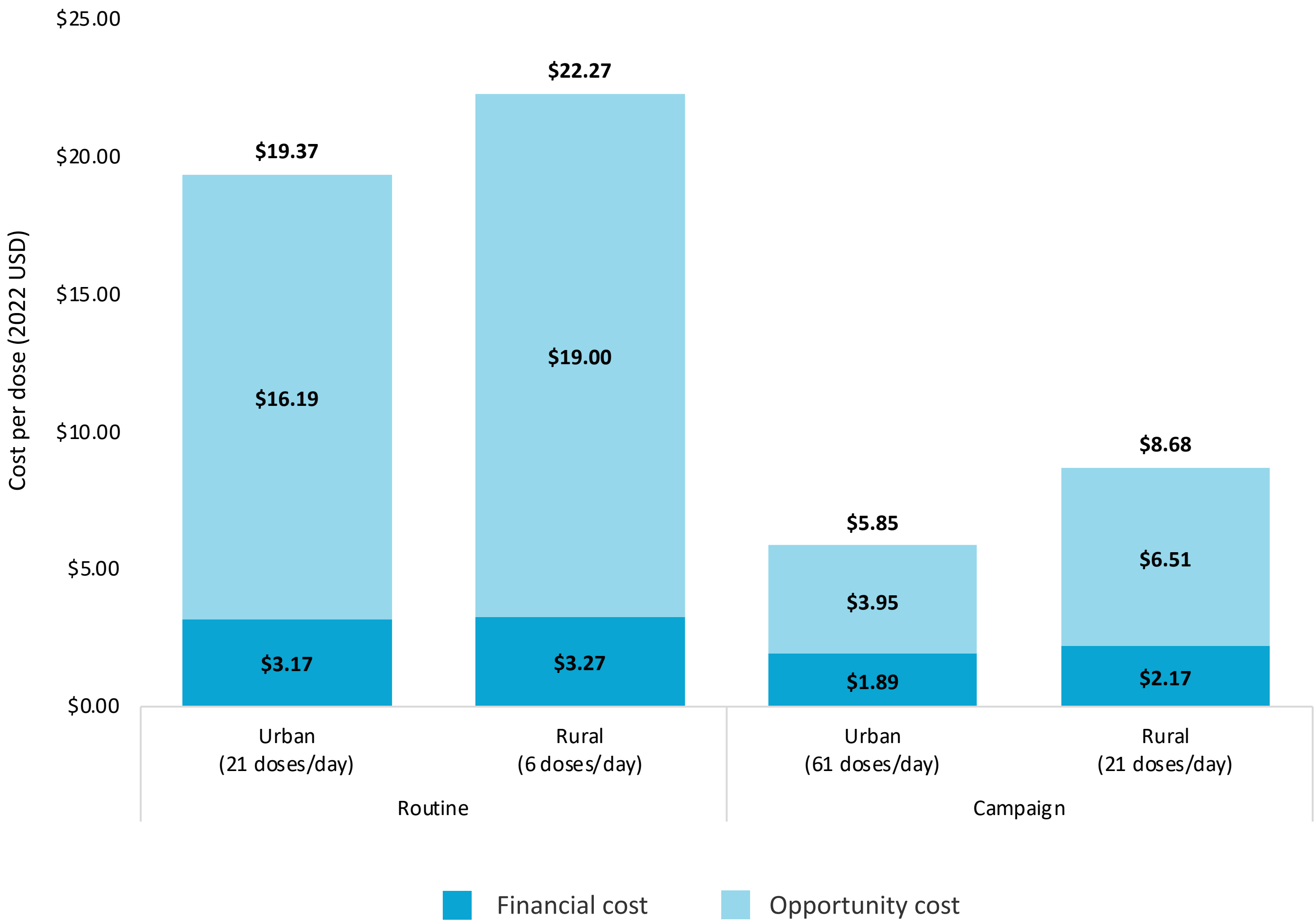


Delivering vaccines in rural areas was more costly, for both delivery modalities

Both financial and economic costs were greater in rural areas, though the difference was more marked for campaign delivery. All rural sites were in the province of Kongo Central, while urban sites were in both Kinshasa and Haut-Katanga. The economic cost in rural areas was 15% higher than in urban areas for routine delivery ($22.27 vs. $19.37), while it was 48% higher than in urban areas for campaigns ($8.68 vs. $5.85) (Figure 11).

When looking at financial costs, the difference between rural and urban areas was less pronounced, particularly for routine delivery where the cost per dose was similar across rural and urban areas ($3.27 vs. $3.17). This is due to urban sites benefitting from relatively more additional funding for the C19 vaccination effort. For instance, while in urban areas 13 sites out of 20 reported receiving per diem for routine or campaign delivery, no rural sites received any per diem for C19 vaccine delivery.

Figure 11. Economic cost per dose for routine and campaign delivery, in urban and rural areas

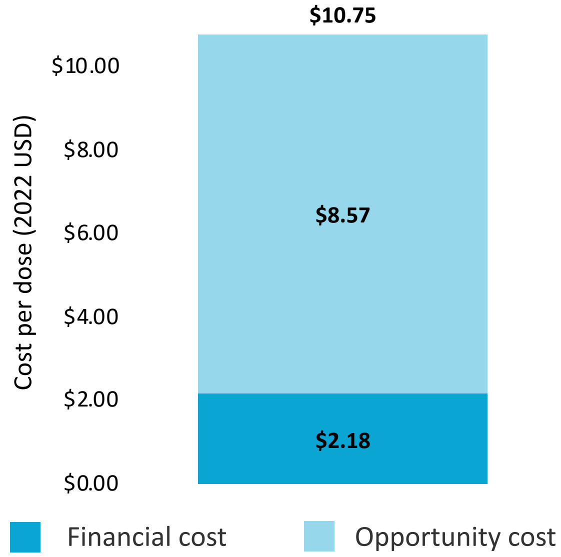


OVERALL COST PER DOSE

The cost per dose of delivering C19 vaccines in the DRC was higher than in other countries, due to the much lower volume delivered

The average financial cost of delivering a C19 vaccine dose in the DRC in 2022 was $2.18, and including opportunity costs, the economic cost of delivery was $10.75 per dose. Both the overall cost per dose across delivery modalities, and the unit cost for routine delivery only are higher than modeled estimates for the delivery of childhood routine immunization in the DRC. While our study is the first to estimate vaccine delivery cost in the DRC using primary data, a modelling exercise has found the economic cost to deliver one dose of childhood routine vaccine to be $1.14 and financial costs to be $1.22.[14] The financial cost per dose for campaign delivery, while significantly lower than the cost for routine delivery, is higher than existing estimates for immunization campaigns, which range from $0.22 for an MR campaign in Uttar Pradesh, India[11] to $1.20 for an OCV campaign in Bangladesh[12].

Figure 12. Economic cost per dose, all delivery modalities



The economic and financial cost per dose of delivering C19 vaccines in the DRC were much higher than found in bottom-up costing studies of C19 vaccination programs in other countries.[13],[14],[15],[16],[17] The financial cost per dose for the delivery of C19 vaccines in other countries was found to range from $0.29 in Bangladesh, to $0.43 in Mozambique, $0.60 in Vietnam, $0.67 in Côte d'Ivoire and $2.03 in the Philippines. All were lower than found in the DRC on average across delivery modalities, and lower than the DRC's most cost-efficient strategy, campaigns. The economic cost per dose in the DRC is also much higher than found in all other countries ($0.85 in Mozambique, $1.05 in Bangladesh, $1.77 in Vietnam, $3.16 in Côte d'Ivoire, and $3.58 in the Philippines).

While Vietnam, Bangladesh and the Philippines reported significantly higher spending for their C19 vaccination efforts compared to the DRC, they all reported lower costs on a per dose basis due to the much higher volume delivered. By the time of the study period, the DRC had only reached 7% of its target population with one dose (compared to 35% to 83% in other countries) and sites included in our study reported a much lower daily delivery volume (35 doses per site per day, compared to 55 to 983 in other countries).
The cost per dose found in the DRC is within the range of costs estimated by the COVAX model, though the model assumed 70% coverage, and thus a much higher volume delivered compared to what found in our study period.

National level start-up costs were low due to little investment during the study period

During the study period (until June 2022), we recorded a total of $49,294 for national-level startup economic costs, exclusively related to labor of national level staff involved in start-up activities (Table 3). We defined initial start-up costs as those costs incurred 30 days before the start of vaccination activities until the end of the study period (June 2022), related to inputs and activities specifically associated with the introduction of the new C19 vaccination program.

Startup costs related to the introduction of a new vaccine typically include costs related to training health workers, the development of new guidance and protocols, microplanning, and potentially the acquisition of additional cold chain equipment. However, at the national level, our study only found labor costs. Out of the total startup costs, $7,170 or 15% were financial costs, fully related to labor of newly hired staff.

Table 3. Total startup costs at the national level, in USD

Level	Financial costs	Opportunity costs	Economic costs
Total national level	$7,170	$42,124	$49,294

At the subnational level, financial startup costs were driven by the acquisition of new cold chain equipment at a few health zones and facilities, as well as per diem for trainings at antenne level. Across all subnational levels, opportunity costs were mostly related to labor for program management, social mobilization, and training. Financial costs at antenne level mostly consisted of per diem for trainings (58%), and expenses related to social mobilization workshops and meetings (39%). At health zone level, 54% of the financial startup costs were due to one newly purchased vehicle at one health zone, while an additional 17% was related to newly purchased cold chain equipment at two health zones. At health facility level over 90% of the volume-weighted average startup financial costs was related to one newly purchased refrigerator at one high-volume site. When excluding that newly purchased refrigerator, volume-weighted average startup financial costs at health facility level dropped from $1,157 to just $100.

Table 4. Volume-weighted average startup costs (antenne, health zone, and health facility), in USD

Level	Financial costs	Opportunity costs	Economic costs
Antenne	$2,156	$1,513	$3,669
Health zone	$1,096	$511	$1,607
Health facility	$1,157 ($100)*	$356	$1,513

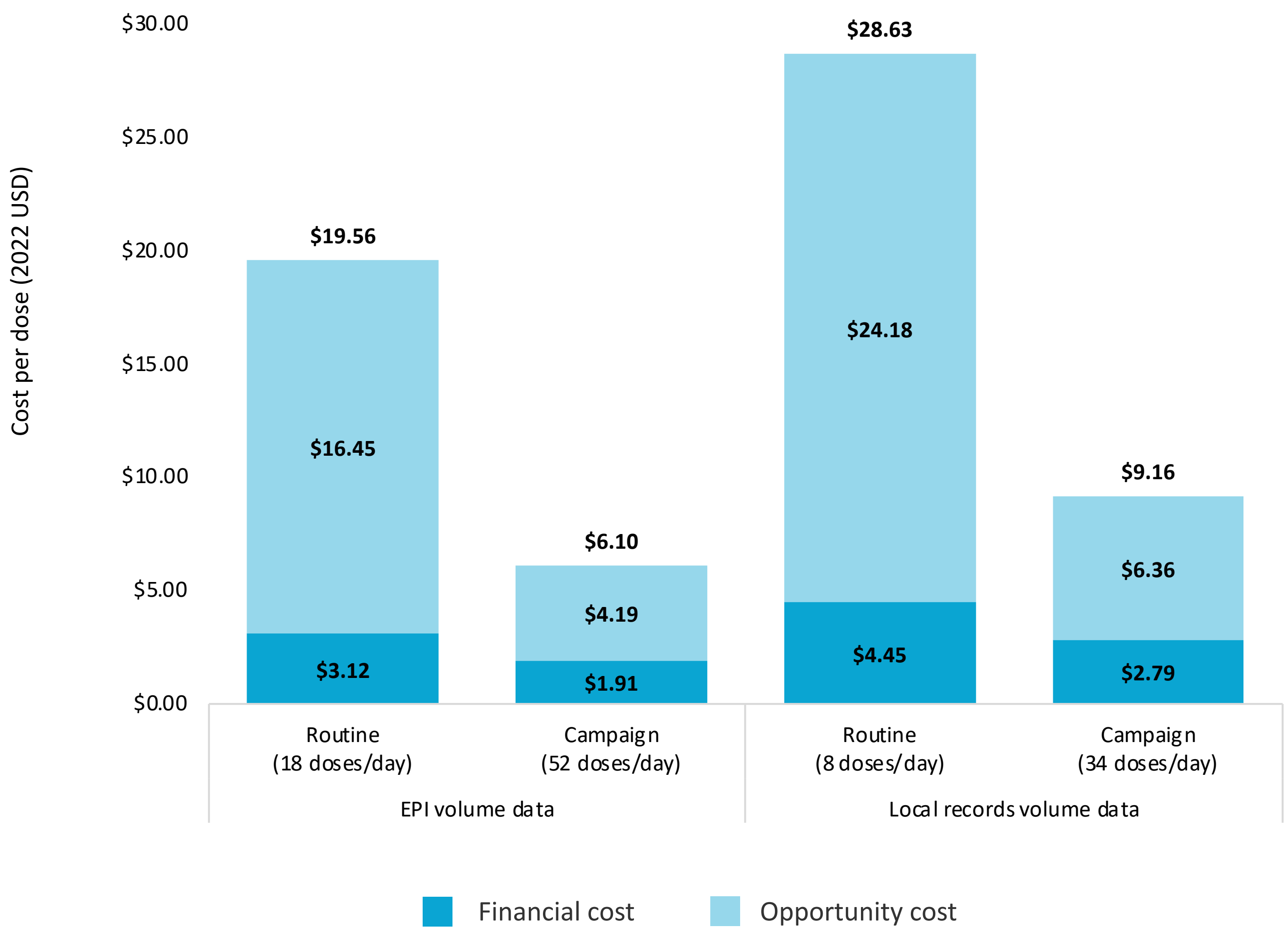
*Volume-weighted average startup cost at facility level when excluding one newly purchase refrigerator at one health facility

SENSITIVITY ANALYSIS

When using the data on volume delivered collected at implementation sites as denominator, the economic cost per dose increases by 46% for routine delivery and 50% for campaign delivery. Data on the number of doses delivered collected from the EPI national office presented fewer discrepancies and was used for the main analysis presented in this report. This sensitivity analysis assesses the impact of using the doses delivered data collected at vaccination sites and subnational administrative offices to estimate the cost per dose.

On average, the volume delivered reported in local records was lower—8 vs 18 doses per day for routine delivery, and 34 vs 52 doses during campaigns—leading to a higher cost per dose. While the cost per dose differs, according to both datasets campaigns reached more people at a considerably lower cost per dose, delivering vaccines in rural areas was found to be more costly, and the key cost drivers and activities are the same (Figure 13).

Figure 13. Economic cost per dose using EPI volume data and local records volume data as denominator, for routine and campaign delivery



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KEY TAKEAWAYS

Findings from this study can provide valuable evidence for policymakers in the DRC and globally. This is the first study estimating the cost of delivering vaccines in the DRC, and one of the first studies on the cost of C19 vaccines delivery globally. Our results can help inform planning and budgeting for the future of the C19 vaccination program in the DRC, as well as in countries for which there is no domestic data. Given the limited literature on immunization delivery costs in the DRC, these findings could also inform resource allocation decisions for other vaccination programs.

Based on our study's results, we draw the following takeaways for policymakers:

Insufficient funding led to inadequate service coverage and inefficient practices, hindering the uptake of the C19 vaccination program which already struggled with very high vaccine hesitancy.

While partners committed to support the DRC's C19 vaccination effort, only a fraction of the funding promised was actually disbursed.[18] Adding a large new vaccination program to an already greatly under-resourced health system without adequate additional funding meant that the rollout of the C19 vaccine suffered from many challenges and inefficiencies. The number of vaccination sites was insufficient to cover the target population, and lack of transport meant that health staff sometimes paid to transport vaccines from their own pockets, or lost time by picking up vaccines on foot. This was exacerbated by the lack of adequate cold chain equipment, which meant that vaccines had to be transported to health zones or neighboring facilities each day. All of this limited the time and resources health workers had available to actually administer C19 vaccines.

Despite the lack of funding, the cost per dose delivered was high due to the very low volume delivered.

The cost per dose was lower at vaccinations sites that achieved a higher delivery volume, but generally the volume delivered at sampled sites was very low. This reflects the fact that by the time of data collection the DRC was still struggling to scale up the vaccination program and had only reached 4% of its population.

While vaccine hesitancy was quickly recognized as a significant issue, not enough resources were available to address this and demand for the vaccine continued to be low. In addition, insufficient funding meant not all communities could be reached with C19 vaccines. Therefore, DRC missed out on the cost-efficiencies that could have been achieved by delivering greater vaccine volumes.

C19 vaccination campaigns were more cost-efficient than routine delivery, reaching more people at a lower cost per dose.

During campaigns health facilities delivered more C19 vaccine doses at a lower cost per dose, making campaigns the most cost-efficient delivery strategy in the DRC. Overall, campaigns were better funded than routine delivery which helped to increase coverage: vaccination team members were more likely to receive a per diem, and some health facilities set up temporary posts in the community to deliver vaccines. Despite a higher level of spending, campaign doses were delivered at a lower cost per dose compared to routine, due to the higher volume delivered by vaccination sties—an average of 52 doses per day during campaigns compared to just 18 for routine delivery.

Committed health workers made the program possible, but without an underlying robust health system and sufficient additional funding, high vaccination coverage remained unattainable.

The DRC was not unique in heavily relying on existing resources and volunteers to implement the C19 vaccination program. However, due to the extremely weak condition of DRC's health system, the commitment of health workers alone was not sufficient to ensure the success of the program. Pre-existing issues such as lack of payments for regular health worker salaries and missing powered cold chain at many health facilities, coupled with very high vaccine hesitancy meant that the commitment of health workers alone was not enough to fill funding gaps.

REFERENCES

[1] UNICEF Supply Catalogue. **https://supply.unicef.org/all-materials.html** [Online resource]

[2] Oanda Historical Exchange Rates for June 30th 2022, DRC. **https://fxds-hcc.oanda.com/** [Online resource]

[3] International Monetary Fund. Inflation rate, average consumer prices, annual percent change for 2021: DRC. **https://www.imf.org/external/datamapper/PCPIPCH@WEO/OEMDC/ADVEC/WEOWORLD** [Online resource]

[4] World Bank (2023). Official exchange rate (LCU per US$, period average) **https://data.worldbank.org/indicator/PA.NUS.FCRF?locations=** [Online resource].

[5] Matuvanga, T. Z., Doshi, R. H., Muya, A., Cikomola, A., Milabyo, A., Nasaka, P., Mitashi, P., Muhindo-Mavoko, H., Ahuka, S., Nzaji, M., Hoff, N. A., Perry, R., Musenga, E. M. (2022): Challenges to COVID-19 vaccine introduction in the Democratic Republic of the Congo – a commentary, Human Vaccines & Immunotherapeutics, DOI: 10.1080/21645515.2022.2127272

[6] Kabamba Nzaji M, Kabamba Ngombe L, Ngoie Mwamba G, Banza Ndala DB, Mbidi Miema J, Luhata Lungoyo C, Lora Mwimba B, Cikomola Mwana Bene A, Mukamba Musenga E. Acceptability of Vaccination Against COVID-19 Among Healthcare Workers in the Democratic Republic of the Congo. Pragmat Obs Res. 2020 Oct 29;11:103-109. doi: 10.2147/POR.S271096. PMID: 33154695; PMCID: PMC7605960.

[7] DRC MoPH (March 2022) Plan National d'Acceleration de la Vaccination Contre La Covid–19 en Republique Democratique Du Congo.

[8] COVID-19 Vaccine Delivery Partnership, Final Situation Report, June 2023. **https://www.who.int/docs/default-source/coronaviruse/covdp-sitrep_issue-12_final-report.pdf?sfvrsn=2191e4c0_3&download=true**

[9] Edouard Mathieu, Hannah Ritchie, Lucas Rodés-Guirao, Cameron Appel, Charlie Giattino, Joe Hasell, Bobbie Macdonald, Saloni Dattani, Diana Beltekian, Esteban Ortiz-Ospina and Max Roser (2020) - "Coronavirus Pandemic (C19)". Published online at OurWorldInData.org. Retrieved from: **https://ourworldindata.org/coronavirus** [Online Resource]

[10] Institute for Health Metrics and Evaluation (IHME). COVID spending on vaccine delivery. Seattle, WA: IHME, University of Washington, 2022. Available from **https://vizhub.healthdata.org/covid-spending/** (link is external). (Accessed July 2023)

[11] Immunization Costing Action Network (ICAN). 2020. The Cost of a Measles-Rubella Vaccination Campaign in India. Washington, DC: ThinkWell

[12] Khan, I. A., Saha, A., Chowdhury, F., Khan, A. I., Uddin, M. J., Begum, Y. A., … Qadri, F. (2013). Coverage and cost of a large oral cholera vaccination program in a high-risk cholera endemic urban population in Dhaka, Bangladesh. Vaccine, 31(51), 6058–6064. **https://doi.org/10.1016/j.vaccine.2013.10.021**

[13] Nguyen, V.M., Moi, F., Boonstoppel, L., Hoang, M.V., Duong, H.T., Vien, C.C. 2023. The Cost of Delivering COVID-19 Vaccines in Vietnam. Geneva: ThinkWell.

[14] Vaughan, K., Smith, E., Schütte, C., Moi, F., Boonstoppel, L. 2023. The Cost of Delivering COVID-19 Vaccines in Côte d'Ivoire. ThinkWell & Genesis Analytics.

[15] Namalela, T., Moi, F., Dipuve, A., Boonstoppel, L. 2023. The cost of delivering COVID-19 vaccines in Mozambique. Maputo: ThinkWell.

[16] Banks, C., Estanislao, R.D., De los Reyes, S.J., De Guzman, J.E., Sumpaico-Tanchanco, L.B., Makani-Lim., B., Archer, R., Boonstoppel, L., 2023. The Cost of Delivering COVID-19 Vaccines in the Philippines. Geneva: ThinkWell

[17] Hossain M.T., Yesmin A., Islam M.M., Moi F., Archer R., Boonstoppel L. 2024. Analysis of the Cost of COVID-19 Vaccine Delivery at Selected Sites in Bangladesh. Geneva: ThinkWell.

[18] Institute for Health Metrics and Evaluation (IHME). COVID spending on vaccine delivery. Seattle, WA: IHME, University of Washington, 2022. Available from **https://vizhub.healthdata.org/covid-spending/** (link is external). (Accessed July 2023)

ANNEXES

ANNEX 1. PROGRAM ACTIVITIES AND RESOURCE TYPES DEFINITIONS

Table 5. Program activities 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	Vaccine acquisition procedures; Vaccine collection at the airports or other distribution points, storing vaccines in national or subnational cold stores, distributing vaccines down to the facility, and to outreach or program sites where relevant.
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 and leaflets.
Supervision	Supervising subordinate or peer health or community workers.
Service delivery	Includes labor related to administration of the vaccine to people within the health facilities, preparation and cleaning up before and after the vaccination event. For facilities that delivered vaccines also at temporary sites, this activity also traveling to and from temporary sites outside of the facility and supporting vaccine administration (crowd control, screening, setting up and cleaning up the vaccination site before and after). For all delivery strategies, also includes vaccine administration and safety supplies used during the vaccination sessions.
Mobile team service delivery	Includes the administration of the vaccine to beneficiaries by mobile vaccination teams, vaccine administration and supplies used during mobile team vaccination sessions, transport of the mobile team and of vaccines from the health zone cold store to the vaccination sites and back, and training exclusively implemented for mobile teams.
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.
Microplanning and social mobilization	Referring to the development of eligible participants lists for each round and inviting eligible participants coming in vaccination sites in the area.

Table 6. Resource types definitions

Resource types	Description	Financial vs. opportunity cost	Start-up vs. operating
Recurrent costs			
Paid labor	Paid salary for health staff, government officers, or staff employed by partner organization. The paid personnel costs were derived from the total working time of each staff and their annual salary in 2022.	Opportunity cost	Operating, unless related to start-up activities
	Paid salary for new staff that were hired specifically for C19 vaccination program.	Financial cost	Operating, unless related to start-up activities
Unpaid labor	Value of volunteer labor (RECOs, medical students, etc.) for those vaccination team members who do not receive a salary from the government or from a partner organization. This cost was calculated based on each volunteer's working time and valued at minimum wage. Value of unpaid overtime of health staff related to C19 vaccination activities. Value of unpaid work done by regular health staff that currently does not receive a government salary, based on their grade.	Opportunity cost	Operating, unless related to start-up activities
Per diem and allowances	Per diem and allowances paid to regular staff as well as volunteers for participation to activities related to the C19 vaccination program.	Financial cost	Operating
Vaccine injection and safety supplies	Cost for vaccine administration and safety supplies and personal protective equipment.	Financial cost	Operating
Stationery and other supplies	Cost for stationery and IEC materials required for the C19 program.	Financial cost	Operating
Transport and fuel	Fuel costs specifically for C19 vaccination program activities that required travelling (supervision, trainings, vaccine collection, distribution, etc.)	Financial cost	Operating
Vehicle maintenance	Cost for vehicles maintenance specifically done for C19 vaccination program during the study period.	Financial cost	Start-up
	Routine and non-routine vehicle maintenance done during the study period.	Opportunity cost	Operating
Cold chain equipment repairs and energy costs	Cost for CCE maintenance specifically done for C19 vaccination program during the study period.	Financial cost	Start-up
	Routine and non-routine cold chain maintenance/repairs done during the study period. The energy cost for the CCE is the energy bill of the storage room (if available).	Opportunity cost	Operating

Resource types	Description	Financial vs. opportunity cost	Start-up vs. operating
Recurrent costs			
IEC and other printing cost	Cost incurred specifically for C19 vaccination program as reported in financial reports (if available), or estimations based on number of pages printed per each participant (per dose delivered) at implementation sites.	Financial cost	Operating
Workshops and meetings	Cost incurred specifically for C19 vaccination workshops and meetings	Financial 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 costs	Other financial outlays that are not included in the categories above, including direct financial support for development of guidelines and policies and vaccine acquisition costs at National level, waste disposal (for a third party) at district level, sugar drinks for vaccine recipients, etc.	Financial cost	Operating, unless related to start-up activities
Unknown resource type	Donor contributions that were spent on unknown resource types and unknown activities	Financial cost	Operating, unless related to start-up activities
Capital costs			
Cold chain equipment	Depreciation costs of existing cold chain equipment used for C19 vaccine storage at study sites	Opportunity cost	Operating
	New cold chain equipment acquired in 2021 and used for C19 vaccination program.	Financial cost	Start-up
Vehicles	Depreciation costs of existing vehicle(s) used for C19 vaccination activities (trainings, supervision, vaccine collection/distribution) at study sites	Opportunity cost	Operating
	New vehicle(s) acquired during the study period and used for C19 vaccination program.	Financial cost	Start-up
Other equipment	Depreciation costs of existing incinerator(s) used for C19 vaccination waste disposal at study sites as well as any other equipment.	Opportunity cost	Operating
	New incinerator(s) as well as any other equipment acquired in during the study period and used for C19 vaccination program.	Financial cost	Start-up

ANNEX 2. ADDITIONAL METHODS

Missing data imputation methods
If after following up with the respondent some data still could not be obtained, assumptions were made to impute the data from the same site or other sites, as detailed in Table 7 below:

Table 7. Imputation methods used for missing data

Missing data	Methods
Salary for health staff	Imputed based on the average salary for staff of the same cadre of at the same study site, and if not available, based on the average salary for staff of the same cadre at other sites.
Salary for staff at partners' organizations	Two partner organizations did not provide salary grades for their staff. Imputed based on the reported job title and a dataset of salary information from partner organizations pooled from several costing studies conducted by the study team (in Sierra Leone, Nigeria, Mozambique and Vietnam).
Quantities used for immunization supplies	At one vaccination site, quantities for vaccine administration and safety supplies were partly missing for the last campaign implemented. Quantities that were missing were imputed based on the average use per dose delivered or per vaccination day provided for other months at the same site.
Waste management costs	At one vaccination site, waste management costs were missing and were imputed based on the average cost per dose at all other sites.
Fuel costs	At one health zone, respondents could only provide distance travelled and not fuel costs. Therefore, costs were imputed using the assumption of 18 liters used per 100km.

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