# Estimation of COVID-19 vaccine delivery costs **in Botswana**


FINAL REPORT

October 2023

Republic of Botswana
Ministry of Health

unicef
for every child

## INVESTIGATORS

**Kelsey Vaughan**, UNICEF consultant, the Netherlands (kvaughan@unicef.org)

**Ulla Kou Griffiths**, Immunization Section, Health Programme,
UNICEF, New York (ugriffiths@unicef.org)

**Dr Goabaone Rankgoane-Pono**, UNICEF consultant,
University of Botswana (goaba2000@yahoo.com)

**Onalenna T Mokena**, Department of Health Policy, Research and Development,
Ministry of Health (otrmabote@gmail.com)

**Mosetsana Modise**, Department of Health Policy, Research and Development,
Ministry of Health (mossmod90@gmail.com)

**Mooketsi Moalosi**, Department of Health Policy, Research and
Development, Ministry of Health (mkmoalosi004@gmail.com)

**Abia Sebaka**, COVID-19 Vaccine Taskforce, Health Services Management,
Nutrition and Food Control Division, Ministry of Health (asebaka@gov.bw)

**Keemenao Ramogalana**, IMCI, Child Health Division,
Ministry of Health (kramogalana@gov.bw)

**Marina Seobakeng**, EPI manager, Child Health Division,
Ministry of Health (mseobakeng@gov.bw)

**Moses Keetile**, Deputy Permanent Secretary, Department of Health Policy,
Research and Development,
Ministry of Health (mkeetile@gov.bw)

# CONTENTS

# BOXES, FIGURES AND TABLES

# ACRONYMS

| | |
|---|---|
| AEFI | Adverse event following immunization |
| AVAT | African Vaccine Acquisition Trust |
| BDF | Botswana Defence Force |
| BMC | Botswana Meat Commission |
| BoMRA | Botswana Medicines Regulatory Agency |
| BVI | Botswana Vaccine Institute |
| BWP | Botswana pula |
| CEPI | Coalition for Epidemic Preparedness Innovations |
| CHN | Community Health Nurse |
| CMS | Central Medical Stores |
| COVAX | COVID-19 Vaccines Global Access |
| cPIE | COVID-19 post-introduction evaluation study |
| CRD | COVAX Readiness and Delivery |
| DEOC | District Emergency Operational Center |
| DHMT | District Health Management Team |
| GDP | Gross domestic product |
| GHSC-PSM | Global Health Supply Chain Program - Procurement and Supply Management |
| GoB | Government of Botswana |
| GPO | Government purchase order |
| HIV/AIDS | Human immunodeficiency virus/acquired immunodeficiency syndrome |
| HMIS | Health management information system |
| HPRD | Health Policy Research and Development |
| HR | Human resources |
| HSM | Health Services Management |
| HSMEQA | Health Services Monitoring & Evaluation and Quality Assurance |
| IAR | Inter Action Review |
| LMIC | Low- and middle-income country |
| M&E | Monitoring and evaluation |
| MoD | Ministry of Defence (previously known as Ministry of Defence, Justice and Security, MDJS) |
| MoF | Ministry of Finance (previously known as Ministry of Finance and Economic Development, MFED) |
| MoH | Ministry of Health (previously known as Ministry of Health and Wellness, MoHW) |
| MST | Ministry for State President (previously known as Ministry of Presidential Affairs, Governance and Public Administration, MoPAGPA) |
| NDVP | National Deployment and Vaccination Plan |
| NEOC | National Emergency Operations Committee |
| NGO | Non-governmental organization |
| PHS | Public Health Specialist |
| PPE | Personal protective equipment |
| RHMT | Regional Health Management Team |
| SKMTH | Sir Ketumile Masire Teaching Hospital |
| UCC | Ultra cold chain |
| US$ | United States dollar |
| WHO | World Health Organization |

Note: for simplicity we use the current names and acronyms of all ministries as of June 2023, but acknowledge in the text at first use the previously used names. Ministerial name changes occurred in May 2022.

# Executive Summary

## Background

The development, distribution and delivery of COVID-19 vaccines is the largest global immunization action in history. Botswana, an upper middle-income country of 2.3 million people in Southern Africa, recorded its first COVID-19 case in March 2020. By end of March 2022, a total of 263,950 COVID-19 cases and 2,619 COVID-19-related deaths had been registered, equivalent to 109 deaths per 100,000 population (COVAX 2022). Botswana started its vaccination program in March 2021. A year later, by end of March 2022, 2.6 million vaccination doses had been delivered.

There are considerable costs incurred with COVID-19 vaccine roll-out, beyond vaccine procurement. These costs are known as delivery costs, also referred to as operational costs (Box 1). Delivery cost estimates are essential for optimal planning and budgeting; however, at the time countries were preparing to roll-out COVID-19 vaccines, actual delivery costs were unknown. During April 2022 – February 2023, the Botswana Ministry of Health (MoH) and UNICEF undertook a study with the primary aim of estimating COVID-19 vaccine delivery costs in Botswana.

BOX 1 **Definition of COVID-19 vaccine delivery costs**

**Delivery costs are the costs associated with delivering vaccines to target populations, exclusive of vaccine costs. They are also often referred to as operational costs. For COVID-19 vaccines, key delivery costs are, for example, those for training, human resources, per diems and allowances, syringes, waste management of used syringes, transport, cold chain, and data reporting systems.**

Source: ThinkWell general study protocol for COVID-19 vaccine delivery costing. 8 November 2021. Adapted from Vaughan K, Ozaltin A, Mallow M, Moi F, Wilkason C, Stone J, et al. The costs of delivering vaccines in low- and middle-income countries: findings from a systematic review. Vaccine X. 2019;2:100034.

## Methods

The study used a mix of ingredients-based and top-down methods to retrospectively collect data on costs of vaccine delivery in Botswana during 1st March 2021 – 31st March 2022, which represents the first 13 months of vaccine delivery in the country. Data collection was undertaken at national and sub-national levels from a sample of six DHMTs and extrapolated to non-sampled DHMTs. Costs incurred by all government sectors, donors/partners and non-governmental organizations (NGOs) were included. Total costs and cost per dose delivered were estimated for 19 different resource items. The study estimated financial outlays (fiscal costs) as well as the costs of existing staff involved in administrating COVID-19 vaccines and their supervisors (economic cots). The study also estimated the costs of vaccine procurement, including purchased and donated doses.

## Results

The total, fiscal delivery costs of COVID-19 vaccination in Botswana are estimated to be BWP 561 million (US$50 million) over the period 1st March 2021 – 31st March 2022 (13 months), including both national and sub-national costs. Fiscal costs include nearly BWP 289 million (US$26 million) for newly hired staff, the main cost-driving resource item. Newly hired staff supported not just the delivery of vaccines, but also planning and coordination of the COVID-19 vaccination program and implementation of ArmReady, the country's social mobilization campaign.

When including the value (opportunity cost) of existing HR working in vaccination teams and their supervisors, economic delivery costs rose to BWP 974 million (US$86 million). This shows that significant existing HR were redeployed to support COVID-19 vaccination, potentially compromising the delivery of other essential health services.

With a total of 2,607,002 vaccine doses delivered during the study period, the fiscal cost per dose delivered was BWP 215 (US$19.12) and the economic cost per dose delivered was BWP 374 (US$33.18).

The majority of costs were incurred at national level (57-74%, depending on whether considering fiscal or economic costs). However, many items purchased at national level (such as cold chain and PPE) were sent directly to the DHMTs. National level costs also included nearly all social mobilization-related costs, though social mobilization programs were largely implemented by partner NGOs in the DHMTs. National level costs also included some vaccine transport costs within the DHMTs, which were incurred by Botswana Defence Force and other government agencies for air transport support. Therefore, the findings around distribution of costs between national level and the DHMTs should be interpreted with caution.

Fiscal and economic costs per dose delivered at sub-national level varied significantly by DHMTs, with fiscal costs ranging from BWP 14 to BWP 152 per dose (US$1.26 to US$13.52) and economic costs BWP 22 to BWP 364 (US$1.98 to US$32.33).

Vaccine procurement costs during the study period amounted to BWP 980 million (US$87 million) for nearly 6.5 million vaccine doses procured, at an average price per dose of BWP 152 (US$13.46). Total economic costs including vaccine procurement costs for the 2.6 million doses delivered during the study period were BWP 1.2 billion (US$110 million), equivalent to BWP 526 (US$46.73) per dose delivered.

## Discussion and policy implications

This retrospective study is one of the first in the world to estimate the costs of COVID-19 vaccine delivery. Results suggest that rolling out a new vaccine to an entire population in the middle of a global pandemic is much costlier than previous vaccination efforts in Botswana or elsewhere, and costlier than modelled estimates predicted.

The study team recommends that the MoH consider a number of measures to improve the efficiency and equity of responses to public health emergencies, such as the COVID-19 pandemic. These include developing a standardized approach to responding to public health emergencies, resource allocation formulas and a partnership strategy. The MoH can consider decentralising some roles and responsibilities to DHMTs to allow for better responses in future public health emergencies, and incorporating the COVID-19 response plan into the routine health system to allow for a more agile response, should future rounds of vaccination be required. Government and non-governmental partners alike should also develop more robust data and financial capturing systems to improve transparency and make studies like this easier to conduct in the future. The MoH should consider whether any additional research is needed on the cost of routine and/or campaign vaccine delivery in Botswana. This would provide a counter-factual against which the study results can be compared. A cost-effectiveness study could also be considered to estimate the cost per death averted as a result of COVID-19 vaccination. Finally, the GoB should consider mechanisms to locally produce and/or access key commodities that may be needed in responses to future public health emergencies.

# 1 Background

The development, distribution and delivery of COVID-19 vaccines is the largest global immunization action in history. Following the outbreak of the global coronavirus pandemic in February 2020, COVID-19 vaccine delivery started in several high-income countries in December 2020 and subsequently in low- and middle-income countries (LMICs) in early 2021. Vaccination was the most important tool used to control the coronavirus pandemic and curb its impact on morbidity and mortality, and there was high global competition for limited vaccine supplies, which put considerable pressure on global supply chains (Pilkington et al, 2022). There are considerable costs incurred with COVID-19 vaccine roll-out, beyond vaccine procurement. These costs are known as delivery costs, also referred to as operational costs (Box 2). Delivery cost estimates are essential for optimal planning and budgeting; however, at the time countries were preparing to roll-out COVID-19 vaccines, actual delivery costs were unknown. A global-level model using data from the literature on childhood and adult flu vaccine delivery estimated fiscal COVID-19 vaccine delivery costs to be between US$0.84 and US$2.64 per dose delivered (COVAX Readiness and Delivery (CRD) Working Group on Delivery Costing, January 2022). The most sensitive parameter in the global model was human resource costs since it was not known to what extent countries would recruit surge staff for vaccine administration.

Botswana, an upper middle-income country of 2.3 million people in Southern Africa, recorded its first COVID-19 case on March 30, 2020. By end of March 2022, a total of 263,950 COVID-19 cases and 2,619 COVID-19-related deaths had been registered, equivalent to 109 deaths per 100,000 population (Our World In Data, 2022). Botswana started its vaccination program on March 26, 2021. By end of March 2022, 2.6 million vaccination doses had been delivered. The country's COVID-19 vaccination program is described in more detail in section 4. As part of its NDVP, Botswana estimated resource needs for COVID-19 vaccination in 2022 to be approximately US$14.2 million, including vaccine procurement (Ministry of Health, November 2021). For future planning for booster doses and cost-effectiveness evaluations of future vaccination strategies, it is important to determine how these estimates compared with actual expenditures.

BOX 2 **Definition of COVID-19 vaccine delivery costs**

**Delivery costs are the costs associated with delivering vaccines to target populations, exclusive of vaccine costs. They are also often referred to as operational costs. For COVID-19 vaccines, key delivery costs are, for example, those for training, human resources, per diems and allowances, syringes, waste management of used syringes, transport, cold chain, and data reporting systems.**

Source: ThinkWell general study protocol for COVID-19 vaccine delivery costing. 8 November 2021. Adapted from Vaughan K, Ozaltin A, Mallow M, Moi F, Wilkason C, Stone J, et al. The costs of delivering vaccines in low- and middle-income countries: findings from a systematic review. Vaccine X. 2019;2:100034.

In March 2022, UNICEF and the Ministry of Health (MoH) launched a costing study to gather primary cost data on COVID-19 vaccine delivery. This report describes the study methods, findings and policy implications. The findings of the present study will be an important contribution to the Botswana Reset Agenda and Vision 2036. The priorities of the Reset Agenda are to "focus on people, making people central as primary beneficiaries of the outcomes produced by the implementation of the priorities. Priority number one is to save Botswana's population from COVID-19, through the implementation of life saving programs that include a successful and timely vaccination program. We save lives first, then improve livelihoods" (Your Botswana, 2022).

# 2 Study aim and objectives

The aim of the study was to evaluate the costs of COVID-19 vaccine delivery from its start in March 2021 until the end of March 2022. This study period is aligned with the first 13 months of vaccine delivery and with the Botswana 2021/2022 financial year.

**Study objectives were:**

1. To estimate the total costs of COVID-19 vaccine delivery during the first 13 months of delivery
2. To estimate the total costs of COVID-19 vaccine procurement during the first 13 months of the programme
3. To estimate the costs per dose delivered

It was particularly important to understand the main cost drivers of human resources, cold chain, social mobilization, and vaccine delivery outside health facilities.

# 3 Methodology

## 3.1. Study setting

Botswana is an upper middle-income country located in Southern Africa with a gross domestic product (GDP) per capita of US$6,805 (2021), largely driven by the country's vast diamond reserves (World Bank, n.d.). Life expectancy at birth for the country's 2.3 million population is 66 years (2020), having recovered from a low of 51 years life expectancy in 2000 during the height of the HIV/AIDS epidemic. While the health system is well-developed, it was nonetheless ranked by WHO in 2018 as underperforming given the country's income status (World Health Organization, 2018). Infant and maternal mortality rates have nevertheless continued to improve, estimated as 36 deaths per 1,000 live births (2021) and 144 per 100,000 live births (2017), respectively (World Bank, n.d.). The country's vaccination program for childhood illnesses was established in 1979 and has since expanded beyond basic childhood vaccines to include Human Papilloma Virus, pneumococcal conjugate and rotavirus vaccines (World Health Organization Botswana).

## 3.2. Study design

This was a retrospective, mixed-methods study, which covered the period 1st March 2021 - 31st March 2022. Cost data were collected quantitatively at both national and DHMT levels. DHMT-level data were expected to cover all resources used at subnational level to deliver COVID-19 vaccines, hence data collection in districts and facilities was not necessary. In a small, complementary qualitative component, researchers interviewed DHMT-level stakeholders with knowledge of the COVID-19 vaccination program to better understand their planning, implementation processes and challenges faced.

The study took a payer perspective, meaning that costs incurred by all government sectors, parastatals, donors/partners and non-governmental organizations (NGOs) were included. Hence, all expenditures regardless of funder (government/parastatal/non-government) and mechanism (on-/off-budget) were included. Excluded were the cost of some donated items, such as broadcasting time, and some private sector donations, such as airtime. Costs incurred by people receiving the vaccine, such as transport costs to go to the vaccination site, were also excluded.

The study collected primarily fiscal costs (for definition see Box 3), meaning actual financial outlays incurred. However, the study also estimated the value of donated vaccines and existing health workers'

BOX 3 **Definition of fiscal and economic costs**

**Fiscal costs: Financial outlays, i.e., additional expenditures incurred due to COVID-19 vaccine delivery and not including the value of existing health system resources that were used. Health workers recruited as surge were included in fiscal costs.**

**Economic costs: Financial outlays plus opportunity costs. In the context of this study, opportunity costs only included select health worker time and donated vaccines.**

time when they worked as part of vaccine administration teams or supervision of these. These opportunity costs of staff time were important to assess because delivery of other essential health services may have suffered while existing health care staff focused on COVID-19 vaccine delivery. Other opportunity costs, such as the use of existing cold chain, buildings (including donated church halls and other community sites), electricity, water, etc. were excluded due to the difficulty in collecting these data and the limited use of such results for future planning and budgeting. Indirect costs incurred by NGOs were also excluded.

## 3.3. Approach to cost estimation

Table 1 summarizes the 19 resource types that were included in the study and the approach for data collection and estimation. These 19 resource types are standard activities and items needed for optimal vaccine delivery (COVAX Readiness and Delivery (CRD) Working Group on Delivery Costing, January 2022). Researchers utilized a mixture of ingredient-based and top-down costing, depending on the resource item. For some of the resource types, a mixture of the two approaches were used. With the ingredient approach, quantities and unit costs of the resources were identified and multiplied; for example, multiplying the number of syringes procured by the price per syringe. With top-down costing, the total amount paid for a particular resource was collected and not separated into specific quantities and unit costs. For both approaches, expenditure records (not budgets) were used to capture actual amounts paid during the study time period.

TABLE 1 **Method used for cost estimation according to resource type**

| No. | Resource type | Ingredient approach | Top-down estimation |
|---|---|---|---|
| 1 | Adverse event monitoring for immunization (AEFI) | | X |
| 2 | Cold chain | X | X |
| 3 | Communications* | | X |
| 4 | Human resources (HR) for vaccine delivery** | | X |
| 5 | Monitoring & evaluation | | X |
| 6 | Planning and coordination | | X |
| 7 | Personal protective equipment (PPE) and hand hygiene supplies | X | X |
| 8 | Refreshments | | X |
| 9 | Regulatory | X | |
| 10 | Social mobilization | | X |
| 11 | Supervision | X | |
| 12 | Syringes & safety boxes | X | |
| 13 | Training | | X |
| 14 | Transport | X | X |
| 15 | Ultra-cold chain equipment (UCC) | X | X |
| 16 | Vaccine procurement incl. freight and handling | X | |
| 17 | Vaccine transport*** | X | X |
| 18 | Waste management of used syringes | X | X |
| 19 | Other**** | | X |

* Includes airtime, internet, cabling and networking, etc.

** "Human resources for vaccine delivery" include vaccinators and other staff on-site at vaccination sites. Other human resources than for vaccine delivery were allocated to the domain they support, for example human resources for social mobilization were listed under "social mobilization." We attempted to include salaries plus benefits, but in some cases only base salary amounts were provided.

*** "Vaccine transport" includes only in-country transport.

**** "Other" includes screening shades for vaccination sites.

With regards to human resources, the costs of all new staff that were specifically recruited to work on COVID-19 vaccination-related activities were included, at vaccination sites as well as support staff, such as consultants engaged in social mobilization activities, monitoring and evaluation (M&E), and data entry clerks. The study also included the value of the time spent by existing staff, given that this time represents an important opportunity cost. However, because the exact amount of time and the respective staff salaries were difficult to collect, and because of the large number of staff from MoH, other government agencies, DHMTs, donors/partners and NGOs who supported COVID-19 vaccination activities to various degrees, the time of all existing staff were not valued. For health workers responsible for direct administration of COVID-19 vaccine, the opportunity costs of time was included because this is likely to be a substantial amount and it is an important indication of the extent to which these staff have not been able to work on other essential health services while the COVID-19 vaccination programme was implemented. The value of other existing staff time was not included. Table 2 summarizes the approach to valuing staff time according to resource type. Note that staff time is not relevant for the categories that largely entail procurement, such as cold chain and syringes.

In some cases, respondents provided health worker/staff salary scales rather than exact salary amounts. These government salary scale lists were then used to estimate employees' salaries.

TABLE 2 **Inclusion of valuation of human resource time according to resource type**

| No. | Resource type | Valuation of new staff | Valuation of existing staff time |
|---|---|---|---|
| 1 | AEFI | Yes | No |
| 2 | Cold chain equipment | -- | -- |
| 3 | Communications | -- | -- |
| 4 | Human resources for vaccine delivery | Yes | Yes |
| 5 | Monitoring and evaluation | Yes | No |
| 6 | Planning and coordination | Yes | No |
| 7 | PPE and hand hygiene supplies | -- | -- |
| 8 | Refreshments | -- | -- |
| 9 | Regulatory | Yes | No |
| 10 | Social mobilization | Yes | No |
| 11 | Supervision | Yes | Yes |
| 12 | Syringes & safety boxes | -- | -- |
| 13 | Training | Yes | No |
| 14 | Transportation for outreach services | -- | -- |
| 15 | UCC | -- | -- |
| 16 | Vaccine procurement incl. freight and handling | -- | -- |
| 17 | Vaccine transport | Yes | No |
| 18 | Waste management of used syringes | Yes | No |
| 19 | Other | -- | -- |

-- = Not applicable.

Although the focus of the research was on delivery costs, we also collected information on vaccine procurement, with a view to providing a comprehensive overview of immunization program costs. Vaccine purchase prices and quantities were provided by the MoH. For valuing donated vaccines, we assumed the same purchase price where it was available from the MoH.

In cases where resources used for COVID-19 vaccination were also used for other, non-vaccination-related purposes, respondents were asked to estimate what percentage of the use was specific to COVID-19 vaccination, and costs were allocated accordingly. This was the case, for example, for fuel usage, since in most cases district vehicles were used for a variety of purposes.

## 3.4. Data sources

### 3.4.1. Quantitative data

An initial list of national level informants that held data on resource quantities, unit costs and funding allocations related to COVID-19 vaccination was developed by the study team following exploratory interviews conducted during March and April 2022. The informant list was expanded during data collection as new informants were identified. Respondents were only asked about resource items that were relevant to their work. For example, respondents involved in vaccine transport were not asked about procurement of PPE or reporting of AEFIs. National level respondents per resource type are listed in Table 3.

TABLE 3 **Respondents per resource type, national level data**

| Resource item / organization | BDF | BoMRA | Botswana Post | Botswana Red Cross | CMS | Debswana | FHI 360 (USAID-funded) | Global Communities (USAID-funded) | MoH (national level) | Office of President | Police | PSM (USAID-funded) | UNICEF | WHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AEFI | | X | | | | | | | | | | X | | X |
| Cold chain | | | | | | | | X | X | | | X | X | |
| Communications* | X | | | | | | | | X | | | | | |
| Delivery HR** | X | | | | | X | X | X | X | | X | | | |
| M&E | | | | | | | | X | X | | | X | | X |
| Other transport | | | | | | | X | | | | | | | |
| Planning and coordination | | | | | | | | X | | X | | | X | X |
| PPE and hand hygiene supplies | | | | | X | X | X | X | | | | X | | |
| Regulatory | | X | | | | | | | | | | | | |
| Social mobilization | | | | X | | | X | X | X | | | | X | |
| Supervision | | | | | | | | X | X | | | | | X |
| Syringes and safety boxes | | | | | X | | | | | | | | | |
| Training | | | | | | | X | X | | | | X | | X |
| UCC | | | | | | | | | | | | | X | |
| Vaccine transport*** | X | | X | | | | | | | | X | | | X |
| Waste management | | | | | X | | | | | | | | | |
| Other**** | | | | | | X | | | | | | | | |

Note: this table reflects the respondents who ultimately provided expenditure data for this research, but not the organizations which may have ultimately supported specific activities. This is because some funding for COVID-19 vaccination may have passed through multiple organizations; for example, Ministry of Finance (MoF) may have provided funding to MoH who then sub-contracted Botswana Red Cross, or CDC funded USAID who then funded their implementing partners. In an effort not to double count financial contributions, not all organizations that provided funding may be reflected in this table.

* Includes airtime, internet, cabling and networking, etc.

** "Human resources for vaccine delivery" include vaccinators and other staff on-site at vaccination sites. Other human resources than for vaccine delivery were allocated to the domain they support, for example human resources for social mobilization were listed under "social mobilization." We attempted to include salaries plus benefits, but in some cases only base salary amounts were provided.

*** "Vaccine transport" includes only in-country transport.

**** "Other" includes screening shades for vaccination sites.

Since it was initially less clear to the research team what types of costs were incurred at DHMT level, DHMTs were asked about all resource items.

Data sources included COVID-19 vaccine project reports, financial records, expenditure reports, staffing lists, salary ledgers, vehicle logbooks and government purchase orders (GPOs[1]).

1. GPO is a sort of contract with a selected vendor that guarantees payment. A GPO follows an open tender process or request for quotations and commits government to purchasing a given number of goods or services at a given cost.

The study collected data on the number of doses delivered from each sampled DHMT and cross checked with DHIS2 data, which provided totals by DHMT. The study used number of doses delivered to extrapolate costs from sampled DHMTs to non-sampled DHMTs and estimated cost per dose delivered for national-level expenditures.

The study also collected globally available data, such as from the UNICEF Supply Division procurement records, and UNICEF financial tracking data on COVID-19 vaccine delivery.

### 3.4.2. Sampling method

At national level, there was no sampling required, as data was collected from all governmental/ parastatal/non-governmental funders identified. Since funds for COVID-19 vaccine procurement and delivery were released from the central level, it was possible to gather a large amount of data about the resources used, unit costs and financial data in Gaborone.

However, because vaccination was organized by DHMTs who undertook some local procurement to support their vaccination activities, it was also important to capture costs and experiences at sub-national level. Initially it was planned to collect data from all 18 DHMTs using telephone interviews and electronic data submission, since costs were expected to vary by DHMT due to varying population densities, geographic terrain, delivery modalities employed, staff availability and other factors. Following the pilot this proved not to be feasible. It was then decided to purposively sample six of the 18 DHMTs, taking into account the following criteria:

1. Geography
2. Vaccination coverage as of 30th March 2022 (end of study time period)
3. DHMT characteristics
4. Physical accessibility

From the sampling frame of 18 DHMTs, DHMTs were first classified in terms of geography: City (Greater Gaborone, Greater Francistown), town (Greater Lobatse, Greater Selebi Phikwe, Southern) or rural (remaining 13 DHMTs), using the Statistics Botswana classification (see map). Vaccine coverage rates were then classified as high (87%-97%), medium (75-87%) or low (63%-74%), using data provided by the Ministry of Health (Ministry of Health). Thirdly, unique characteristics of each area were identified, such as presence of special population groups, proximity to mining areas, vastness, etc. The location of each DHMT was also taken into consideration and its potential physical accessibility for the data collectors. These characteristics are shown for each DHMT in Table 4. The final sample included a mix of cities (2/2), towns (1/3) and rural areas (3/13): The six DHMTs sampled were:

- Boteti (rural)
- Chobe (rural)
- Greater Francistown (city)
- Greater Gaborone (city)
- Kgalagadi North (rural)
- Southern (town)

**District map**


Source: Department of Surveys and Mapping, 2022.

Note: DHMTs don't always align with districts. Ghanzi DHMT includes the districts of Charleshill and Ghanzi. Greater Gaborone DHMT includes the districts of Gaborone and South East. Greater Lobatse DHMT includes the districts of GoodHope and Lobatse. Greater Selebi Phikwe DHMT includes the districts of Phikwe and Bobirwa. Kgalagadi North DHMT is noted on the map by its district capital, Hukuntsi. Ngamiland DHMT is also known as North West. Kgalagadi South DHMT is known by its district capital of Tsabong. Kweneng DHMT includes the districts of Kweneng (Letlhakeng) and Kweneng West. Southern DHMT includes the districts of Jwaneng, Kanye, Mabutsane and Moshupa. The remaining DHMTs (Boteti, Chobe, Greater Francistown, Khatleng, Mahalapye, North East, Okavango, Tutume) are comprised of a single district of the same name.

TABLE 4 **DHMT characteristics and sample selection**

| | DHMT | Target population | Vaccination coverage as of 30th March 2022 | Coverage classification | Geographical classification | Characteristics | Physical accessibility issues? | Included in sample? |
|---|---|---|---|---|---|---|---|---|
| 1 | **Boteti** | 58,086 | 89% | High | Rural | Near Orapa, dynamic, mining, nomads | Yes, during rainy season in areas where there are no tarred roads | Yes |
| 2 | **Chobe** | 18,446 | 97% | High | Rural | Near Kasane (Delta) | Would need to fly to hard to reach areas | Yes |
| 3 | **Ghanzi** | 33,203 | 87% | High | Rural | Bushmen tribe, poor, lower education levels, nomads | During the rainy season in areas where there are no tarred roads | No |
| 4 | **Greater Francistown** | 170,494 | 69% | Low | City | | | Yes |
| 5 | **Greater Gaborone** | 296,804 | 96% | High | City | | | Yes |
| 6 | **Greater Lobatse** | 76,091 | 76% | Medium | Town | Management complex, confusing reporting (hospital vs DHMT) | | No |
| 7 | **Greater Selebi Phikwe** | 109,152 | 66% | Low | Town | | | No |
| 8 | **Kgalagadi North** | 22,825 | 63% | Low | Rural | Bushmen tribe, nomadic, low socio-economic status | During the rainy season in areas where there are no tarred roads | Yes |
| 9 | **Kgalagadi South** | 25,599 | 81% | Medium | Rural | Bushmen tribe, nomadic, low socio-economic status | During the rainy season in areas where there are no tarred roads | No |
| 10 | **Kgatleng** | 81,204 | 75% | Medium | Rural | Near Gaborone | | No |
| 11 | **Kweneng** | 169,813 | 69% | Low | Rural | Vast, starts 40 km west of Gaborone | | No |
| 12 | **Mahalapye** | 105,682 | 69% | Low | Rural | In center of country, sandwiched between two urban areas | | No |
| 13 | **Ngamiland** | 73,622 | 77% | Medium | Rural | NW, broad | Would need to fly to some hard-to-reach areas | No |
| 14 | **North East** | 35,030 | 81% | Medium | Rural | Close to Francistown | | No |
| 15 | **Okavango** | 49,120 | 81% | Medium | Rural | Vast, river, previously used boats, | Transport very challenging; would need to fly to some areas | No |
| 16 | **Serowe/ Palapye** | 156,172 | 77% | Medium | Rural | In center of country, vast, along major highway, has big hospital, Palapye more of a town | | No |
| 17 | **Southern** | 139,900 | 73% | Low | Town | | | Yes |
| 18 | **Tutume** | 73,093 | 80% | Medium | Rural | Near Francistown | | No |

## 3.5. Data collection

For national-level respondents, MoH researchers sent each identified respondent a formal invitation letter (known locally as a savinggram) to explain the study and request their participation. The study team then followed up with each respondent to schedule an interview. During the interview, respondents were asked to clarify the roles they played with regards to COVID-19 vaccine delivery and requested to provide any relevant expenditure data. Respondents were asked to isolate the vaccination-related share of any expenditures that also supported non-vaccination activities, such as PPE procured as part of the general COVID-19 pandemic response and used in isolation wards for infected patients. In many cases, respondents could not provide the requested data during the interview itself, and the research team spent considerable time following up with respondents to obtain the requested data. Resource quantities, unit prices and expenditure data were collected from BoMRA, Botswana Post, BDF, Botswana Police, Central Medical Stores, Ministry of Defence, Ministry of Finance, Ministry of Health (Procurement, HR & Admin, Corporate Services, Health Services, Health Education, HSMEQA, HPRD, Logistics Team), NEOC, Presidential COVID-19 Task Force and Office of the President, as well as donors/partners, NGOs and others (Botswana Red Cross Society, DEBSWANA, FHI 360, Global Communities, Global Health Supply Chain Program-Procurement and Supply Management (GHSC-PSM), USAID, UNICEF and WHO (see Annex 1 for a full list of respondents). Data from the MoH about waste management costs, the purchase of tents, vehicles and other capital items, as well as social mobilization expenditures from WHO were not received by the study team and therefore are not reflected in findings.

Collected data were entered into a Microsoft Excel-based data collection and analysis tool developed by the study team based on exploratory interviews conducted in March and April 2022. Collected data were coded and a database of cost data created. Due to lack of detail provided by respondents, expenditures incurred at national level were not allocated to the DHMT(s) that these expenditures supported, or where the procured items were used.

At DHMT level, MoH researchers sent each sampled DHMT written correspondence to communicate about the study, planned dates for data collection, the respondents to be interviewed and the types of data that would be collected. The sampled DHMTs were visited in person by a team of two researchers to collect data. Each visit lasted a maximum of two days. Similar to national level, respondents were asked to isolate the vaccination-related share of any expenditures which supported non-vaccination activities. This was particularly relevant at DHMT level for vehicle usage. The study team again followed up by phone and/or email on any data not available during the visit. At DHMT level, data were gathered from DHMT Coordinators, EPI Coordinators (COVID-19 vaccine team leaders), Head of Corporate, Chief Pharmacist, Procurement Head/Officers, Head Accounts, Community Health Nurses, Chief Medical Officers, M&E Officers, Public Health Specialists, Pharmacists, Family Physicians, HR Officers and Admin Officers (see Annex 1 for a full list of respondents).

Since no exploratory interviews were conducted at DHMT level, data collection instruments were first pilot tested in Southern DHMT. The instruments were significantly revised before being used in the six sampled DHMTs (see Annex 3). A separate Microsoft Excel-based workbook was used to collect, code by resource item and analyse data from each DHMT.

## 3.6. Data cleaning and analysis

### 3.6.1. Quantitative data

Researchers used Microsoft Excel to check the data for outliers using analytic techniques, such as summary pivot tables. To identify possible data entry errors, any findings that appeared on visual inspection to be problematic were investigated, and results discussed by the research team. These discussions also helped to identify possibly missing or incomplete data. In cases of missing or incomplete data, researchers first contacted respondents to obtain clarifications, and where necessary, imputed missing values or made assumptions. This was primarily with regards to kilometer usage of DHMT-level vehicles and/or fuel expenditures. At the time of publication of this report (February 2023), no missing data from MoH (waste management, capital items), WHO (social mobilization) and Southern DHMT (transport costs, some HR, waste management) has been imputed, in hopes that these data would still be provided.

Researchers triangulated findings where possible using data from multiple respondents. Researchers also reviewed data to ensure no double counting of expenditures, for example funds provided by donors/partners to government and also reported by government, and items used at DHMT-level, but procured centrally. Researchers also made some assumptions about the share of expenditures related to COVID-19 vaccination and for allocation of expenditures across activities.

At national level, total costs were divided by total doses delivered to generate an average cost per dose delivered. Following global trends, the study did not estimate a cost per person fully vaccinated given the changing definition of "fully vaccinated" to reflect booster doses and the complications related to the use of both 1- and 2-dose vaccination schedules (Wang H, 2023).

Researchers compiled results from the sampled DHMTs into a single database to allow for further analysis, including extrapolation to non-sampled DHMTs. DHMT-level findings were extrapolated to the non-sampled DHMTs on a per-dose basis, based on the DHMT characteristics. Hence, researchers multiplied the cost per dose from Southern DHMT by the number of doses delivered in each of the other two towns to estimate the total costs in these non-sampled towns. Similarly, findings from the three sampled rural DHMTs were pooled and a weighted average cost per dose calculated. Researchers multiplied the weighted average cost per dose by the number of doses delivered in each of the ten non-sampled rural DHMTs to estimate the total costs in those non-sampled rural DHMTs.

Total costs from all DHMTs and national level were summed together to arrive at the total cost of COVID-19 vaccine delivery in Botswana. Cost per dose estimates sum the DHMT-level cost per dose, which varies per DHMT, with the national-level cost per dose, which is the same for all DHMTs.

Total costs from all DHMTs and national level were summed together to arrive at the total cost of COVID-19 vaccine delivery in Botswana. Cost per dose estimates sum the DHMT-level cost per dose, which varies per DHMT, with the national level cost per dose, which is the same for all DHMTs.

Researchers estimated fiscal and economic costs separately, with and without the value of vaccine procurement. We present total and unit cost findings by resource item. All results are presented in 2022 US dollars (US$) using a conversion rate of 1 U.S. dollar (US$) = 11.262 Botswana pula (BWP), the average United Nations exchange rate over the study period (United Nations Treasury, n.d.).

Although delivery costs normally differ according to modality, such as outreach versus fixed site (Vaughan, et al., 2019), it was not possible to accurately estimate the resources (human, transport, etc.) used for each modality. Additionally, although the number of doses delivered per modality was available at DHMT level, there was some overlap in modalities, for example fixed points were conducting outreaches to farms and schools, but may have reported these doses as delivered at the fixed site as well. The study has therefore estimated a single cost per dose across all delivery modalities.

### 3.6.2. Qualitative analysis

Researchers summarized notes from the interviews with the key informants by resource item. These findings are included in the description of the COVID-19 vaccination program in section 4.

## 3.7. Data validation and dissemination

In March 2023, the draft study report was circulated to the MoH's Senior Management Team and a group of national level stakeholders. Validation workshops were held for both audiences, where researchers presented draft findings and received feedback on the results. See Annex 5 for a list of attendees. This feedback is reflected in this final version of the report.

## 3.8. Ethics and informed consent

The study was carried out according to the principles of Declaration of Helsinki (World Medical Association, 2013). Ethical Clearance was sought and obtained from the MoH through the Health Research and Development Office in May 2022. The research permit was amended in October 2022 to account for the change in sampling approach to the DHMTs and the revised DHMT data collection instruments.

All stakeholders interviewed were sent an informed consent form (see Annex 2) in advance of their interview. They signed the form after the interviewer explained the purpose of the study. At times the interviews were recorded to facilitate accurate note-taking.

## 3.9. Study team

The study team consisted of staff from MoH and UNICEF as well as a short-term consultant recruited by UNICEF Botswana. The roles and responsibilities of team members are outlined in Table 5.

TABLE 5 **Roles of study team members**

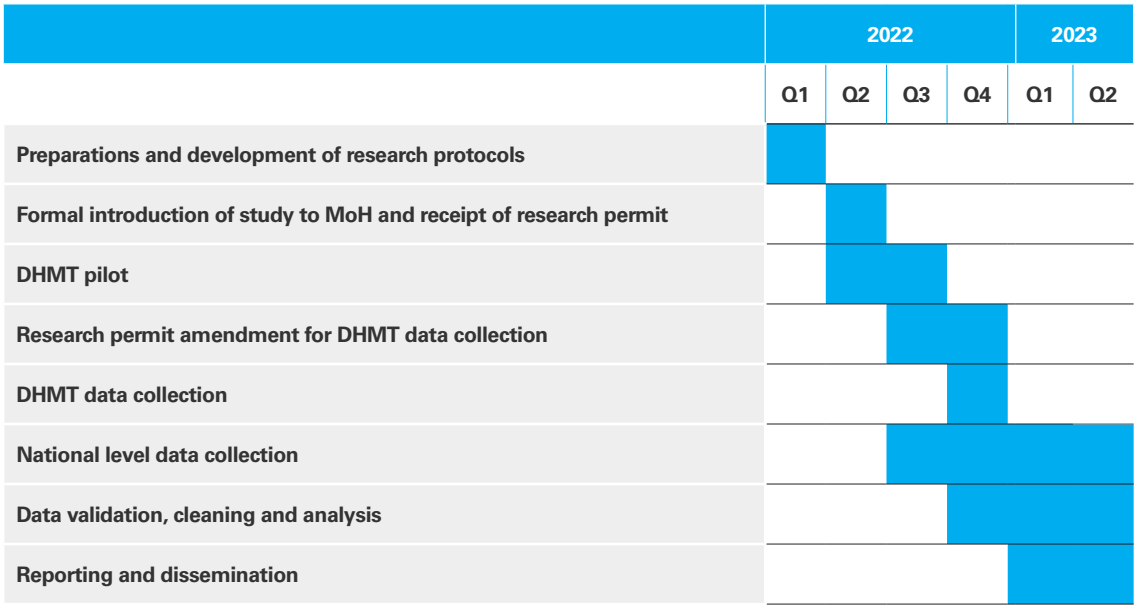
| Investigator name and affiliation | Role and responsibilities of investigator |
|---|---|
| **Moses Keetile, MoH** | Overall direction and co-ordination, quality assurance, dissemination |
| **Onalenna T Mokena, MoH** | Principal Investigator, data collection and analysis, report writing, dissemination |
| **Goabaone Rankgoane-Pono, UNICEF consultant** | Co-ordination of data collection, completion of DHMT fieldwork, data analysis, report writing, dissemination |
| **Ulla Kou Griffiths, UNICEF** | Study design, technical oversight on data collection and analysis, quality assurance on reporting, dissemination |
| **Kelsey Vaughan, UNICEF consultant** | Study design, technical oversight on data collection, data analysis, report writing, dissemination |
| **Mooketsi Moalosi, MoH** | Data collection and analysis |
| **Mosetsana Modise, MoH** | Data collection and analysis |
| **Abia Sebaka, MoH** | Co-ordination with key informants at central level, quality assurance |
| **Keemenao Ramogalana, MoH** | Co-ordination with key informants in DHTMs, formulate interview questions |
| **Marina Seobakeng, MoH** | Co-ordination with key informants in DHMTs, formulate interview questions |

Additionally, Alex Illmer, Makhosini Mamba, Joan Matji, Yvonne Morgan and Samuel Phiri from UNICEF Botswana provided logistical, administrative and analytical support to the study.

## 3.10. Timeframe

The study timeline is shown in Figure 1. Preparatory work began in March 2022. The study team submitted a permit for research approval in April 2022, and received approval in May 2022. The DHMT pilot was completed over the period June-August 2022. Based on findings of the pilot, DHMT sampling was revised and a research permit amendment applied for in September 2022. This concerned only the DHMT data collection and was approved in October 2022. DHMT data collection took place during October-November 2022. National level data collection started in August 2022 and was completed in January 2023. Data analysis was done over the period December 2022 to February 2023. Data validation workshops were held for March 2023.

FIGURE 1 **Study timeline**



# 4 Findings

The following sections summarize Botswana's COVID-19 vaccination program and are organized by resource item. There are also sections describing financing and how vaccines were delivered, and some identified successes and challenges. Unless noted, all findings come from the present study.

## 4.1. Planning and coordination

The National Deployment and Vaccination Plan (NDVP) for COVID-19 in Botswana guided vaccine roll-out. This extensive document was developed by the MoH with guidance from the Presidential COVID-19 Task Force (January-March 2021). It identified the target groups for vaccination, described how vaccination sites would be set up, specified cold chain requirements and human resource needs, outlined a demand creation strategy to increase vaccine uptake among the population, planned for vaccine safety surveillance and more. The November 2021 version also included a budget for 2022 (Ministry of Health, November 2021). The NDVP was later revised to include planning for vaccinating children aged 5-11 years and adolescents 12-17 years (Ministry of Health).

At national level, there were various coordinating bodies involved in the vaccine rollout. COVID-19 vaccination planning and coordination was initially done through the Presidential COVID-19 Task Force, a multidisciplinary team of nearly 59 members that was established by the President and housed under the Ministry for State President (MST, previously known as the Ministry for Presidential Affairs, Governance and Public Administration, MoPAGPA[2]) to coordinate the response amongst government ministries and other actors, including the private sector (Presidential COVID-19 Task Force, March 2021). It was comprised of representatives from the Government of Botswana (GoB), civil society, religious leaders, unions and others, and also included 16 paid technical subject matter experts. Under the state of emergency declared by the government, this team had the power to pool resources across government entities. The Presidential COVID-19 Task Force was organized into different committees; for example, there was a vaccine procurement committee as well as a financing committee. There was also a vaccination technical working group that worked closely with the Presidential COVID-19 Task Force to ensure evidence-based implementation of vaccination. The Presidential COVID-19 Task Force initially met daily, then less frequently as the pandemic progressed. Health-related functions were at some point transferred to the MoH, where the EPI manager was responsible for operational planning and coordination and linking with districts. There was also a MoH control command under the Director of Health Services (DHS) to facilitate flow of information to the districts.

Other coordinating bodies included the existing Inter-Agency Coordination Committee (ICC), which was expanded to serve as the coordinating committee for vaccine deployment (Ministry of Health, April 2021), and the National Emergency Operation Center (NEOC), which was housed under the Ministry of Defence (MoD, previously known as the Ministry of Defence, Justice and Security, MDJS[3]) and in charge of implementing directives from the Presidential COVID-19 Task Force.

2. For simplicity we use the current names of all ministries as of June 2023, but acknowledge in the text at first use the previously used names. Ministerial name changes occurred in May 2022.

3. For simplicity we use the current names of all ministries as of June 2023, but acknowledge in the text at first use the previously used names. Ministerial name changes occurred in May 2022.

Sub-nationally, coordination & planning was done through the District Emergency Operations Centers (DEOCs), led by the District Commissioner. These multisectoral structures provided support on operational and tactical issues. The DEOCs were responsible for the pooling, distribution and augmentation of resources. Each District Health Management Team (DHMT) developed costed microplans for vaccination activities in their district to be carried out by the DHMT and community-level entities. These plans were used to inform resource distribution at national level. At MoH headquarters, there were 16 liaison officers assigned to the 18 DHMTs to ensure effective communication between central and sub-national levels. This technical link between the national and sub-national level helped ensure that DHMTs had adequate supplies and other resources, and that DHMTs reported to central level in a timely manner. Because of its proximity to the MoH, Greater Gaborone DHMT reported more involvement from the MoH in their planning than other DHMTs likely received, for example in setting up vaccination sites and communicating this information to the public.

## 4.2. Budgeting and financing

GoB established a COVID-19 Relief Fund to financially support the country's response to the COVID-19 pandemic. All received donations were paid into this fund, and then either used to directly purchase medicines, vaccines and PPE or distributed to various government ministries and other stakeholders to fund their response efforts. Additionally, the MoH had a dedicated budget line from the Ministry of Finance (MoF, previously known as the Ministry of Finance and Economic Development, MFED[4]) for funding various COVID-19 interventions, known as the COVID vote. Each DHMT had its own COVID vote as well, which they used for local procurement of PPE, airtime, refreshments for vaccinators, organization of trainings and for other related activities.

The November 2021 revised NDVP included a budget for 2022 of BWP 163,261,541 (US$14,496,674), of which BWP 157,293,341 (US$13,966,732) was for vaccination[5] (Table 6). It is important to note that this budget excludes the vaccination delivery strategy budget, which the NDVP says is included in other sectors' budgets, but no details are provided. It is also unclear if this budget includes both national and DHMT-level costs.

TABLE 6 **NDVP vaccination budget for 2022 (November 2021)**

| | BWP | US$ |
|---|---|---|
| **AEFI** | 1,481,700 | 131,566 |
| **Human resources and training** | 3,302,750 | 293,265 |
| **Logistics, supplies, cold chain and waste management** | 126,423,591 | 11,225,678 |
| **Planning and coordination** | 755,400 | 67,075 |
| **Regulatory** | 150,000 | 13,319 |
| **M&E** | 4,602,400 | 408,666 |
| **Social mobilization** | 20,577,500 | 1,827,162 |
| **Total** | **157,293,341** | **13,966,732** |

Source: NDVP. November 2021 revision.

It is not possible to directly compare this estimate with study findings as it represents a different time period (1 January to 31 December 2022, versus the study time period of 1 March 2021 to 31 March 2022) and includes different resource items. It is also unclear how many vaccine doses were planned to be delivered with the specified budget.

4. For simplicity we use the current names of all ministries as of June 2023, but acknowledge in the text at first use the previously used names. Ministerial name changes occurred in May 2022.

5. The budget also included BWP 5,968,200 (US$529,941) for COVID-19 surveillance.

Because of the multisectoral nature of COVID-19 vaccination in Botswana, various government ministries, agencies outside the MoH and parastatal organizations contributed to the COVID-19 vaccination response. This included Botswana Defence Force (BDF), Botswana Medicines Regulatory Authority (BoMRA), Botswana Post, Central Medical Stores (CMS), MoH, MST and the police. Debswana, the diamond company, contributed both to the COVID-19 Relief Fund for vaccine purchases as well as provided direct financial support for screening shades, labour, PPE and other items.

## 4.3. Vaccine procurement

COVID-19 vaccine procurement was done centrally by both MoH and MST, with coordination and monitoring by the Presidential COVID-19 Task Force to ensure procurement guidelines were followed. Vaccine procurement was funded primarily by the COVID-19 Relief Fund, but also from the MoH's COVID vote. Vaccine donations were handled through the MoH Partnership office. The GoB purchased the majority of its vaccines directly from manufacturers, and received limited donations from Debswana, various bilateral partners and regional and global initiatives, including the African Vaccine Acquisition Trust (AVAT) and the COVID-19 Vaccines Global Access Facility (abbreviated as COVAX)[6]. The government also purchased a small percentage of its acquired vaccines from COVAX. UNICEF supported some vaccine acquisitions with freight and customs clearance.

At times vaccines arrived in-country with short shelf lives. It was beyond the scope of this study to examine wastage rates.

## 4.4. Vaccine storage, transport and security

At national level, vaccines were initially stored at the MoH, then later at CMS. The Presidential COVID-19 Task Force and later the logistics team from MoH was responsible for distributing vaccines to DHMTs based on availability and need. Each DHMT considered the size of their remaining target population given the vaccination phase that was unfolding at the moment as well as disease incidence, prevalence and epidemiology. They also took into account vaccine demand from the population.

Botswana Post was the main transport partner, picking up vaccines at the airport, storing them nationally and then distributing them to 113 district delivery points. This was an existing arrangement in place for transport of drugs and other medical supplies, which was expanded for COVID-19 vaccines. Botswana Post worked closely with NEOC and the DEOCs on transport planning. The MoD, including BDF, Police and Wildlife, provided additional air and road transport, particularly to hard-to-reach areas. Their role extended to also providing security of the vaccines during their transport and in some cases at sub-national vaccination storage and vaccination sites as well. In some DHMTs, such as Chobe and Ngami, private safari camps supported the DHMTs with small aircrafts to carry vaccines and vaccinators. The BDF and Police also offered security for the vaccines.

## 4.5. New purchase of regular cold chain equipment

A 2019 cold chain assessment was used to predict a lack of regular cold chain capacity to accommodate COVID-19 vaccines. The NDVP noted the need to plan alternative cold room capacity. Various possible storage sites were proposed, including Botswana Vaccine Institute (BVI), Botswana Meat Commission (BMC) and private sector partners. BVI and Sir Ketumile Masire Teaching Hospital (SKMTH) were ultimately used. Some new cold chain equipment was also purchased by GoB and UNICEF and

6. COVAX is the worldwide initiative aimed at equitable access to COVID-19 vaccines directed by the GAVI Vaccine Alliance, the Coalition for Epidemic Preparedness Innovations (CEPI), and the World Health Organization (WHO), with UNICEF as key delivery partner

distributed to DHMTs according to need.

## 4.6. New purchase of Ultra-Cold Chain (UCC) equipment

It was originally thought that there would be insufficient Ultra-Cold Chain (UCC) capacity, and as a result, the government did not include Pfizer in its initial procurement plan. However, the GoB and UNICEF ultimately supported the purchase of UCC equipment. The MoH also borrowed existing UCC capacity from laboratories and other ministries, such as the Ministry of Agriculture. Some of this equipment was relocated to CMS.

## 4.7. Syringes & safety boxes (vaccine accessories)

CMS was responsible for procuring vaccine accessories. These were stored centrally at CMS and distributed to district pharmacies according to rationing decisions taken at the MoH HQ. Where there were shortages, particularly early in the pandemic, districts often used existing stocks of syringes and safety boxes, which were intended for routine childhood vaccination.

UNICEF provided some syringes and diluents. Donors like the Government of Japan contributed funding for vaccine accessories.

## 4.8. Vaccine delivery and delivery modalities

With a population of 2.3 million persons, Botswana initially targeted 1,694,336 persons for COVID-19 vaccination and planned to roll out vaccines by age groups across four phases, as per the NDVP:

1. **Phase I:** Above 55-year-olds and health care workers (264,383 target population)
2. **Phase II:** 30–54-year-olds (765,764 target population)
3. **Phase III:** 18–30-year-olds (501,351 target population)
4. **Phase IV:** 12–17-year-olds and boosters for people above age 17 (161,838 target population)

The target population was later increased to 2,181,623 persons, reflecting increased vaccine availability and the expansion of vaccination to children aged 5-11 (Ministry of Health).

Vaccination started on 26 March 2021 in seven DHMTs with high mortality from COVID-19 and initially targeted adults 55 years old and above. The remaining 11 DHMTs started vaccination on 9 April 2021, initially targeting adults aged 75 years and above due to vaccine supply constraints. Health workers in clinical and high-care areas for COVID-19 and isolation centres were vaccinated regardless of their age.

Four delivery modalities were used in Botswana for COVID-19 vaccine delivery:

1. Fixed points
2. Outreach services
3. Drive-throughs (Greater Francistown and Greater Gaborone only)
4. Schools

Fixed points included a variety of types of sites, including private health facilities which were used in both Greater Francistown and Greater Gaborone. Private health facilities often used vaccines supplied by the government, but privately-employed human resources and other inputs (such as cold chain equipment) to deliver vaccinations. Researchers have attempted to exclude the number of doses delivered by private clinics (n=8,381) since the delivery costs to support these doses were outside the scope of this study. Some DHMTs also opened sites at ports of entry (such as border crossings). Areas with large amounts of tourism (such as Chobe) also worked with local tourism operators to provide

vaccination services.

Sites were not static, but changed over time depending on the number of doses available and the target groups at the time. At times, new or additional vaccination sites were opened for accessibility purposes, for example when a large number of doses with pending expiry arrived in the DHMT and needed to be quickly used.

As of end March 2022, a total of 2,607,002 doses including first doses, second doses, single doses of Johnson & Johnson and booster doses had been delivered (Table 7).

Figure 2 shows the cumulative doses delivered during the study period.

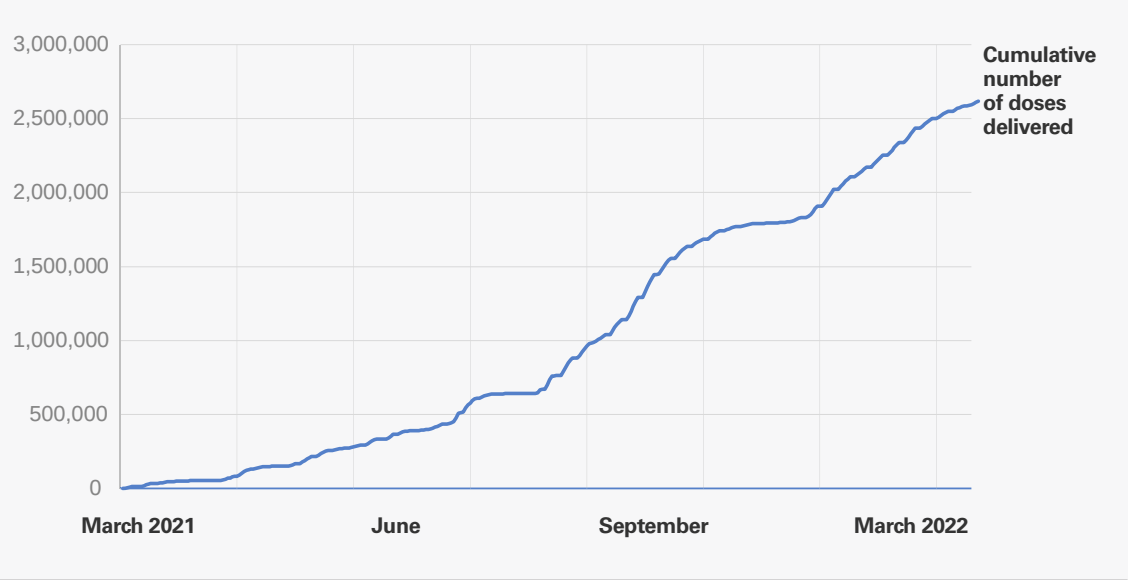
TABLE 7 **Doses delivered by DHMT, 1st March 2021 - 31st March 2022**

| DHMT | 1st Dose | 2nd Dose | Johnson & Johnson (single dose) | 1st Booster | 2nd Booster | Total no. doses delivered |
|---|---|---|---|---|---|---|
| **Boteti** | 34,384 | 29,333 | 22,273 | 9,319 | 0 | 95,309 |
| **Chobe** | 13,101 | 10,048 | 7,942 | 7,753 | 0 | 38,844 |
| **Ghanzi** | 19,608 | 15,821 | 13,094 | 7,351 | 0 | 55,874 |
| **Greater Francistown*** | 89,422 | 79,782 | 38,551 | 18,697 | 0 | 218,796 |
| **Greater Gaborone*** | 193,310 | 173,029 | 111,380 | 60,819 | 0 | 537,813 |
| **Greater Lobatse** | 44,017 | 35,366 | 22,970 | 13,950 | 0 | 116,303 |
| **Greater Selebi Phikwe** | 58,632 | 50,559 | 21,284 | 16,471 | 0 | 146,946 |
| **Kgalagadi North** | 10,311 | 8,346 | 5,925 | 4,583 | 0 | 29,165 |
| **Kgalagadi South** | 15,303 | 13,123 | 8,324 | 6,823 | 1 | 43,574 |
| **Kgatleng** | 43,849 | 41,915 | 18,870 | 11,743 | 0 | 116,377 |
| **Kweneng** | 104,186 | 77,693 | 39,999 | 23,642 | 0 | 245,520 |
| **Mahalapye** | 51,094 | 45,754 | 26,774 | 15,797 | 0 | 139,419 |
| **Ngamiland** | 42,080 | 30,803 | 25,640 | 8,739 | 0 | 107,262 |
| **North East** | 26,255 | 23,296 | 4,979 | 13,377 | 0 | 67,907 |
| **Okavango** | 28,372 | 24,375 | 15,433 | 11,920 | 0 | 80,100 |
| **Serowe/Palapye** | 91,224 | 75,286 | 45,167 | 23,252 | 0 | 234,929 |
| **Southern** | 78,741 | 68,167 | 34,670 | 23,214 | 0 | 204,792 |
| **Tutume** | 52,140 | 45,174 | 13,641 | 17,117 | 0 | 128,072 |
| **TOTAL** | **996,029** | **847,870** | **476,916** | **294,567** | **1** | **2,607,002** |

Source: Ministry of Health, February 2023.

*Doses delivered in private facilities with private HR have been removed (n=8,381).

FIGURE 2 **Cumulative number of doses delivered, 26th March 2021 - 31st March 2022**




Source: MoH, March 2023.

## 4.9. Human resources for vaccine delivery

Vaccines were delivered through vaccination site teams comprised of team leaders, registration clerks, vaccinators and health care auxiliaries who supported on directing patient flow, taking patient vitals and other tasks. The DHMT Coordinator was the overall overseer of the vaccine delivery activities in the DHMT, supported by the district-level EPI Coordinators, who in most cases was the Community Health Nurse (CHN).

A large number of both existing staff and newly hired staff were used on-site at vaccination sites. Both the MoH and most DHMTs hired new staff, many on a temporary basis. Other government agencies (such as BDF and police) and non-governmental partners (such as USAID grantees) also provided staff to support vaccination efforts.

## 4.10. Supervision

Sixteen MoH liaison officers provided supervision and support to the 18 DHMTs. There were weekly meetings at national level to monitor progress and address gaps.

At DHMT level, DHMT coordinators were overall supervisors, while district EPI Coordinators were responsible for supervising sites and ensuring that processes ran smoothly on the ground. Most DHMTs initially held weekly meetings, then moved to daily meetings to address implementation problems.

## 4.11. Training

A training of trainers approach was used to train vaccinators on all COVID-19 vaccines to be rolled out: there was an initial, national level training done for all DHMTs, and later DHMTs conducted their own trainings using funding from their local COVID vote. The mode of training depended on funding availability. Most districts booked a paid venue and offered imprest (reimbursement for expenses upon receipts), accommodation costs, and refreshments. Some DHMTs, such as Boteti, conducted in-service training and did not incur any direct costs. Some trainings were done online through the WHO's Resource Centers to ensure high training coverage at low cost.

## 4.12. Hand hygiene supplies and PPE

The GoB provided a PPE use standard for COVID-19 including vaccination. Hand hygiene supplies and PPE were largely procured by GoB through local procurement tendering processes. Some DHMTs also procured directly. Donated hand hygiene supplies and PPE were received from Debswana, bilateral partners and several UN agencies.

## 4.13. Refreshments

Initially, many DHMTs purchased refreshments for vaccination teams. Several months into the vaccination program, however, as the COVID-19 Relief Fund started to get depleted, the MoH management communicated that they should no longer buy refreshments for vaccinators.

## 4.14. Communications

To help coordinate vaccination activities, vaccination teams and supervisors received airtime procured by the GoB as well as some donated by network provider companies. At DHMT level, airtime support was particularly noted early in the study period, suggesting that funding may have run out later.

## 4.15. Transport

In addition to vaccine transport, transport was needed to move staff to vaccination sites, support supervision activities and coordination. Because most vehicles were shared with non-COVID-19 vaccination activities, for example at DHMT level where vehicles supported many health activities, the study team has attempted to allocate a reasonable percentage of use and its associated cost to COVID-19 vaccination. However, newly purchased vehicles are excluded, as well as lubricants at national and DHMT levels.

## 4.16. Social mobilization

Social mobilization activities were coordinated by the MoH's Health Education and Promotion division using existing staff. With support from UNICEF and other partners, the MoH led the development of a national social mobilisation campaign known as ArmReady. This included a communication strategy and implementation plan for vaccine acceptance and uptake, which featured continuous social listening, media monitoring and rumour tracking. Messages were subsequently adjusted to reflect public perceptions and to combat misinformation. The campaign used donated broadcasting services from BTV and other radio stations to share messages, and also used celebrities and other prominent leaders to serve as vaccination champions and influencers. The value of donated broadcasting services were excluded from the analysis.

ArmReady was also rolled out at district level through a series of demand creation and uptake activities, often supported by partners, such as Botswana Red Cross, FHI360 and others who employed community mobilizers.

## 4.17. M&E data and vaccination certificates

The country's existing health management information system (HMIS), DHIS2, was adapted in March 2021 to be able to record data on COVID-19 doses delivered, though initially data entry of doses delivered was done manually using COVID-19 registers, tally sheets, summary forms and vaccination cards, and later transferred to DHIS2. District staff were trained in the data collection tools. Data entry was done using a mix of existing and new equipment, such as laptops and tablets; some routers and modems were also purchased, along with data bundles for sim cards.

DHIS2 offered the distinct advantage of being able to provide real-time data on the number of persons vaccinated. However, during the transition from paper records to DHIS2 and even many months after DHIS2 was operational, many districts faced a data entry backlog due to inadequate human resources. This meant that some districts continued to maintain paper records and only much later were able to catch-up on electronic data entry and upload their data to DHIS2 with the help of the data entry staff. Data entry clerks were a mix of existing staff as well as at least 146 newly hired data clerks and system support officers who supervised data entry clerks at district level. MoH HQ also hired three desk officers for DHIS2 registration and two analysts to consolidate district reports into a national report.

There was an online registration system for persons to enter their personal details prior to vaccination; anyone not pre-registering was assisted on-site by data entry clerks. The pre-vaccination online registration was used to track the vaccination demand by the community, which was used to estimate the vaccine supply request at national level. The online system also offered appointment reminders via SMS. However, the online system was reportedly plagued by internet challenges (Ministry of Health, April 2021).

Initially, all vaccinated persons received a paper vaccination card; later digital vaccine certificates were developed by MoH HSMEQ officers using DHIS2, which was adapted to allow for this functionality. Initially, data entry and producing the certificates was only done at HQ, but later it was rolled out to the districts.

## 4.18. Management of vaccination waste

The MoH initially had an ongoing contract for waste management, which was also servicing the DHMTs. As part of this contract, the contracted party also collected COVID-19 vaccination-related waste. When the contract ended, DHMTs had to engage local service providers to manage clinical waste, including non-vaccination activity waste.

## 4.19. Adverse Event Following Immunizations (AEFI)

BoMRA, coordinated by the Pharmacovigilance and Clinical Trials (PVCT) department, was responsible for arranging for refresher training for the country's existing AEFI committee as well as training district vaccinators on vaccine safety monitoring. WHO provided some financial support for AEFI-related trainings.

Monitoring of AEFIs was primarily passive, as clients were to report on the BoMRA mobile application and then were seen at a local health facility if necessary. The cost of managing AEFIs was not captured by the study.

## 4.20. Successes and challenges

An Inter Action Review (IAR) was conducted in April 2021 by MoH, BoMRA, UNICEF and WHO to provide an opportunity to share experiences and collectively analyse the ongoing in-country COVID-19 vaccination rollout (Ministry of Health, April 2021). The review focused on the NDVP pillars and assessed best practices and challenges during the COVID-19 vaccine deployment and vaccination.

Regarding planning and financing, firstly, the review praised BoMRA for having an existing policy for assessment of products availed during public emergencies, which could be quickly applied to COVID-19 vaccination-related products. The review was also complimentary of the country's development of the NDVP and district microplans to inform the vaccine deployment exercise and accommodate the changing vaccine supply scenarios, the expansion of ICC to serve as the National Coordinating Committee for the vaccine deployment, and the establishment of the NEOC with representative structures at district level (DEOC) to provide support on operational and tactical issues, e.g., pooling transport. Finally, the IAR found the availability of designated vote (funding) for COVID-19 activities, including vaccination, to be highly positive.

Although vaccination had only been ongoing for a short amount of time at the time of the assessment, the IAR identified a number of best practices related to implementation, namely around the expansion of vaccination sites over time as well as the country's use of political and cultural figures as part of the ArmReady campaign to promote demand creation.

The assessment identified a number of key challenges faced during the early days of the country's vaccination program. These included:

- Uncertainty of vaccine supplies due to global limited supply of vaccines resulting in change in prioritizing target groups and monitoring indicators.
- Vaccine hesitancy by some health workers especially the younger age group; fast-paced global media/information releases leaving the country communication and media response trailing behind, especially on social media.
- Knowledge gaps in AEFI assessment and management, and medical screening for vaccination eligibility e.g., very sick patients.
- Human resource shortage (nurses, doctors, health care auxiliary, safety, health and environment officers, health education assistants, data clerks).
- Delay of client's registration due to lack of knowledge on use of ICT (phones and ICT equipment by the community (older adults) and Internet bandwidth.
- Disruption in access to essential health services, particularly for vulnerable populations, possibly as a result of facility closures due to staff deployment to vaccination sites.

## 4.21. Delivery cost results

This section first presents fiscal and economic total and unit delivery cost findings, then presents more detailed results at national and DHMT levels.

### 4.21.1. Fiscal delivery costs

Tables 8 and 9 show the total fiscal delivery cost in BWP and US$, by resource item. Expenditures incurred at national level (including government, parastatals and partners/donors) and at DHMT level are presented separately. Nearly three-quarters of resources (74%) were expended at national level, while DHMT-level expenditures represented 26% of total resources expended.

TABLE 8 **Total delivery fiscal costs, in BWP (March 1, 2021 to March 31, 2022)**

| Resource item | National level | DHMTs | Total | % Total |
|---|---|---|---|---|
| AEFI | 1,764,486 | - | 1,764,486 | <1% |
| Cold chain | 17,216,771 | 1,182,962 | 18,399,733 | 3% |
| Communications* | 37,000 | 1,074,345 | 1,111,345 | <1% |
| Delivery HR** | 178,272,635 | 65,019,745 | 243,292,380 | 43% |
| M&E | 12,313,752 | 29,023,295 | 41,337,047 | 7% |
| Planning and coordination | 10,055,846 | 7,035,555 | 17,091,401 | 3% |
| PPE and hand hygiene supplies | 102,827,411 | 2,280,179 | 105,107,589 | 19% |
| Refreshments | - | 1,050,485 | 1,050,485 | <1% |
| Regulatory | 661,455 | - | 661,455 | <1% |
| Social mobilization | 56,205,084 | 5,439,263 | 61,644,346 | 11% |
| Supervision | 19,363,111 | - | 19,363,111 | 3% |
| Syringes and safety boxes | 1,911,703 | 265,200 | 2,176,903 | <1% |
| Training | 1,255,902 | 987,331 | 2,243,233 | <1% |
| Transport | 3,452,688 | 14,835,402 | 18,288,089 | 3% |
| UCC | 4,507,492 | - | 4,507,492 | 1% |
| Vaccine transport*** | 5,521,702 | 12,757,344 | 18,279,046 | 3% |
| Waste management | 654,397 | 2,499,040 | 3,153,438 | 1% |
| Other**** | 1,822,394 | 107,752 | 1,930,146 | <1% |
| **Total** | **417,843,827** | **143,557,897** | **561,401,724** | **100%** |
| **% Total** | **74%** | **26%** | **100%** | **100%** |

* "Communications" includes airtime, internet, cabling and networking, etc.

** Delivery HR = vaccinators and other staff on-site at vaccination sites. Other human resources are allocated to the domain they support, for example human resources for social mobilization are listed under "social mobilization."

*** Vaccine transport includes only in-country transport.

**** "Other" includes screening shades for vaccination sites.

Note: National level costs exclude expenditures from the MoH about waste management costs and the purchase of tents, vehicles and other capital items, as well as social mobilization expenditures from WHO.

TABLE 9 **Total delivery fiscal costs, in US$ (March 1, 2021 to March 31, 2022)**

| Resource item | National level | DHMTs | Total | National level as % total | DHMT level as % total |
|---|---|---|---|---|---|
| AEFI | 156,676 | - | 156,676 | <1% | - |
| Cold chain | 1,528,749 | 105,040 | 1,633,789 | 4% | 1% |
| Communications** | 3,285 | 95,396 | 98,681 | <1% | 1% |
| Delivery HR*** | 15,829,572 | 5,773,375 | 21,602,946 | 43% | 45% |
| M&E | 1,093,389 | 2,577,100 | 3,670,489 | 3% | 20% |
| Planning and coordination | 892,901 | 624,716 | 1,517,617 | 2% | 5% |
| PPE and hand hygiene supplies | 9,130,475 | 202,467 | 9,332,942 | 25% | 2% |
| Refreshments | - | 93,277 | 93,277 | - | 1% |
| Regulatory | 58,733 | - | 58,733 | <1% | - |
| Social mobilization | 4,990,684 | 482,975 | 5,473,659 | 13% | 4% |
| Supervision | 1,719,331 | - | 1,719,331 | 5% | - |
| Syringes and safety boxes | 169,748 | 23,548 | 193,296 | <1% | <1% |
| Training | 111,517 | 87,669 | 199,186 | <1% | 1% |
| Transport | 306,579 | 1,317,297 | 1,623,876 | 1% | 10% |
| UCC | 400,239 | - | 400,239 | 1% | - |
| Vaccine transport**** | 490,295 | 1,132,778 | 1,623,073 | 1% | 9% |
| Waste management | 58,107 | 221,900 | 280,007 | <1% | 2% |
| Other***** | 161,818 | 9,568 | 171,386 | <1% | <1% |
| **Total** | **37,102,098** | **12,747,105** | **49,849,203** | **100%** | **100%** |
| **% Total** | **74%** | **26%** | **100%** | **100%** | **100%** |

* "Communications" includes airtime, internet, cabling and networking, etc.

** Delivery HR = vaccinators and other staff on-site at vaccination sites. Other human resources are allocated to the domain they support, for example human resources for social mobilization are listed under "social mobilization."

*** Vaccine transport includes only in-country transport.

**** "Other" includes screening shades for vaccination sites.

Note: National level costs exclude expenditures from the MoH about waste management costs and the purchase of tents, vehicles and other capital items, as well as social mobilization expenditures from WHO.

By resource item, delivery HR represents the largest share of total fiscal costs, at 43%. The next most important resource item is PPE and hand hygiene supplies, representing 19% of total costs. Social mobilization accounts for 11% of total costs. AEFI, other communications, refreshments, regulatory, syringes and safety boxes, training, and other each represent less than 1% of total costs.

Based on 2,607,002 vaccine doses delivered during the study period, the fiscal delivery cost per dose delivered is BWP 215 (US$19.12) (Table 10).

TABLE 10 **Delivery fiscal cost per dose delivered, BWP and US$**

| | BWP | | | US$ | | |
|---|---|---|---|---|---|---|
| | National level | DHMTs | Total | National level | DHMTs | Total |
| **Total delivery fiscal cost** | **417,843,827** | **143,557,897** | **561,401,724** | **37,102,098** | **12,747,105** | **49,849,203** |
| Number of doses delivered | | | | | | **2,607,002** |
| Delivery fiscal cost | 160 | 55 | **215** | 14.23 | 4.89 | **19.12** |

Note: National level costs exclude expenditures from the MoH about waste management costs and the purchase of tents, vehicles and other capital items, as well as social mobilization expenditures from WHO.

### 4.21.2. Economic delivery costs

Tables 11 and 12 show the total economic delivery cost findings in BWP and US$, by resource item. This includes all financial outlays presented above, plus the value of existing human resources used for vaccination (noted in the table as "Delivery HR") and their supervisors. Expenditures incurred at national level (including government, parastatals and partners/donors) and at DHMT level are presented separately. Fifty-seven percent (57%) of resources were expended at national level, while DHMT level expenditures represented 43% of total resources expended.

TABLE 11 **Total delivery economic costs, in BWP (March 1, 2021 to March 31, 2022)**

| Resource item | National level | DHMTs | Total | % Total |
|---|---|---|---|---|
| AEFI | 1,764,486 | - | 1,764,486 | <1% |
| Cold chain | 17,216,771 | 1,182,962 | 18,399,733 | 2% |
| Communications* | 37,000 | 1,074,345 | 1,111,345 | <1% |
| Delivery HR** | 262,760,308 | 338,414,527 | 601,174,835 | 62% |
| M&E | 12,313,752 | 29,023,295 | 41,337,047 | 4% |
| Planning and coordination | 10,055,846 | 7,035,555 | 17,091,401 | 2% |
| PPE and hand hygiene supplies | 102,827,411 | 2,280,179 | 105,107,589 | 11% |
| Refreshments | - | 1,050,485 | 1,050,485 | <1% |
| Regulatory | 661,455 | - | 661,455 | <1% |
| Social mobilization | 56,205,084 | 5,439,263 | 61,644,346 | 6% |
| Supervision | 74,147,623 | - | 74,147,623 | 8% |
| Syringes and safety boxes | 1,911,703 | 265,200 | 2,176,903 | <1% |
| Training | 1,255,902 | 987,331 | 2,243,233 | <1% |
| Transport | 3,452,688 | 14,835,402 | 18,288,089 | 2% |
| UCC | 4,507,492 | - | 4,507,492 | <1% |
| Vaccine transport*** | 5,521,702 | 12,757,344 | 18,279,046 | 2% |
| Waste management | 654,397 | 2,499,040 | 3,153,438 | <1% |
| Other**** | 1,822,394 | 107,752 | 1,930,146 | <1% |
| **Total** | **557,116,012** | **416,952,679** | **974,068,691** | **100%** |
| **% Total** | **57%** | **43%** | **100%** | **100%** |

* "Communications" includes airtime, internet, cabling and networking, etc.

** Delivery HR = vaccinators and other staff on-site at vaccination sites. Other human resources are allocated to the domain they support, for example human resources for social mobilization are listed under "social mobilization."

*** Vaccine transport includes only in-country transport.

**** "Other" includes screening shades for vaccination sites.

Note: National level costs exclude expenditures from the MoH about waste management costs and the purchase of tents, vehicles and other capital items, as well as social mobilization expenditures from WHO.

TABLE 12 **Total delivery economic costs, in US$ (March 1, 2021 to March 31, 2022)**

| Resource item | National level | DHMTs | Total | National level as % total | DHMT level as % total |
|---|---|---|---|---|---|
| AEFI | 156,676 | - | 156,676 | <1% | - |
| Cold chain | 1,528,749 | 105,040 | 1,633,789 | 3% | <1% |
| Communications** | 3,285 | 95,396 | 98,681 | <1% | <1% |
| Delivery HR*** | 23,331,585 | 30,049,239 | 53,380,824 | 47% | 81% |
| M&E | 1,093,389 | 2,577,100 | 3,670,489 | 2% | 7% |
| Planning and coordination | 892,901 | 624,716 | 1,517,617 | 2% | 2% |
| PPE and hand hygiene supplies | 9,130,475 | 202,467 | 9,332,942 | 18% | 1% |
| Refreshments | - | 93,277 | 93,277 | - | <1% |
| Regulatory | 58,733 | - | 58,733 | <1% | - |
| Social mobilization | 4,990,684 | 482,975 | 5,473,659 | 10% | 1% |
| Supervision | 6,583,877 | - | 6,583,877 | 13% | - |
| Syringes and safety boxes | 169,748 | 23,548 | 193,296 | <1% | <1% |
| Training | 111,517 | 87,669 | 199,186 | <1% | <1% |
| Transport | 306,579 | 1,317,297 | 1,623,876 | 1% | 4% |
| UCC | 400,239 | - | 400,239 | 1% | - |
| Vaccine transport**** | 490,295 | 1,132,778 | 1,623,073 | 1% | 3% |
| Waste management | 58,107 | 221,900 | 280,007 | <1% | 1% |
| Other***** | 161,818 | 9,568 | 171,386 | <1% | <1% |
| **Total** | **49,468,657** | **37,022,969** | **86,491,626** | **100%** | **100%** |
| **% Total** | **57%** | **43%** | **100%** | **100%** | **100%** |

* "Communications" includes airtime, internet, cabling and networking, etc.

** Delivery HR = vaccinators and other staff on-site at vaccination sites. Other human resources are allocated to the domain they support, for example human resources for social mobilization are listed under "social mobilization."

*** Vaccine transport includes only in-country transport.

**** "Other" includes screening shades for vaccination sites.

Note: National level costs exclude expenditures from the MoH about waste management costs and the purchase of tents, vehicles and other capital items, as well as social mobilization expenditures from WHO.

By resource item, delivery HR continues to represent the largest share of total costs (up from 43% of fiscal costs to 62% of economic costs). The next most important resource item is again PPE and hand hygiene supplies, representing 11% of total costs (down from 19% of the share of total fiscal costs). Supervision represents 8% of total costs, followed by social mobilization at 6%.

Based on 2,607,002 doses delivered during the study period, the economic delivery cost per dose delivered is BWP 374 (US$33.18), an increase of 74% compared to the fiscal cost per dose delivered (Table 13).

TABLE 13 **Delivery economic cost per dose delivered, BWP and US$**

| | BWP | | | US$ | | |
|---|---|---|---|---|---|---|
| | **National level** | **DHMTs** | **Total** | **National level** | **DHMTs** | **Total** |
| **Total delivery economic cost** | **557,116,012** | **416,952,679** | **974,068,691** | **49,468,657** | **37,022,969** | **86,491,626** |
| Number of doses delivered | | | | | | **2,607,002** |
| Delivery economic cost per dose delivered | 214 | 160 | **374** | 18.98 | 14.2 | **33.18** |

Note: National level costs exclude expenditures from the MoH about waste management costs and the purchase of tents, vehicles and other capital items, as well as social mobilization expenditures from WHO.

### 4.21.3. National level costs

At national level, fourteen different financing sources were identified: seven government agencies and parastatals, six external partners and one private entity (Debswana). This study has not captured additional private entities, for example those who donated airtime and other goods and services to support the implementation of COVID-19 vaccination.

The most significant resource items at national level were delivery HR (43% of total fiscal costs and 47% of total economic costs). This reflects the large number of vaccination team staff hired by the national MoH to support the DHMTs, as well as by partners, namely FHI 360 and Global Communities, as well as BDF and Police (Table 14). Existing staff numbers include 16 MoH supervisors, 29 BDF vaccinators and 104 police vaccinators. Newly hired staff numbers include 83 vaccinators hired by MoH (Corporate Services), 16 Presidential COVID-19 Task Force members (technical subject matter experts), 25 social mobilizers hired by MoH (Corporate Services) and 3,228 social mobilizers hired by Botswana Red Cross. Due to data availability the number of existing and newly hired staff used by the following organizations is unknown, though the costs of these staff are included in Table 14:

- FHI360 (Delivery HR with newly hired staff)
- FHI360 (Social mobilization with newly hired staff)
- Debswana (Delivery HR with newly hired staff)
- WHO (Planning and coordination with newly hired staff)
- Global Communities (Delivery HR with newly hired staff)
- Global Communities (Planning and coordination with newly hired staff)
- UNICEF (Planning and coordination with newly hired staff)

TABLE 14 **Overview of national level existing and newly hired HR for COVID-19 vaccination**

| | | | BWP | US$ |
|---|---|---|---|---|
| **Type of human resources** | **Resource type** | **Number of staff*** | **Total economic cost** | **Total economic cost** |
| **Existing staff** | Delivery HR | 133 | 84,487,673 | 7,502,013 |
| | Supervision | 16 | 54,784,512 | 4,864,546 |
| *Existing staff sub-total* | | *149* | *139,272,185* | *12,366,559* |
| **New staff** | Delivery HR | 83 | 178,272,635 | 15,829,572 |
| | Planning and coordination (Presidential Task Force) | 16 | 9,559,067 | 848,789 |
| | Social mobilization | 3,253 | 49,270,942 | 4,374,973 |
| *New staff sub-total* | | *3,352* | *237,102,644* | *21,053,334* |
| **Total both existing and newly hired staff*** | | **3,501** | **376,374,829** | **33,419,892** |

* Due to data availability the number of existing and newly hired staff used by the following organizations is unknown, though the costs of these staff are included in the table: FHI360 (Delivery HR, newly hired staff); FHI360 (Social mobilization, newly hired staff); Debswana (Delivery HR, newly hired staff); WHO (Planning and coordination, newly hired staff); Global Communities (Delivery HR, newly hired staff); Global Communities (Planning and coordination, newly hired staff); UNICEF (Planning and coordination, newly hired staff).

The overwhelming majority of PPE and hand hygiene supplies used by vaccination teams were procured centrally and distributed to DHMTs for use by vaccination teams. Accordingly, this resource item accounts for 25% and 18% of total national level fiscal and economic costs, respectively. Table 15 provides an overview of the number of items purchased centrally, the unit prices per item and the total cost.

TABLE 15 **PPE items purchased nationally during the study period (BWP and US$)**

| | | BWP | | US$ | |
|---|---|---|---|---|---|
| Item | Number of items | Average unit price | Total cost | Average unit price | Total cost |
| Caps, theatre (box of 50) | 39,821 | 55 | 2,194,535 | 4.89 | 194,862 |
| Disposable coveralls | 36,615 | 65 | 2,379,975 | 5.77 | 211,328 |
| Disposable face shields | 45,579 | 2 | 82,042 | 0.16 | 7,285 |
| Gloves (box of 100) | 369,069 | 111 | 41,019,144 | 9.87 | 3,642,261 |
| Gowns | 456,402 | 70 | 31,948,140 | 6.22 | 2,836,809 |
| Masks (box of 50) | 250,248 | 714 | 17,852,603 | 6.33 | 1,585,207 |
| **Total cost** | | | **95,476,439** | | **8,477,752** |

Social mobilization represented the third-highest share of total national level fiscal costs (11%), but when considering economic costs supervision became more important than social mobilization (13% vs 10% of total economic costs).

Some resource items expected to feature more prominently in national level cost findings proved to be less significant. For example, AEFI, cold chain, UCC, M&E and regulatory together represented less than 10% of total national level costs (Table 16).

TABLE 16 **Resource items as share of total fiscal and economic costs at national level**

| Resource item | % share of total fiscal costs | % share of total economic costs |
|---|---|---|
| AEFI | <1% | <1% |
| Cold chain | 4% | 3% |
| Communications* | <1% | <1% |
| Delivery HR** | 43% | 47% |
| M&E | 3% | 2% |
| Planning and coordination | 2% | 2% |
| PPE and hand hygiene supplies | 25% | 18% |
| Refreshments | - | - |
| Regulatory | <1% | <1% |
| Social mobilization | 13% | 10% |
| Supervision | 5% | 13% |
| Syringes and safety boxes | <1% | <1% |
| Training | <1% | <1% |
| Transport | 1% | 1% |
| UCC | 1% | 1% |
| Vaccine transport*** | 1% | 1% |
| Waste management | <1% | <1% |
| Other**** | <1% | <1% |
| **% Total** | **100%** | **100%** |

* "Communications" includes airtime, internet, cabling and networking, etc.

** Delivery HR = vaccinators and other staff on-site at vaccination sites. Other human resources are allocated to the domain they support, for example human resources for social mobilization are listed under "social mobilization."

*** Vaccine transport includes only in-country transport.

**** "Other" includes screening shades for vaccination sites.

Note: National level costs exclude expenditures from the MoH about waste management costs and the purchase of tents, vehicles and other capital items, as well as social mobilization expenditures from WHO.

It is important to note that all expenditures by national level respondents are presented as national level expenditures, though the expenditures may have directly benefitted DHMTs. This includes the delivery HR and PPE discussed above, but also many of the social mobilization activities, which were implemented by partners (Botswana Red Cross, FHI 360, Global Communities and the Global Health Supply Chain Program – Procurement and Supply Management (GHSC-PSM), see Table 17 for a list of the DHMTs they supported) as well as some vaccine transport costs (for example, air transport of vaccines from national level to district storage points). Some cold chain equipment purchased nationally was also deployed to sub-national levels.

TABLE 17 **Support from NGO partners by DHMT**

| NGO partner | DHMTs supported |
|---|---|
| **Botswana Red Cross** | Chobe, Ghanzi, Greater Francistown, Greater Gaborone, Kgalagadi North, Kweneng, Ngamiland |
| **FHI 360** | Boteti, Chobe, Ghanzi, Greater Francistown, Greater Gaborone, Kgalagadi North, Kweneng, Ngamiland, Serowe/Palapye |
| **Global Communities** | Kgatleng, Kweneng, Mahalapye, Selebi Phikwe, Serowe/ Palapye, Southern |
| **Global Health Supply Chain Program Procurement and Supply Management (GHSC-PSM)** | All DHMTs |

### 4.21.4. DHMT-level costs

Similar to national level, delivery HR were the main fiscal cost driver in most DHMTs. Notable exceptions include Greater Francistown, where delivery HR (31% of total costs) were overshadowed by high M&E costs (36% of total costs), and Kgalagadi North, where transport represented a quarter of total fiscal costs (25%), followed by delivery HR and vaccine transport at 21% each. In most rural DHMTs, transport and vaccine transport are sizeable shares of total costs, likely reflecting the large distances covered in some of these vast and less densely populated areas (Table 18).

TABLE 18 **DHMT-level expenditures by resource item, as share of total fiscal costs**

| DHMT/ resource item | AEFI | Cold chain | Communications* | Delivery HR** | M&E | Planning and coordination | PPE and hand hygiene supplies | Refreshments | Regulatory | Social mobilization | Supervision | Syringes and safety boxes | Training | Transport | Vaccine transport*** | Waste management | Other**** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Boteti** | - | - | <1% | 21% | 28% | - | 3% | - | - | - | - | - | - | 24% | 24% | - | - |
| **Chobe** | - | - | <1% | 52% | 24% | 9% | - | <1% | - | 6% | - | - | <1% | 6% | 2% | - | - |
| ***Ghanzi*** | - | - | *1%* | *37%* | *23%* | *5%* | *1%* | *<1%* | - | *5%* | - | - | *<1%* | *15%* | *13%* | *1%* | - |
| **Greater Francistown** | - | 2% | <1% | 31% | 36% | 14% | 3% | 2% | - | 6% | - | - | <1% | <1% | <1% | 4% | <1% |
| **Greater Gaborone** | - | 3% | <1% | 74% | 12% | 2% | 2% | <1% | - | 2% | - | <1% | - | 2% | 2% | <1% | <1% |
| ***Greater Lobatse*** | - | - | *2%* | *42%* | - | *2%* | *5%* | *7%* | - | - | - | - | *8%* | *13%* | *13%* | *9%* | - |
| ***Greater Selebi Phikwe*** | - | - | *2%* | *42%* | - | *2%* | *5%* | *7%* | - | - | - | - | *8%* | *13%* | *13%* | *9%* | - |
| **Kgalagadi North** | - | - | 6% | 21% | 5% | - | - | <1% | - | 12% | - | - | 2% | 25% | 21% | 8% | - |
| ***Kgalagadi South*** | - | - | *1%* | *37%* | *23%* | *5%* | *1%* | *<1%* | - | *5%* | - | - | *<1%* | *15%* | *13%* | *1%* | - |
| ***Kgatleng*** | - | - | *1%* | *37%* | *23%* | *5%* | *1%* | *<1%* | - | *5%* | - | - | *<1%* | *15%* | *13%* | *1%* | - |
| ***Kweneng*** | - | - | *1%* | *37%* | *23%* | *5%* | *1%* | *<1%* | - | *5%* | - | - | *<1%* | *15%* | *13%* | *1%* | - |
| ***Mahalapye*** | - | - | *1%* | *37%* | *23%* | *5%* | *1%* | *<1%* | - | *5%* | - | - | *<1%* | *15%* | *13%* | *1%* | - |
| ***Ngamiland*** | - | - | *1%* | *37%* | *23%* | *5%* | *1%* | *<1%* | - | *5%* | - | - | *<1%* | *15%* | *13%* | *1%* | - |
| ***North East*** | - | - | *1%* | *37%* | *23%* | *5%* | *1%* | *<1%* | - | *5%* | - | - | *<1%* | *15%* | *13%* | *1%* | - |
| ***Okavango*** | - | - | 1% | 37% | 23% | 5% | 1% | <1% | - | 5% | - | - | <1% | 15% | 13% | 1% | - |
| ***Serowe/Palapye*** | - | - | *1%* | *37%* | *23%* | *5%* | *1%* | *<1%* | - | *5%* | - | - | *<1%* | *15%* | *13%* | *1%* | - |
| **Southern** | - | - | 2% | 42% | - | 2% | 5% | 7% | - | - | - | - | 8% | 13% | 13% | 9% | - |
| ***Tutume*** | - | - | *1%* | *37%* | *23%* | *5%* | *1%* | *<1%* | - | *5%* | - | - | *<1%* | *15%* | *13%* | *1%* | - |
| **Total** | **-** | **1%** | **1%** | **45%** | **20%** | **5%** | **2%** | **1%** | **-** | **4%** | **-** | **<1%** | **<1%** | **10%** | **9%** | **1%** | **<1%** |

* "Communications" includes airtime, internet, cabling and networking, etc.

** Delivery HR = vaccinators and other staff on-site at vaccination sites. Other human resources are allocated to the domain they support, for example human resources for social mobilization are listed under "social mobilization."

*** Vaccine transport includes only in-country transport.

**** "Other" includes screening shades for vaccination sites.

Note: results for DHMTs in italics were extrapolated based on the sample.

The story is similar when looking at economic costs. The large number of existing staff used in some DHMTs led to an increase in their total delivery costs. For example, including the value of 30 existing staff used for vaccination in Kgalagadi North increased total economic costs more than four-fold, from BWP 1,518,809 (US$134,861) to BWP 6,927,407 (US$615,113) (Table 19).

TABLE 19 **DHMT-level expenditures by resource item, as share of total economic costs**

| DHMT/ resource item | AEFI | Cold chain | Communications* | Delivery HR** | M&E | Planning and coordination | PPE and hand hygiene supplies | Refreshments | Regulatory | Social mobilization | Supervision | Syringes and safety boxes | Training | Transport | Vaccine transport*** | Waste management | Other**** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Boteti** | - | - | <1% | 85% | 5% | - | 1% | - | - | - | - | - | - | 5% | 5% | - | - |
| **Chobe** | - | - | <1% | 80% | 10% | 4% | - | <1% | - | 2% | - | - | <1% | 2% | 1% | - | - |
| ***Ghanzi*** | - | - | *<1%* | *83%* | *6%* | *1%* | *<1%* | *<1%* | - | *1%* | - | - | *<1%* | *4%* | *3%* | *<1%* | - |
| **Greater Francistown** | - | 1% | <1% | 48% | 27% | 11% | 2% | 1% | - | 5% | - | - | <1% | <1% | <1% | 3% | <1% |
| **Greater Gaborone** | - | 2% | <1% | 85% | 7% | 1% | 1% | <1% | - | <1% | - | <1% | - | <1% | <1% | <1% | <1% |
| ***Greater Lobatse*** | - | - | *<1%* | *63%* | - | *1%* | *3%* | *4%* | - | - | - | - | *5%* | *8%* | *8%* | *6%* | - |
| ***Greater Selebi Phikwe*** | - | - | *<1%* | *63%* | - | *1%* | *3%* | *4%* | - | - | - | - | *5%* | *8%* | *8%* | *6%* | - |
| **Kgalagadi North** | - | - | 1% | 83% | 1% | - | - | <1% | - | 3% | - | - | <1% | 5% | 5% | 2% | - |
| ***Kgalagadi South*** | - | - | *<1%* | *83%* | *6%* | *1%* | *<1%* | *<1%* | - | *1%* | - | - | *<1%* | *4%* | *3%* | *<1%* | - |
| ***Kgatleng*** | - | - | *<1%* | *83%* | *6%* | *1%* | *<1%* | *<1%* | - | *1%* | - | - | *<1%* | *4%* | *3%* | *<1%* | - |
| ***Kweneng*** | - | - | *<1%* | *83%* | *6%* | *1%* | *<1%* | *<1%* | - | *1%* | - | - | *<1%* | *4%* | *3%* | *<1%* | - |
| ***Mahalapye*** | - | - | *<1%* | *83%* | *6%* | *1%* | *<1%* | *<1%* | - | *1%* | - | - | *<1%* | *4%* | *3%* | *<1%* | - |
| ***Ngamiland*** | - | - | *<1%* | *83%* | *6%* | *1%* | *<1%* | *<1%* | - | *1%* | - | - | *<1%* | *4%* | *3%* | *<1%* | - |
| ***North East*** | - | - | *<1%* | *83%* | *6%* | *1%* | *<1%* | *<1%* | - | *1%* | - | - | *<1%* | *4%* | *3%* | *<1%* | - |
| ***Okavango*** | - | - | *<1%* | *83%* | *6%* | *1%* | *<1%* | *<1%* | - | *1%* | - | - | *<1%* | *4%* | *3%* | *<1%* | - |
| ***Serowe/Palapye*** | - | - | *<1%* | *83%* | *6%* | *1%* | *<1%* | *<1%* | - | *1%* | - | - | *<1%* | *4%* | *3%* | *<1%* | - |
| **Southern** | - | - | <1% | 63% | - | 1% | 3% | 4% | - | - | - | - | 5% | 8% | 8% | 6% | - |
| ***Tutume*** | - | - | *<1%* | *83%* | *6%* | *1%* | *<1%* | *<1%* | - | *1%* | - | - | *<1%* | *4%* | *3%* | *<1%* | - |
| **Total** | **-** | **<1%** | **<1%** | **81%** | **7%** | **2%** | **1%** | **<1%** | **-** | **1%** | **-** | **<1%** | **<1%** | **4%** | **3%** | **1%** | **<1%** |

* "Communications" includes airtime, internet, cabling and networking, etc.

** Delivery HR = vaccinators and other staff on-site at vaccination sites. Other human resources are allocated to the domain they support, for example human resources for social mobilization are listed under "social mobilization."

*** Vaccine transport includes only in-country transport.

**** "Other" includes screening shades for vaccination sites.

Note: results for DHMTs in italics were extrapolated based on the sample.

This study analysis found variation in delivery costs across DHMTs. The fiscal cost per dose ranges from BWP 14 (US$ 1.26) in the towns (Greater Lobatse, Greater Selebi Phikwe and Southern) to a high of BWP 152 (US$13.52) in Chobe. When considering target population sizes, fiscal costs per person in the target population range from a low of BWP 19 (US$1.70) in Greater Selebi Phikwe to a high of BWP 278 (US$24.70) in Chobe (Tables 20 and 21). Economic costs per dose range from BWP 22 (US$1.98) in the towns (Greater Lobatse, Greater Selebi Phikwe and Southern) to a high of BWP 364 (US$32.33) in Chobe. When considering target population sizes, economic costs per person in the target population range from a low of BWP 30 (US$2.67) in Greater Selebi Phikwe to a high of BWP 665 (US$59.04) in Chobe (Tables 20 and 21).

TABLE 20 **Fiscal and economic unit cost findings per DHMT, in BWP**

| | Fiscal cost | | | Economic cost | | |
|---|---|---|---|---|---|---|
| DHMT | Total | Per dose | Per person in target pop. | Total | Per dose | Per person in target pop. |
| **Boteti** | 3,600,015 | 37 | 62 | 18,618,177 | 192 | 321 |
| **Chobe** | 5,131,681 | 152 | 278 | 12,265,566 | 364 | 665 |
| ***Ghanzi*** | *3,640,978* | *65* | *110* | *13,430,514* | *240* | *404* |
| **Greater Francistown** | 13,065,245 | 85 | 77 | 17,469,905 | 113 | 102 |
| **Greater Gaborone** | 33,974,172 | 70 | 114 | 57,941,576 | 120 | 195 |
| ***Greater Lobatse*** | *1,655,349* | *14* | *22* | *2,595,214* | *22* | *34* |
| ***Greater Selebi Phikwe*** | *2,091,493* | *14* | *19* | *3,278,990* | *22* | *30* |
| **Kgalagadi North** | 1,518,809 | 57 | 67 | 6,927,407 | 258 | 304 |
| ***Kgalagadi South*** | *2,839,460* | *65* | *111* | *10,473,946* | *240* | *409* |
| ***Kgatleng*** | *7,583,600* | *65* | *93* | *27,973,708* | *240* | *344* |
| ***Kweneng*** | *15,999,084* | *65* | *94* | *59,015,999* | *240* | *348* |
| ***Mahalapye*** | *9,085,111* | *65* | *86* | *33,512,347* | *240* | *317* |
| ***Ngamiland*** | *6,989,629* | *65* | *95* | *25,782,723* | *240* | *350* |
| ***North East*** | *4,425,097* | *65* | *126* | *16,322,904* | *240* | *466* |
| ***Okavango*** | *5,219,643* | *65* | *106* | *19,253,753* | *240* | *392* |
| ***Serowe/Palapye*** | *15,308,932* | *65* | *98* | *56,470,225* | *240* | *362* |
| **Southern** | 3,083,908 | 14 | 22 | 4,834,873 | 22 | 35 |
| ***Tutume*** | *8,345,694* | *65* | *114* | *30,784,852* | *240* | *421* |
| **Total** | **143,557,897** | **55** | **85** | **416,952,679** | **160** | **246** |

* "Communications" includes airtime, internet, cabling and networking, etc.

** Delivery HR = vaccinators and other staff on-site at vaccination sites. Other human resources are allocated to the domain they support, for example human resources for social mobilization are listed under "social mobilization."

*** Vaccine transport includes only in-country transport.

**** "Other" includes screening shades for vaccination sites.

Note: results for DHMTs in italics were extrapolated based on the sample.

TABLE 21 **Fiscal and economic delivery total and unit cost findings per DHMT, in US$**

| | Fiscal cost | | | Economic cost | | |
|---|---|---|---|---|---|---|
| DHMT | Total | Per dose | Per person in target pop. | Total | Per dose | Per person in target pop. |
| **Boteti** | 319,660 | 3.30 | 5.50 | 1,653,186 | 17.09 | 28.46 |
| **Chobe** | 455,663 | 13.52 | 24.70 | 1,089,111 | 32.33 | 59.04 |
| ***Ghanzi*** | *323,298* | *5.79* | *9.74* | *1,192,551* | *21.34* | *35.92* |
| **Greater Francistown** | 1,160,118 | 7.53 | 6.80 | 1,551,226 | 10.07 | 9.10 |
| ***Greater Gaborone*** | *3,016,709* | *6.22* | *10.16* | *5,144,874* | *10.61* | *17.33* |
| ***Greater Lobatse*** | *146,985* | *1.26* | *1.93* | *230,440* | *1.98* | *3.03* |
| **Greater Selebi Phikwe** | 185,712 | 1.26 | 1.70 | 291,155 | 1.98 | 2.67 |
| **Kgalagadi North** | 134,861 | 5.02 | 5.91 | 615,113 | 22.89 | 26.95 |
| ***Kgalagadi South*** | *252,127* | *5.79* | *9.85* | *930,025* | *21.34* | *36.33* |
| ***Kgatleng*** | *673,379* | *5.79* | *8.29* | *2,483,902* | *21.34* | *30.59* |
| ***Kweneng*** | *1,420,625* | *5.79* | *8.37* | *5,240,277* | *21.34* | *30.86* |
| ***Mahalapye*** | *806,705* | *5.79* | *7.63* | *2,975,701* | *21.34* | *28.16* |
| ***Ngamiland*** | *620,638* | *5.79* | *8.43* | *2,289,356* | *21.34* | *31.10* |
| ***North East*** | *392,923* | *5.79* | *11.22* | *1,449,379* | *21.34* | *41.38* |
| ***Okavango*** | *463,474* | *5.79* | *9.44* | *1,709,621* | *21.34* | *34.80* |
| ***Serowe/Palapye*** | *1,359,344* | *5.79* | *8.70* | *5,014,227* | *21.34* | *32.11* |
| **Southern** | 273,833 | 1.26 | 1.96 | 429,309 | 1.98 | 3.07 |
| ***Tutume*** | *741,049* | *5.79* | *10.14* | *2,733,516* | *21.34* | *37.40* |
| **Total** | **12,747,105** | **4.89** | **7.52** | **37,022,969** | **14.20** | **21.85** |

* "Communications" includes airtime, internet, cabling and networking, etc.

** Delivery HR = vaccinators and other staff on-site at vaccination sites. Other human resources are allocated to the domain they support, for example human resources for social mobilization are listed under "social mobilization."

*** Vaccine transport includes only in-country transport.

**** "Other" includes screening shades for vaccination sites.

Note: results for DHMTs in italics were extrapolated based on the sample.

This variation is driven by both total cost findings as well as population sizes. For example, high unit costs in Chobe are driven by high total costs and a small number of doses delivered: total costs in Chobe were two-thirds those in Boteti, although Boteti has a target population over three times as large as Chobe, and delivered nearly three times as many doses (Table 22). On the cost side, Chobe hired 47 staff to support COVID-19 vaccination whereas Boteti only hired 10.

TABLE 22 **DHMT target population sizes, number of doses delivered and coverage levels**

| DHMT | Sampling status | Target population | No. doses delivered | Coverage (% target) | Geographical classification |
|---|---|---|---|---|---|
| **Boteti** | Sample | 58,086 | 95,309 | 89% | Rural |
| **Chobe** | Sample | 18,446 | 38,844 | 97% | Rural |
| **Ghanzi** | Extrapolated | 33,203 | 55,874 | 87% | Rural |
| **Greater Francistown** | Sample | 170,494 | 218,796 | 69% | City |
| **Greater Gaborone** | Sample | 296,804 | 537,813 | 96% | City |
| **Greater Lobatse** | Extrapolated | 76,091 | 116,303 | 76% | Town |
| **Greater Selebi Phikwe** | Extrapolated | 109,152 | 146,946 | 66% | Town |
| **Kgalagadi North** | Sample | 22,825 | 29,165 | 63% | Rural |
| **Kgalagadi South** | Extrapolated | 25,599 | 43,574 | 81% | Rural |
| **Kgatleng** | Extrapolated | 81,204 | 116,377 | 75% | Rural |
| **Kweneng** | Extrapolated | 169,813 | 245,520 | 69% | Rural |
| **Mahalapye** | Extrapolated | 105,682 | 139,419 | 69% | Rural |
| **Ngamiland** | Extrapolated | 73,622 | 107,262 | 77% | Rural |
| **North East** | Extrapolated | 35,030 | 67,907 | 81% | Rural |
| **Okavango** | Extrapolated | 49,120 | 80,100 | 81% | Rural |
| **Serowe/Palapye** | Extrapolated | 156,172 | 234,929 | 77% | Rural |
| **Southern** | Sample | 139,900 | 204,792 | 73% | Town |
| **Tutume** | Extrapolated | 73,093 | 128,072 | 80% | Rural |
| **Total** | | **1,694,336** | **2,607,002** | | |

Target population and coverage are as per COVID-19 vaccination daily update, 31 March 2022. Number doses delivered as per updated data provided by MoH as part of the research (February 2023).

This combination of high total costs and the low number of doses delivered means unit costs in Chobe are much higher than Boteti: fiscal costs in Chobe are BWP 152 (US$13.52) per dose delivered and BWP 278 (US$24.70) per person in the target population, compared to BWP 37 (US$3.30) and BWP 62 (US$5.50), respectively, in Boteti. Economic costs in Chobe are BWP 364 (US$32.33) per dose delivered and BWP 665 (US$59.04) per person in the target population, compared to BWP 192 (US$17.09) and BWP 321 (US$28.46), respectively, in Boteti.

The variation also reflects programmatic decisions, for example on the number of existing human resources to redeploy, and the number of new staff to hire. As discussed above, Boteti appears to have hired a disproportionately small number of staff given their size, as compared to Chobe. On the other hand, Greater Gaborone is an example of a DHMT that hired a large number of staff (478), though seemingly proportional to the number of doses delivered (537,813). Across all six sampled DHMTs, a total of 266 existing staff were used to deliver vaccines and an additional 692 staff hired to support:

- Cold chain delivery (19)
- Delivery of vaccines (480)
- M&E (146)
- Planning and coordination (16)
- Social mobilization (24)

- Transport (7)

By DHMT, there were a total of 958 existing and newly hired staff who supported COVID-19 vaccination:

- Boteti: 42 existing staff, 10 newly hired staff (52 total staff)
- Chobe: 48 existing staff, 47 newly hired staff (95 total staff)
- Greater Francistown: 20 existing staff, 135 newly hired staff (155 total staff)
- Greater Gaborone: 115 existing staff, 478 newly hired staff (593 total staff)
- Kgalagadi North: 30 existing staff, 12 newly hired staff (42 total staff)
- Southern: 11 existing staff, 10 newly hired staff (21 total staff)

Finally, the other programmatic decision that is likely reflected in the total and unit cost findings by DHMT is the microplanning and its accompanying budget. Some DHMTs did not report any locally procured PPE (for example, Chobe and Kgalagadi North), meaning they relied on existing stock or deliveries from national level, which may not have allocated the same proportional number of goods to each DHMT or reflected local need. Therefore, our findings reflect both national decisions about disbursements as well as the amount of locally available financial resources and their use.

## 4.22. Vaccine procurement costs

Over six million doses were acquired during the study period at a value of nearly one billion BWP (US$87 million), representing a mix of purchases (76% of all doses acquired) and donations (24% of all doses acquired). Doses were purchased from vaccine manufacturers directly (49%), AVAT (21%) and COVAX (6%) at an average cost per dose of BWP 143 (US$12.67). Doses were donated via AVAT (1%), COVAX (12%) and others (11%), valued at BWP 175 per dose (US$15.53). Overall across purchased and donated doses, the weighted average cost per dose was BWP 152 (US$13.46) (Table 22).

TABLE 23 **Cost of purchased and donated doses, BWP and US$**

| | | BWP | | US$ | |
|---|---|---|---|---|---|
| Type of doses | Number of doses acquired during study period | Total cost | Average cost per dose | Total cost | Average cost per dose |
| Purchased doses | 4,900,544 | 706,002,579 | 143 | 62,688,917 | 12.79 |
| Donated doses | 1,564,750 | 273,732,257 | 175 | 24,305,830 | 15.53 |
| **Total** | **6,465,294** | **979,734,836** | **152** | **86,994,747** | **13.46** |

This study has estimated estimate the value of the 2.6 million doses delivered during the study period to be BWP 395,058,705 (US$35,078,912), based on the weighted average cost per dose of purchased and donated doses.

A total of BWP 7,118,519 was paid for freight and customs clearance charges during the study period, split between those facilitated by the MoH (69%) and those facilitated by UNICEF (31%). The cost per dose of freight and customs clearance charges was BWP 1 (US$0.10). For the 2.6 million doses delivered during the study period, this represents a total cost of BWP 2,870,402 (US$254,875) (Table 23).

TABLE 24 **Cost of freight and customs clearance charges during the study period, BWP and US$**

| | | BWP | | US$ | |
|---|---|---|---|---|---|
| Freight and customs clearance charges paid during study period | Number of doses acquired during study period | Total cost | Average cost per dose | Total cost | Average cost per dose |
| Facilitated by MoH | | 4,921,347 | 1 | 436,987 | 0.07 |
| Facilitated by UNICEF | | 2,197,172 | <1 | 195,096 | 0.03 |
| **Total doses acquired during study period** | **6,465,294** | **7,118,519** | **1** | **632,083** | **0.10** |

# 5 Discussion

This study has estimated the total fiscal delivery costs of COVID-19 vaccination in Botswana to be BWP 561 million (US$50 million) over the period 1st March 2021 – 31st March 2022 (13 months), including both national and sub-national costs. Fiscal costs include nearly BWP 289 million (US$26 million) for newly hired staff, who supported not just the delivery of vaccines but also planning and coordination of the COVID-19 vaccination program and implementation of the country's social mobilization campaign, ArmReady.

When including the value (opportunity cost) of existing HR working on vaccination teams and their supervisors, costs rose to BWP 974 million (US$86 million). The true economic cost of labour may be even higher, since several respondents noted that overtime was earned but not paid, and staff therefore stopped documenting it. The economic cost findings show how significantly existing HR were redeployed to support COVID-19 vaccination, potentially compromising the delivery of other essential health services, which was also confirmed by the IAR (Ministry of Health, April 2021). When adding vaccine procurement and the value of vaccine donations, total economic costs amounted to BWP 1,960,922,051 (US$174,118,456).

With a total of 2,607,002 vaccine doses delivered during the study period, the fiscal cost per dose delivered was BWP 215 (US$19.12) and the economic cost per dose delivered was BWP 374 (US$33.18). Total economic costs per dose when including vaccine procurement were BWP 526 (US$46.73).

The majority of costs were incurred at national level (57-74%, depending on whether considering fiscal or economic costs), though many items purchased at national level (such as cold chain and PPE) were sent directly to the DHMTs. National level costs also include nearly all social mobilization-related costs, though social mobilization programs were largely implemented in the DHMTs. It should be noted that some funding originated with other funders (such as Ministry of Finance), or passed through multiple organizations before ultimately being expended (for example, funding from CDC was given to USAID who then funded implementing partners FHI 360, GHSC-PSM and Global Communities on the ground); these sources are not reported. Therefore, the findings around distribution of costs should be interpreted with caution.

Fiscal and economic costs per dose delivered at sub-national level varied significantly by DHMT, with fiscal costs ranging from BWP 14 to BWP 152 (US$1.26 to US$13.52). and economic costs BWP 22 to BWP 364 (US$1.98 to US$32.33). These findings are driven by differences in total costs as well as the number of doses delivered, but also programmatic and financial decisions at both national and sub-national levels. For example, DHMTs may have received different amounts of nationally-procured items, such as PPE, influencing their decision to procure locally (or not). Though outside the scope of this study, it can be speculated that DHMTs likely also had different amounts of funding (budgets) from government available to support COVID-19 vaccination, which likely influenced local hiring and other local procurement decisions. Some DHMTs were also supported by one or more NGOs, who provided

different levels of support across different resource items: AEFI, cold chain, delivery HR, M&E, planning and coordination, PPE, social mobilization, supervision, training and transport. Due to data availability these costs have not been allocated to the respective DHMTs, which would offer a more complete picture of the DHMT-level costs and variations across DHMTs. Finally, vaccine transport costs may appear low in some DHMTs because vaccines were transported largely by air. These expenditures are included in national level data and similar to NGO support, could not be allocated to DHMTs due to data availability. Some variation in costs can be expected simply given different characteristics. For example, densely populated cities (Greater Francistown, Greater Gaborone) benefit from economies of scale due to the large number of doses delivered, but may also have incurred lower transport costs due to the smaller distances travelled. The vastness of some DHMTs (see map, section 3.4.2), and the large distances that had to be travelled, can account for some of the higher costs in rural DHMTs.

With this study, Botswana is one of the first countries in the world to estimate the costs of COVID-19 vaccine delivery[7], therefore it is difficult to ascertain if study results are in line with other countries. The estimated costs of COVID-19 vaccine delivery in Botswana over the period 1 March 2021 to 31 March 2022 are substantially higher than Botswana's own estimated resource needs for 2022 of US$14.2 million (including vaccine procurement), though it is not possible to directly compare these numbers to understand where the major differences lie. Despite methodological differences, study findings are significantly higher than global fiscal model estimates of US$0.84-US$2.64 per dose delivered (COVAX Readiness and Delivery (CRD) Working Group on Delivery Costing, January 2022). The main reason for the difference is that the global estimates did not account for such a substantial proportion of vaccine delivery staff being new hires.

There have been no other immunization costing studies conducted in Botswana,it cannot be concluded whether these findings are in-line with the costs of immunization delivery in Botswana or represent an escalation on normal delivery costs. Although there are many programmatic differences between COVID-19 vaccination and childhood immunization, it is interesting to note that this study's findings are also significantly higher than estimates from childhood vaccination of US$1.45-1.50 per dose for routine childhood vaccine delivery in low- and lower middle-income countries, based on data collated during a systematic review of immunization delivery costs (Portnoy, et al., 2020; Vaughan, et al., 2019). Study cost findings are also significantly higher than the latest evidence on the financial costs of delivering vaccines in campaigns in India, Nigeria and Sierra Leone (US$0.15-0.42 per dose), though again there are issues of methodological comparability (ThinkWell, 2022)[8].

When interpreting these findings, it is also important to remember that it was outside the scope of this costing study to consider the immense benefits of vaccination. Without the vaccination program, thousands of persons are likely to have died and the health system would have incurred significantly treatment costs. A cost-effectiveness study which considers these parameters as well as healthy life years gained is likely to show favourable results (Utami AM, 2022).

These findings can best be interpreted together with results from a COVID-19 post-introduction evaluation study (cPIE), which may identify aspects of the programmatic implementation of vaccination that could be improved. A cPIE has not yet been done in Botswana. Considering only cost findings and this study's small-scale qualitative study, it seems there is space for improving cost-efficiency. Since human resources were the main cost-driving resource item, examining the use of existing human resources and the decisions made to hire new staff in more detail may help identify areas for cost savings, particularly at low-volume vaccination sites. Additional policy implications of these findings are discussed in section 6.

7. ThinkWell, in collaboration with its partners and with support from the Bill & Melinda Gates Foundation, is in the process of conducting facility-based costing studies using detailed, bottom-up (ingredients) costing in Bangladesh, Vietnam, Philippines, Cote d'Ivoire, Mozambique and Uganda. They have not yet released any findings.

8. Financial costs included financial expenditures at all administrative levels, and excluded the cost of vaccines, syringes, safety boxes, as well as any opportunity costs, such as volunteer time, regular staff salaries, depreciation of capital and other routine expenditures shared across the health system. Purchases of capital items—such as cold chain equipment—and expenses incurred outside of the country—like payments for international consultants— were also excluded.

This study has a few limitations. This study has made every effort to capture all resources used to support COVID-19 vaccination, but due to the multisectoral nature of implementation and the fragmentation of data cross many actors, some data may be missed – for example, Greater Gaborone DHMT reported filling driver vacancies with staff from partners and other ministries, and these costs have not been captured. Private health facilities in both Greater Francistown and Greater Gaborone conducted vaccinations using their own resources, but with vaccines provided by the government; these costs are not included, though the known number of doses delivered at these private health facilities is minimal (n=8,381). Some private safari camps used their own transport to deliver vaccines and/or vaccination staff to hard-to-reach areas (such as Project Sanitise that collaborated with the local DHMT to assist the GoB with vaccination efforts); these costs are also excluded. It was not possible to capture transport costs at MoH (national level) due to missing data, the cost of drivers at DHMT level, and researchers have made some assumptions about kilometres travelled and/or fuel use at DHMT level due to missing data. This was done using MoH fuel costs per km for tar roads, though in some DHMTs travel may have been on sand or gravel roads, which incurs a higher cost. Researchers used log books for the trips travelled where available but they were not always all available for all vehicles, and the purpose of the visit was not always properly documented to be able to discern if it was COVID-19 vaccination-related or not, forcing us to make some assumptions. In some cases the study also had to make assumptions about the percentage share of expenditures corresponding to COVID-19 vaccination (as opposed to other COVID response activities). Finally, cost findings should be considered minimum estimates as some requested data, such as MoH waste management costs, the purchase of tents, vehicles and other capital items by MoH and social mobilization expenditures from WHO were not received by the study team and therefore are not reflected in findings.

As this was a retrospective study, there is the possibility of recall bias by respondents. Some staff with knowledge of implementation who had been transferred to new positions and could not be reached. These movements impact on institutional memory. Internal reorganization within DHMTs also added some additional complications with regards to locating financial and programmatic records.

In some cases, respondents only reported financial year (April 2021-March 2022) data. It is believed that the impact of this on study findings is minimal, since vaccination only started mid-March in a few districts, but ramped up after, and most funds were released at the start of the financial year. It is also possible that some resources used during the study time period, such as PPE, were procured outside the study period; these have been excluded.

In summary, these results suggest that rolling out a new vaccine to an entire population in the middle of a global pandemic is much costlier than previous vaccination efforts in Botswana or elsewhere, and costlier than modelled estimates predicted. On the one hand, it is possible the study has overestimated the cost of COVID-19 vaccination in Botswana by overestimating the cost of human resources and PPE. On the other hand, it is possible costs have been underestimated due to the exclusion of some March 2021 costs, the exclusion of other Ministry costs and the exclusion of costs incurred by private entities other than Debswana.

# 6 Policy recommendations

Study findings lend themselves to a number of policy recommendations:

1. **The MoH should consider developing standardized guidance for responding to public health emergencies.** Although the GoB issued vaccination guidelines, findings indicate that DHMTs had a high level of flexibility in their approach to vaccination implementation. Some of the cost differences revealed by this study may be a result of these implementation differences. A standardized approach for responding to public health emergencies such as pandemics but also polio outbreaks and other similar emergencies should be developed before it is needed to facilitate a timely response, and should emphasize integration into primary health care infrastructure where possible and provide guidance about human resources requirements. This can help increase efficiency and control costs.

2. **The MoH should consider developing a resource allocation formula for distributing resources to sub-national level.** This study found no evidence that the GoB used a resource allocation formula to distribute financial and non-financial resources to sub-national level, and findings have suggested that DHMTs incurred widely varying costs and received different levels of support from partners. A resource allocation formula which takes into account local resource availability and need can help improve equity in resource distribution (Love-Koh, 2020).

3. **The MoH should consider which roles and responsibilities, if any, could be decentralised to DHMTs to allow for better responses in future public health emergencies.** DHMTs may be more agile in responding to future public health emergencies if some roles and responsibilities were decentralised from national level to the DHMTs. Further work would be needed to determine which roles and responsibilities could be decentralised, and the process for doing so.

4. **The GoB should consider developing a partnership strategy.** Botswana can be commended for the timely mobilization of existing public health partners to support COVID-19 vaccination. However, utilizing these partners in the geographical areas they already supported without considering need appears to have led to disproportionate numbers of human resources in some areas while leaving others in need. A partnership strategy together with better guidance to partners about what is needed – and where – can help improve program delivery.

5. **The MoH should consider incorporating the COVID-19 response plan into the routine health system.** This may allow for a more agile response should future rounds of vaccination be required.

6. **Government and non-governmental partners should develop more robust data and financial capturing systems.** During fieldwork, the study team faced considerable challenges collecting the necessary quantitative data – not just cost data, but also data the number of doses delivered and the number of PPE procured. The information requested was not readily available and took government and non-governmental partners time to compile. Digitization of the Health Procurement and Human Resources systems and linking them to the Financial Management System would make this data much more readily available. One option could be to adopt an Enterprise Resource Planning System consistent with the Government Digitization Strategy. Improved data and accounting systems can help increase transparency around budgeting, spending and program implementation and also make studies like this easier to conduct in the future.

7. **The MoH should consider whether any further research is needed.** Since there are no other immunization costing study results from Botswana, researchers were unable to conclude whether study findings are in-line with immunization delivery costs in Botswana. The current polio campaign presents an ideal opportunity to gather costing data, but the MoH could also consider conducting a costing study of routine/childhood immunization. Additionally, if of interest and use, a cost-effectiveness study could estimate the cost per death averted as a result of the COVID-19 vaccination program.
8. **The GoB should explore the feasibility and potential cost-savings of local manufacturing of key commodities and consider pre-negotiated agreements with select partners.** During public health emergencies it is essential to be able to access key commodities such as vaccines and supplies quickly and at a reasonable cost. The COVID-19 pandemic highlighted this. The GoB should explore whether local manufacturing and/or pre-negotiated agreements may be beneficial to providing cost-effective and timely access to key commodities that may be required for future public health emergencies.

# 7 References

COVAX Readiness and Delivery (CRD) Working Group on Delivery Costing. (January 2022). *Costs and predicted financing gap to deliver COVID-19 vaccines in 133 low- and middle-income countries.*

Love-Koh, J. G. (2020). Methods to promote equity in health resource allocation in low- and middle-income countries: an overview. *Global Health, 16(6)*. doi: https://doi.org/10.1186/s12992-019-0537-z

Ministry of Health. (n.d.). A*ddendum to the NDVP: Vaccination of children aged 5-11 years and adolescents*.

Ministry of Health. (April 2021). *Intra Action Review (IAR) - COVID 19 Vaccination Report*.

Ministry of Health. (n.d.). *COVID-19 vaccination daily update. 31 March 2022. Vaccination coverage by districts: 26/03/2021 – 30/03/2022*.

Ministry of Health. (November 2021). *National Deployment and Vaccination Plan for COVID-19 Vaccine in Botswana. Revised November 2021*.

Our World In Data. (2022). *Coronavirus (COVID-19) Vaccinations.* Retrieved from https://ourworldindata.org/covid-vaccinations

Pilkington, V., Keestra, S.M., and Hill, A. (2022). Global COVID-19 Vaccine Inequity: Failures in the First Year of Distribution and Potential Solutions for the Future. Front. Public Health, 10. https://doi.org/10.3389/fpubh.2022.821117.

Portnoy, A., Vaughan, K., Clarke-Deelder, E., Suharlim, C., Resch, S. C., Brenzel, L., & Menzies, N. A. (2020). Producing Standardized Country-Level Immunization Delivery Unit Cost Estimates. *PharmacoEconomics*, 38, 995–1005. doi:https://doi.org/10.1007/s40273-020-00930-6

Presidential COVID-19 Task Force. (March 2021). *National Deployment and Vaccination Plan (NDVP) for COVID-19 in Botswana*.

ThinkWell. (2022). *Findings from immunization campaign costing studies: policy and program implications*.

United Nations Treasury. (n.d.). Retrieved from https://treasury.un.org/operationalrates/OperationalRates.php

Utami AM, R. F. (2022, September). Utami AM, Rendrayani F, Khoiry QA, Alfiani F, KusumCost-Effectiveness Analysis of COVID-19 Vaccination in Low- and Middle-Income Countries. *J Multidiscip Healthcare, 15*, 2067-2076. doi:10.2147/JMDH.S372000

Vaughan, K., Ozaltin, A., Mallow, M., Moi, F., Wilkason, C., Stone, J., & Brenzel, L. (2019). The costs of delivering vaccines in low- and middle-income countries: Findings from a systematic review. Vaccine X. doi:10.1016/j.jvacx.2019.100034

Wang H, Y. B. (2023, Feb). Global pattern and determinants of coronavirus disease 2019 (COVID-19) vaccine coverage and progression: a global ecological study. *Glob Health* J. doi:10.1016/j.glohj.2023.02.003

World Bank. (n.d.). *World Bank DataBank*. Retrieved from https://data.worldbank.org/

World Health Organization. (2018). T*he state of health in the WHO African Region: an analysis of the status of health, health services and health systems in the context of the Sustainable Development Goals*. Brazzaville: WHO Regional Office for Africa. Retrieved from https://www.afro.who.int/publications/state-health-who-african-region

World Health Organization Botswana. (n.d.). *Biennial report: 2016-2017.* Retrieved from https://apps.who.int/iris/bitstream/handle/10665/276033/Botswana2016-2018.pdf?sequence=1&isAllowed=y

Your Botswana. (2022). *The new reset priorities for the government of Botswana*. Retrieved from https://yourbotswana.com/2021/05/30/the-new-reset-priorities-for-the-government-of-botswana/

# ANNEX 1: List of respondents

TABLE 25 **DHMT-level respondents**

| DHMT NAME | NAME OF RESPONDENT | ROLE/POSITION |
|---|---|---|
| **Boteti** | Ms Kedikilwe | DHMT Coordinator |
| | Dr Phuswane | PHS |
| | Mr Senthumole | M&E Officer |
| | Ms Maseba | Head of Corporate |
| | Ms Ntumelang | Pharmacist |
| | Ms Moile | Procurement officer |
| **Chobe** | Ms Kamwi | CHN |
| | Dr Mukandi | Chief Medical Officer |
| | Mr Matsela | M&E Officer |
| **Greater Francistown** | Dr Monamodi | Coordinator |
| | Mrs Masunda | EPI Coordinator (COVID-19 Vaccine Team Leader) |
| | Mrs Benn | Head of Corporate |
| | Mr Mgadla | Chief Pharmacist |
| | Mrs Phuti | Head Procurement |
| | Mrs Bafana | Head Accounts |
| **Greater Gaborone** | Dr Mogatle | Family Physician |
| | Dr Mpete | Chief Medical Officer |
| | Ms Baruti | Head Pharmacy |
| | Ms Tladi | HR Officer |
| | Ms Mabona | M&E Officer |
| | Ms Pono | CHN |
| **Kgalagadi North** | Dr Solomon | PHS |
| | Ms Ntwaetsile | CHN |
| | Nametso Morapedi | Procurement Officer |
| | Ms Madzeveri | Pharmacist |
| | Ms Morapedi | Head of Corporate |
| **Southern** | Ms Matengu | Head of Corporate |
| | Dr Chembe | PHS |
| | Mr Pitso | CHN |
| | Ms Ntuanyane | M&E Officer |
| | Ms Moses | M&E |
| | Mr Bailey | Pharmacist |
| | Ms Ramongala | Head of Corporate |

TABLE 26 **National level respondents**

| STAKEHOLDER | RESPONDENT NAME | ROLE/POSITION |
|---|---|---|
| BDF | Major Rammona | Nurse Vaccinator |
| BoMRA | Dr. S. Ghanie | Chief Executive Officer |
| BoMRA | Ms. Hobe | Regulatory Officer |
| BoMRA | Ms. Raditladi | Quality Manager |
| Botswana Police | Mr A. Wally | COVID-19 response lead |
| Botswana Post | Mr. H. Ssemakula | General Manager-Warehousing |
| Botswana Red Cross Society | Mr. K. Mukokomani | Secretary General |
| Debswana | Dr. Vanzyl | Corporate Sector Health Lead |
| FHI 360 | Dr V. Letsatsi | Project Manager |
| FHI 360 | Ms. R. Molomo | Finance Officer |
| Global Communities | Ms. D. Tlagae | Country Director |
| Global health supply chain program | Ms. Phetogo Phoi | Country Director |
| Ministry of Defence | Mr. Mphothwe | SHE Officer |
| Ministry of Defence | Ms. E. Mogwera | Principal Administrative Officer |
| Ministry of Finance | Mr. Makgwa | Finance Officer |
| Ministry of Finance | Mr. K. Bogatsu | Financing Officer |
| Ministry of Health | Colonel Molate | Logistician |
| Ministry of Health | Mr. C. Modise | Logistician |
| Ministry of Health | Colonel B. Modise | Logistician |
| Ministry of Health | Major. K. Moswenyane | Logistician |
| Ministry of Health | Mr. K. Motau | Refrigeration Technician |
| Ministry of Health | Ms. S. Dube | Manager (Finance) |
| Ministry of Health | Ms. B. Mothowabeng | Health Education Officer |
| Ministry of Health | Mr. Matome | Procurement Officer |
| Ministry of Health | Ms. K. Gabadise | Supplies Officer |
| Ministry of Health | Mr. K. Motau | Refrigeration Technician |
| Ministry of Health | Mr. Laba | Logistician |
| Ministry of Health | Mr. K. Malomo | Deputy Manager (HR& Admin) |
| Ministry of Health (CMS) | Mr. T. Baaisi | Acting Director (Medicines, Logistics and Supplies) |
| Ministry of Health (CMS) | Mr. Tirelo | Principal Pharmacist |
| Ministry of Health (HSM) | Dr. P. Smith-Lawrence | Director Health Services |
| Ministry of Health (HPRD) | Ms. R. Molomo | Acting Chief Health Officer (Partnerships) |
| Ministry of Health (HSMEQA) | Mr. T. Chebani | Chief Health Officer (Informatics) |
| Ministry of Health | Mr. Matome | Procurement Officer |
| Ministry of Health | Ms. Ramonna | Health Education Officer |
| Ministry of Health | Ms. Faith Mafa | Media |
| Presidential COVID-19 Task Force | Dr. Matshaba | Scientific Advisor to the Presidential COVID-19 Task Force, and Executive Director- Botswana-Baylor Children's Clinical Centre Of Excellence |
| NEOC | Mr. Ranjo | Senior Superintendent |
| NEOC | Mr. Tlhalerwa | Sergeant |
| Office of the President | Mr. Senthumoleng | Procurement Officer |
| UNICEF Botswana | Tryphinah Lungah | Operations Manager |
| UNICEF Botswana | Joseph Segodi | Social & Behavior Change Officer |
| USAID | Ms. Setshwano | COVID-19 Manager |

| | | |
|---|---|---|
| WHO | Dr. Juliet Bataringaya | Health Systems Advisor |

# ANNEX 2: Informed consent form

## Informed consent form for the study

### "Estimation of COVID-19 vaccine delivery costs in Botswana"

April 2022

My name is X, and I work for [Ministry of Health or UNICEF]. I am a researcher involved in a study about the costs of delivering COVID-19 vaccines in Botswana, being conducted by the Ministry of Health and UNICEF. I would like to invite you to participate in this research.

The aim of our study is to evaluate costs of COVID-19 vaccine delivery from its start in March 2021 until the end of March 2022. Vaccine delivery costs are also referred to as operational costs and include costs such as cold chain, subsistence allowances and social mobilization. Knowing these costs are essential for optimal planning and budgeting.

This research will involve your participation in providing some programmatic and/or financial data about the COVID-19 vaccination program. We may also ask you some questions about your role in the vaccination program. You are being invited to participate because of your knowledge about this data and the vaccination program.

During the interview we will take notes about your answers, but not record the session. Following our initial interaction we may contact you again during the study period, which is expected to run through July 2022, with follow-up questions or requests for additional data. Any data you provide to us either verbally or by electronic communication will be kept secure and only used for the purposes of this study.

The questions we will ask and data we request from you are primarily programmatic and financial, but in some cases you may also provide your personal opinion. You do not have to answer any question or provide the requested data if you feel the request is too personal or makes you uncomfortable.

There may be no direct benefits to you personally in participating in the research, but the information collected from all participants will be useful to the Ministry of Health, other government agencies and partners involved in COVID-19 vaccination efforts in Botswana for planning and budgeting purposes. The study will also contribute to the global knowledge about COVID-19 vaccination delivery costs.

You will not be provided any financial incentive to take part in the research.

Your participation in this research is entirely voluntary. The choice that you make will have no bearing on your job or on any work-related evaluations or reports. You may change your mind later and stop participating even if you agreed earlier.

This study has been reviewed and approved by the Ministry of Health's Department of Health Policy, Research and Development, as of [date]. If you have any questions about the study, you can contact Onalenna T Mokena, Principal Investigator (PI) from Department of Health Policy, Research and Development, Ministry of Health, tel. +267 71 452 069, email otrmabote@gmail.com.

[Ask participant if they have any questions about the study.]

## "Estimation of COVID-19 vaccine delivery costs in Botswana" study

### Participant certification

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions I have been asked have been answered to my satisfaction. I consent voluntarily to be a participant in this study.

| | |
|---|---|
| **PRINT NAME OF PARTICIPANT** | |
| **SIGNATURE OF PARTICIPANT** | |
| **DATE** | |

# ANNEX 3: Interview topic guides

This annex contains the topic guides for the national level interviews as part of the costing study of Botswana's COVID-19 vaccination program. They are organized by resource item; there may be various respondents for each resource item.

## General

### Objectives

**Obtain general information about Botswana's COVID-19 vaccination program**

### Questions

1. How many doses have been delivered via each delivery modality (fixed site, outreach, drive-through, private facilities and schools)?
2. Is there any difference between outreach and mobile clinics?
3. We understand a budget was prepared as part of the NDVP (March 2021), and then revised in November; have you worked from the NDVP budgets or do you have a separate budget that you use?
4. If yes, what are the main differences between the two?
5. Did you feel the budgets developed for the two NDVPs (March and November) were accurate? Were all budget lines able to be financed? What challenges did you have with regards to budgeting and financing this budget?
6. Can you explain how you came up with the unit cost and quantity assumptions for both the 8 March and the November NDVP budgets?
7. What was the process for revising the budget for the March version of the NDVP? Did this include revision unit cost assumptions or only activities and quantities?
8. How are COVID-19 vaccine expenditures tracked in terms of budget lines – is there a separate budget line(s) or are expenditures included in existing budget lines?
9. What have been the sources of financing for COVID-19 vaccination, not only for vaccine procurement, but for delivery costs such as surge HR, cold chain equipment, social mobilization activities, etc.
10. Can you share exact expenditures related to COVID-19 vaccination since the vaccine was introduced? Again, not only for procurement but also for delivery costs such as surge HR, cold chain equipment, social mobilization

## Human resources

### Objectives

**To better understand how existing health workers were utilized to support COVID-19 vaccination and if additional health workers were hired**

### Questions

1. Can you describe how the overall needs for human resources (HRH) were identified for supporting COVID-19 vaccination? Are we correct that RHMTs[9] estimated the HRH needs per district?
2. How were existing HRH utilized for COVID-19 vaccination (redeployment)?
   a. Do you have any idea of the number of existing HRH redeployed?
   b. Were they redeployed full-time or part-time (one day a week, for example)?
   c. Besides training, were there costs associated with redeploying HRH? For example, having to pay subsistence allowance for HRH working outside their normal working areas, etc.?
   d. Did you put in place any measures to try to mitigate the impact of the redeployment on existing health service delivery?
   e. Have you done any analysis to try and understand the impact of this redeployment on the delivery of other health services?
3. Were additional HRH hired to support COVID-19 vaccination (surge)?
   f. If surge hires were needed, how were these needs met? (volunteers / students / retired health workers / others)
   g. Were needs for additional HRH concentrated at a particular level (e.g. service delivery, district level) or in a particular area (e.g. vaccination, social mobilization, etc.)
   h. To what extent have these needs been met?
   i. Was the additional recruitment managed at central level or at lower levels?
   j. What funds were used to meet these additional needs?
   k. What is the long-term plan for these additional HRH? Will they be retained in the health system after the campaign?
4. If not already mentioned, did you use CHWs for any tasks related to COVID-19 vaccination?
5. Have you monitored how many vaccines each health worker delivered per day?

## Cold chain

### Objectives

**To understand cold chain capacity, cold chain equipment ordered including UCC and how vaccine transport was organized**

### Questions

9. The data collection tools referenced RHMTs, though we refer to DHMTs elsewhere in the report.

1. Can you describe how the cold chain for COVID-19 vaccines is maintained?
2. Are vaccines stored at health facilities or collected directly from a district medical store or another type of intermediate deposit?
3. How is cold chain maintained on outreach/mobile clinics, schools and at drive-through sites?
4. Was there any additional investment in cold chain equipment needed for COVID-19 vaccination? How were needs identified?
   a. If more equipment was needed: at what administrative level were the needs gap, how were additional investments financed, etc.)
   b. Did you procure any ultra-cold chain (UCC) equipment?
   c. From whom was cold chain equipment procured? Who financed this procurement?
   d. Were all procurement needs able to be met?
5. Was the contract with Botswana Postal Services for warehousing and transport of vaccines modified or otherwise expanded as a result of the COVID-19 vaccination program?

## Social mobilization

### Objective

**To understand which types of social mobilization strategies were used for COVID-19 vaccination, if more social mobilization was needed to address vaccine hesitancy issues, etc.**

### Questions

1. Can you describe the social mobilization strategy that was implemented/is being implemented?
   a. Was there a nation-wide social mobilization campaign? (e.g. what medium were/are used, how was social mobilization content produced and distributed, etc.)
   b. Were there localized campaigns in certain areas of the country, or targeting certain population groups?
   c. Did the social mobilization strategy change as vaccine rollout progressed, in response to vaccine hesitancy issues, for example?
   d. How is social mobilization financed? Are nation-wide campaign and local social mobilization events financed in the same way? Please elaborate.
   e. How were social mobilization activities staffed – for example existing HRH, surge HRH, volunteers, CHWs, etc.?
2. Compared to other new vaccines introduced recently, such as RV and PCV, would you say that more or less social mobilization activities were planned?
3. What do you think worked well with regards to the social mobilization strategy for COVID-19 vaccination, and what challenges did you face?

# ANNEX 4: RHMT[10] Data collection tools

Revised 16 September 2022

## 1. Regional profile

| | |
|---|---|
| **NAME OF THE RHMT[11]:** | |
| **NO OF ADMINISTRATION POINTS:** | |
| **NAME OF DISTRICTS PART OF THIS RHMT:** | |
| **NO OF VILLAGES:** | |
| **GEOGRAPHICAL CLASSIFICATION AS PER SAMPLING (CITY/TOWN/RURAL):** | |
| **DESCRIBE THE GEOGRAPHY OF THIS RHMT (PHYSICAL ACCESSIBILITY, VASTNESS, ETC.):** | |
| **NO OF HARD TO REACH AREAS:** | |
| **TERRAIN STATUS:** | |

10. The original data collection tools referenced RHMTs, though we refer to DHMTs elsewhere in the report.
11. The original data collection tools referenced RHMTs, though we refer to DHMTs elsewhere in the report.

# 2. Respondent names, titles and contact information

| NAME | TITLE/ROLE | TELEPHONE NO. | DATE(S) INTERVIEWED |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

# 3. Qualitative questions

1. Who were the main persons involved in organizing and delivering COVID-19 vaccinations in this region?
2. Please describe the process of requesting and receiving resources (human resources, funding, supplies and equipment from MoH, local procurement, etc.) to support COVID-19 vaccination in this district.
3. Please describe the process for budgeting for COVID-19 vaccination-related costs. Were you given your budgets as requested, and how timely were they received? If not which areas were cut/or not covered? Or how short was the budget?
4. In terms of resources (not funding) requested: were you given the resources as per your implementation needs? If not, what was limited? How timely were resources provided?
5. Can you share a copy of the GABS system (Accounting System) report for the period 1 March 2021 to 31 March 2022, for all expenditures related to COVID-19 vaccination?
6. How were vaccines, vaccination supplies and other equipment/ supplies received from national MoH to this region? How were these items then distributed throughout the region?

# 4. Vaccination by modes of vaccine delivery

## 4.1. Summary

| Vaccinating Facility | Date | Mode of vaccination (Fixed, mobile, schools, high volume) | Distance from administration point | Estimated popn | No of nurses used | No of vehicles | No of people vaccinated | No of vaccines used | No of vaccines wasted |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

**All data should be collected for the period 1 March 2021 to 31 March 2022.**

Comments:

## 4.2. Monthly totals –doses delivered

In the below table please record the number of doses delivered through each delivery modality, per month.

| | DELIVERY MODALITY | | | | | |
|---|---|---|---|---|---|---|
| | FIXED SITE | OUT-REACH | DRIVE-THROUGH | PRIVATE FACILITIES | SCHOOLS | **TOTAL (ALL MODALITIES)** |
| MARCH 2021 | | | | | | |
| APRIL 2021 | | | | | | |
| MAY 2021 | | | | | | |
| JUNE 2021 | | | | | | |
| JULY 2021 | | | | | | |
| AUGUST 2021 | | | | | | |
| SEPTEMBER 2021 | | | | | | |
| OCTOBER 2021 | | | | | | |
| NOVEMBER 2021 | | | | | | |
| DECEMBER 2021 | | | | | | |
| JANUARY 2022 | | | | | | |
| FEBRUARY 2022 | | | | | | |
| MARCH 2022 | | | | | | |
| **TOTAL** | | | | | | |

**All data should be collected for the period 1 March 2021 to 31 March 2022.**

Comments:

# 5. Utilized resources

## 5.1. Human resources - existing

Note: Everyone who is present at a vaccination site should be recorded here; if there is a staff type missing from the list please indicate where it is marked "other". If personnel from outside the health sector, such as soldiers/police were used for security, do not note these in the below table.

If there have been variations over time, such as in the number of HRH used or allowances paid, you can note this is "comments" below the table.

Use this table only for EXISTING staff. Any HRH newly hired specifically for COVID-19 vaccination should be indicated in the following table.

| CADRE | NUMBER OF EXISTING STAFF USED FOR COVID-19 VACCINATION | AVERAGE DAYS/WEEK SPENT ON COVID-19 VACCINE DELIVERY | VACCINATION TEAM POSITION | SCALE | SALARY PAID/ MONTH | OVERTIME PAID/ MONTH | ALLOWANCES PAID/MONTH (SPECIFY TYPE – SUBSISTENCE, TRANSPORT) | TOTAL PAYMENTS/ MONTH |
|---|---|---|---|---|---|---|---|---|
| Nurses | | | | | | | | |
| Midwives | | | | | | | | |
| Data clerks | | | | | | | | |
| Supervisors* | | | | | | | | |
| Other: _____ | | | | | | | | |

**All data should be collected for the period 1 March 2021 to 31 March 2022.**

* Besides the MoH liaison officers who provided supervision, indicate any local supervision in place.

Note: if there were variations over time, for example in some months they received overtime but in others not, note in "comments" below.

Comments:

## 5.2. Human resources – newly hired

Note: Everyone who is present at a vaccination site should be recorded here; if there is a staff type missing from the list please indicate where it is marked "other". If there have been variations over time, such as in the number of HRH used or allowances paid, you can note this is "comments" below the table.

Use this table only for NEW staff. Any existing HRH who were allocated to support COVID-19 vaccination should be indicated in the previous table.

| **CADRE** | Number of newly hired staff used for COVID-19 vaccination | Average days/week spent on COVID-19 vaccine delivery | Vaccination team position | Scale | Salary or other remuneration paid/ month | Overtime paid/ month | Allowances paid/ month (specify type – subsistence, transport) | **Total payments/ month** |
|---|---|---|---|---|---|---|---|---|
| Nurses | | | | | | | | |
| Retired nurses | | | | | | | | |
| Student nurses | | | | | | | | |
| Volunteers | | | | | | | | |
| Interns | | | | | | | | |
| Unemployed nurses on temporary basis | | | | | | | | |
| Midwives | | | | | | | | |
| Data clerks | | | | | | | | |
| Security** | | | | | | | | |
| Supervisors* | | | | | | | | |
| Other: _____ | | | | | | | | |

**All data should be collected for the period 1 March 2021 to 31 March 2022.**

* Besides the MoH liaison officers who provided supervision, indicate any local supervision in place.

** Do not note existing soldiers/police who were used for security here.

Note: if there were variations over time, for example in some months they received overtime but in others not, note in "comments" below.

Comments:

## 5.3. Transport & logistics

| PERIOD | ALLOCATED TEAM | VEHICLE REGISTRATION NO | FUEL COSTS PER LITRE | FUEL COSTS PER KM | DISTANCE TRAVELLED | TIME (HRS) | PURPOSE OF TRIP (IF VACCINATION, SPECIFY MODE OF VACCINATION DELIVERY) | DESTINATION | ESTIMATED TRANSPORT COSTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

**All data should be collected for the period 1 March 2021 to 31 March 2022.**

Comments:

## 5.4. Communication costs

| PERIOD | ALLOCATED TEAM | AIRTIME AMOUNT ISSUED PER TEAM |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

**All data should be collected for the period 1 March 2021 to 31 March 2022.**

Comments:

## 5.5. Refreshment costs

| PERIOD | REFRESHMENT COSTS | NUMBER OF TEAM MEMBERS | COST PER PERSON |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

**All data should be collected for the period 1 March 2021 to 31 March 2022.**

Comments:

# 6. Local procurement

## 6.1. Planned activities – local procurement

| ACTIVITIES | QUANTITY | TRAINING COSTS | IMPREST | SUBSISTENCE | OVERALL COSTS |
|---|---|---|---|---|---|
| TRAINING OF COVID-19 VACCINE DELIVERY TEAM | | | | | |
| CASCADING OF TRAINING | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**All data should be collected for the period 1 March 2021 to 31 March 2022.**

Comments:

## 6.2. Equipment/supplies/services – local procurement

| EQUIPMENT/ SUPPLY/SERVICE | PURPOSE | QUANTITIES | DATE PURCHASED | DATA SOURCE | COSTS |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**All data should be collected for the period 1 March 2021 to 31 March 2022.**

Note: include expansions to the cold chain here only if the items were locally purchased. If the DHMT received additional cold chain-related equipment from national MoH, please note it in comments below so we can triangulate at national level.

Comments:

## 6.3. Refreshments (do not repeat data already reported) – local procurement

| DATE/PERIODS | PURPOSE | TYPE | QUANTITIES | COSTS |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**All data should be collected for the period 1 March 2021 to 31 March 2022.**

Comments:

## 6.4. Infection control – local procurement

| PERIOD | SERVICES/GOODS | PURPOSE | TYPE | QUANTITIES | COSTS |
|---|---|---|---|---|---|
| | VACCINE WASTE DISPOSAL | | | | |
| | SANITISERS | | | | |
| | SOAP | | | | |
| | PPE | | | | |
| | MASKS | | | | |
| | APRONS | | | | |
| | | | | | |

**All data should be collected for the period 1 March 2021 to 31 March 2022.**

Comments:

## 6.5. Health promotion & education – local procurement

| DATE | ACTIVITY | PURPOSE | VENUE | QUANTITIES | COSTS |
|---|---|---|---|---|---|
| | | *Campaigns* | | | |
| | | *Community Mobilisation* | | | |
| | | *PA system* | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**All data should be collected for the period 1 March 2021 to 31 March 2022.**

Comments:

## 6.6. Transportation costs – local procurement

| PERIOD | VEHICLE REGISTRATION NUMBER | PURPOSE | MILEAGE | FUEL COSTS | DRIVER COSTS(OVERTIME) | OVERALL COSTS |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

**All data should be collected for the period 1 March 2021 to 31 March 2022.**

Comments:

## 6.7. Running costs – local procurement

| PERIOD | PRODUCT | PURPOSE | AMOUNT USED | COSTS |
|---|---|---|---|---|
| | FUEL | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**All data should be collected for the period 1 March 2021 to 31 March 2022.**

Comments:

# 7. Use of pooled resources

## 7.1. Transport & logistics

| VEHICLE REGISTRATION | DRIVERS COSTS | DISTANCE TRAVELLED | FUEL COSTS | PERIOD OF USE | PURPOSE | ESTIMATED OVERALL COSTS | SOURCE OF POOLED RESOURCE / FUNDING |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**All data should be collected for the period 1 March 2021 to 31 March 2022.**

Comments:

## 7.2. Services & other goods

| SERVICE/GOODS | PERIOD USED | PURPOSE | ESTIMATED PERIOD COSTS |
|---|---|---|---|
| *Broadcasting services* | | | |
| | | | |
| | | | |
| | | | |
| | | | |

**All data should be collected for the period 1 March 2021 to 31 March 2022.**

Comments:

## 7.3. Security costs if utilized soldiers/police

| PERIOD | CADRES | QUATITIES | SALARY PAID | OVERTIME | OVERALL COSTS |
|---|---|---|---|---|---|
| | *Soldiers* | | | | |
| | *Police* | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**All data should be collected for the period 1 March 2021 to 31 March 2022.**

Comments:

# ANNEX 5: Validation Meeting Participants

## MoH Senior Management Team participants

### March 2023

| NAME | DESIGNATION |
|---|---|
| Grace Muzila | Permanent Secretary (MoH) |
| Abia Sebaka | Deputy Director (Health Research) |
| Kerileng M. Thela | Deputy Director (Health Policy Planning & Financing) |
| Judith Nawa | Director (HSMEQA) |
| Onkemetse Mathala | Director (HPRD) |
| Moses K. Keetile | Deputy Permanent Secretary (HPRD) |
| Gosego Pilane | ASICS (Legal) |
| Onalenna Mokena | SHO (HPPF) |
| Dr. Pamela Smith-Lawrence | Director Health Services |
| Dr. Christopher Nyanga | CPRO |
| Mpaphi Mbulawa | DHLS |
| Setso-O-Setso | DITI (CMS) |
| Pinkie K.Letsholo | Deputy Director (HI) |
| Moagi Mbayi | Manager-Corporate-BPHI |
| Karabo Thokwane | Ag. DPS-HSM |
| Alexandre illmer | Deputy Country Representative, UNICEF |
| Yvonne Tswelelo Morgan | Health & Nutrition Specialist, UNICEF |
| Samuel Phiri | Social Policy Manager, UNICEF |
| Goabaone Rankgoane-Pono | UNICEF Consultant |
| Kenalefe Mhusiwa | ACU mg |
| Gaolope Rodrick Mogotsi | Private Sector Rep. |
| Nonofo Kgosiyagae | Chief Economist |

# Stakeholder validation workshop attendees

## March 2023

| NAME | DESIGNATION | ORGANISATION |
|---|---|---|
| Nayang Masinta | Procurement Officer | Greater Gaborone DHMT |
| Rachel Nlada | Financial & Operations Manager | GHSC-PSM |
| Kaone P. Bogatsu | Acting Deputy Director BADM | Ministry of Finance |
| Mogomotsi Matshaba | Executive Director | Botswana-Baylor Children's Clinical Centre Of Excellence |
| Neo Mogowa | Project Manager | Botswana Red Cross |
| Kenole Ntumelang | Pharmacist | Boteti DHMT |
| Tirelo. O. Mompati | Procurement | Boteti DHMT |
| Goabaone Rankgoane-Pono | UNICEF Consultant | UNICEF |
| Moses K. Keetile | DPS-HPRD | MoH |
| Onalenna Mokena | SHO (HPPF) | MoH |
| Dr. Clement Mukadi | Head of Preventive | Chobe DHMT |
| Mosetsana Modise | Research Officer | MoH |
| Samuel Phiri | Social Policy Manager | UNICEF |
| Thato Masire | Communications | UNICEF |
| Thabiso Mogowa | Resident | University of Botswana |
| Dorothy Tlagae-Gaseitsiwe | Country Director | Global Communities |
| Dineo Kebadiretse | Resident | University of Botswana |
| Yvonne Morgan | HN Specialist | UNICEF |
| Solomon Mphothwe | SHEC | MDS HQ |
| Dikeledi Matebu | PAO | Southern DHMT-Jwaneng |
| Itumeleng Mokweni | POII | Southern DHMT-Kanye |
| Neo Olerile | POII | Kgalagadi North DHMT |
| Kebitsang Rammona | Nurse | BDF |
| Setshwano Gaosenkwe | COVID-19 Manager | USAID |
| Mabel Mbewe | PP Technician | Central Medical Stores-MoH |
| Mavis . M. Kgosimore | Bots. Youth Focal Person | Botswana Police |
| Catherine R. Rauwe | HOS/ SHE Officer | Botswana Police |
| Neo Palai | F&A Manager | FHI360 |
| Goitseone Fiona Moses | M&E Officer | Southern DHMT-Moshupa |
| Mooketsi K. Moalosi | PHO (HPP&F) | MoH/HQ |
| Anthony Wally | Deputy Director | Botswana Police |
| Tony Chebani | Chief Health Officer | Health Informatics, DHSMEQA, MoH |
| Tshego Chilume | Manager IR | BoMRA |
| Mothusi Mogatle | Family Physician | Greater Gaborone DHMT |

# Estimation of COVID-19 vaccine delivery costs **in Botswana**


unicef
for every child