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COVID-19 Vaccination: Opportunity to Strengthen Immunization System in Belize

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ABSTRACT

Objective: **To describe the process of leveraging COVID-19 vaccination roll out to strengthen immunization system in Belize.**

Methodology**: The Case study was conducted using desk review of relevant documents for the roll out of COVID 19 vaccination in response to the pandemic and analysis of the COVID-19 vaccination and routine immunization data extracted from the Belize Health Information System. The approach was a retrospective review of the strategies adopted by the government of Belize with support of UNICEF and other health partners using the roll out of COVID-19 vaccination to strengthen the country's immunization system. Descriptive data is presented in graph and table and a test of association was done using a paired t-test to compare the mean change in annual routine immunization coverage before (2020) and after (2022) roll out of COVID-19 vaccination and p-value was set at a significant level of 5%**

Results**: The National Vaccine Implementation Plan for the introduction of COVID-19 vaccination in 2021 was used as a transformative opportunity for building resilient immunization programs. Key areas focused on in the study were the enhancement of cold chain equipment and storage capacity, utilization of digital tools, improved data management, and innovative immunization service delivery.**

The result shows that the annual coverage of the first dose and third dose of pentavalent vaccine (Penta 3) increased from 79% and 78.5% in 2020 to 91% and 84.3% in 2022 respectively though not statistically significant (p value> 0.05). So far, 258,443 (65% of the total population) have received at least one dose of COVID-19 vaccine and 221,402 individuals (51.3% of the total population) have been fully vaccinated.

Conclusion**: The study contributes to the existing literature on the use of COVID-19 investments as an opportunity to strengthen the health system with a focus on immunization services which is essential in building a resilient health system.**

Keywords: COVID-19 vaccination, immunization, opportunity, strengthen, system.

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I. Introduction

The COVID-19 pandemic negatively affected the health system in almost all countries of the world and has stalled progress towards achieving universal health coverage [1]. Belize, like many countries around the world, was hit hard by the COVID-19 pandemic and recorded the first case on 23rd March 2020 [2]. The country has historically maintained high levels of vaccination coverage but has experienced a considerable decrease over the last few years and reported a decline in immunization coverage from over 95% to less than 70% in the last 2 years before the pandemic [3]. The onset of the COVID-19 pandemic has exacerbated this trend, and more children have missed essential vaccines while migration also contributed significantly especially to the rural areas and border communities. The zero-dose percentage share of children under the age of one in Belize is 17% and the prevalence of zero-dose children in the rural area is 8.7 % and 4.7% in the urban area [3]. Poorest households are almost three times as likely to be zero doses as children in the wealthiest households [3].

The impact of COVID-19 pandemic on the health systems underscored the need for strengthening health system resilience to make and sustain progress toward Universal Health Coverage (UHC) and global health security [4].

Belize officially launched the introduction of COVID-19 vaccination on March 1, 2021, as part of the preventive measures to respond to the pandemic [2].

This case study described the process of leveraging COVID-19 vaccination roll out to strengthen the immunization system and the outcome of the initiative in Belize.

II. Case Study

The Case study was conducted using desk review of relevant documents for the roll out of COVID 19 vaccination

in response to the pandemic and analysis of the COVID-19 vaccination and routine immunization data extracted from the Belize Health Information System. The approach was a retrospective review of the strategies adopted by the government of Belize with support of UNICEF and other health partners in using the introduction of the COVID-19 vaccination to strengthen the country's immunization system. Descriptive data is presented in the graph and table and a test of association was done using a paired t-test to compare the mean change in annual routine immunization coverage before (2020) and after (2022) roll out of COVID-19 vaccination and the p-value was set at a significant level of 5%. Descriptive data is presented in graph and table and univariate analysis was done by generating frequencies of the variables and a test of association was done using a paired t-test to compare the mean change in annual routine immunization coverage before (2020) and after (2022) roll out of COVID-19 vaccination in 2021 and p-value was set at the significant level of 5%.

The result is organized and presented along two major themes:

1) The description of the process for COVID-19 vaccination roll out

2) Program Results; the analysis of immunization coverage for COVID-19 vaccination and annual routine immunization coverage between 2020 and 2022.

A. The Description of the Process of COVID-19 Vaccination Roll Out

The introduction of COVID-19 vaccination was guided by the national vaccine implementation plan developed following the completion of multiple rounds of Vaccine Introduction Readiness Assessment Tool (VIRAT)/Vaccine Readiness Assessment Framework (VRAF 2.0) for COVID-19 vaccination [5]. The process was led by the National Coordinating Committee with technical guidance from the National Immunization Technical Advisory Group (NITAG) [5].

Learning from the polio legacy of leveraging polio investment to strengthen primary health care [6], the country leveraged the COVID-19 vaccination rollout as a transformative opportunity for building resilient immunization programs. The key areas focused on were enhancement of the cold chain equipment and storage capacity, utilization of digital tools, improved data management, and innovative service delivery strategies.

1) Cold chain equipment and temperature monitoring devices

UNICEF and the Ministry of Health and Wellness (MOHW) conducted technical screening of the cold chain equipment in the country using WHO Cold Chain Equipment Inventory and Gap Analysis Tool [7]. This is a planning tool for conducting and analysing cold chain equipment inventory. Some of the functions of the planning tool included recording and analysis of cold chain equipment inventory data and generating facility segmentation for appropriate cold chain equipment to match each of the health facility and national store profiles. The tool also helped in equipment replacement based on the type, working status, and age and supported in estimating maintenance and running costs of the existing cold chain equipment. The outcome of the technical screening led to the enhancement of the cold chain infrastructure at the national and district levels across all the health facilities with funding from the government and support from other partners which included UNICEF, PAHO, Inter-American Development Bank, World Bank, Embassy of Japan and other donors. Additional walk-in cold rooms were installed to expand the national vaccine storage capacity and at the health facilities level domestic freezers and refrigerators were replaced with quality biomedical freezers and freezer/refrigerators including ultra-cold chain freezers. All the cold chain equipment was connected to remote vaccine temperature monitoring devices (RTM) which provide real-time data and alarms from the cold chain network.

Remote Temperature Monitoring (RTM) system is a compact wireless temperature sensor that tracks temperature and humidity conditions for real time monitoring of storage conditions at different levels of the cold chain from the national storage to the health facilities where vaccines are stored for day-to-day vaccination [8]. It is integrated with an audio-visual alarm and automatic transmission of data to a server and with data access, setup of alarm thresholds, and alarm recipients through internet accessible dashboard capable of alarm notifications via SMS, email, and/or iOS and Android mobile applications [8]. Fig.1 shows a sample of the monthly temperature monitoring chat.

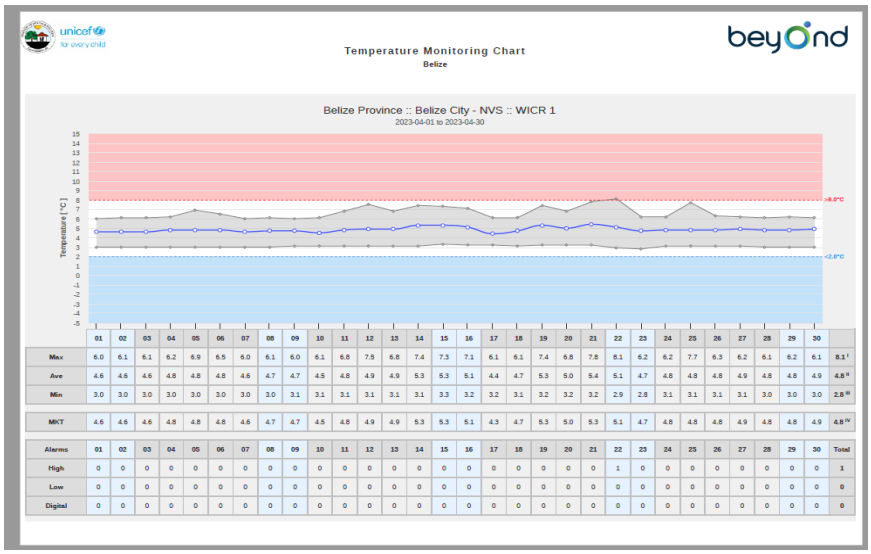

Fig. 1. Sample of chart from the remote temperature monitoring dashboard.

2) Data management

The Belize Health Information System (BHIS) was updated to accommodate COVID-19 immunization data and provides real-time tracking of both COVID-19 vaccination and routine vaccination coverage from most of the public health facilities However, paper-based system was used to collect vaccination data in some rural health facilities and outreach centers without access to BHIS, which are later entered in the system at a BHIS-ready facility. This usually leads to a backlog in data entry. In order to ensure fully digitized immunization data entry at all vaccination sites and real time data monitoring for all vaccination services, the government with the support of UNICEF and Salud Mesoamerica Initiative (SMI) and Inter America Development Bank (IADB) introduced the use of CommCare Vaccination mobile App which is synchronized with the BHIS [9]. The Vaccine App is used to record immunization data from health facilities without BHIS and vaccination outreach sites. The App saves a lot of time for the health workers providing the immunization services because the data entry is quicker using the App than the paper registers and also ensures accurate data entry. The data entry into the Vaccine App can be done offline in the field where there is no internet connectivity and then uploaded into the BHIS when the devices are connected to the internet. The synchronization of the vaccination app with the BHIS ensures real time and updated vaccination data for each individual. Fig. 2 shows CommCare Vaccine mobile App for recording immunization data.

Fig. 2. CommCare Vaccination mobile App for Immunization data collection.

3) Services delivery

Within the framework of the National Vaccination Implementation Plan, with active engagement of the local stakeholders, the district vaccine deployment plan was developed for the six health districts. The mass COVID-19 vaccination campaigns were conducted in all health facilities while mobile clinics were deployed to schools, community centres, and hard to reach communities. COVID-19 vaccines were provided to eligible individuals based on the national guideline along with routine vaccines for all residents, irrespective of immigration status. The vaccines were administered mainly by health workers in the public health facilities and several private sector healthcare providers who volunteered their support with the deployment efforts. Home visits were also used to reach persons with mobility restrictions and for tracking and vaccination of children who have missed routine immunization as a result of COVID-19 pandemic.

However, the campaign negatively affected the utilization of routine health services because healthcare workers and resources were diverted from providing essential health services, including immunization services. The government of Belize with support from partners commenced the integration of COVID-19 vaccination with the routine immunization system in April 2022. The service delivery approach used was a collaboration between COVID-19 vaccination and other existing immunization delivery platforms targeting different age groups using fixed health facilities, mobile clinics, and home visits as the delivery strategies [10]. The fixed health facilities offered both routine and COVID-19 vaccines daily while the mobile teams were deployed based on schedule to villages that are far reach from the fixed health centres and the communities with the lowest vaccination coverages prioritized for both routine and COVID-19 Vaccines. The mobile team and the home visit teams also tracked and provided mop up vaccination for missed children to help with the reduction of zero-dose children.

B. Programme Results

1) Quantitative analysis

The data on both COVID-19 and routine vaccinations were analysed. The data provided the coverage of COVID-19 vaccination at the time of the study and the trend in the annual coverage of the various routine vaccines before roll out (2020) and after roll out (2022) of COVID-19 vaccination.

By May 2023, a total of 258,443individuals which is 65% of the total population had received at least one dose of COVID-19 vaccine, and 221,402 individuals (51.3% of the total population) were fully vaccinated [2].

Fig. 3 shows that the annual coverage of the first dose and third dose of pentavalent vaccine (Penta 3) increased from 79% and 78.5% in 2020 to 91% and 84.3% in 2022 respectively, while the annual coverage of the second dose of measles, mumps, and rubella (MMR 2) vaccine decreased from 87.1% in 2020 to 76.3% in 2022.

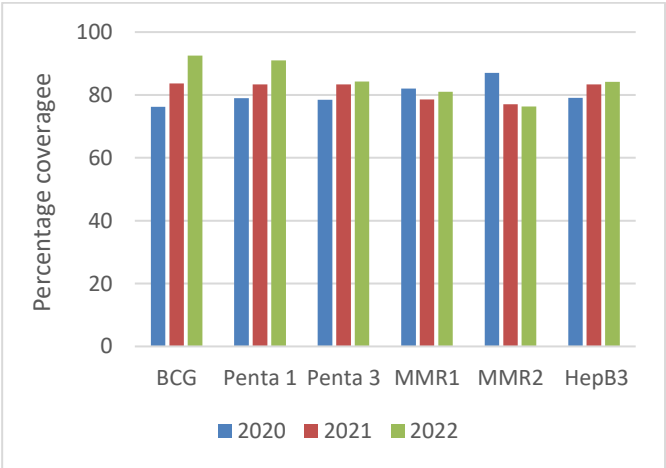

Fig. 3. Routine Immunization Coverage (2020-2022).
Source: MOHW(BHIS). Trend in immunization coverage (2020-2022)

These differences in the coverage are however not statistically significant as shown in Table I, which is the results of bivariate analysis using paired t-test of the change in annual immunization coverage for 1st and 3rd doses of pentavalent vaccines [Penta 1 and Penta 3] and second dose of Measle Mumps and Rubella vaccine (MMR 2) between 2020 and 2022. The mean number of children who received the first dose of the pentavalent vaccine (Penta 1) in 2020 (mean=978.83; SD= 360.86) compared to (mean=975.67; SD=361.45) with p-value of 0.98 in 2022. The mean number of children who received the third dose of pentavalent vaccine (Penta 3) in 2020 (mean=795.83; SD=270.00) compared to (mean=915; SD=308.21) with p-value of 0.49 in 2022.

The mean number of children who received the second dose of Measle Mumps and Rubella vaccine (MMR 2) in 2020 (mean=899; SD =287.67) compared to (mean=841.16; SD=307.39) with p-value of 0.74 in 2022.

TABLE I: BIVARIATE ANALYSIS OF ANNUAL IMMUNIZATION COVERAGE BETWEEN 2020 AND 2022

Variables	Mean± SD	T-test value	P-value
Number of children who received 1st dose of pentavalent vaccine (Penta 1) in 2020	978.83±360.86	0.0152	0.98
Number of children who received 1st dose of pentavalent vaccine (Penta 1) in 2022	975.67+361.45		
Number of children who received 3rd dose of pentavalent vaccine (Penta 3) in 2020	795.83±270.00	0.7124	0.49
Number of children who received 1st dose of pentavalent vaccine (Penta 3) in 2022	915±308.21		
Number of children who received 2nd dose of Measles Mumps and Rubella (MMR2) vaccine in 2020	899±287.67	0.3365	0.74
Number of children who received 2nd dose of Measles Mumps and Rubella (MMR2) vaccine in 2022	841.16±307.39		

Source: MOHW(BHIS). Trend in immunization coverage (2020-2022).

III. DISCUSSION

The Coronavirus disease (COVID-19) pandemic exposed the weakness and vulnerability of the health system in ensuring health security and achieving universal health coverage [11], [12]. A systematic review that assessed the extent of integration of essential health services in the COVID-19 preparedness and response plan of 106 countries reported that the majority of the plans had a high degree of alignment with pillars of emergency response such as surveillance (99%), laboratory systems (96%) and COVID-19-specific case management (97%) but less than half considered leveraging on the response to maintain or strengthen essential health services (47%) [13].

There is growing recognition of the need to leverage the investments for the COVID-19 pandemic as an opportunity to strengthen the health system [11], [12]. Many countries have been implementing various innovative integrated approaches and actions to build health systems resilience leveraging on the COVID-19 pandemic [14], [15]. This includes utilizing digital tools, strengthening essential health services, improvements in all-hazard emergency risk management, developing multisectoral partnerships, strengthening health information and surveillance systems, and community engagement aimed at increasing country investment into health systems resilience and strengthening national response to the pandemic [14], [15]. There is limited documented evidence on leveraging the investment in COVID-19 vaccination as the opportunity to strengthen immunization systems to compare with our findings.

Leveraging the roll out of COVID-19 vaccination as an opportunity to strengthen immunization system in Belize aligns with the fourth strategic priority of the Immunisation Agenda 2030 (IA2030) which aims at using context appropriate measures to address the missed opportunities for vaccination [16].

The disruption of routine immunization services due to the COVID-19 pandemic has worsened the decline in global immunization coverage below the targets in the Global Vaccine Action Plan [17], [18]. A study by WHO that assessed missed opportunities for immunization within and between countries reported a prevalence of missed opportunities as high as 89% in some settings [19]. Thus, addressing missed opportunities for vaccination by leveraging the investment for COVID-19 vaccination has become imperative for attaining unmet aspirations in the Global Vaccine Action Plan and for providing catch-up vaccinations to undo the pandemic's damage on immunisation progress [20].

Case studies from selected countries which included Guyana, Sri Lanka, Rwanda, Tanzania, and Malawi reported on how the countries leveraged the investment in the COVID-19 response to implement innovative strategies to ensure the continuity of essential health services and incorporation of COVID-19 vaccination into their National Response Plans [14].

Similar to the use of the COVID-19 investment to strengthen Health information system and real time data monitoring for immunization services in Belize, various studies reported that the use of COVID-19 response fund contributed to strengthening the national electronic disease surveillance system in countries where COVID-19 surveillance was integrated into an existing surveillance system [21]–[23]. The COVID-19 response was used to enhance Afghanistan's national surveillance system to improve on case detection, investigation, screening, and decentralized testing [21]. In Tanzania, Sierra Leone, Uganda, and Sri Lanka, the investment made in digital technology for COVID-19 pandemic preparedness and response to improve case base reporting at health facilities and facilitate contact tracing was integrated into the existing national surveillance to facilitate better data-driven planning and decision-making which are essential to health system building [22], [23].

The innovative digital technology used to support COVID-19 response in strengthening monitoring, surveillance, case management, contact tracing, training of health workers, and vaccine deployment among others are essential investments in pandemic recovery plans.

IV. Conclusion

The study contributes to the existing literature on the use of COVID-19 investments as opportunity to strengthen the health system with a focus on immunization services which is essential in building a resilient health system.

Authors Contribution

This work was carried out in collaboration among all authors. Author OO conceived the manuscript documentation, analysed the data drafted, and finalized the manuscript. Authors NLB, AB, and LM collected the data. All the authors read, reviewed, and approved the final draft of the manuscript.

Conflict of Interest

The authors declare that they do not have any conflict of interest.

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Disclaimer

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