RESULTS FOR DEVELOPMENT

Case Study

Using Digital Tools for COVID-19 Vaccinations: Perspectives from inside Ghana's health system

February 2023

Background

The first cases of COVID-19 were reported in Ghana in March 2020, following which the government declared a national emergency. In March 2021, the National Vaccine Deployment Plan (NVDP) was launched with the goal of fully vaccinating ~72% of the total population. As of December 2022, Ghana had delivered over 21.4 million doses of the COVID-19 vaccine, covering more than 50% of its population.

This has been the country's largest mass vaccination exercise to date, led by the Ghana Health Service (GHS). It is also the first-time digital tools have been used to capture vaccination details to inform decision-making and ensure the safety and confidence of Ghana's citizens. The effort has required coordination across the health system, integrating the work of individuals all the way from the national government to the regional, district and subdistrict levels, to the frontline healthcare workers who travel door to door administering vaccines.

At every level, Ghanaians have encountered challenges and triumphs, including overcoming poor internet connectivity, managing through a shortage of digital devices, building staff capacity, navigating remote rural communities and densely populated urban areas, and providing education and social mobilization to improve vaccine acceptance. Time and time again, individuals have devised creative solutions and pressed forward with the task at hand.

Results for Development (R4D) interviewed some members of the Ghana Health Service (GHS) to learn how the process of using digital tools for COVID-19 vaccinations was going. The individuals represented a cross-section of the health system from the national, regional, district, sub-district and facility levels. We wanted to learn how the use of tablets had impacted their work, both administering vaccines and using data to drive decision-making and illustrate how this had changed from previous exercises. We also wanted to know what challenges they had encountered, how they improvised to get to the last mile and the farthest person, and what lessons they could share that could help improve similar efforts in the future or in other contexts.

This case study is their story and the story of thousands of others like them who made the vaccination of Ghana against COVID-19 and the digitization of the process a reality. Their comments form the backbone of this report although their names have been changed to protect identities and encourage open dialogue.

Early Planning — The Need for Detailed Patient Information

In early 2021, members of a technical working group convened in Dodowa, a small town near Ghana's capital, Accra. They were grappling with how to approach the monumental task of vaccinating most of Ghana's population against COVID-19. Ghana was about to receive its first shipment of COVID vaccines through the COVAX Initiative, and leaders in the national government were busy planning how to manage the vaccination process. Since the vaccines were novel, they wanted to ensure a robust safety monitoring system was in place.

"It wasn't enough to just collect the number of people who had been vaccinated, we needed to know where and when they received their vaccine so any adverse effects could be tracked. We wanted to be able to track individual case-based details," said Pascal Adu*, a national-level systems analyst.

GHS had a lot of experience conducting National Immunization Days (NIDs) for polio, yellow fever and other vaccines. They had previously collected information on the number of people vaccinated, but they had never been able to see case-based details like age, sex, location, telephone number, underlying health conditions, type of vaccine administered, dosage and any adverse effects experienced.

Pascal explained further, *"If you need to have a good safety monitoring system, if you need to have control over whatever you are doing, then there should be something more than just aggregates. So that was when the thinking of getting more details came up."*

Mobilizing Resources and Staff

The working group members decided that Ghana would need to digitize the COVID-19 vaccination exercise and push beyond aggregate data to collect case-based information. This would aid health managers in a number of ways, including identifying and targeting locations with low vaccination rates and sharing updates with local and global stakeholders including information on the type of vaccines used, the number of doses received and the populations vaccinated.

"We foresaw that a time would come when we would need the information about people who have been vaccinated. A time would come when we would need to have a good safety monitoring system in place since the vaccine was novel. And for accountability purposes, we needed this ourselves to make sure that we are on top of issues," said Pascal.

Front-line workers who have been the backbone of previous vaccination exercises would carry out the ambitious vaccination plan. They would have to travel the breadth of the country and navigate rivers, lakes and poor roads. For the first time, they would also have to contend with inadequate internet infrastructure and insufficient digital tools (such as tablets) to collect patient information.

Some challenges were easier to overcome than others. The Ghanaian government galvanized support from the development partners, private sector, civil society, and religious associations to finance and deploy digital tools. Several development partners, including USAID, the World Health Organization and the Rockefeller Foundation, provided over 5,000 electronic tablets (as of the end of December

> *"In as much as we were ambitious, and we knew we were going to hit the whole country; we also took note of the realities. What were the realities? That vaccines were not going to be available enough for deployment across the board at the same time. So that was where the use of data came on board. We had to focus on priority areas, and the data informed us that we had some hotspot areas that needed to be handled. We had to firefight those areas before looking at the less burdened areas."*
>
> *— Pascal Adu*

* Names have been changed to protect the identity of those interviewed and to encourage open dialogue.

2022) to augment the government's investments.

Health workers have embraced the challenges associated with digitalizing the vaccination exercise, innovating along the way and modifying national guidelines to fit within local contexts. They have learnt along the way, incorporating lessons from this and previous vaccination drives to improve the outcomes.

Setting up the Digital Systems

Ghana has extensive experience using digital tools for health service delivery. Since 2012 it has adopted the DHIS2-based DHIMS 2 platform as its national health management information system for aggregate reporting of facility-level data. The system has been used by health facilities and district health directorates to collect, analyze, transmit and report aggregates of routine health service data.

Later, the patient-level companion, the tracker, was adopted, as facility and planning managers expressed a need for more granular information. This step would also help facilities move away from paper registers, tally sheets and monthly summary reports. It began with the deployment of the child health tracker module and has since expanded to cover other disease areas including maternal health, HIV and TB.

It is against this backdrop that the COVID-19 Immunization Registry was introduced following the decision to collect electronic data. Whilst the other tracker modules have been deployed in a few regions for specialist clinics, and scale-up is a slower deliberate process, nationwide deployment of the COVID-19 module was rapid, intensive and completed within a short time across all districts and sub-districts. Learning and application were continuous with frequent training on both the vaccines and the tracker. It was a steep hill to climb, learning through a virtual medium, with most HWs being exposed to the e-tracker for the first time whilst learning how to utilize the novel vaccines.

Results for Development (R4D) facilitated the procurement and deployment of 2,829 tablets through the Rockefeller Foundation and the USAID Health Systems Strengthening Accelerator. R4D also facilitated capacity-building on the e-tracker application and on tablet use and management for frontline workers in select regions.

Moving Tools (and Information) Within the Health System

The Ghana Health Service is a multi-tiered service delivery and administrative system. The national level provides oversight and policy direction to

> *"For every data management system, you need to have some structures in place. And for us, we have a well-structured health system hierarchy. So, once we got to know what system we were going to use, the deployment or use started with the planning of training sessions. So, there were various levels of training that targeted this cadre of officers across the board: national, regional, district and facility levels."*
>
> *— Pascal Adu*

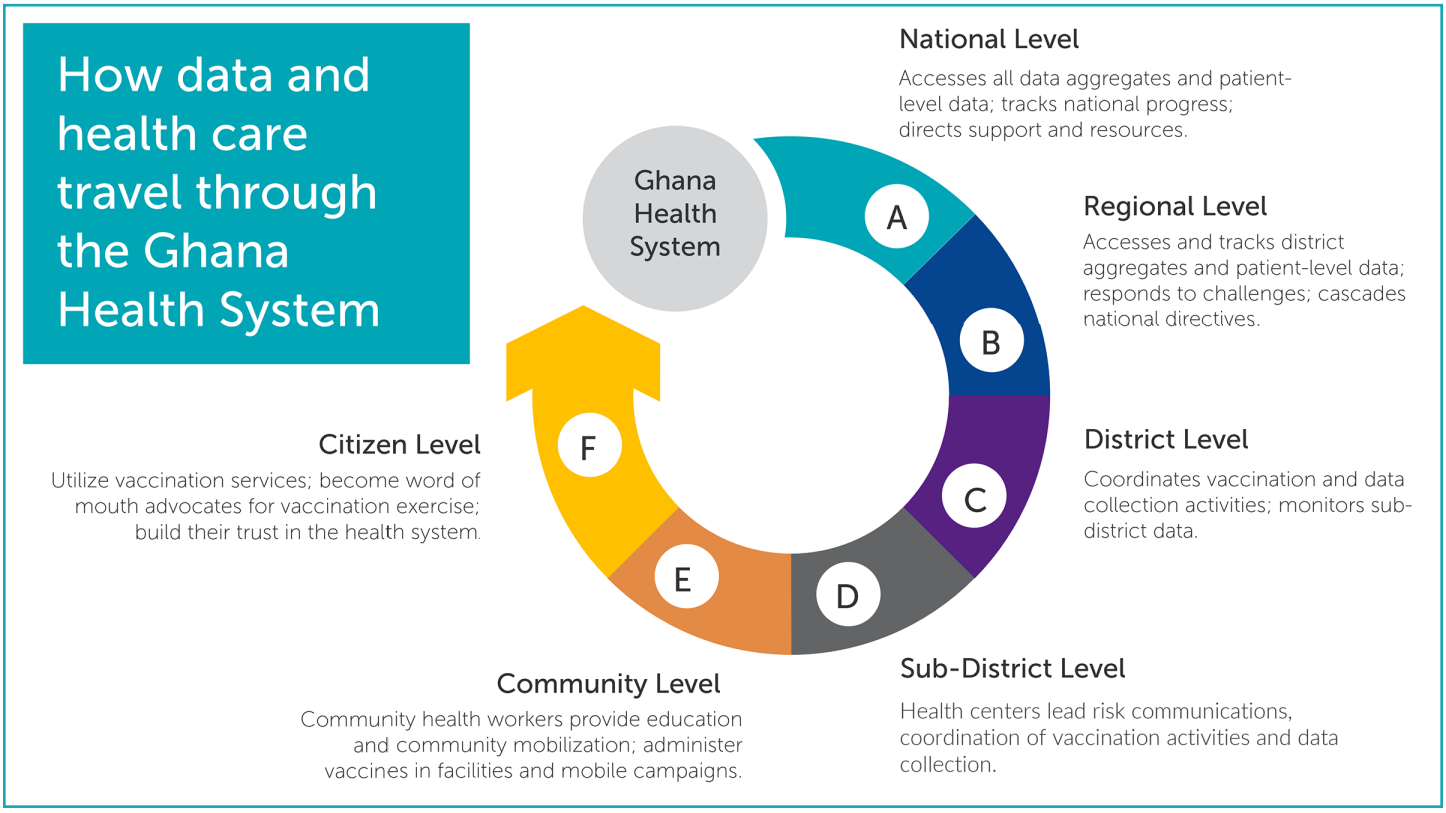
the regional, district and sub-district levels. Service delivery is carried out at the sub-national levels, each with its own administrative unit. The regional hospital provides the most comprehensive level of care in the GHS structure, followed by the district hospitals which are further broken down to the sub-district level with the health centres and maternity homes. The smallest unit within the service delivery structure is the community health and planning service (CHPS) zones, which provide outreach and home-based services at the community level.

It is within these systems that COVID-19 logistics have been managed and vaccinations carried out. For example, when the national level secures tablets, they are disbursed to the regions based on need. The regional level then deploys to the districts using the same approach, cascading the tools to the sub-district and facility-level service delivery points. (See infographic below.)

By December 2022, this region had received over 1,000 tablets which had been shared with the districts throughout the region. Kofi Ntim*, a health information officer, is using the data reported from the districts to monitor vaccination coverage in his region, respond to challenges as they arise and provide support where needed.

"The tablets have been a good data capture tool for real-time decision-making and planning interventions. We know which of the 29 districts are vaccinating more, and if a district has a low rate of vaccination, we can zoom in to see what the challenge is and decide if they need to do more social mobilization, create more awareness for people to get vaccinated based on the data coming from the tablets."

He reflected on vaccination rates in his region and his perception that digital tools helped increase them. *"The tablet enables more people to vaccinate, using a laptop or desktop at a site delays data entry, but tablets are faster, and workers can serve more people. When there is a queue, it turns people away. Using the tablets makes the queue move faster and encourages those who have been vaccinated to tell others that the process is only a maximum of 5-10 minutes."*



Monitoring from the Regional Level: Coastal Ghana

The GHS regional offices provide oversight and direction for all sub-regional activities, including deploying devices tracking and keeping records.

An Urban Perspective: A Bustling and Crowded City

In a densely populated sub-district on the coast of Ghana, 20 mobile vaccination teams have served a population of 78,600 people with 15 tablets. The sub-district Disease Control and Surveillance Officer (DSO), Mariama Abdul* said she receives tablets from the regional office and shares them among staff working in facilities, and those traveling out in the community. They try to ensure that each zone has at least one tablet to serve as a central data-capturing point and reserve the remaining tablets for mobile teams so they can easily move from house to house. Computers are used in the static delivery points (health facilities), and paper books are given to mobile teams that will not have internet services where they are going.

"There are some areas where the network is very good, so they go out with the tablets. But there are other areas where we need to supplement the tablets with booklets to ensure entries. And we also look at where they can get a lot of vaccinations. Based on that, we deploy more people who do data entries there for the vaccinations."

Mobile vaccination teams travel in groups of three (3): a vaccinator, a social mobilizer and a data capturer. Sometimes, a volunteer from the community will accompany them to facilitate entrance and engagement with the community. Located in an urban centre, this sub-district has a more reliable wireless network and the tablets are used mainly by mobile teams out in the field who can synchronize data to the DHIS in real-time with a stable internet connection. Paper for backup record keeping is still a staple in the teams' arsenal for the periods when the internet is less reliable.

Ms. Abdul said the teams appreciate using the tablets because of their convenience. *"These tablets are very portable. Laptops can't be in the field, but you can move around with this device. The battery life can also stay longer. You can walk with it throughout the vaccination period of the day without it coming down. And people say it's also very fast. So, with these considerations, it's really been very helpful for the teams and the vaccinations. They're able to do the entries wherever they are and synchronize it to the next level and it's in the system, so it has also alleviated us of backlogging a lot of data in the office. We carry less paper and it's really very effective."*

She reported that digitization has also boosted the public's confidence in the vaccination process in her locality, *"seeing you're not just writing their details on paper, but rather you're entering it in the server they know that in the future they can retrieve their details later. It makes the people have that confidence that those coming around to vaccinate, they are not just vaccinating but they are very particular about the data they are capturing."*

Health workers are enthusiastic about the ability to do mobile campaigns, traveling out into the community delivering services from house to house. *"It isn't like before when we sit and wait for people to come to us. As a public health worker, we always want to go the extra mile to give people the information and get them to use our services,"* she said.

She also reported that they have seen the benefits of digital data collection for decision-making: *"With the tablets, you can know the number of people, where they live, the places they are giving more coverages. So, at your level, you can know what each team is doing, and segregate the data easily without having to walk to them or to take their hard copies to go through to do this sort of thing. So, it's made it very easy for all these things to be done."*

Outside the City Centre: in a Rural District on the Coast

Sixty kilometres from the bustling city centre, in a more rural district, Anowa Boateng*, the District Health Information Officer (DHIO) says her district has 15 tablets in use. *"Initially, when we started, we were challenged with logistics, as in inadequate tablets and laptops to use for data entry, and we would have to sometimes work in turns with one device. But since the tablets came in, it has been very helpful. So now all the data officers have access to tablets, and they can do the data entry in their free time."*

The mobile vaccination teams consist of two (2) people: a vaccinator and the person capturing the client data. The data capturer will also sometimes do social mobilization, going from door to door and announcing the team's presence in the community when they first arrive.

Working at the edge of the city, mobile teams can't rely on a stable network connection, so during mobile campaigns, they collect the appropriate documentation using paper registers.

"What we've done is we've designed vaccination registry sheets which have all the basic information required, so as they do the vaccination, they do the appropriate documentation, then they bring it at the end of the day for the data officer [in the office] to do the data entry."

She also reported, *"In terms of analysis, as we vaccinate, we report to the regional health directorate. The entries that we do in the system help us to check the vaccination that has been given and the records that are in the DHIS II. It's a double-check for us, because sometimes there are errors. So, this helps. At any point in time, we are able to track the vaccination coverage."*

Central Ghana: A District far from Accra

In this district, 385 kilometres inland, mobile vac-cination teams travel in groups of 4: a vaccinator, a social mobilizer, a data recorder and a volunteer from the community. The vaccinators are nurses, midwives or others with a clinical background and the social mobilizers are other health staff who can answer questions, provide information, and report any adverse events.

The Municipal Health Information Officer (HIO), Boadu Asenso* said, *"for us, continuity of the COVID vaccine is a concern. As you know, when you give the vaccine, you are supposed to take the second and at times even the booster, so using the tablets helps us look that up. If somebody takes the first jab in location A then moves to location B, it becomes very easy to capture the person's details and to match the two. So you are able to know that someone took the first vaccine in x city and they are coming to our district now. They can take [the vaccine], and you can confirm that."*

He also reports that the digital system builds con-fidence in the community. *"When the community members come, and you can tell them 'I realize that you took your first jab at this location' it builds their confidence, they are able to tell the other people that look, they are recording what we're doing so it's good you go and take your vaccine."*

Mr. Asenso said he felt the tablets had helped to ease the work of health workers in his district. *"Because of the recording on the app, when it comes to data analysis and reporting, you're just capturing, clicking and you're good to go."*

At the Frontline: A Health Centre Vaccinating Citizens

Naa Kwaley Quartey*, a midwife at a Health Centre in inland Ghana, works on the frontlines as a vaccinator on mobile teams during COVID-19 national immunization days.

"In the facility where I work, our teams are made up of six members, two midwives, one nurse, and three community health nurses," she said. They also use volunteers from the community. "We pick one volunteer from each town in our subdistrict, sometimes we even get two. Most of them live in remote areas, so they know the rules and everything," she said.

Before the vaccinations begin, mobile teams travel door to door in the communities where they will be working. *"We go around and give people the pre-information. We give them the dates and other information. Some people have misconceptions about the whole thing. So, you must take them through it and you educate them before you take the vaccination to them, or else they won't accept it,"* she said.

"I remember we encountered a challenge during one of the last episodes of the vaccination. One community decided not to take the vaccination because we were strangers, and we didn't know their culture. The volunteer led us to the assemblyman so we could talk to him and educate him. The volunteers are really helping us a lot. They are helping us talk to their people, they know the roads, the landmarks and everything. They lead us to the various places where we want to go."

"You know, it's how you talk to people, you need to educate them, let the education come down to them or else they won't understand. They really trust their friends, so as soon as their friend says, 'this is not good,' the person won't participate. But glory be to God, we've been able to speak to them, we've educated them and now they've changed."

The midwife said the subdistrict motivates the community volunteers by giving them t-shirts

from GHS, *"That makes them happy because most of our t-shirts are labelled 'Ghana Health Service,' so for them, wearing the Ghana Health Service t-shirt brings them much joy."*

Her facility is one of 3 clinics in the subdistrict working with a total of 7 tablets for both static and mobile vaccinations. *"We are doing both paper records and digital records, but I prefer the tablets over paper," "We have a lot of books and when you're going on outreach you have to carry all of them, but this tablet is a handheld device you can just take along to the doorstep of the client, you enroll the client on it then you start your vaccination, so I prefer the tablets over the books."*

Ms. Quartey explained that she and her team had to help their clients adjust to the use of digital tools in the beginning, *"Initially when we introduced the tablets, sitting in front of the clients holding a mobile phone is like you're disrespecting them. So we needed to educate the clients that this is the new device that we are using to take care of you. After educating the clients they understand and they prefer the tablets to the books because they know the books can be destroyed or torn,"* she said.

She added that she believed the use of digital tools has helped her subdistrict improve vaccination rates, *"We know the number of people to be vaccinated and the tablets are helping increase our numbers because they make the work much easier. The registers take a lot of time so this even helps increase the numbers of people you can vaccinate as compared to the time we were writing in our various registers."*

Closing the Loop: Using Digital Data to Inform Decisions at the National Level

As data from the tablets flow back to GHS officials at the district, regional and national levels, it is used to track the progress of fully vaccinated citizens and direct support to the districts that need it most. Pascal Adu explained, *"Recently, I had to do some district-level analysis to see the proportion of fully vaccinated and categorize them. Once we categorize, we can fish out which district needed more support based on the percentage fully vaccinated. And that informed the push of some implementing partners in the northern zone. Now, as we speak, all the northern zones, with the support they received, have turned green because the proportions fully vaccinated have gone beyond 50%, some are even hitting 75% and above. And without data and monitoring systems, we wouldn't have been able to say, if you have any opportunity to deploy a team somewhere, we should go here, or we should go there."*

"Currently, our focus is in the Volta region. And some parts of the Ashanti because we have data to speak to the reality on the ground based on performance.

So for me, it's been very, very helpful when we issue periodic slide decks about this performance and the trends. If you see the trend as we speak now, it's so amazing because you can see well."

"Without data, you couldn't have identified which areas perhaps need some support, and for us as a program, we are very impressed with the performance happening in the northern sector. Now some of them have even gone beyond 75%, they're deep green. In the Volta region, which used to be all yellow, less than 25% from May, June, July, August, September, October, even in November. Now you see the picture is changing even in the Volta region."

Challenges and the Lessons They Taught

As with any new and ambitious endeavor, Ghana has encountered many challenges in the process of administering and digitizing COVID-19 vaccinations, many of which have taught lessons that can be applied in other settings.

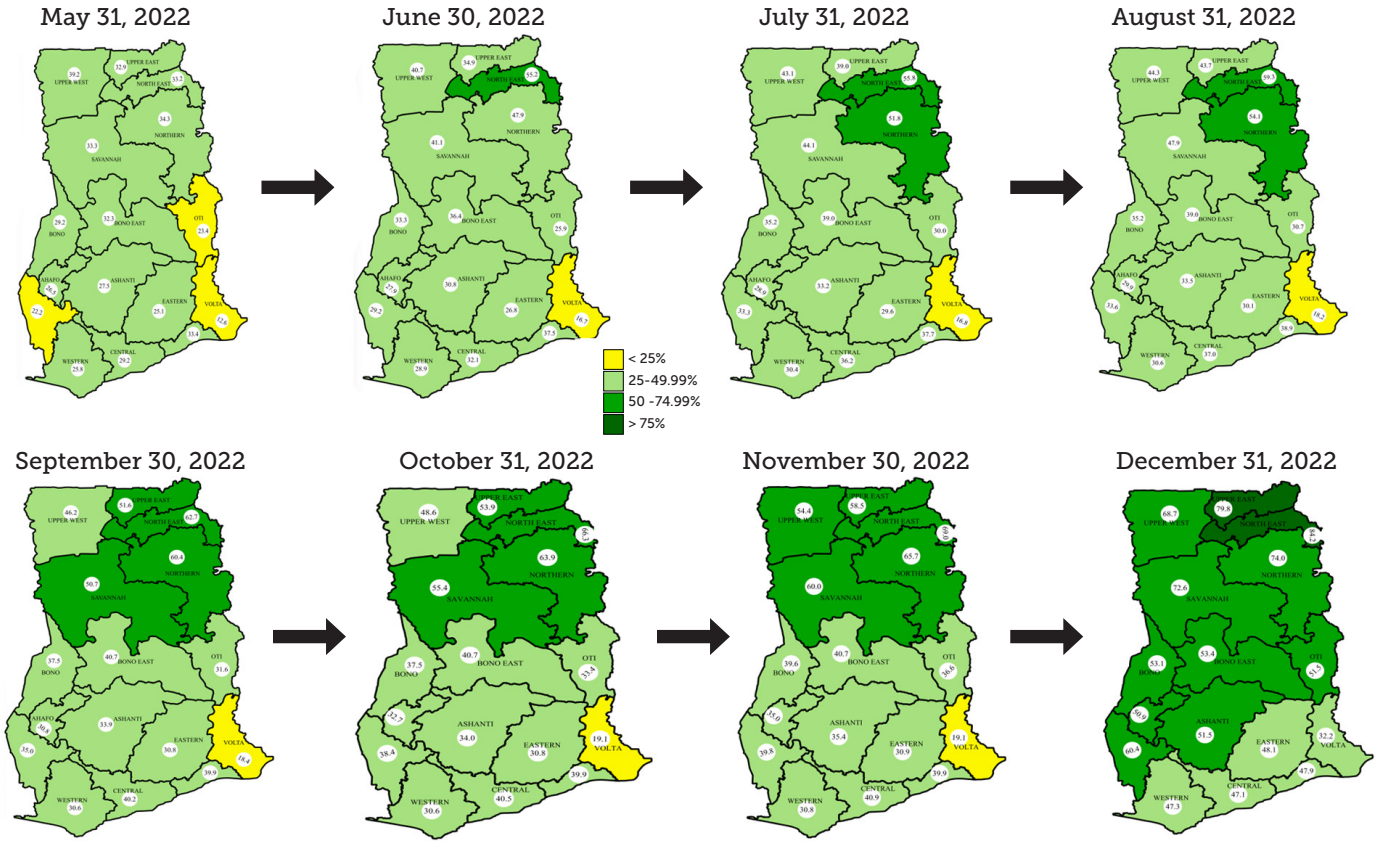
Limited tablet availability. The need for digital tools was greatest early in the pandemic when fewer tablets were available, but more national immunization days were occurring. At the onset, the GoG brought onboard partners and other stakeholders in the planning process in anticipation of the challenges and the resources needed to tackle them. Partners have supplied the government with more than 6000 electronic tablets since the start of the vaccination exercise, but health workers report that most districts need additional tablets, some more than others.

"Resources in our settings are never adequate, but there were resources to kick start districts, regions and the national level to start doing what we ought to have been doing."

In some settings health workers have resorted to using personal devices, but this is not encouraged by the GHS, causing health workers to adopt the hybrid paper/electronic approach to data collection.

"In some instances, personnel are supporting with

Proportion fully vaccinated by region, May - December 2022



private phones which officials are guarding against. It is against data collection laws to protect people's personal information. Some districts have enough tablets when doing the static data capture in the facilities, but when doing the mobile campaigns, they need more."

Unreliable internet connectivity. This is a significant challenge throughout Ghana, increasing in significance the further a district is situated from a major city. Internet connectivity issues have significantly contributed to the hybrid data collection process, and officials and health workers have adapted various solutions to suit their local context. In urban areas with better network connection, tablets are carried by mobile teams who use them during client interactions. These teams still carry paper registers, but only as a backup to digital records. In suburban and rural areas, mobile vaccination teams primarily use paper registers to manually capture client details. At the end of the day, the registers are conveyed to data officers in the healthcare facilities who use tablets to enter the details into the online database.

One GHS official said, *"As I mentioned earlier, in my district, we have challenges with the internet. Sometimes the staff at the periphery of the district are unable to do their data entry due to issues of internet challenges, so the data piles up. I prefer the work be done closer to the urban area where I get data officers to do the entry. It works out better for us. It's better doing the data entry on the live server."*

Adaptability of the tracker application. Ghana uses both the offline and online options for the e-tracker to counter the internet connectivity challenges common across most localities. However, users have reported that the offline version has its own challenges, whilst the main DHIMS 2 server can go down during peak vaccination periods. Health workers across the board said they preferred using the software online, even though it requires the two-step process of transferring paper records to the tablet. *"Sometimes you have to update the app. You have to download and install the update and it takes forever. That's also part of the reason we stopped using the offline version."*

Another reported, *"There are times when, if you get to an area where there isn't a good network connection, you want to work offline and sync later. If you are syncing and there are any errors which you couldn't capture during the time you were in the field, it means it becomes very difficult to try to get those details to correct the error and enable the use of the system."*

One official reported that workers report the offline version of the e-tracker comes with its own challenges. Health workers across the board said they preferred using the software online, even though it requires the two-step process of transferring paper records to the tablet.

"There are times when, if you get to an area where there isn't network, you want to work offline and sync later. If you are syncing and there are any errors which you couldn't capture during the time you were in the field, it means it becomes very difficult to try to get those details to correct the error and enable use of the system."

Another reason they adopted the two-step system was that some staff on mobile teams still prefer using paper to digital devices. *"Some are not too tech savvy, and so, they prefer using the manual process, and then they bring their hard copies to us to enter. We understand them, and now they do their manual registration."*

Health workforce development. Training is needed for application and tablet use and for administering and managing the novel vaccines. In the acute stage of the vaccination rollout, most training was conducted virtually and cascaded from the national to the community level. However, some localities had to use interns and short-term staff to compensate for the shortage of data entry personnel.

One official said, "*trained health workers are administering the shots, so sometimes we have to use volunteers for data entry. These can be high school graduates or maybe recent university graduates looking for jobs. They need to understand the information that they are entering, but sometimes they do not, and we need to train them. We also need to train them to troubleshoot so they can get the tablet to work in the moment, and we need to retrain when the software is updated."*

Many people expressed challenges with the virtual training sessions and expressed a preference for in-person training because of network interruptions in virtual sessions. *"My number one rec-*

ommendation would be that whatever trainings have to be done should be done in-person, especially for the data officers. Sometimes you must do tutorials, the person is just online, and sometimes you don't even know if they are behind the PC and listening to whatever you say. But if it is in-person, it helps, there is one-on-one contact, and you can follow them to make sure they are understanding what you are walking them through."

National officials are aware of this preference and moving towards more in-person training. One official reported, *"when we started, most of the training was virtual. It was good because we explored the opportunity of handling things virtually. But the issue of the data management came with some challenges because they really enjoy seeing us demonstrate and work with them through their trainings, hands-on and in-person, compared to the virtual."*

Cascading training can also be a challenge. As information is passed down through the various levels of the health system, officials can't be sure the information taught at the sub-regional levels is the same as those shared with the regions. To help remedy this, GHS has created videos and tutorials to supplement live training sessions and to help troubleshoot. They hope that knowing the information is coming directly from GHS will help people rely on the official source of accurate information. *"Another tough thing was the cascading of training. What you say — is it the same thing that is going out there? How we handle this is the fact that we did some videos and other things from the national level. So it means that if they are hearing you, they know that this is from the right source and there are not any loose ends."*

Geographic accessibility. Health workers mentioned that some remote and rural areas are hard to get to. *"The recent NID was in the dry season, so the challenge wasn't much, but when it comes to the rainy season, how to get access to the people is a challenge for some of us. There are roads, but the road network is very bad so sometimes you need to get a motorbike to go to the people. Also, when it's the rainy season, we mostly go to the farms, we need to go there very early, as early as 4:30 am, in order to meet them, or else you won't meet them. So, these are some of the few challenges."*

As the challenges have arisen, Ghanaians throughout the health system have learned and devised solutions allowing them to continue administering vaccinations. This hybrid approach to data collection to manage poor internet connectivity and the lack of tablets was necessary, but it also increased the administrative burden and the data backlog. Frontline workers, especially those in more rural settings, duplicated the electronic form in paper format in the field and then completed the electronic version and uploaded it when the internet was available. Issues were further complicated when the server was disabled in mid-2022, forcing services to switch entirely to paper-based records. They continued to track summaries electronically via shared online documents and keeping paper records for when the e-tracker services were back online. Frontline health workers were encouraged to persevere by patients who espoused confidence in the digital nature of the exercise and the rapid retrieval of previous vaccination records.

The tools, skills and systems developed for COVID-19 vaccinations apply to other health systems challenges, including routine childhood vaccinations and yellow fever vaccines for travelers. The ability to collect individual case-based information, not just aggregate numbers, will benefit decision-making, problem-solving and resource allocation to build a resilient health system, particularly at the primary care level where these activities occur.

"Thank you so much for supporting us and also following up to know what we are doing with the tablets and even trying to meet the challenges to address them. We are grateful."

— Mariama Abdul

Results for Development

Results for Development (R4D) is a leading non-profit global development partner. We collaborate with change agents around the world — government officials, civil society leaders and social innovators — to create strong systems that support healthy, educated people. We help our partners move from knowing their goal to knowing how to reach it. We combine global expertise in health, education and nutrition with analytic rigor, practical support for decision-making and implementation and access to peer problem-solving networks. Together with our partners, we build self-sustaining systems that serve everyone and deliver lasting results. Then we share what we learn so others can achieve results for development, too.