BETTER IMMUNIZATION DATA
INITIATIVE

Better Immunization Data (BID) Initiative Functional Requirements Document

Tanzania Immunization Registry (TImR) | December 2015

BID Initiative Team

Contents

1 Introduction

You have to have a big vision and take very small steps to get there. You have to be humble as you execute but visionary and gigantic in terms of your aspiration. It's not about grand innovation, it's about a lot of little innovations; every day, every week, every month, making something a little bit better. Joseph Calacanis

The Better Immunization Data (BID) Initiative is employing a holistic approach that brings together appropriate information system products, data use practices, and supports the people who use them from the front line health worker to the Minister of Health. If the BID Initiative is successful, the following is representative of an article that would be written about it three years from today.

November 23, 2018- Article in "The New York Times"

Process over Products: How the Bill & Melinda Gates Foundation and African Governments Delivered Better Child Health Outcomes with an Integrated Approach

Bill Gates is happiest in the field. Today, we are in Sierra Leone with the Minister of Health and Sanitation, visiting nursing clinics where we are watching children arrive and receive their wellness check-ins. The man equally famous for betting big to change the computing world and global health is beaming, and the reason is obvious.

This clinic, once famous for long wait times and vaccine stock outs a few years ago, is now bustling with efficiency. Mothers come in, provide some basic information, are entered into a basic online child health registry, and the intake coordinator tells them where to queue for treatment based on need and current wait times. The health workers can access a summary of treatments prescribed if it is a returning patient and quickly follow up with the mother on any observations or concerns from her last appointment. One mother whom we spoke with as she left the clinic, Elodie, indicated that although this was her second child, she had not bothered to come in the past because she knew that it would take the whole day. Now, the efficiency improvements brought in by the government and World Vision (who adopted and adapted the Better Immunization Data (BID) Initiative platform of products, practices, and policies implemented in Tanzania by PATH), had dramatically shortened that wait time. Front line nurses, no longer tied up with filling in cumbersome paper reports or checking logs to figure out which vaccines were last administered, were actually able to provide counsel and the commodities needed for her newborn. Elodie said that based on today's experience, she would be back with her other children as her confidence in the public health system has been restored.

In all the noise about technology improving healthcare, what was realized as we watched this scene was that the technology was only a small part of the story. Yes, there are impressive tablets and barcode readers to tackle automated stock inventory and quickly access a child's health record, but the technology is not overly complex or innovative by Silicon Valley standards. The real innovation is in workflow improvements, and the technology was simply an

enabler of the care delivery – not the point of the care delivery. In order to effectively deliver, the entire system has to be stable, affordable at scale, flexible to country needs, and intuitive for users who may not be literate or comfortable with the latest technology trends.

The BID Initiative also focused on change management interventions that help health workers to better use the information provided (via the technology) to do a few simple things really well. The best practices include: checklists for nurses, supportive supervisors who can see how their districts are doing and direct resources where needed, and peer learning groups within countries so colleagues can share challenges and get help or encouragement through WhatsApp messages.

Each country is different, but as Bill Gates knows all too well from his Microsoft experience, technology platforms are designed to scale and cross borders. The BID Initiative initially gathered input from thirteen countries, worked with software developers to create platform variants, tested them in two countries (Tanzania and Zambia), and then made the components of the platforms available to be adapted to multiple locations and systems.

The key to BID Initiative's innovative and technology-agnostic approach is the concept of 'global back-end, and local front-end'. The Initiative's consortium of developers, representing the most experienced global health technology teams in the world, collaborated on a powerful immunization registry platform that incorporates best data and business practices from immunization experts around the world. The consortium made this platform fully open source and standards-compliant, supporting developers to connect any 'client' technology to the platform. This allows country leaders to choose and refine any method of contributing to and accessing data from the platform, appropriate to their country's context, eHealth architecture, and user needs. These methods can include existing digital health systems, web access, short message service (SMS), feature phones, smartphones or tablets, or future technologies yet to come.

We asked the Minister of Health what she thought about it all and she responded: "I have worked to improve health in my country for over forty years. I have seen development partners promise to work together, to listen to country needs, and develop systems that scale beyond pilots but in truth, it rarely happens. We care about improving our health system and this is the first partnership I have seen that really does that. We were required from the beginning to commit our time and attention to how we would scale it, help with design choices, and then later, expand it to include the data we needed from other areas such as malaria and HIV/AIDS, using our own development teams. In truth, we now have a health record and we can use this information to get ahead of outbreaks and concerns that once plagued us."

As we left the clinic that day, we watched the nurses print out the workflow for the next day. A task that used to take one to two hours now took one to two minutes. I was reminded as I called home that evening to check on my five year old how much my life had changed for the better when simple technology was introduced. Emails replacing fax, Skype replacing overseas phone

calls, and remembered one important thing that we often lose sight of – technology is the tool – not the goal.

1.1 User Stories

The above article articulates the BID Initiative's broader future and global vision of the immunization registry we are seeking to develop over the coming years. First, we must be successful in Tanzania and engage its stakeholders. To ensure that success, we must begin with specific user stories.

For government health officials in Tanzania, the more specific story they tell of their journey may go something like this:

> As the expanded program on immunization (EPI) manager, I used to be frustrated not knowing where we had gaps in immunization coverage and then be surprised by outbreaks I couldn't prepare for. I did not have the information I needed to plan the best use of the scarce resources I had available for my program and be able to direct them where they were most needed. I knew that the data I used in my reporting was of poor quality and not reliable, but felt there was nothing I could do about it. Now, I can rely on the data I receive from the regions through the electronic immunization registry to help me do better planning and reporting and know where to target my resources. The information I get tells me performance clear down to each facility, and what the true catchment areas are so I can allocate resources accordingly. This information also feeds into the national health management information system (HMIS) system for the Ministry of Health and Social Welfare (MOHSW) to be used in their monitoring and planning alongside other health programs to allow for better alignment across the health system.
>
> As the District Official, I found it difficult to properly monitor the facilities in my district, know their true performance, and where to focus my time and resources to help them. I could not monitor where the stock was (or was not) and work to reduce stock outs through better allocation of stock across my district. I spent days each month entering data by hand from each facility into an Excel spreadsheet to send to the Regional Officer, knowing that the reports from the facilities had many errors due to the way the health workers did their reporting and tallying while managing heavy workloads. Now, I can monitor the high volume facilities daily through the data they input into the electronic immunization registry, and make decisions in a timely fashion to address any challenges I see such as low stock levels or high numbers of defaulters in a facility. My monthly reporting is much quicker as I scan in the paper forms from the smaller facilities and only enter the new children by hand into the registry. I can plan my supervision visits to ensure I go to the facilities that need my support the most, and I can share information to all my facilities through a monthly dashboard they receive to motivate them to make their plans with the data they get for their facility.

> As a nurse in a busy health facility, I used to have to look up each child as they came into the facility in the large register books in order to document their immunization that day. I never had time to go through these registers to see which children were overdue for their immunizations, especially because I wouldn't have had the information I needed to go find them anyway. Each month, I worked late several nights to fill out the reports that I submitted monthly to the district, but never got to see how these reports translated into my performance nor how my peers were doing as well. I did not know how many children I should be providing services too, and therefore could not plan well in ordering stock and supplies, or for planning outreach sessions and where best to spend our time to reach more children. Now, I can easily find a child's record when they come to my facility by scanning the barcode on their child health card and the record appears on my tablet. I see what vaccines they are due for, and can record their weight and other key elements related to their visit. I can look up a report that shows which children have not come in for their immunizations, and get the contact information for their caregiver or plan an outreach session to their area. Best of all, I no longer have to spend my evenings doing reports. My facility's data is synced daily to the web-based system so it can be accessed and used by the district official. My colleagues in smaller facilities also no longer have to use the big register books, but get monthly print outs of the children due for immunizations in their catchment area. They can easily see who has not come each month on their print outs to provide follow up, and they send in their filled out print outs at the end of the month instead of spending hours doing reports like they used to. Best of all, we all know who we should be providing services to and when, and can make plans to have all the supplies we need and provide follow up when and where we need to.

We have the opportunity to make these testimonies a reality through the work of the government of Tanzania with the BID Initiative, and the plans to implement an electronic immunization registry in combination with targeted interventions to build a data use culture across the health system.

1.2 Background

Led by PATH and funded by the Bill & Melinda Gates Foundation, the BID Initiative is grounded in the belief that better data, plus better decisions, will lead to better health outcomes. Its vision is to empower countries to enhance immunization and overall health service delivery through improved data collection, quality, and use. Reaching this vision requires investments in information system products, practices, people, and packaging solutions for use by others.

The BID Initiative is unique. It is designed to partner with countries in Africa through the BID Learning Network to introduce information system products and immunization practices that can be tested in a few demo countries, packaged for dissemination, and then deployed at scale in many countries.

Tanzania's Ministry of Health and Social Welfare (MoHSW) has strengthened their immunization programs, yet systemic problems such as identifying the under-vaccinated and unvaccinated children continue to stall efforts. Tanzania still faces challenges related to data quality and have identified a few of the problems that are their highest priority:

Accurate denominator	The source used to estimate number of clients for each clinic is provided by National Bureau of Statistics. However, in practice, the actual client numbers in any given catchment area often vary widely from the estimated numbers.
Defaulter tracing	Ability to identify children that may not have received their full dosing regimen.
Unique identification of children	Individuals are associated with a particular health facility, so if they receive services from another clinic; their full immunization history may not be captured accurately.
Complexity of data collection forms	The complexity of data collection and reporting forms increases the burden on health workers and the chances of errors.
Data visibility	It is practically impossible to review data from clinics at the village or even district levels, especially stock status.

Unfortunately, information systems and a culture of evidence-based decision-making that would help solve these operational issues and provide actionable information to users are very weak.

While technology capabilities and internet/network connectivity are improving rapidly in Tanzania, effective, affordable information systems that automate national immunization data collection and support delivery of routine child health services (e.g., immunizations, nutrition screening, and counseling) for health workers have not yet been built or deployed at scale. Information and computer technology (ICT) systems for the national HMIS, monthly immunization reporting, and supply chain logistics are not interoperable with one another, nor linked into an emerging national-level eHealth architecture.

1.3 Purpose

The purpose of this document is to present a description of the Tanzania Immunization Registry (TImR), a system to be developed in collaboration with MOHSW and PATH through the BID Initiative to address many of the challenges the immunization program faces as outlined above. This document will explain the purpose and features of TImR, how it should interface with external systems, the constraints under which the system must operate, and the data that will need to be collected.

1.4 Definition of Scope of TImR

The system will be used to collect and store immunization service delivery information and display the information to end users in a manner that facilitates evidence-based decision making at all levels of the health system. The system will be used by Health Care Workers (HCW) in health facilities to:

- Register children
- Enter child weight
- Update stock information
- Update immunization record of the child
- Update child information

HCWs will also use the system to generate reports that will help them make decisions to improve performance of their health facility. District Immunization and Vaccines Officers will use the system to measure the performance of health facilities in their jurisdiction and identify stock requirements based on consumption. Regional and National level users will use the system to generate reports to measure the performance of immunization services in Tanzania. Generated reports should be informative to facilitate evidence-based decision making at all levels of the health system.

The system should be designed to increase productivity and efficiency of immunization service delivery by reducing data collection burden and ensuring data collected by TImR is available to external systems and that TImR can reuse data collected by other systems. The aim is to ensure that data is collected once and shared across different systems.

The system should be easy to understand and use and be as configurable as possible so that typical changes to the immunization services in Tanzania do not necessitate a rewrite or big development effort. For example, the system should allow easy configuration with these type of changes that occur in the national immunization program:

- Introduction of new vaccines
- Introduction of new vaccine targeting new target population
- Introduction of new target group
- Changes to vaccine schedule

1.5 Assumptions and Constraints

The following are our current assumptions:

- The system will be accessible on a desktop/laptop and a tablet personal computer (PC) using a common code base so that changes do not need to be made separately to each access method.
- The system will work effectively in an environment with intermittent internet connectivity and power through methods such as caching and store-and-forward.
- Facilities without infrastructure should be able to use simple technology or a paper system that can later be scanned and/or entered into the central database at the district level.

- The system will be easy to understand and use so that end users are able to train other end users.
- Data will be stored centrally and be accessible from different locations.
- System upgrades should be simple to avoid the need of requiring physical access to the device for upgrades when network connectivity is available.
- User interface design will be based on available standards and best practices to ensure ease of use.

1.6 Communication with External Systems

The system should be able to communicate with other external systems used by Tanzania MoHSW. The communication with external systems should be through a standards-based interoperability layer. The following are external systems that are currently known:

Health Facility Registry: contains a list of all health facilities that exist in Tanzania and information about their ownership, services provided, status, and contact information. TImR should extract health facility information from this system and update its list regularly.

VIMS: consumption information should be submitted to Vaccine Information Management System (VIMS) monthly, and TImR should also expect information of stock allocation including lots, by facility, based on what has been dispatched to a particular health facility. VIMS will then submit information into DHIS2 based on the indicators that can be reported using data collected by TImR and VIMS.

Client registry: contains a list of all clients. This system is also responsible for merging duplicate records.

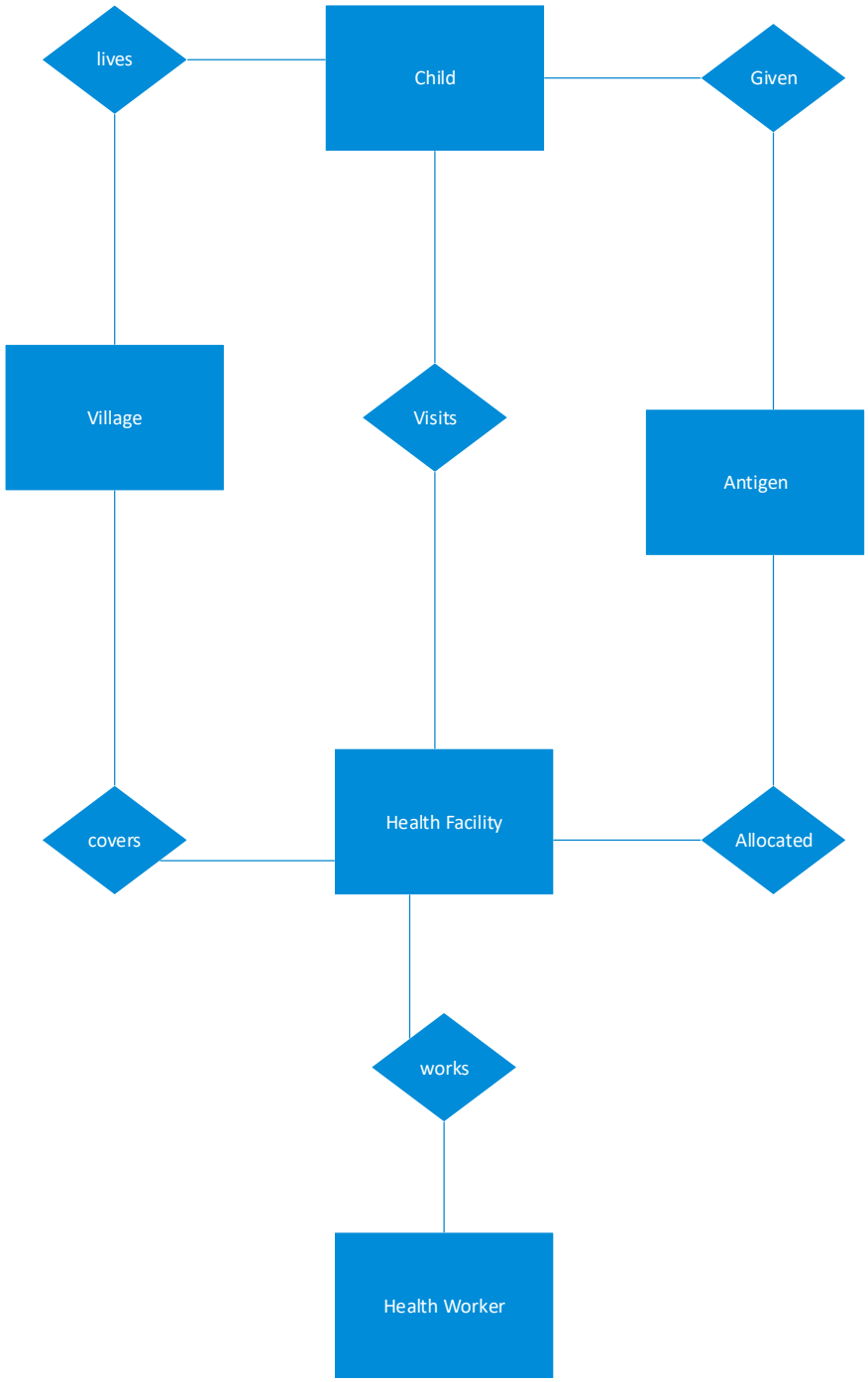
Shared Health Record: contains medical records of all clients that are sharable.

DHIS2: the health management system responsible for providing the aggregate-level data and indicators.

2 Functional Requirements

2.1 Data Requirements

The following is the logical structure of data that will need to be stored in TImR.



2.1.1 Child Entity

Item	Description
Child name	Name of the child. If the name is known, up to three names can be provided. If not known, this can be left blank until the child is named.
Date of birth	Child date of birth.
Gender	Gender of the child.
Village	Name of village where the child lives.
Registered health facility	The health facility the child was originally registered.
Attending health facility	The name of the facility where the child plans to receive their immunizations. If the child is receiving immunization in the facility they were first registered, the attending facility will be the same as registered facility.
Mother name	Child mother's name.
Father name	Child father's name.
Contact details	Telephone number of the mother or caretaker.
Place of birth	Where the child birth took place (home, health facility, other).
ID	Internal unique identifier of the child.
TT status	TT status of the mother to determine if the child is born protected.
Breastfeeding	If the child is exclusively breastfed or not.
Barcode	Number used to automatically identify the child.

2.1.2 Health Facility Entity

Item	Description
ID	Unique identifier of the health facility.
Health facility name	Name of the health facility.
District	District where the facility is located.
Target population	Number of clients the health facility should expect annually.
Catchment area	Villages the health facility provides services to.
Contact details	Contact details for the health facility (telephone number or email address).

2.1.3 Antigen Entity

Item	Description
ID	Unique product identifier.
Name	Name of the vaccine.
Packaging	Number of doses per vial.
Target	Diseases the antigen is targeting.
Schedule	Number of doses the child is to receive to be fully immunized.
Wastage	Estimated open vial wastage rate for vaccine.

2.1.4 Village Entity

Item	Description
Village name	Name of the village.
District	District where the village is located.
Target population	Number of people in the village.
ID	Unique identifier of the village.
Region	Region where the village is located.

2.1.5 Vaccination Events

Item	Description
Child	Child ID
Antigen	Unique product identifier of the antigen that the child has been given.
Scheduled date	Date the vaccination is scheduled based on date of birth.
Vaccination date	Date the vaccination was given.
Health facility	ID of the health facility where the child was immunized.

2.2 Functional Process Requirements

2.2.1 User Management

- The user should be able to add new users and enter basic information about the users.
- The system should allow the user to specify the health facility the user will belong to; this must be from a centralized list to ensure consistency across systems.
- The system should allow the administrative user to create user roles and assign specific functionality to those roles.
- The system should allow the administrative user to be assigned a particular role (or roles).
- The system should allow the administrative user to reset password of a particular user.
- The system should allow the user to recover a forgotten password.
- The system should allow the administrative user to disable/enable a particular user.
- The system should allow the end user to update their basic information (e.g., contact information, first and second names, etc.).

2.2.2 Health Facility Management

If available, TImR should extract health facility information from the Health Facility Registry and update its list regularly, minimizing administrative management. However, administrative functions should allow the user to manage health facilities by ensuring the health facility information in the system are up-to-date and contain all relevant information.

- The administrative user should be able to import health facility list from Health Facility Registry.
- The administrative user should be able to extract new health facilities from the Health Facility Registry.

- The administrative user should be able to identify new health facilities extracted from Health Facility Registry.
- The user should be able to disable/enable a health facility.
- The user should be able to specify catchment area (village) the health facility covers.
- The user should be able to enter target population served by the health facility.
- The user should be able to generate a list that shows heath facility and village association.

2.2.3 Child Registration

- The user should be able to register a child and provide the following information:

Child names (up to three)	Optional
Mother's name	Mandatory
Father's name	Optional
Village name (from static list)	Mandatory
Child home health facility name	Mandatory
Date of birth	Mandatory
Telephone	Optional
Barcode	Mandatory
Gender	Mandatory
Breastfeeding	Optional
TT status	Optional
HIV Status	Optional
Place of birth (home, health facility, other)	Mandatory

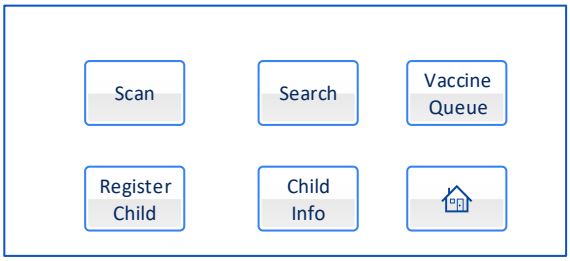
- The system should prompt the user to search for the child first, by providing some of the basic mandatory information. Only if the child is not found should they be allowed to continue on and add information to make a full registration.
- The system should prompt the user to save when navigating away from registration without saving.
- The system should display a child summary page (see section 2.2.12) to enter child weight or immunizations once the information is saved.
- The system should generate a vaccination schedule based on child date of birth after registration.
- The system should warn the user of possible match to already existing child by providing enough information to enable the user to make informed decision to avoid duplication.
- The system should provide the ability to update the child registration information.

2.2.4 Administer Vaccine

The system should generate a schedule of future vaccines based on antigen specific rules that include (note this is not a complete list):

- "Give no earlier than" constraints (based on age and/or timing of other antigens).
- "Give no later than" constraints (driven by age and/or timing of last vaccine).

- “Group with” constraints that group specific antigens together at the same event.
- “Date/schedule” constraints that avoid weekends and holidays.
- The rules should be configurable by a national administrator.
- The system should reschedule future vaccinations based on given vaccine, where applicable.
- The system should allow the user to administer a subset of scheduled vaccines.
- The system should warn the user if the user is giving vaccination outside acceptable range (too early or too late) by looking at defined minimum time that need to pass between doses of the same vaccine.
- The system should recommend the next visiting date and avoid weekends (configurable option to avoid weekends).
- The system should not allow the user to enter a date of the 2nd dose before date of the 1st dose of the same antigen.
- The system should not allow the user to select the vaccination date which is before the child was born or in the future.
- The system should default lot number to NO LOT if user is entering previous given immunizations.
- The system should allow the user to specify the lot number of the antigen given to a child.
- The system should deduct stock based on given antigen and selected lot number.
- The system should not display expired lot numbers for the user to select on the screen.
- The system should not display lot numbers of vaccines that facilities has reported stock on hand of zero.
- The system should remove from the queue children who have been vaccinated (see Appendix I for workflow).
- The user should be able to record the administration of Vitamin A supplements and deworming.
- The system should allow the user to specify if a child has been immunized during outreach.
- After administering vaccines the system should navigate to the page that shows the following menu items:



2.2.5 Update Child Weight

- The system should allow the user to enter child weight in kilograms with one decimal point.

- The system should calculate z-score (standard deviations) based on a child's gender and age and recommend child for counseling based on the entered weight.
- The system should store one captured weight a day per child and warns the user if there was another weight that was captured previously on the same day for that child.
- The system should provide an option to overwrite previously entered weight that was captured the same day or ignore newly entered weight.
- The system should display previously captured weight with color codes (green if the weight if fine, red if child underweight, white if the child is overweight).
- The system should provide an ability to display weight trend in a graph as done on the child health card.

2.2.6 Update Immunization Information

- Update immunization information the same day the data was entered.
- The system should prompt the user to save if the user navigates away from the update form without saving changes.
- The system should regenerate child vaccination schedule based on the changes made to the immunization date of given immunizations.
- Should auto- update/generate vaccine schedule calendar, excluding the weekends.

2.2.7 Update Child Information

- The system should allow user to update child information and maintain a record of changes that have been made.
- The system should prompt the user to save if the user navigates away from the update page without saving changes.

- The system should reschedule all vaccines when date of birth is changed according to business rules, but should not change vaccination date for all vaccines that are already given.
- The user should be able to change the facility the child will be attending but maintain the name of the facility where they were originally registered.
- The user should be able to mark the child as inactive and provide a reason (e.g., moved, deceased, etc.).

2.2.8 Update Stock Information

- The user should be able to enter stock on hand by lot number.
- The user should be able to enter stock adjustment (both negative and positive) and the reason for the adjustment that matches the national waste reporting categories (e.g., transferred in, cold chain failure, expired, etc.).
- The system should allow the user to enable and disable lot numbers that are being used in the health facility.
- The system should allow the user to confirm receiving stock by lot number that has been distributed to a facility from the district vaccine store.
- The user should be able to create stock requisition to bring the facility back to the maximum stock level.
- The system should alert the user if stock is going below or approaching re-order level.
- The system should allow the user to enter stock consumed by other target groups (e.g., TT given to pregnant women, injured adults, tuberculosis vaccine (BCG) and oral polio virus (OPV0) vaccine given to newborns).
- The system should estimate stock need based on post consumption data, population, and minimum quantity threshold.

2.2.9 Dashboard

The dashboard, first thing to be displayed when the user logs into the system should provide a snapshot of what is happening in the health facility by displaying the following in a graph:

- Stock on hand.
- Coverage rate by antigen including number immunized for the past three months.
- Drop out (DTP1 – DTP3).
- Trend of DTP3 vaccination coverage (monthly).

2.2.10 Adverse Event Following Immunization (AEFI) Report

The system should allow the user to record AEFI for each child to include information on the lot number, type of AEFI, and whether the case was investigated or not.

2.2.11 Reports

The system should be able to generate static and dynamic reports. To generate a dynamic report, the system should prompt the user to specify what information they want in the report

and how they want the information to be displayed (and include the filters). See Appendix II for sample reports.

The following are mandatory static reports that the system should be able to generate:

- Visiting trends
- On-time vaccination rate.
- Number of children immunized per antigen by gender in a specific day within and outside catchment area.
- List of all children immunized in a specific day within and outside catchment area, filtered and sorted by location, age, antigen, and date.
- Stock balance and average monthly consumption.
- Summary of child weight by age range (age in months, gender, number of children [<2SD, SD, >2SD]).
- Number of new registrations between specific dates within and outside catchment area.
- Number of children immunized during outreach sessions.
- Number of children born with protected status if the mother has received greater than three doses of tetanus toxoid (TT).
- List of defaulters including their contact information for follow-up, filtered by village, age, and scheduled dose.
- Stock consumption rate.
- Stock ledger report.
- Stock adjustment report.
- Vaccine coverage report as in Immunization & Vaccines Development (IVD) program of MOHSW report.
- Vaccine wastage report (opened and unopened vials).
- Dropout rate trend.
- Non-vaccination reason report.
- AEFI report as in IVD report.

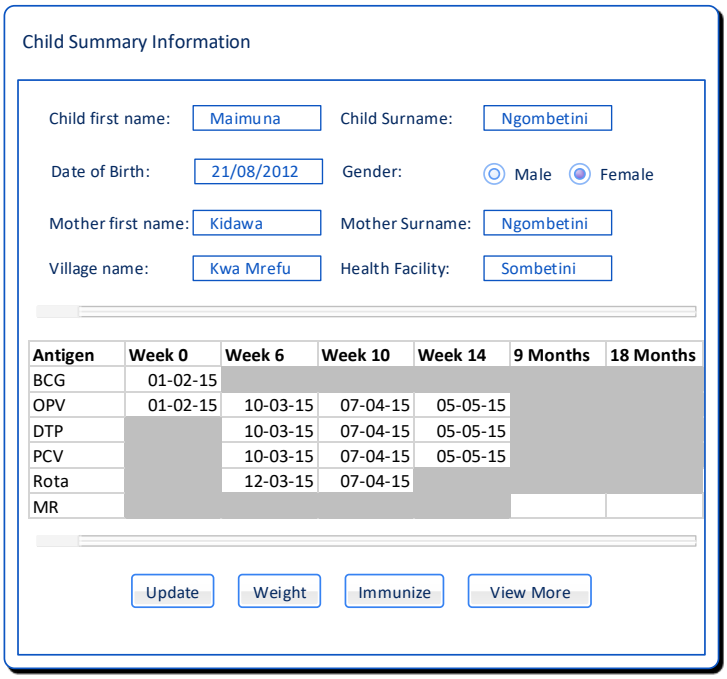
The system should allow the user to export reports into different formats (e.g., Excel, PDF).

In both static and dynamic reports, the user should be able to specify filters for the above reports by specifying the following:

- Location (region, district, village, or health facility)
- Start date
- End date
- Disaggregation by various options

2.2.12 Display Child Summary Information

The system should display child summary information to allow the user to easily identify the child.



2.2.13 Search For a Child

- The system should allow the user to search child records by scanning a barcode on child health card.
- The system should allow the user to search child records based on a combination of any of the fields used for child registration or given demographic information.
- The system should allow the user to search based on partial information (such as partial birth dates).
- The system should display sufficient information from all potential matches to determine if there is a true match.

3 Non-Functional Requirements

3.1 General

- Prompt the user to save when navigating away from an edit or new registration screen, and require user to confirm changes if data was modified.
- The system should be able to receive stock from external systems (i.e., VIMS) allocated to a particular health facility. The information should include lot number, expiry date, and number of doses
- The system should provide meaningful alerts to the users; these alerts should be configurable by an administrator rather than hard coded.

- The system should alert for ongoing and completed processes rather than running invisibly in the background with no feedback to the user.
- The system should be able to roll back a transaction if the full update was not successfully completed.
- The ability to generate a report of missing information in fields for data cleaning.
- The system should be accompanied by a well-structured user manual.
- The system should have informative error messages.
- The system should be able to work offline for weeks and synchronize with the central database in the background once online.

3.2 Security Requirements

The system should provide role-based access to the system that is password protected. A logged-in user should have access to information that is relevant to them only. For example, District Immunization Officers should not have access or the ability to edit information of another district, and the same applies to the health facility level. Only known users should have access to information in TImR. The system should contain the following security requirements:

- The system should provide a mechanism for the user to recover a forgotten password and allow the user to update their information including their password.
- The system should maintain an audit of all data that was added or modified by user (including timestamp and user ID).
- The system needs to have automatic log out of a user after a defined (configurable) amount of inactivity.
- There should be appropriate protection for data on a device (data at rest) in the event it is stolen (e.g., the data should be encrypted).

3.3 Audit Trail

The system should maintain a record of all changes done to the system and a log of who logged in and what they did in the system after log in. The administrator should be able to extract the following information from the system:

- When was the last time a specific user logged into the system.
- For every change that is done to a record, the system should record who made the change and a timestamp of when the change was made.
- What activities the user performed while logged in.
- Audit trail information should be accessible and the system should provide a way to visualize this information.
- Modifications done as the “system” (for example modifications to schedules) should be clearly identifiable as done by system.

The system should log all events including system log-ins, log-outs, system errors, failed log-in information, and provide a simple way to view this information as a report.

3.4 Capacity

- The system should be able to support more than 7,000 facilities.
- The system should be able to accommodate 9,000 concurrent users.
- The system is expected to register two million children per year.
- Each registered child is expected to have a minimum of eight vaccination events with one to several antigens per event.

3.5 Loading Data

- The system should be able to configure historical data uploaded from external data sources.
- The system should present a fully editable screen of any externally loaded data for verification by the health worker when the patient is first seen.
- During the data verification step, potentially problematic data should be highlighted (based on specific rules) for example: vaccinations should not be given prior to the child's DOB, first vaccinations should not be given after second vaccinations, and blank fields should be flagged (e.g., missing dates).
- The user should confirm and validate that the data is correct (by checking a box).

3.6 System Maintenance

- The system should display the current version number on each device.
- The system should be capable of being updated remotely.
- The system should maintain all data after update.
- The system should have the capacity to optimize limited processing power on tablet.

Appendix I: Vaccination Queue Workflow

There are two ways the vaccination queue can work:

1. Child database search, due for immunization, and entry of child's weight

Step 1

A child arrives at the facility and the health worker scans the barcode on the child's health card or searches for the child in the database.

Step 2

The child is weighed and the health worker enters the child's weight into the database.

Step 3

The child is put in the queue and the system shows the child's name and vaccines that are due.

Step 4

If the health facility is using multiple tablets, the child will appear in the queue of all the tablets.

Step 5

After a vaccine is administered, the health worker updates the child's immunization information in the database, thus removing them from the immunization queue in all tablets.

2. Check in functionality for immunization only

Step 1

A child arrives at the facility and the health worker scans the barcode on the child's health card or searches for the child in the database.

Step 2

The child is marked as checked in and put in the queue of and the system shows the child's name and vaccines that are due.

Step 3

If the health facility is using multiple tablets the child will appear in the queue of all the tablets.

Step 4

After a vaccine is administered, the health worker updates the child's immunization information in the database, thus removing them from the immunization queue.

Appendix II: Sample Reports

Authored by the BID Initiative Tanzania staff.

1 Introduction

System report play key role in system usability and acceptance to end users. Tanzania Immunization information system required adoption of existing immunization report requirement in addition to new reports capable to be produced by the system. The document provide description of the required reports.

2 Internal Reports of the system

These are reports produced in the back end by the system. Ideally these report should provide an overview of system usage by different users as well as measure system performance. The requirement are as listed below.

Report	Description
User last login	This report will show the last time a particular user logged in to the system.
Number of days user login per month	This report will show number of days user have login the system per month
Children registered per day by a specific user	This report will be able to show number of children registered per day by a particular user
	Should be able to filter date range
Login failed attempt	This Is the report which shows failed login attempts
User activity report	This report shows what user has accessed in the system. i.e Registration form, search.

3 System End-user reports

There are number of report requirements required by immunization and vaccine development program for routine reporting. These report t across all level of health system, health facility being the primary data collection point. This document provide the description for these reports. These report have been groped into four category as listed below.

1. Vaccination activities reports
2. Immunization program performance report
3. Child report
4. Stock management reports

3.1 Vaccination activities report

Indicator definitions

Indicator name	Report Definition	Disaggregated by
Total number of visits	This refers to total number of children who visited a particular health facility in a given time period including those who came just for weighing.	○ Facility catchment area (within or outside catchment) ○ Vaccination strategy (Fixed or Outreach)
Vaccinated	Total number of children who have been vaccinated by at least one antigen in a particular at a given time period	○ Facility catchment area (within or outside catchment) ○ Vaccination strategy (Fixed or Outreach) ○ Antigen ○ Vaccination schedule

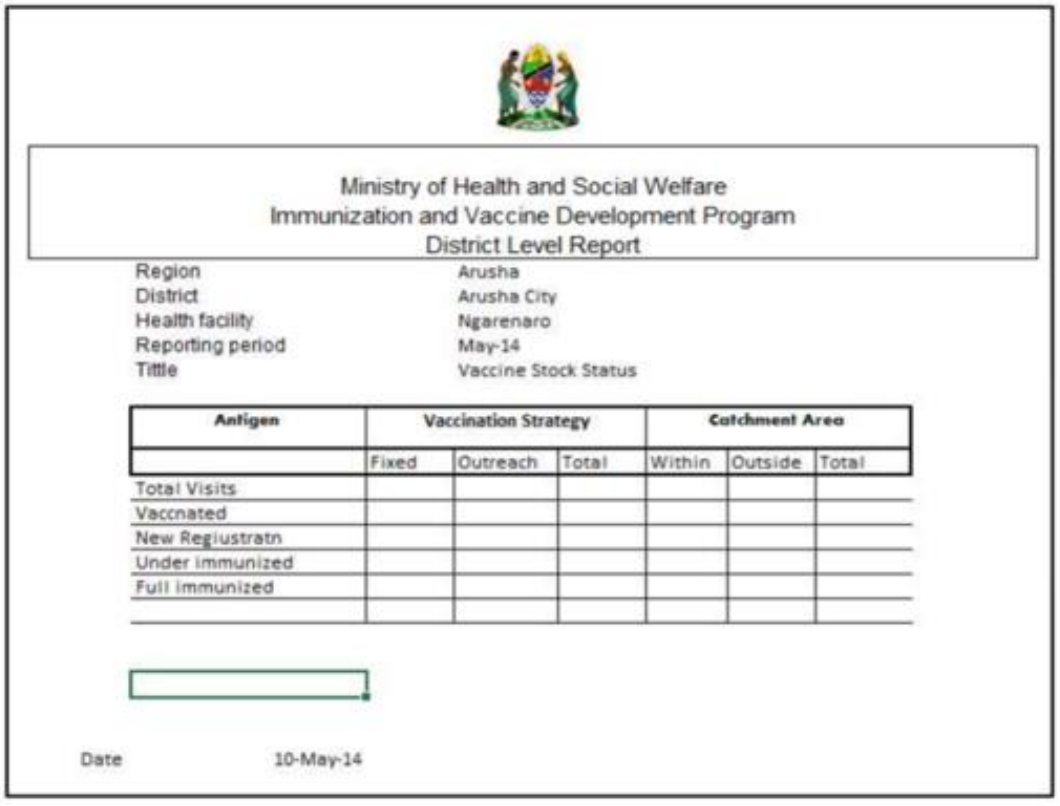
New registration	Total number of children who visited facility for their first immunization schedule in a particular month	○ Facility catchment area (within or outside catchment) ○ Vaccination strategy (Fixed or Outreach)
Under immunized	number of children who completed immunization schedule but missed at least one antigen in any schedule	○ Facility catchment area (within or outside catchment) ○ Vaccination strategy (Fixed or Outreach) ○ Missed antigen
Full immunized children	Number of children who completed all immunizations and received the immunization on time.	○ Facility catchment area (within or outside catchment) ○ Vaccination strategy (Fixed or Outreach)

Primary filters

1. Facility name (Multiple selection enabled)
2. Reporting period (Multiple selection enabled)

Sample mock up

- Immunization report for Ngarenaro Health Center for the period of January 2015.



Ministry of Health and Social Welfare
Immunization and Vaccine Development Program
District Level Report

Region	Arusha
District	Arusha City
Health facility	Ngarenaro
Reporting period	May-14
Tittle	Vaccine Stock Status

Antigen	Vaccination Strategy			Catchment Area		
	Fixed	Outreach	Total	Within	Outside	Total
Total Visits						
Vaccnated						
New Regiustratn						
Under immunized						
Full immunized						

Date 10-May-14

Preferable presentation

- Table
- Grouped bar graph for trending

3.2 Immunization program performance report

Indicator definition

There standardized indicators to measure the performance of immunization program across all levels from facility to national level. These report are mandatory requirement for any immunization system.

Indicators and definitions

Indicator Name	Report Definition	Disaggregated by
Coverage	This measure the percentage difference between number of children immunized with third dose and first dose for each antigen against pre-determined monthly immunization target	Health facility Antigen reporting period
Dropout rate	Measure percentage difference between two or three preceding doses of particular antigen. It is commonly measure by (DPT3 –DPT1)/DPT1 or (MR1- BCG)/BCG times 100.	By facility
Wastage rate	This measure the difference between number of doses used for particular antigen minus number of children immunized divide by number of immunized children multiply by 100	By antigen, by facility

Primary filters

All these report should be filtered by

- Health facility
- And antigen

Sample mockup Coverage

Ministry of Health and Social Welfare
Immunization and Vaccine Development Program
District Level Report

Region Arusha
District Arusha City
Health facility Ngarenaro
Reporting period Jan-16

Antigen	Immunized Children		Total immunized	Target population	% Coverage	Cummulative Coverage
	Within	Outside Catchment				
PCV2						
PCV3						
Penta2						
Penta3						
OPV2						
OPV3						
Rota2						
MR1						
MR2						

Date 18-Feb-15

Sample mockup dropout

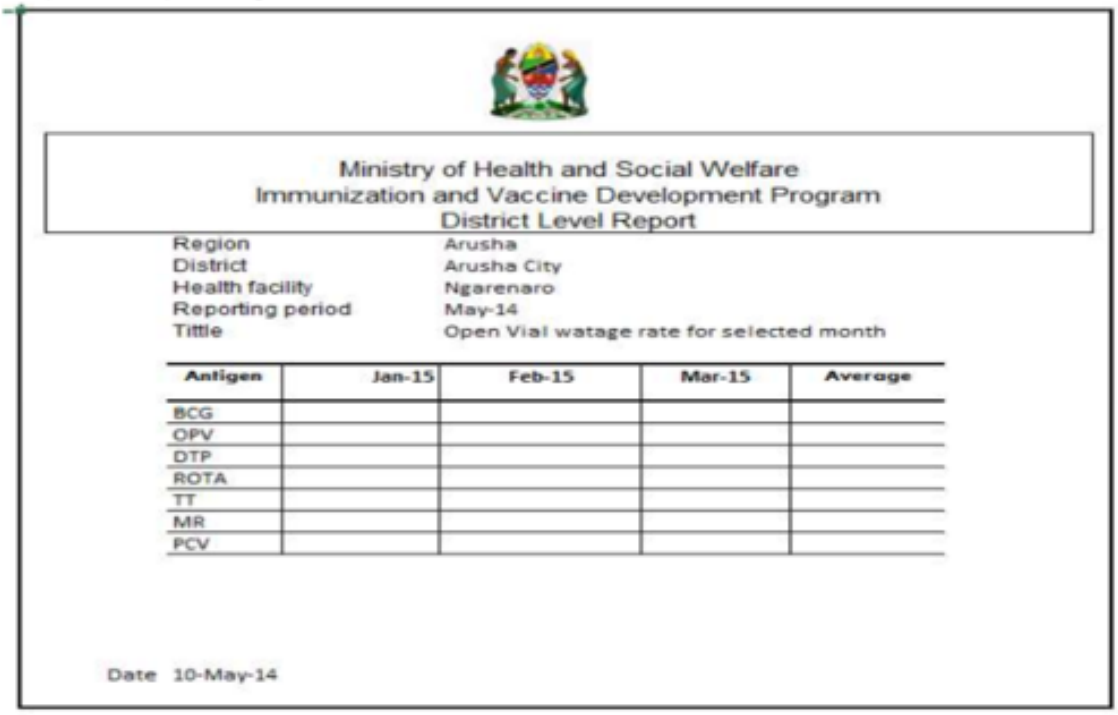
Ministry of Health and Social Welfare
Immunization and Vaccine Development Program
District Level Report

Region Arusha
District Arusha City
Health facility Ngarenaro
Reporting period May-14

Antigen	Jan-15	Feb-15	Mar-15	Average
OPV3				
DPT3				
MR				
Rota2				

Date 10-May-14

Sample mockup wastage



Ministry of Health and Social Welfare
Immunization and Vaccine Development Program
District Level Report

Region Arusha
District Arusha City
Health facility Ngarenaro
Reporting period May-14
Tittle Open Vial watage rate for selected month

Antigen	Jan-15	Feb-15	Mar-15	Average
BCG				
OPV				
DTP				
ROTA				
TT				
MR				
PCV				

Date 10-May-14

Preferable output presentation

Coverage report

- Table and line graph

Dropout rate

- Table and line graph

Wastage rate

- Table and grouped bar graph

3.3 Child reports

These report should show the individual child information starting with names and other variables as per reporting requirement

Indicators definitions

Indicator	Description	Disaggregated
Defaulter	This refers to number and list of children who missed at least one immunization schedules for specific time period.	Health facility Village Reporting period
Lost follow-up	this refer to list f children who missed as least one immunization schedule for prolonged period of time	Health facility Village Reporting period

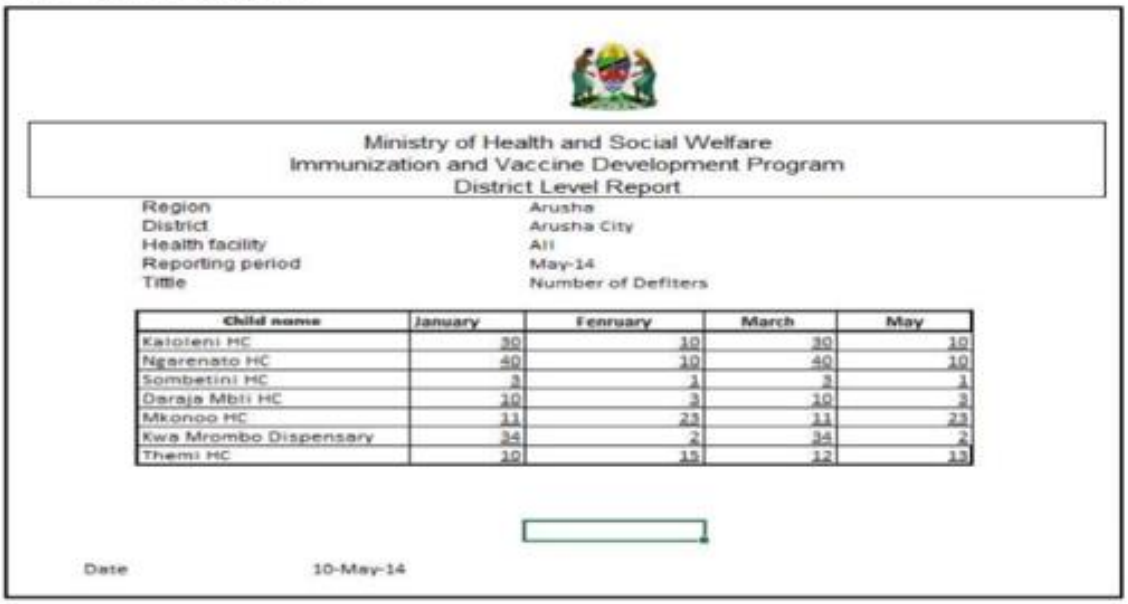
Full immunized children	List of children who received their full dose as per immunization schedule	Health facility reporting period

Primary filters

- Health facility
- Village within facility catchment
- Reporting period in month

Sample mockup

3.3.1.1 Number of defaulters



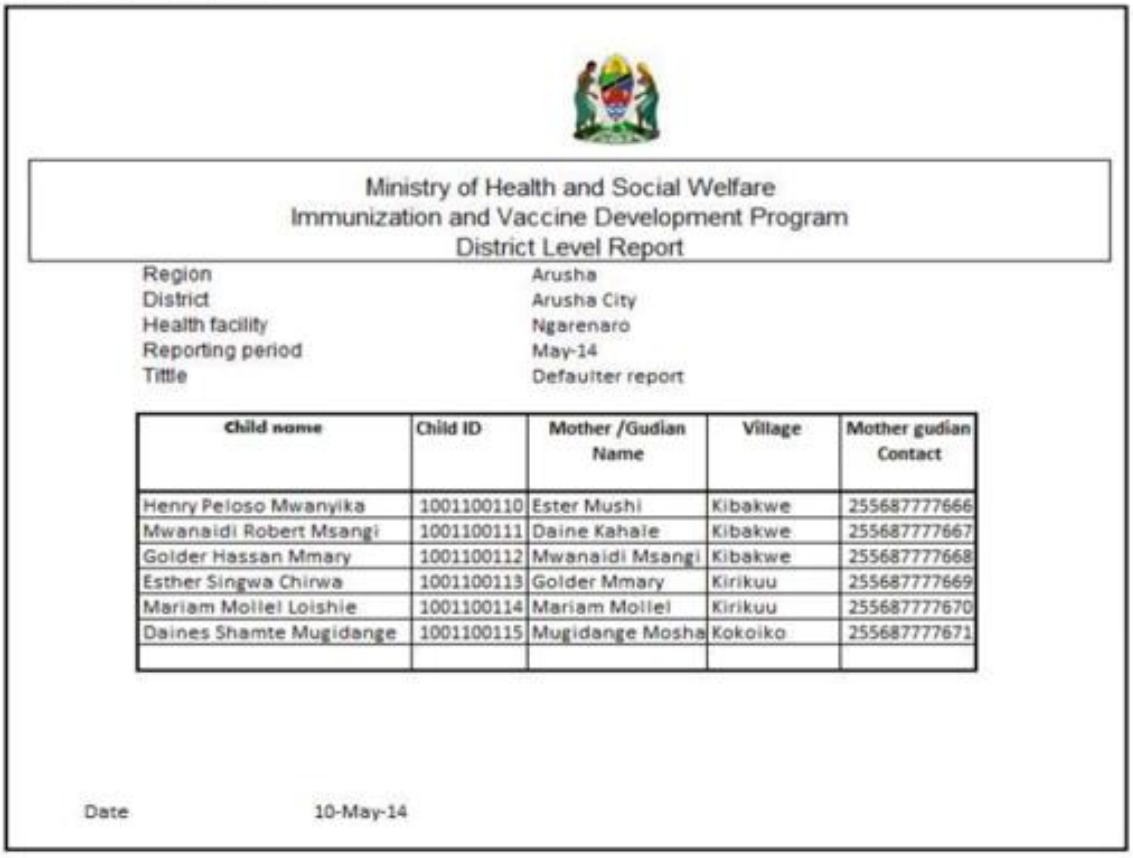
Ministry of Health and Social Welfare
Immunization and Vaccine Development Program
District Level Report

Region	Arusha
District	Arusha City
Health facility	All
Reporting period	May-14
Title	Number of Defiters

Child name	January	Feruary	March	May
Kaloleni HC	30	10	30	10
Ngarenato HC	40	10	40	10
Sombetini HC	3	1	3	1
Daraja Mbli HC	10	3	10	3
Mkonoo HC	11	23	11	23
Kwa Mrombo Dispensary	34	2	34	2
Themi HC	10	15	12	13

Date 10-May-14

3.3.1.2 Defaulter report



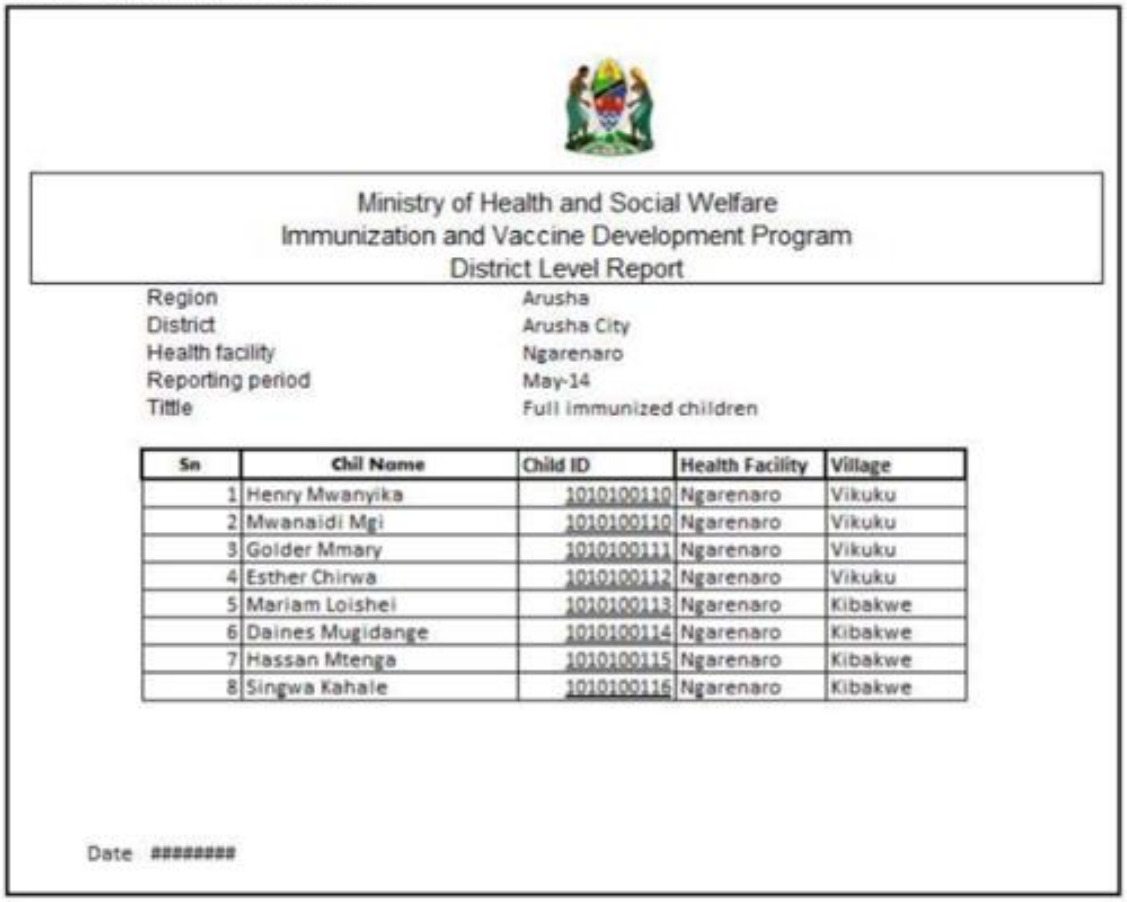
Ministry of Health and Social Welfare
Immunization and Vaccine Development Program
District Level Report

Region	Arusha
District	Arusha City
Health facility	Ngarenaro
Reporting period	May-14
Tittle	Defaulter report

Child nome	Child ID	Mother /Gudian Name	Village	Mother gudian Contact
Henry Peloso Mwanyika	1001100110	Ester Mushi	Kibakwe	255687777666
Mwanaidi Robert Msangi	1001100111	Daine Kahale	Kibakwe	255687777667
Golder Hassan Mmary	1001100112	Mwanaidi Msangi	Kibakwe	255687777668
Esther Singwa Chirwa	1001100113	Golder Mmary	Kirikuu	255687777669
Mariam Mollel Loishie	1001100114	Mariam Mollel	Kirikuu	255687777670
Daines Shamte Mugidange	1001100115	Mugidange Mosha	Kokoiko	255687777671

Date 10-May-14

3.3.1.3 Fully immunized children



Ministry of Health and Social Welfare
Immunization and Vaccine Development Program
District Level Report

Region	Arusha
District	Arusha City
Health facility	Ngarenaro
Reporting period	May-14
Tittle	Full immunized children

Sn	Chil Name	Child ID	Health Facility	Village
1	Henry Mwanyika	1010100110	Ngarenaro	Vikuku
2	Mwanaidi Mgi	1010100110	Ngarenaro	Vikuku
3	Golder Mmary	1010100111	Ngarenaro	Vikuku
4	Esther Chirwa	1010100112	Ngarenaro	Vikuku
5	Mariam Loishei	1010100113	Ngarenaro	Kibakwe
6	Daines Mugidange	1010100114	Ngarenaro	Kibakwe
7	Hassan Mtenga	1010100115	Ngarenaro	Kibakwe
8	Singwa Kahale	1010100116	Ngarenaro	Kibakwe

Date ########

Preferable output presentation

- Table

3.4 Stock management reports

Indicator definitions

Indicator	Description	Disaggregated by
Received stock	Number of doses of vaccine received in a facility in particular month	Health facility Antigen Reporting period
Adjusted stock	Number of doses of vaccine adjusted by reasons of adjustment in a particular month	Health facility Antigen Reporting period
Stock balance	number of doses of vaccine physically counted at the end of particular month	Health facility Antigen Reporting period
Facility vaccine consumption	Number of doses consumed for each antigen including wastage	Month Antigen

Facility wastage doses	The difference between the number of children immunized in a month and stock status at the end of the month	Month Antigen

Primary filters

- Health facility
- Antigen
- Reporting period

Sample mockup

3.4.1.1 Vaccine stock status

Ministry of Health and Social Welfare
Immunization and Vaccine Development Program
District Level Report

Region	Arusha
District	Arusha City
Health facility	Ngarenaro
Reporting period	May-14
Tittle	Vaccine Stock Status

Antigen	Received	Consumed	Balance	Adjusted
BCG	10	1	11	3
OPV	11	3	12	1
DTP	22	1	1	13
ROTA	22	2	12	13
TT	113	1	13	13
MR	44	3	13	1
PCV	11	3	1	1

Date 10-May-14

On clicking the hyper link the systems houdl navigate to specific report

3.4.1.2 *Stock recet report*

Ministry of Health and Social Welfare
Immunization and Vaccine Development Program
District Level Report

Region	Arusha
District	Arusha City
Health facility	Ngarenaro
Reporting period	May-14
Tittle	Vaccine receipt

Antigen	Batch Numbe	Expiry Date	Quantity Received	Receipt Date
BCG	BFG-00-J2	10-May-17	11	11-05-15
OPV	BFG-00-J3	11-May-17	12	12-05-15
DTP	BFG-00-J4	12-May-17	1	13-05-15
ROTA	BFG-00-J5	13-May-17	12	14-05-15
TT	BFG-00-J6	14-May-17	13	15-05-15
MR	BFG-00-J7	15-May-17	13	16-05-15
PCV	BFG-00-J8	16-May-17	1	17-05-15

Date 10-May-14

3.4.1.3 *Stock Adjustment*

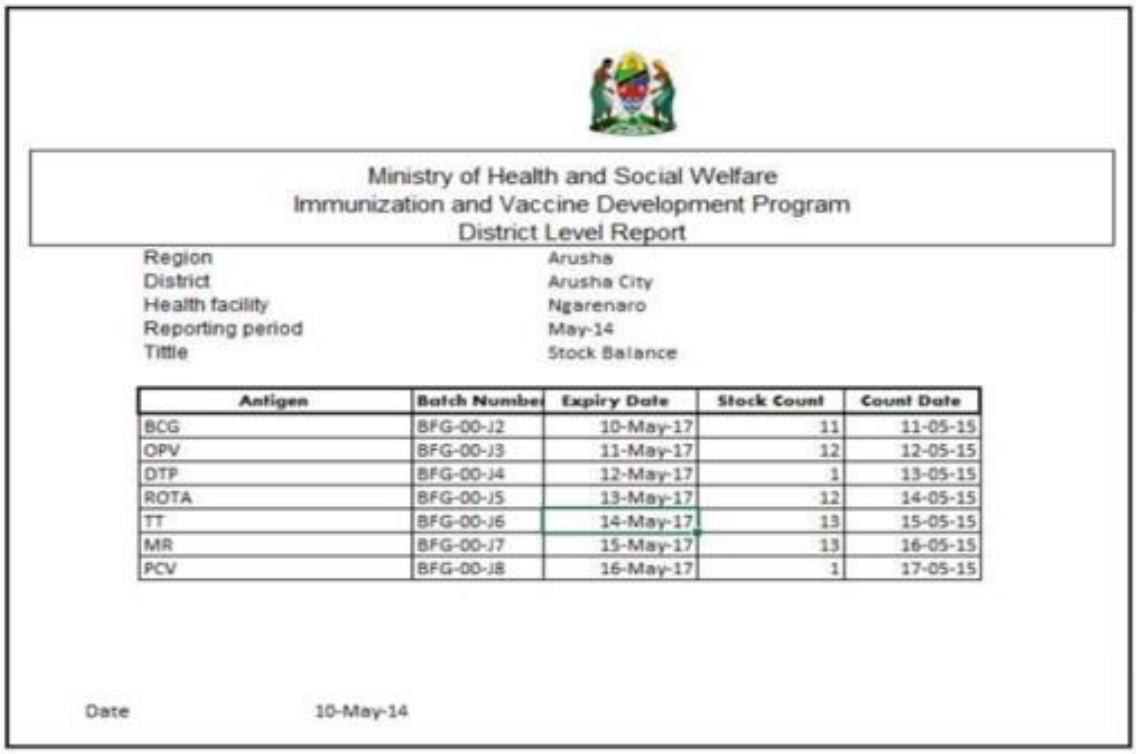
Ministry of Health and Social Welfare
Immunization and Vaccine Development Program
District Level Report

Region	Arusha
District	Arusha City
Health facility	Ngarenaro
Reporting period	May-14
Tittle	Vaccine Stock Status

Antigen	Expiry	VVM Change	Physical Damage	Discarded
BCG	10	1	11	3
OPV	11	3	12	1
DTP	22	1	1	13
ROTA	22	2	12	13
TT	113	1	13	13
MR	44	3	13	1
PCV	11	3	1	1

Date 10-May-14

3.4.1.4 Stock Balance



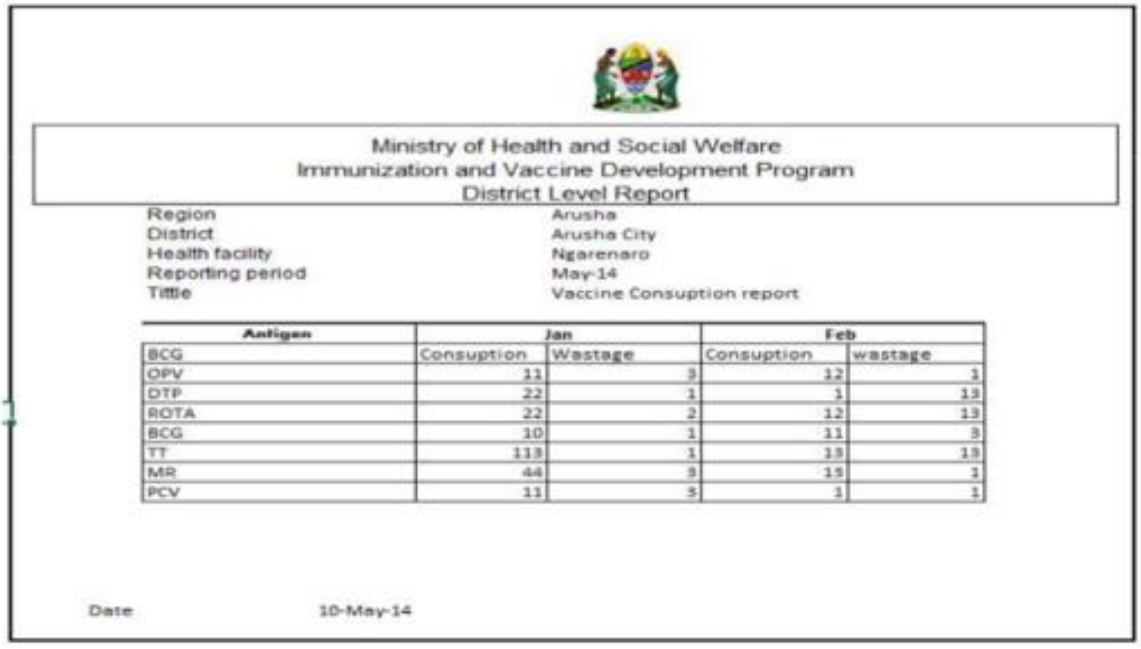
Ministry of Health and Social Welfare
Immunization and Vaccine Development Program
District Level Report

Region	Arusha
District	Arusha City
Health facility	Ngarenaro
Reporting period	May-14
Tittle	Stock Balance

Antigen	Batch Numbe	Expiry Date	Stock Count	Count Date
BCG	BFG-00-J2	10-May-17	11	11-05-15
OPV	BFG-00-J3	11-May-17	12	12-05-15
DTP	BFG-00-J4	12-May-17	1	13-05-15
ROTA	BFG-00-J5	13-May-17	12	14-05-15
TT	BFG-00-J6	14-May-17	13	15-05-15
MR	BFG-00-J7	15-May-17	13	16-05-15
PCV	BFG-00-J8	16-May-17	1	17-05-15

Date 10-May-14

3.4.1.5 Vaccine consumption & wastage



Ministry of Health and Social Welfare
Immunization and Vaccine Development Program
District Level Report

Region	Arusha
District	Arusha City
Health facility	Ngarenaro
Reporting period	May-14
Tittle	Vaccine Consuption report

Antigen	Jan		Feb	
BCG	Consuption	Wastage	Consuption	wastage
OPV	11	3	12	1
DTP	22	1	1	13
ROTA	22	2	12	13
BCG	10	1	11	3
TT	113	1	13	13
MR	44	3	15	1
PCV	11	5	1	1

Date 10-May-14

Preferable output presentation

- Table and bar chart