

**UNITED REPUBLIC OF TANZANIA
MINISTRY OF HEALTH**



**PLAN FOR REVITALIZATION AND SCALE UP OF ELECTRONIC IMMUNIZATION SYSTEM
IN TANZANIA**

SYSTEM AND USER REQUIREMENTS SPECIFICATION DOCUMENT

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Abbreviations

AEFI	adverse event following immunization
BCG	Bacillus Calmette–Guérin
CCIT	container closure integrity testing
CHW	community health worker
CIF	case investigation form
CRDM	Collaborative Requirements Development Methodology
DHIS2	District Health Information System
DIVO	District Immunization and Vaccination Officer
DOB	date of birth
DTP	Diphtheria, pertussis, and tetanus
DVD-MT	District Vaccination Data Management Tool
eIDSR	electronic Integrated Disease Surveillance and Response system
EIS	electronic immunization system
HCW	health care worker
HF	Health facility
HFR	Health Facility Registry
HIM	Health Interoperability Mediator
HMIS	health management information system
HPV	human papilloma virus
ICT	information communication technology
IVD	Immunization and Vaccination Department
MCV	Mean Corpuscular Volume
MOH	Ministry of Health
MR	Measles Rubella
NMFL	National Master Facility List
OpenLMIS	Open Logistics Management Information System
PIRI	Periodic Intensification of Routine Immunization (PIRI).
RCH	reproductive and child health
RIVO	Regional Immunization and Vaccination Officer
RTM	Remote Temperature Monitoring
SIA	Supplementary Immunization Activities
SMS	short message service
SMT	Stock Management Tool
Td	Tetanus Diphtheria
TImR	Tanzania Electronic Immunization Registry
TZHEA	Tanzania Health Enterprise Architecture
UCS	Unified Community System
UNICEF	United Nations Children’s Fund
VIMS	Vaccine Information Management System
VVM	Vaccine vial monitor
WHO	World Health Organization
FP	Family Planning
OPD	Outpatient Department

IPD	In Patient Department
CRVC	Civil Registration and Vital Statistics
CTC	Care and Treatment
MCV	Meningococcal vaccine
API	Application Program Interface
HPV	Human Papillomavirus
PORALG	President's Office, Regional Administration and Local Government Tanzania
NHIF	National Health Insurance Fund
eSRS	Electronic Sample Referral System

1. Introduction

Background

The Ministry of Health (MOH), through the Immunization and Vaccine Development (IVD) program, has designed, tested, and implemented an electronic immunization registry in Tanzania since 2014. The Tanzania Electronic Immunization Registry (TImR) was designed to improve availability and quality of data, eliminate duplication of work through integration, and support planning and decision-making. By the end of 2020, the MOH had implemented TImR in 15 regions of Tanzania in 3,748 health facilities providing routine immunization services, with more than two million children registered, and provided with lifesaving vaccines.

The MOH conducted ecosystem mapping to understand the available electronic immunization system, coverage, and technology used and the overall operational challenges. The following are the overview findings of the ecosystem mapping:

ChanjoCOVID: ChanjoCOVID is a DHIS2-based platform that allows for the management of vaccination appointments, vaccination admission registration, certificate issuing, and certificate verification for COVID-19 vaccines. The system is challenged with lack of stock management and interoperability.

VIMS: Vaccine Information Management System (VIMS) is a web-based information management system, which computerizes the existing Excel-based stock management tool (SMT), district vaccination data management tool (DVD-MT), and container closure integrity testing (CCIT), which was developed by the World Health Organization (WHO). VIMS is used by IVD to capture logistics data, routine immunization data, and cold chain inventory data. VIMS does not currently exchange data with other systems. Though VIMS is technically able to interoperate with the immunization registry and facility registry through the Tanzania health interoperability mediator (HIM), this functionality is not currently operational.

DHIS2: District Health Information Software 2 (DHIS2) is an open source, flexible, web-based health management information system (HMIS). DHIS2 has limited capacities at all levels in data management, technical infrastructure and support, data analytics and use, skilled personnel, and funding to support digitalization of health facilities.

eIDSR: The electronic Integrated Disease Surveillance and Response system (eIDSR) was developed and deployed to support routine surveillance and reporting of notifiable diseases. Following the COVID-19 pandemic, the system was used to track and verify reported cases and if a patient was vaccinated or not.

Unified Community Services (UCS): OpenSRP is an open source mobile digital global goods platform whose primary users are frontline health workers. The system is comprised of three components: the WAJA application for community health workers (CHW), the KITUONI application for facility health care workers (HCW), and the reporting application (In-App and dashboard) for the managerial level to provide insights and analytics of data to support decision-making. UCS is currently used to support the following health domains: HIV/AIDS; reproductive, maternal, newborn, and child health (RMNCH); tuberculosis/leprosy; and malaria. UCS has a Health Interoperability Mediator (HIM) layer funded through the U.S. President's Emergency Plan for AIDS Relief (PEPFAR), which allows it to securely exchange data with other systems.

Though UCS does not currently possess immunization-related workflows or features, it could be adapted to do so.

HFR: Health Facility Registry (HFR) is a tool used to provide access to information on officially recognized public and private health facilities in Tanzania mainland. The system does not restrict on minimum facility registration requirements per facility type. The system has two menus for updating and upgrading facilities that offer similar functionalities which confuses users. The system does not capture the inspection process at the council and regional level.

eLMIS: OpenLMIS is a powerful, open source, cloud-based electronic logistics management information system (LMIS) built to manage health commodity supply chains. OpenLMIS automates LMIS business processes throughout the entire supply chain, reducing the burden on health workers while improving data accuracy, data timeliness, and data visibility.

GOTHOMIS: The Government of Tanzania Health Operation Management Information System (GOTHOMIS) is a web-based application that digitalizes the business process of service delivery at health facilities. The system is not centralized and therefore cannot conduct referral processes among health facilities such as hospitals, dispensaries, and health centers. The system is not integrated with other health information systems such as NHIF verification portal, DHIS2, eLMIS, and eSRS.

HIM: The Tanzania Health Information Mediator (HIM) is a middleware component designed to ease interoperability between disparate systems, with more than 36 systems connected and able to exchange information. Even though mediators through the HIM were developed to support information exchange between VIMS and HFR and VIMS and TImR, they are yet to be fully operational. 160 interoperability use cases are available at the national level. The HIM is compliant with FHIR and Tanzania Health Enterprise Architecture (TZHEA) blueprint standards and guidelines.

The MOH identified the following challenges for TImR:

- Lack of additional features especially tracking zero dose for under five.
- Even though the system is FHIR compliant, it is currently not exchanging information with other systems in the ecosystem.
- The mediators between TImR and VIMS were developed and tested but have not been operational. The MOH heavily relies on the original developers of the system for technical support in resolving bugs and implementing any upgrades.
- Lack of technical support from non-local system developers who initially supported the system design and development, which affected the system sustainability and operationalization.

Given the challenges described above and lessons learnt in more than seven years of the electronic immunization system (EIS, which in Tanzania is TImR) implementation, the MOH is implementing major upgrades and revitalization of TImR. This upgrade will include the integration of ChanjoCOVID into TImR. The upgrade and country wide rollout of TImR is expected to be finalized by December 2023.

This requirements document comprises eight interlinked components: (1) background; (2) user personas; (3) user scenarios; (4) business processes and workflows; (5) core data elements; (6) decision-support logic; (7) indicators and reporting requirements; and (8) high-level functional and non-functional requirements. 1

2. User Persona

A user persona describes the general background, demographics, work environment, motivations, and key challenges for various country stakeholders that interact with the health information system. It is a method for enhancing engagement with stakeholders and building context for prototyping and implementation efforts. The purpose of creating user personas is to enable team members and stakeholders to better understand and relate to end-users with visuals about users, so team members are designing for someone specific. The general personas in charge of the immunization processes are as follows:

No.	Title	Description	Other names
1	Client	A person who intends to receive vaccination services from the targeted health worker personas.	Vaccinated person, Patient, Infant, Baby.
2	Caregiver	This can be the mother, father, guardian, caregiver of the child or infant.	Parent, Guardian.
3	Community health worker	Community health workers provide health education, referral, and follow-up; primary preventive health care; and home visiting services to specific communities. They provide support and help clients by reminding clients to receive their vaccinations and reporting community births.	CHWs.
4	Health care worker	Health care workers facilitate education sessions, administer immunizations, provide counseling when needed, record stock movements, and compile/generate and approve facility reports.	Vaccinator, Facility in charge.
5	Clerical staff	Assist in scheduling appointments, answering phones, greeting patients, keeping/documenting medical records, and handling medical billing.	Registration clerk.
6	Subnational level immunization officer	Oversee immunization activities at regional/district level, manage vaccine logistics cold chain system, reporting, surveillance, and supervision.	Regional immunization and vaccination officer (RIVO), District immunization and vaccination

No.	Title	Description	Other names
			officer (DIVO).
7	National staff	Responsible for developing annual and multi-annual plans; immunization communication and mobilization; management of logistics, the cold chain, and vaccines; monitoring, supervision, and evaluation of immunization services; and coordination of immunization activities at the national level.	IVD/MOH; President's office, Regional Administration and Local Government Tanzania (PORALG); MOH M&E national staff.

2.1 Community Health Worker

Table 1: Persona 1

Persona	Shamsi Macha, Community Health Worker, Arusha City
About	A 51-year-old woman living in Osunyai ward, Arusha City. Shamsi has 11 years of experience working in community health services, where she received training. However, she currently leads a different professional life as a full-time businesswoman.
Responsibilities	<ul style="list-style-type: none">• Community mobilization.• Community health education.• Client follow up.• Referral.• Immunization, nutrition, HIV/AIDS.• Reproductive and child health (RCH) community services including family planning (FP).• Not less than 5,000 population within the catchment area.
Challenges	<ul style="list-style-type: none">• Low awareness and demand for vaccines among community members.• Limited knowledge on immunization.• Inadequate tools and resources to support provision of services and follow-ups.
Connectivity and eHealth	<ul style="list-style-type: none">• Has a smartphone.• Limitation in airtime.• Has connectivity and electricity.

2.2 Health Care Worker

Table 2: Persona 2

Persona	Zakayo Manota, Health Care Worker, Nkwansira Health Center
About	<p>A dedicated and experienced registered nurse with 11 years of valuable expertise in the healthcare field. At 34 years of age, Zakayo is passionate about providing compassionate and high-quality care to his patients.</p> <p>Zakayo is based in Kilimanjaro, specifically in the Hai district, where he serves at the Nkwansira Health Center. Zakayo's dedication to his profession is complemented by his personal life as a committed husband and father of two children.</p>
Responsibilities	<ul style="list-style-type: none"> • Maintain cold chain. • Administer vaccines. • Reporting. • Data entry. • Health education. • Outreach. • Provision of RCH services. • Provision of nutrition services. • Labor and delivery. • Outpatient department (OPD), inpatient department (IPD), dispensing, Care and Treatment (CTC).
Challenges	<ul style="list-style-type: none"> • Short electronic immunization system (EIS) application timeout. • EIS takes a long time to load and the system is slow. • Lack of data bundles. • Stock management challenge in the system. • Insufficient training to use the TImR. • Work overload: multiple responsibilities resulting from not having enough staff at the health center. • Data entry: challenged to enter data during service provision. Workers need to take time after hours to do data entry for work done during working hours.
Connectivity and eHealth	<ul style="list-style-type: none"> • Has mobile phone, tablet. • Facility has grid electricity power supply. • Power management on tablets: challenged when tablet drains to 0% and shuts down, would take longer to boot up. • Internet connection challenges.

2.3 DIVO

Table 3: Persona 3

Persona	Neema Daudi, DIVO, Arusha City
About	<p>She is in her late twenties, with five years of working experience as an immunization and vaccination officer in Arusha City Council, complemented by certifications in Family Planning, Vaccination, and Immunization from esteemed organizations like WHO and UNICEF.</p>
Responsibilities	<ul style="list-style-type: none"> • Oversee 66 health facilities. • Ensure availability of accurate, complete, and updated information required for an effective immunization and vaccination program in the city council. • Conduct field visits for monitoring and supervision of vaccination activities to improve immunization coverage across the city. • Conduct disease surveillance at health posts and community level for vaccine preventable diseases. • Draft monthly, quarterly, and final reports to other levels (e.g., regional and national). • Maintain proper vaccine storage across the city council. • Implement national immunization and vaccination policy in the community. • Conduct vaccine and cold chain audits in health facilities across the city council. • Distribute and fill monthly electronic report forms in the VIMS. • Participate in routine and COVID-19 data verification. • Provide education to the community on vaccine preventable diseases. • Participate in periodic immunization sessions (e.g., Supplementary Immunization Activities [SIAs], Periodic Intensification of Routine Immunization [PIRI]). • Conduct training for health care workers on immunization activities. • Support mapping of defaulters tracing and zero doses of vaccines in Arusha City Council.
Challenges	<ul style="list-style-type: none"> • Inadequate permanent city council vaccine store. • Lack of transport. • No budget for airtime and data. • Multiple systems in use (VIMS, DHIS2, TImR, VIGIMOBILE, AFYASS, etc.). • Scarcity of data tools (registers, updated ledger books) at facility level. • Lack of a PC to use for work. • Competing priorities in Council Health Management Team (CHMT).

Persona	Neema Daudi, DIVO, Arusha City
Connectivity and eHealth	<ul style="list-style-type: none">• Reliable power supply, good internet connection, tablets.

2.4 National Supply Chain Officer

Table 4: Persona 4

Persona	Bonaventura Nestory, National Supply Chain Officer, IVD Program
About	<p>A public health specialist in his mid-forties who has been working with the International Vaccine Distribution (IVD) organization for more than 10 years. With extensive experience in the public health domain and expertise in vaccine logistics, Bonaventura plays a crucial role in ensuring the efficient ordering and distribution of vaccines and cold chain equipment.</p> <p>Bonaventura's passion for public health led him to pursue a master's degree in supply chain management, allowing him to apply his knowledge to the specific context of vaccine distribution. He has completed various online courses offered by reputable organizations like the WHO and the UNICEF.</p>
Responsibilities	<ul style="list-style-type: none"> • Prepare procurement plan for cold chain equipment and vaccines. • Prepare training materials and facilitate training for vaccine supply chain and logistics officers at the subnational level. • Monitor performance of cold chain equipment.
Challenges	<ul style="list-style-type: none"> • Increased demand for distributing cold chain equipment across the country. • Lack of visibility of performance of cold chain equipment especially for those that are not connected to the remote temperature monitoring (RTM) devices. • Competing priorities at national level.
Connectivity and eHealth	<ul style="list-style-type: none"> • Is computer literate. • Has access to reliable connectivity and power supply.

3. Business Processes

3.1 Overview of business process matrix

A business process matrix contains a set of processes and tasks that logically group together to accomplish a goal or produce something of value for the benefit of the organization, stakeholder, or customer. Together, these processes define the boundaries of the system domain. The process matrix contains the following key elements.




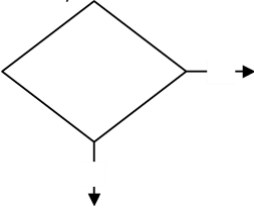
Title	Definition
Process name	Set of tasks that accomplish a specific goal.
Persona	Individuals interacting to complete the process.
Objectives	A concrete statement describing what the process seeks to achieve.
Task set	The general set of activities performed within the process.


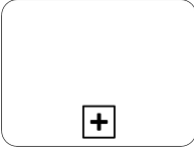




3.2 Overview of business process workflow

Workflow diagrams depict people, their actions, decisions points, and the sequence (process) of those actions and decision points. It allows for the systematic organization of activities and those who perform those activities. Workflows help to visually tell a story of how a series of tasks produce a final outcome.

3.2.1 Task flow diagrams notation

The business process diagram is a formal, standardized depiction of a workflow. These diagrams illustrate communications patterns between actors and are read from left to right. Collaborative Requirements Development Methodology (CRDM) utilizes a simplified subset of symbols from the Business Process Model and Notation 2.0 specification as described below.

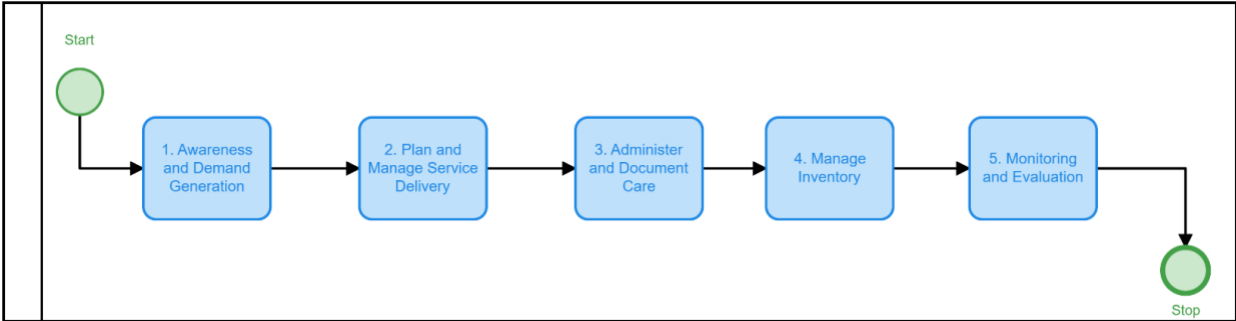
Symbol	Description	Symbol	Description
	A group, department, organization, or unit that contains multiple functional lanes (functional groups). Often the physical location where the tasks take place. Also referred to as a "pool".		Numbered item with a short description of an action performed by the function or persona.
	A persona or function that performs or is accountable for designated tasks in the process. Sometimes referred to as a "lane".		Numbered item that requires a choice to be made in the process. Typically, an approval or a decision-point.

Symbol	Description	Symbol	Description
	A process mapping shape used to define the “start” of the process.		Numbered item used to refer to another process.
	A process mapping shape used to define the “end” of the process.		Multi-page connector that links to another page when a process is too large to fit on a single page.
	Sequence flow showing the logical direction of information and tasks.		A text description to add clarity or context to any point of the process (although the narrative process note provides a more robust option).

3.2.2 Overview of business process workflow and data elements

A basic unit of information that has a unique meaning and subcategories (data items) of distinct value. Examples of data elements include gender, age, geographic location, type of vaccine, patient/client identifier, etc. Data elements are recorded at various points within the business process (workflow), usually on paper forms, paper registers, or electronic systems (using a tablet, mobile phone, or desktop computer).

3.2.3 High level immunization product suite workflow



4. Awareness and demand generation

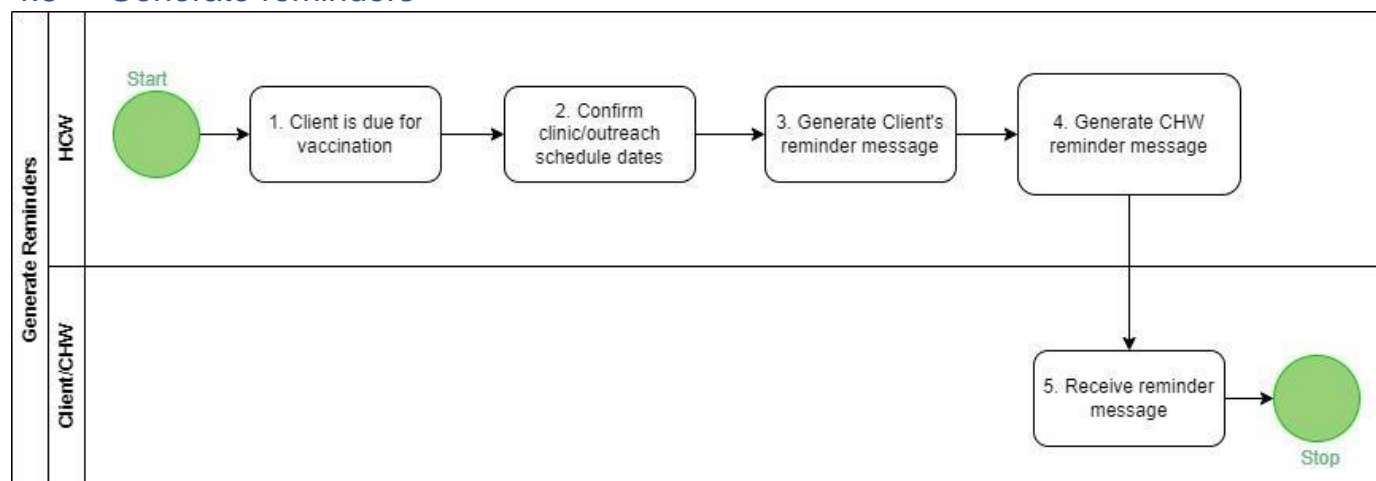
4.1 Awareness and demand generation process matrix

No.	Process name	Personas	Objectives	Task set
A	Generate reminders	<ul style="list-style-type: none"> • HCW • CHW • Client 	To communicate to the client or parent/ guardian if a patient is due now, due on a future date, or past due for vaccination.	<p><i>Starting point: Health care worker (HCW) checks if client is due for vaccination.</i></p> <ul style="list-style-type: none"> • Check list of clients due for vaccination. • Confirm clinic/outreach dates. • Send reminder message to client. • Send reminder message to CHW. • Receive message reminder (client/CHW).
B	Vaccination follow-up	<ul style="list-style-type: none"> • HCW • CHW • "Wajumbe wa mtaa" 	To identify clients who were due to come for vaccination but missed their follow-up dates and are now past due.	<p><i>Starting point: HCW checks registry and determines if vaccinations were missed.</i></p> <ul style="list-style-type: none"> • Review planned vaccination list and determine if some were missed. • Determine if CHW is available in the area. • Follow up with CHW to ensure client is vaccinated. • Follow up with "Wajumbe wa mtaa" to ensure client is vaccinated if the CHW is unavailable. • Record vaccination event. • Plan for follow up at clinic/ outreach session for missed vaccinations.

4.2 Digital systems in use

Process name	Name of digital system	System gaps	Recommendations
Generate reminder	<ul style="list-style-type: none"> • TImR • UCS • ChanjoCOVID 	<ul style="list-style-type: none"> • Non-functional short message services (SMS) for both systems. • No linkage between TImR and UCS. • No linkage between TImR and ChanjoCOVID. 	<ul style="list-style-type: none"> • Ensure UCS system captures immunization and CHW information. • Consider reminders for Human Papilloma Virus (HPV), COVID-19 and Td clients.
Vaccination follow-up	<ul style="list-style-type: none"> • TImR • UCS • ChanjoCOVID 	<ul style="list-style-type: none"> • No linkage between TImR and UCS. • No linkage between TImR and ChanjoCOVID. 	<ul style="list-style-type: none"> • Ensure UCS system captures vaccination and CHW information. • Consider follow-up for HPV, COVID-19, and Tetanus/ Diphtheria (TD) clients.

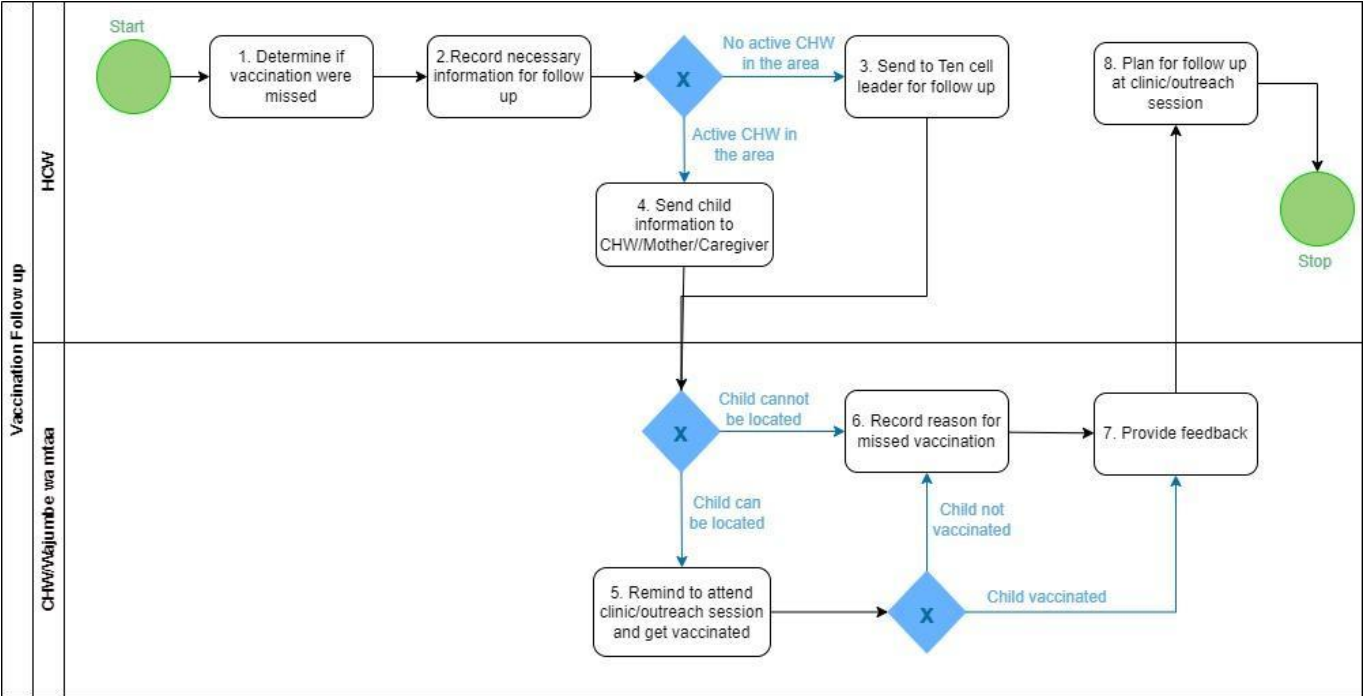
4.3 Generate reminders



S/n	Data element label	Description and definition
A1	Client ID	Unique, system generated patient ID.
A2	Client name	Client's first, middle (optional), and last name.
A3	Vaccination schedule	Client's required vaccination according to schedule.
A4	Vaccination status	Current status of required vaccine.

S/n	Data element label	Description and definition
	Vaccine due	Vaccination is due.
	Vaccine overdue	Vaccination is overdue.
A5	Client contact number	Client or guardians contact number, if available.
A6	Facility name	The name of the facility.
A7	Facility location	Physical address of where the facility is located.
A8	Outreach start date	Start date of vaccination outreach.
A9	Outreach end date	End date of vaccination outreach.
A10	Reminder message to CHW & Parent/Caretaker (Template)	
A11	CHW name	CHW's first and last name.
A12	CHW service area	CHW's operation location.
A13	CHW contact number	CHW phone number.
A14	Client DOB	Client's date of birth.
A15	Client residency	Client physical address.

4.4 Vaccination follow up.



S/n	Data element label	Description and definition
	<i>Search vaccination event record for missed vaccinations</i>	
B1	Client ID	Unique, system generated patient ID.
B2	Client name	Client's first, middle (optional) and last name.
B3	Vaccination	Client's required vaccination according to schedule.
B4	Vaccine status- Overdue	Current status of required vaccine.
B5	Client contact number	Client or guardians contact number, if available.
B6	Facility name	The name of the facility.
B7	Facility location	Physical address of where the facility is located.
B8	Outreach start date	Start date of vaccination outreach.
B9	Outreach end date	End date of vaccination outreach.
B10	Reminder message to CHW & "Wajumbe wa mtaa" (Template)	
B11	CHW name	CHW's first and last name.
B12	CHW service area	CHW's operation location.
B13	CHW contact number	CHW's contact number
B14	"Wajumbe wa mtaa" name	"Wajumbe wa mtaa"'s first and last name
B15	"Wajumbe wa mtaa" service area	"Wajumbe wa mtaa" service area
B16	"Wajumbe wa mtaa" contact number	"Wajumbe wa mtaa" contact number

5. Plan and manage service delivery

5.1 Plan and manage service delivery process matrix

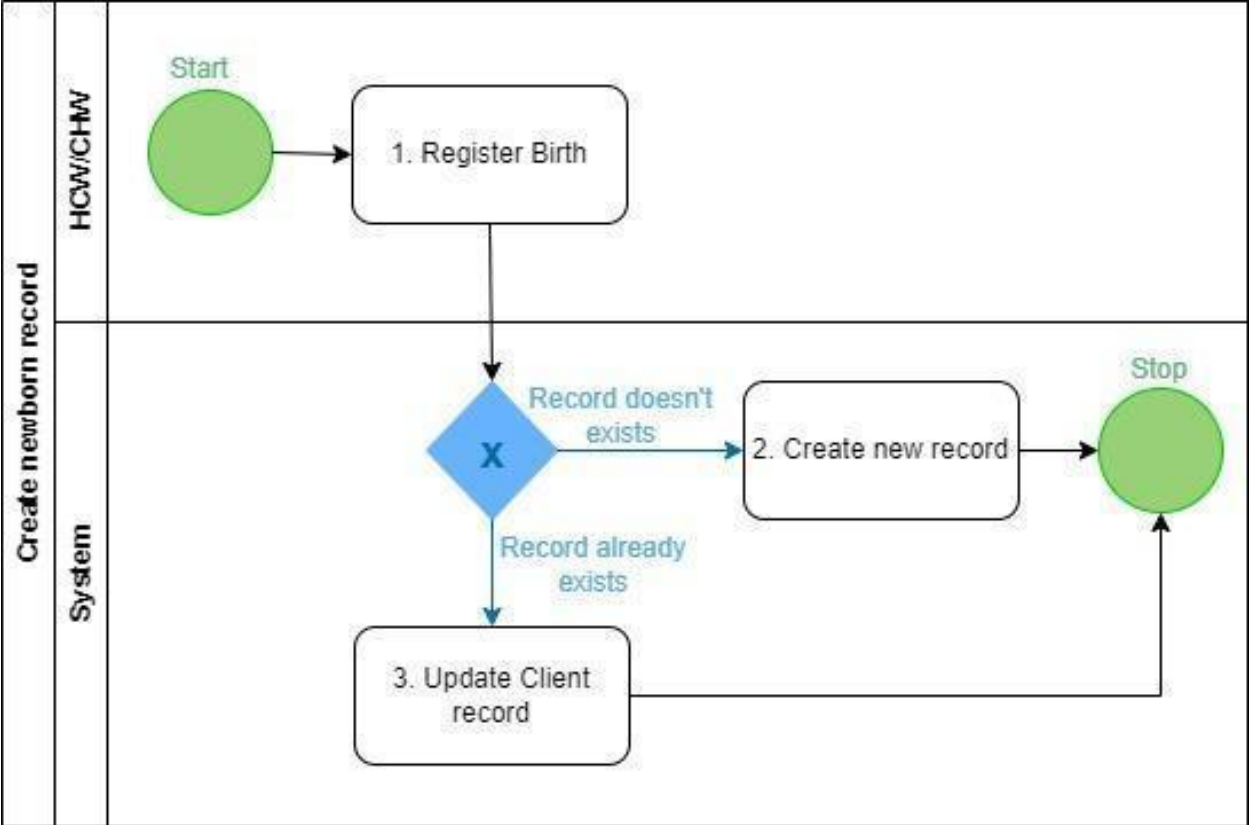
No.	Process name	Personas	Objectives	Task set
C	Create newborn record	<ul style="list-style-type: none"> • HCW • CHW 	To create an initial record in the system following the birth of a newborn.	<p><i>Starting point: CHW/HCW registers birth of newborn or receives the birth data.</i></p> <ul style="list-style-type: none"> • Query if the record already exists. <p>Create or update record. <i>Access of CHW will be limited to registration.</i></p>
D	Register facilities	<ul style="list-style-type: none"> • HCW • RIVO • DIVO • HMIS Coordinator • Facility Staff 	To enroll facilities into TImR for vaccine reporting and reconcile with the National Master Facility List (NMFL).	<p><i>Starting point: HCW searches for the facility.</i></p> <ul style="list-style-type: none"> • Validate NMFL. • Verify information for additional data required. • Create or update facility record. • Generate unique EIS identification. • Send facility registration notification.
E	Plan service delivery	<ul style="list-style-type: none"> • HCW 	To prepare for an immunization session, either at the facility or done on outreach basis.	<p><i>Starting point: HCW wants to prepare for an immunization session.</i></p> <ul style="list-style-type: none"> • Review register to determine estimates of vaccine needed. • Check stock levels. • Order for stock, if needed. • Record stock levels taken.

5.2 Digital systems in use

Process name	Name of digital system	System gaps	Recommendations
Create newborn record	<ul style="list-style-type: none"> • TImR • Civil Registraticn and Vital Statistics (CRVS) • UCS 	<ul style="list-style-type: none"> • No linkage between TImR and CRVS. • No linkage between TImR and UCS. • No access for CHW to register clients at community-level. 	<ul style="list-style-type: none"> • Integration between TImR and CRVS. • Integration between TImR and UCS. • CHW to register

Process name	Name of digital system	System gaps	Recommendations
			clients at community-level.
Register facilities	<ul style="list-style-type: none"> HFR TImR 	<ul style="list-style-type: none"> No linkage between TImR and HFR. 	<ul style="list-style-type: none"> Integration between TImR and HFR.
Plan service delivery	<ul style="list-style-type: none"> TImR VIMS ChanjoCOVID 	<ul style="list-style-type: none"> No linkage between TImR and VIMS. No linkage between TImR and ChanjoCOVID. 	<ul style="list-style-type: none"> Integration between TImR and VIMS.

5.3 Create newborn record



S/n	Data element label	Description and definition
C1	Birth registration date	Date and time of registration of the birth.
C2	Date and time of birth	Client's date of birth.
C3	Place of birth	Client's place of birth.

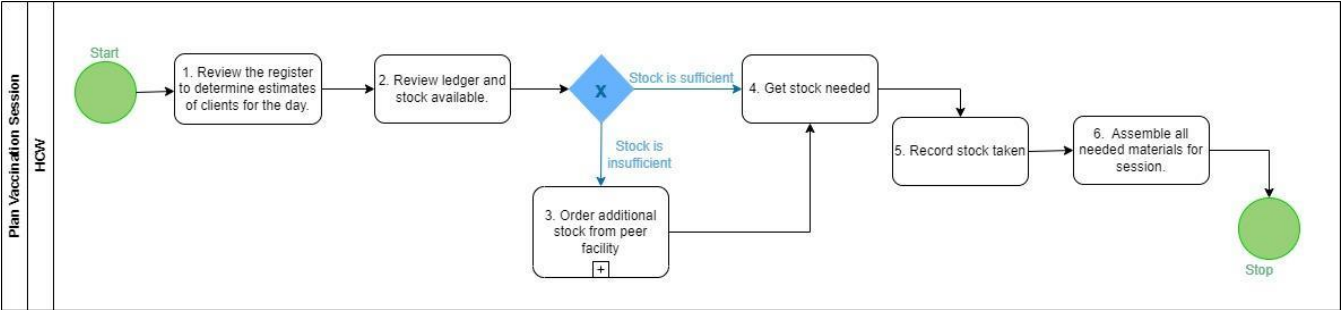
S/n	Data element label	Description and definition
C4	Name of Facility	The facility where the birth took place, if appropriate.
C5	Sex	Baby's biological sex, either male or female.
	Female	Female client.
	Male	Male client.
C6	Birth weight	Client's weight at birth in grams.
C7	Gestational age	Client's gestational age at birth in weeks.
C8	Multiple pregnancy	Pregnancy with two or more fetuses.
C9	Multiple birth type (name)	The birth of more than one baby from a single pregnancy.
	Twins	Two babies.
	Triplets	Three babies.
	Quadruplets	Four babies.
	Quintuplets	Five babies.
	Sextuplets	Six babies.
	Septuplets	Seven babies.
	Other (Specify)	More than seven babies.
C10	Baby's state	Baby's life state after birth.
	Alive	Baby is alive.
	Dead	Baby is dead (records should be removed).
C11	Mother's name	Mother's first, middle (optional) and last name.
C12	Mother's contact	Mothers contact information (mobile number).
C13	Father's name	Father's first and last name.
C14	Father's contact	Father's contact information (mobile number).
C15	Mother's Td vaccination status	Mother's Td vaccination status.

5.4 Register facility

S/n	Data element label	Description and definition
D1	Facility ID	Unique identifier for the facility.
D2	Facility name	Name of the facility.
D3	Facility type	Type of facility.
	Level 1: Dispensary	Facility that offers service in the village catchment area.

S/n	Data element label	Description and definition
	Level 2: Health centers	Facility that offers service in the ward catchment area.
	Level 3: District hospitals	Facility that offers service in the district catchment area.
	Level 4: Regional hospitals	Facility that offers service in the regional catchment area.
	Level 5: National referral hospitals	Facility that offers service in the national catchment area.
D4	Facility location	Physical address of where the facility is located.
D5	Service area	Facility service area.
D6	Services provided	Services delivered at the facility.
D7	Facility contact information	Contact information for the facility.
D8	Operational status	Operational status of the facility.
D9	Administrative level/ areas	Administrative level of the facility.
D10	Geographic coordinates	Global Positioning System (GPS) coordinates.

5.5 Plan for vaccination session



S/n	Data element label	Description and definition
E1	Vaccine quantity in stock	Number of vaccine doses available.
E2	Vaccine quantity required	Number of vaccine doses required to deliver the vaccination sessions.
E3	Vaccine quantity shortfall	Number of vaccine doses required to complete the vaccination session.
E4	Next vaccination session	The date that the next vaccination session is scheduled.
E5	Number of clients due	Number of clients due at the next vaccination session.
E6	Number of clients overdue	Number of clients who missed the vaccination session.

S/n	Data element label	Description and definition
E7	Vaccine product name	The name of the vaccine.
E8	Batch number	The vaccine product code.
E9	Vaccine expiry date	The last date of vaccine usage.
E10	Vaccine manufacturer	The name of vaccine manufacturer.
E11	Vaccines doses ordered	Number of vaccine doses ordered at peer facility.
E12	Stock request date	Date new vaccine stock ordered at peer facility.
E13	Stock request number	Unique identifier for the stock request (order).
E14	Stock requestor ID	The User ID, or Provider ID, of the person requesting stock, if available.
E15	Number of vaccine doses dispensed	Number of vaccine doses dispensed or removed from fridge at facility to prepare for clinic.

6. Administer and document care

6.1 Administer and document care process matrix

No.	Process name	Personas	Objectives	Task set
F	Register client	<ul style="list-style-type: none"> • HCW 	To start and contribute to the clients' lifelong vaccine record.	<p><i>Starting point: HCW wants to register client information into the health record.</i></p> <ul style="list-style-type: none"> • Before registration, query the client record. • Create client records. • Update a client health record.

No.	Process name	Personas	Objectives	Task set
G	Query client record	<ul style="list-style-type: none"> • HCW 	<p>To correctly locate or identify a client's vaccination record as well as review and update a client's record to provide a client's complete immunization history.</p>	<p><i>Starting point: Client vaccination visit.</i></p> <ul style="list-style-type: none"> • Search for the client using their name/demographic information. • Determine if there is an exact or partial match. • Use additional search criteria (barcode number) to establish an exact match. • If client is not existing, create a new registration.
H	Administer vaccine	<ul style="list-style-type: none"> • HCW 	<p>To determine what vaccines a client needs, administer vaccines, and record the relevant necessary data in the system as well as on the appropriate on home-based record.</p>	<p><i>Starting point: Client requires vaccination.</i></p> <ul style="list-style-type: none"> • Query the client record. • Compare client record with physical card and probe client's history if there is any discrepancy. • Determine if vaccine is available and safe to administer. • Prepare and administer vaccine. • Record appropriate data. • Monitor adverse events and record appropriately. • If needed, reschedule the next date of visit. • Generate the digital certificate, if needed.

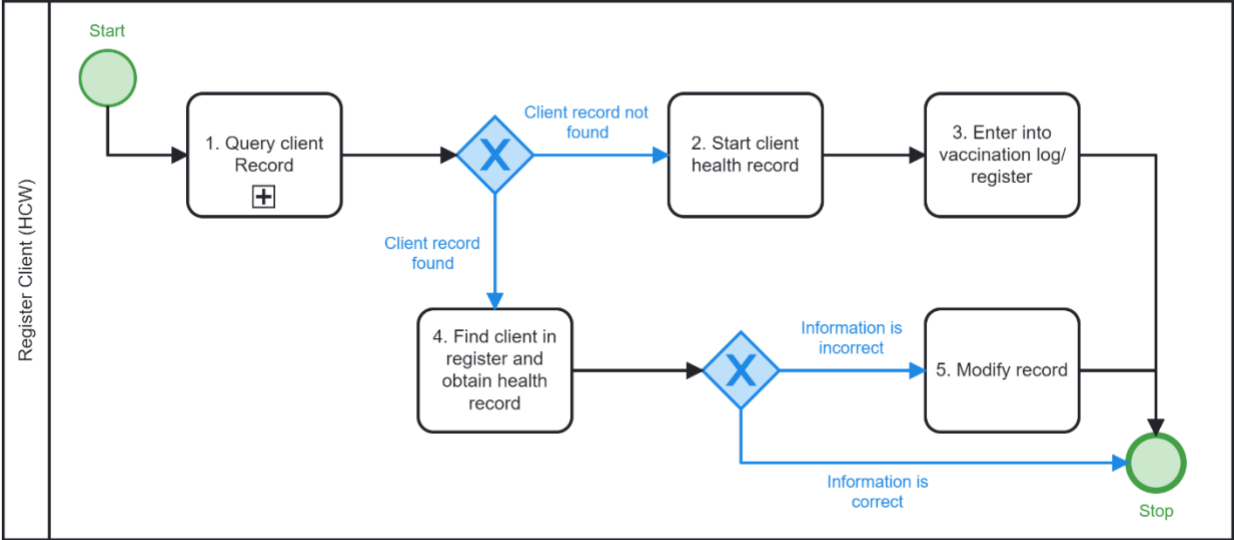
No.	Process name	Personas	Objectives	Task set
I	De-duplication of client patient records	<ul style="list-style-type: none"> • HCW • DIVO 	To identify duplicate client records and consolidate them into one most accurate/suitable record.	<p><i>Starting point: Identify duplicate client records and flag for evaluation.</i></p> <ul style="list-style-type: none"> • Query client record. • Flag duplicate records for evaluation. • Produce a list of the duplicate records and review them. • Determine if duplicate records can be merged into a single record. • Merge, as appropriate. If the records are not duplicates, indicate that in the individual records. mark as not duplicate.
J	De-duplication of vaccine events	<ul style="list-style-type: none"> • HCW • DIVO 	To identify duplicate vaccination events within a client record and update into one event.	<p><i>Starting point: Identify duplicate vaccine events and flag for evaluation.</i></p> <ul style="list-style-type: none"> • Identify potential duplicate vaccine events. • Determine if events are duplicates. • Update record appropriately. • Generate a report to show the resolution.

6.2 Digital systems in use

Process name	Name of digital system	System gaps	Recommendations
Register client	<ul style="list-style-type: none"> • TImR • UCS • Under 5 birth registration • ChanjoCOVID 	<ul style="list-style-type: none"> • No linkage between TImR and VIMS. • No access for CHW to register clients at community level using 	<ul style="list-style-type: none"> • TImR to pull data from UCS. • To strengthen UCS with the additional feature that supports

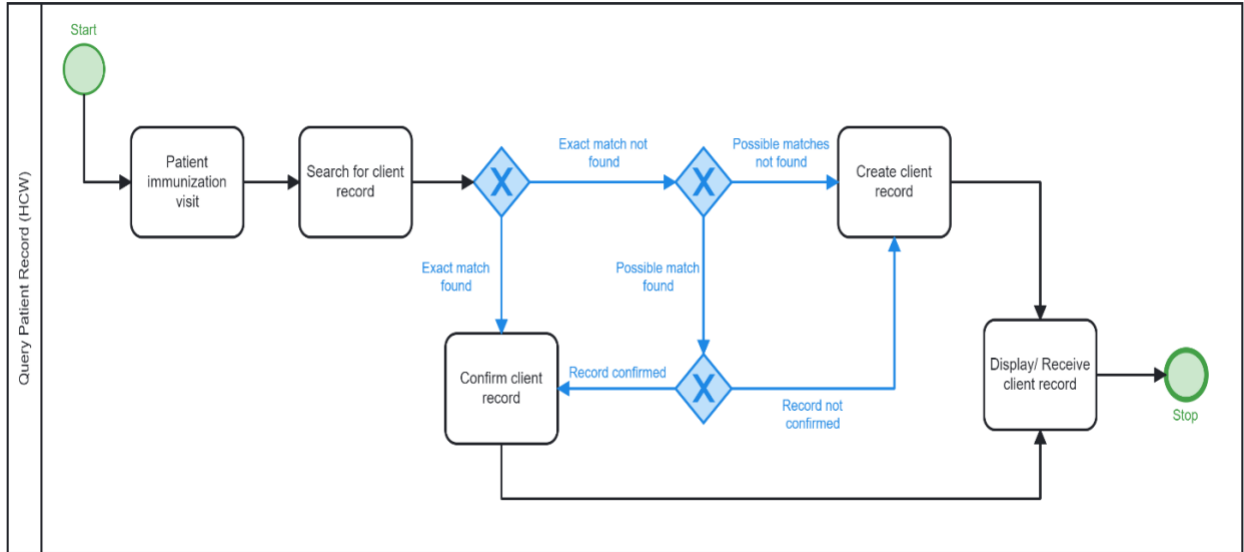
Process name	Name of digital system	System gaps	Recommendations
	<ul style="list-style-type: none"> PMCTC 2 	TImR.	capturing zero doses for under 5 at community level by using CHW.
Query client record	<ul style="list-style-type: none"> TImR ChanjoCOVID 	<ul style="list-style-type: none"> No linkage between TImR and ChanjoCOVID. 	<ul style="list-style-type: none"> Integrate TImR with ChanjoCOVID system.
Administer vaccine	<ul style="list-style-type: none"> TImR ChanjoCOVID VIGIMOBILE (capture adverse event following immunization [AEFI] details) 	<ul style="list-style-type: none"> No linkage between TImR and VIMS. 	<ul style="list-style-type: none"> Linkage between TImR and VIMS.
De-duplicate of client records	<ul style="list-style-type: none"> TImR ChanjoCOVID 	<ul style="list-style-type: none"> No linkage between TImR and ChanjoCOVID. 	<ul style="list-style-type: none"> Integrate TImR with ChanjoCOVID system.
De-duplicate of vaccine event	<ul style="list-style-type: none"> TImR ChanjoCOVID 	<ul style="list-style-type: none"> No linkage between TImR and VIMS. 	<ul style="list-style-type: none"> Linkage between TImR and VIMS.

6.3 Register client

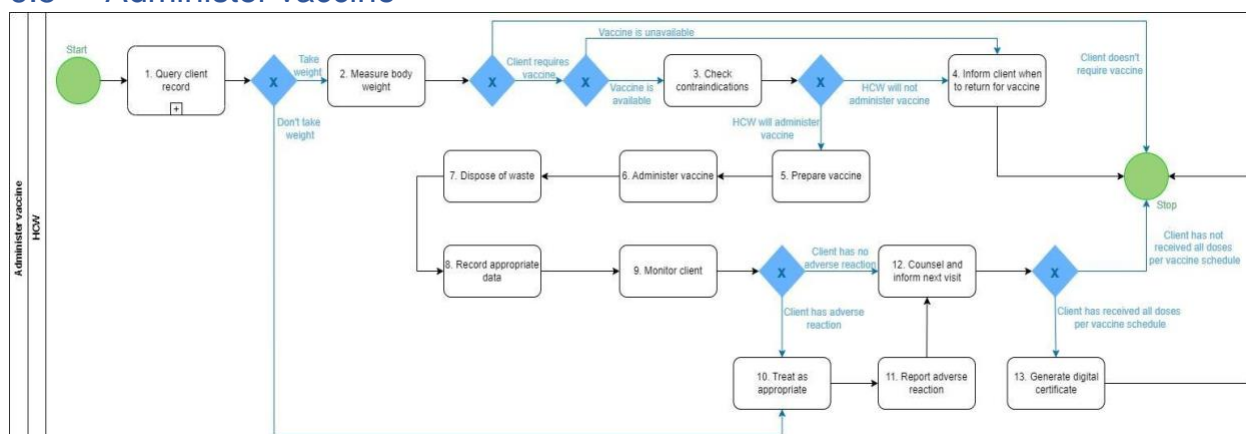


S/n	Data element label	Description and definition
F1	Client ID	Unique, system generated client ID.
F2	Client first name	Client's first name.
F3	Client middle name	Client middle name
F4	Client last name	Client's last or family name.
F5	Client birth date	Client's date of birth capturing day, month, and year of birth.
F6	Age	Estimated age in years and months of the client. Captured if client_birth_date is unknown.
F7	Sex	Client's biological sex, either male or female.
	Male	Client identifies as male.
	Female	Client identifies as female.
F8	Client contact number	Personal phone number through which the client may be reached or close relative's number.
F9	Client address/residence	Client's address including street name, village, shehia, district, city, and region.
F10	Next of kin	Client's next of kin details including name, address, and contact number.

6.4 Query client record



6.5 Administer vaccine



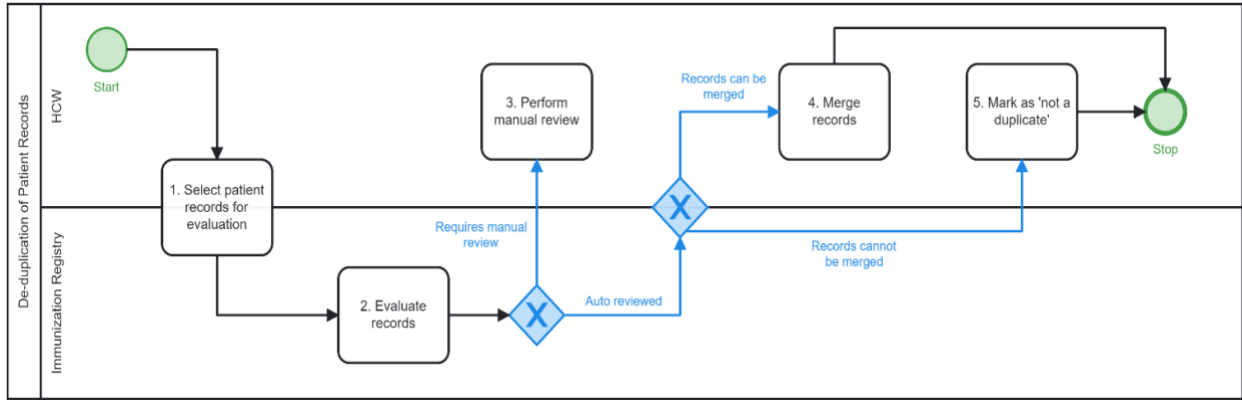
S/n	Data element label	Description and definition
H1	Client details (search)	Search for any client registration details.
H2	Display client record	Display client record.
H3	Vaccine schedule	Display client's current vaccine card.
	Vaccine type	Name of antigen
	Vaccine dose	Vaccine dose (i.e., first, second, third, booster, etc.)
	Vaccination status	Vaccine due/missed/requested (non-routine).
	Vaccine stock availability (yes/no)	Is a vaccine currently available?
H4	Contraindication/reaction to vaccine (yes/no)	Has the client had any severe, life-threatening adverse events from current or previous vaccines administration?
H5	Health status	Client is currently very sick and/or has a very high temperature (greater than 39 degrees Celsius), pressure, etc.
H6	Administer vaccine (yes/no)	Does the HCW recommend for the vaccine to be administered?
H7	Reason for non-administration of vaccine	Reason for non-administration of vaccine.
	Stockout	Reason for non-administration of vaccine, syringe, or diluent stockout.
	Health condition	Reason for non-administration of vaccine is postponed for health condition of client.
	Contraindication/	Reason for non-administration of vaccines is vaccine

S/n	Data element label	Description and definition
	adverse events	contraindication.
	Guardian/client refusal	Reason for non-administration of vaccine is guardian/client refusal.
	Other (specify)	Reason for non-administration of vaccine other (specify).
H9	Client first name	Client's first or given name.
H10	Client family name	Client's last or family name.
H11	Client ID	Unique, system generated patient ID.
H12	Vaccine type	Type of vaccine.
H13	Vaccine dose	Vaccine dose (i.e., first, second, third, booster, etc.).
H14	Vaccination status	Vaccine due, missed, or requested (non-routine).
H15	Follow-up date	Scheduled date for immunization follow-up.
H16	Additional notes/Comments	Any additional notes.
H17	Vaccine type	Name of antigen.
H18	Vaccine product code	The unique number that identifies the vaccine in the system.
H19	Vaccine dose	Vaccine dose (i.e., first, second, third, booster, etc.).
H20	Date of administration	Date that the vaccine was administered to the client.
H21	Mode of administration	Route in which vaccine was administered.
	Oral route (PO)	Oral vaccine is administered through drops to the mouth.
	Subcutaneous route (Sub cut)	Subcutaneous injections are administered into the fatty tissue found below the dermis and above muscle tissue.
	Intramuscular route (IM)	Intramuscular injections are administered into the muscle through the skin and subcutaneous tissue.
	Intradermal route	Intradermal injections are administered into the dermis (between the epidermis and subcutaneous tissue).
H22	Vaccine batch number	Batch number of the vaccines for traceability purposes.
H23	Vaccine manufacturer (drop-down)	Manufacturer of the vaccines for traceability purposes.
H24	Place of administration	Place or area where the vaccination session was conducted.

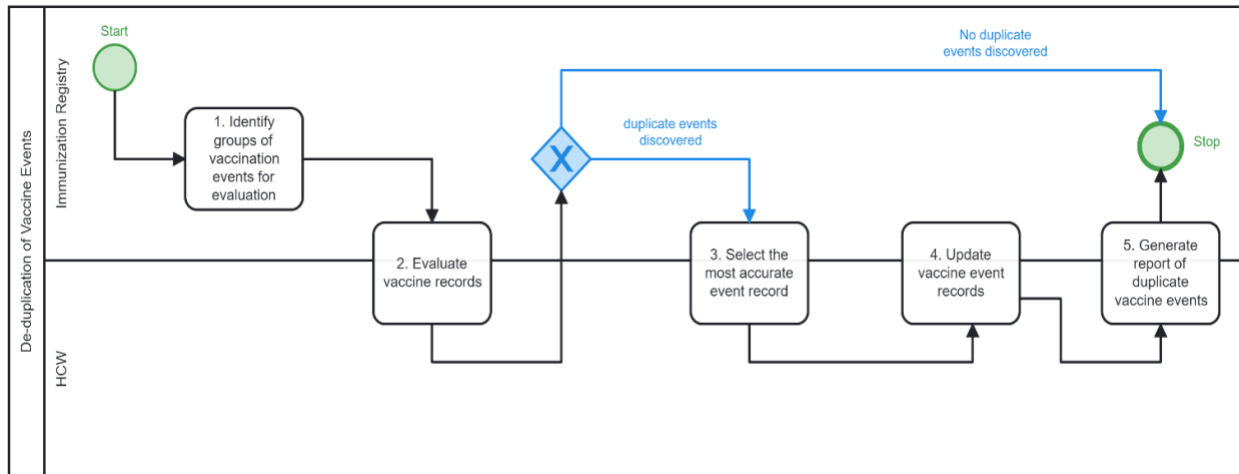
S/n	Data element label	Description and definition
H25	Vaccinator (provider ID)	Provider ID (UID) of the person performing the vaccination, if available.
H26	Strategy	E.g., static or outreach/mobile.
H27	Client ID	Unique identifier generated for new clients or returned from a query to client registry.
H28	Client consent	Indicates if the client (or guardian if client < 18 years old) has given consent. Note: Applies only for vaccines under emergency use listing.
H29	Facility ID	The unique identifier for the facility.
H30	Next visit date	Next date client is due for vaccination (immunization appointment). Weight, status, etc.
H32	Type of adverse reaction experienced	Adverse reaction experienced by client.
	Fever	Client has experienced an adverse reaction of fever.
	Headache	Client has experienced an adverse reaction of headache.
	Body aches	Client has experienced an adverse reaction of body aches.
	Fatigue	Client has experienced an adverse reaction of fatigue.
	Other (specify)	Specify any other adverse reaction experienced.
H33	Case investigated and treatment received? (yes/no)	Whether or not the health worker investigated the case investigated and provided treatment to the client.
H34	Prescription given? (yes/no)	Whether or not the health worker provide any kind of medicine or prescription to the client.
H35	Type of prescription	Prescription given (list all).
H36	Was case investigation form (CIF) filled for AEFI reporting? (yes/no)	Whether or not the CIF was filled for AEFI reporting. Note: In case the CIF hasn't been filled, remind to fill the form.
H37	Additional notes	Any extra notes by provider regarding treatment or prescription.
H38	Next visit date	Client's next visit day.

S/n	Data element label	Description and definition
H44	Name	Full name of the tested person.
H45	Date of birth	Tested person's date of birth (DOB), if known. If unknown, use assigned DOB for administrative purposes.
H46	Unique identifier	Unique identifier (ID) for the tested person, according to the policies applicable to each country. There can be more than one unique identifier used to link records (e.g., national ID, health ID, medical record ID).
H47	Vaccine type	Type of vaccine.
H48	Vaccine product code	Vaccine product code.
H49	Vaccine dose	Vaccine dose i.e., first, second, third, first booster, etc.
H50	Date of administration	Date that the vaccine was administered to the client.
H51	Mode of administration	Route in which vaccine was administered.
H52	Vaccine batch number	The batch number of the vaccines for traceability purposes.
H53	Vaccine manufacturer	The manufacturer of the vaccines for traceability purposes.
H54	Place of administration	The place where the vaccines was administered to the client.
H55	Certificate Issued	Certificate details, i.e., Certificate ID, date issued, antigen, vaccine name and doses, issuing authority.

6.6 De-duplication of client records



6.7 De-duplication of vaccine events



7. Manage inventory

7.1 Manage inventory processes matrix.

No.	Process name	Personas	Objectives	Task set
K	Manage cold chain inventory	<ul style="list-style-type: none"> HCW 	To plan for equipment requirements at facility level.	<p><i>Starting point: HCW creates a plan for equipment requirements.</i></p> <ul style="list-style-type: none"> Identify routine cold chain equipment maintenance needs. Prepare and submit equipment requirements to the council level. Monitor daily temperature. Receive equipment and update maintenance reports.
L	Manage arrivals of vaccine and related supplies (stock)	<ul style="list-style-type: none"> HCW 	To manage the arrival of stock at facility level.	<p><i>Starting point: HCW creates a plan for vaccine and related supplies requirements.</i></p> <ul style="list-style-type: none"> Identify and review vaccine and related supplies requirements. Prepare and submit

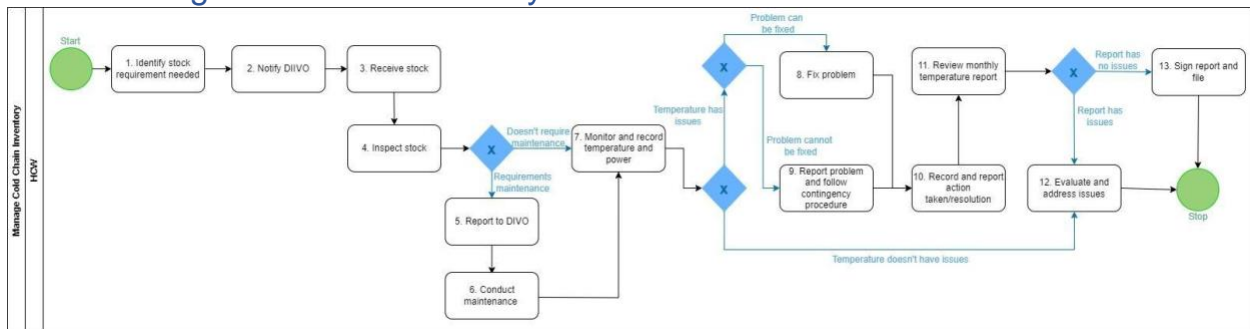
No.	Process name	Personas	Objectives	Task set
				<p>vaccine and stock requirements to the council-level.</p> <ul style="list-style-type: none"> ● Receive, inspect, and clear the stock order, and update issue voucher. ● Report any discrepancies, like mismatching stock and damage. ● Accept and submit stock arrival report.
M	Manage stock	HCW	Manage stock at facility level.	<p><i>Starting point: stock requirement at starting session.</i></p> <ul style="list-style-type: none"> ● Query the stock availability. ● Compare with physical stock. ● Determine if stock is available and safe to administer (check expiry date, Vaccine vial monitor [VVM] status). ● Automate deduction of vaccine doses used in a daily basis. ● Automate deduction of syringes for every client vaccinated. ● Automate deduction of diluent for every vial of lyophilized vaccine. ● Update stock at the end of every session. ● Receive and issue stock from other facilities and update. ● Perform monthly physical count and update for any

No.	Process name	Personas	Objectives	Task set
				discrepancies.

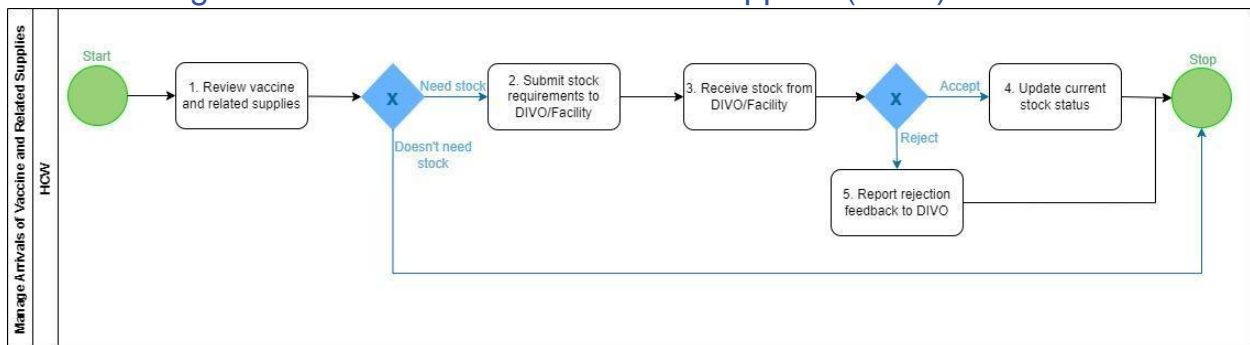
7.2 Digital systems in use

Process name	Name of digital system	System gaps	Recommendations
Manage cold chain inventory	<ul style="list-style-type: none"> RTM VIMS 	TImR was not capturing stock.	Check possibility of linking TImR with RTM/VIMS.
Manage arrivals of vaccine and related supplies (stock)	<ul style="list-style-type: none"> TImR VIMS 	Poor synchronization between TImR and VIMS.	Integrate TImR with VIMS.
Manage stock	<ul style="list-style-type: none"> TImR VIMS 	TImR not integrated with VIMS.	Integrate TImR with VIMS.

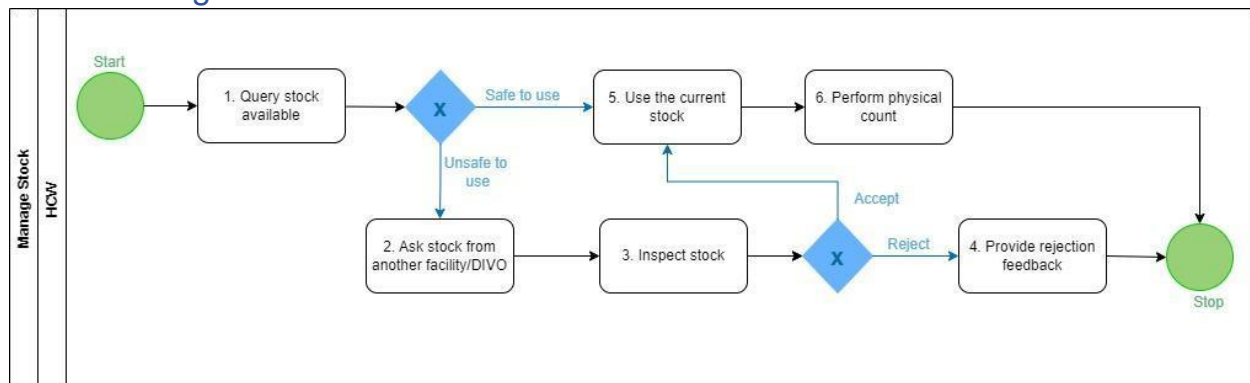
7.3 Manage cold chain inventory



7.4 Manage arrivals of vaccine and related supplies (stock)



7.5 Manage stock



8. Monitoring and evaluation

8.1 Monitoring and evaluation process matrix

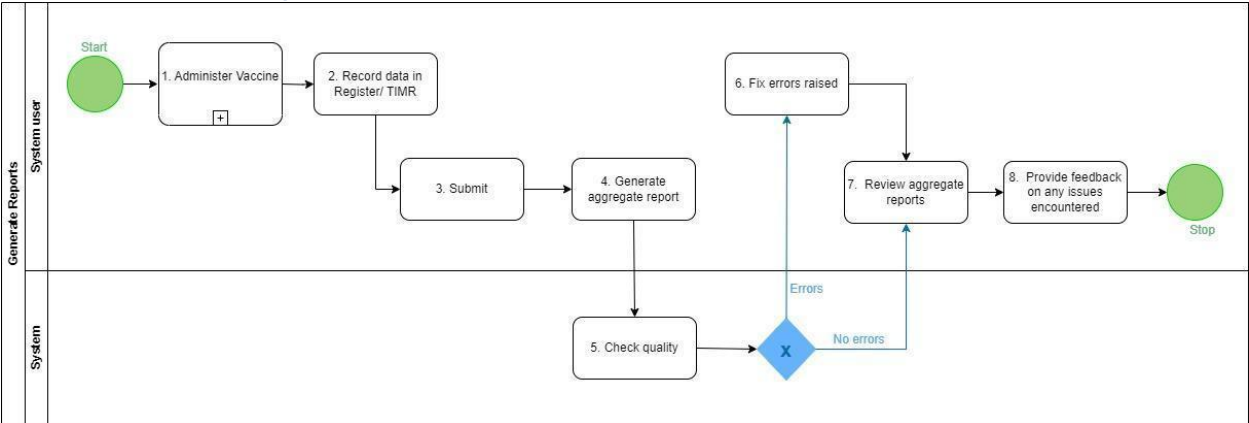
No.	Process name	Personas	Objectives	Task set
N	Generate reports	<ul style="list-style-type: none"> • HCW • DIVO • RIVO • Authorized system user 	<p>The objective is to provide the ability to access and analyze data to improve immunization program decision making. This business process outlines the general steps to generate a variety of reports that are routinely needed by DIVO, RIVO, providers, and other partners.</p>	<p><i>Starting point: Time for periodic (monthly, quarterly, semi-annually, annual, and ad-hoc) reporting.</i></p> <ul style="list-style-type: none"> • Check data quality. • Correct fixable errors. • Generate and review aggregate reports. • Provide feedback on any issues encountered during the process.

8.2 Digital systems in use

Process name	Name of digital system	System gaps	Recommendations
Generate reports	<ul style="list-style-type: none"> • TImR • VIMS • DHIS2 • ChanjoCOVID 	<ul style="list-style-type: none"> • No linkage between TImR and VIMS. • No linkage between TImR and DHIS2. • No integration between TImR 	<ul style="list-style-type: none"> • There will be a single point of immunization collection TImR and ChanjoCOVID but DHIS2 will pull data in order to

		and ChanjoCOVID.	generate reports.
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8.3 Generate reports



S/n	Data element label	Description and definition
K1	Unique identification	Unique identifier generated for new clients or a universal ID, if used in the country.
K2	Report identification	A unique identifier for the instance of the report that has been generated.
K3	Report status	The status of the report (for example, initial, complete, etc.).
K4	Report type	The type of report which has been generated (i.e., is the report a list of individuals, a summary, etc.).
K5	Report indicator code	The indicator or measure definition which is being reported on (for example: dropout rate, defaulters, etc.).
K6	Coverage rate	Report generated indicates the coverage rate of vaccinations versus target population.
K7	Dropout rate	Report generated indicates the aggregate dropout rate based on antigen/antigens.
K8	Vaccination sessions conducted	Report generated indicates the immunization session conducted.
K9	Availability of vaccine and injection supplies	Report generated contains summary data related to availability of vaccine and injection supplies.
K10	Wastage of vaccine and injection supplies	Report generated contains summary data related to wastage of vaccines and injection supplies.

S/n	Data element label	Description and definition
K11	Adverse events following vaccination	Report generate contains summary data related to adverse events following immunization.
K12	Report subject area	Location (facility or place) for which the data in the report is being represented.
K13	Report generation date	The date on which the report was generated.
K14	Reporting period	The period for which data in the report has been included (for example: from 2021-01-01 until 2021-02-01). Period can be monthly, quarterly, bi-annual, annual, or customized.
K15	Improvement indicator	Indicates to the receiver how to interpret the data (i.e., what constitutes an improvement or deterioration).
K16	Increase in improvement	Indicates that when the measure scores increase, the data can be interpreted as an improvement (used for coverage indicator).
K17	Decrease in improvement	Indicates that when measure scores decrease, the data can be interpreted as an improvement (used for dropout, wastage, AEFI indicators).
K18	Report generator/author	Indicates the organization or location which is generating or producing the report.
K19	Report measures	Grouping of information related to the values of a measure for each population group in the report.
K20	Measure identifier/meaning	Codifies the meaning of the group/measure. For example, if the report indicator is "coverage" each antigen/vaccine would have a measure (i.e., Bacillus Calmette–Guérin [BCG] coverage or BCG target).
K21	Measure population	Information related to the population of the reported measure/score in this group. For example, if the indicator being reported is "BCG coverage" it would represent the population for that grouping.
K22	Measure numerator	The count of individual objects (persons, doses, etc.) which was used as the numerator to calculate the measure score.
K23	Measure denominator	The count of individual objects (persons, doses, etc.) which was used as the denominator to calculate the measure score.
K24	Measured score	The calculated score of the measure/indicator which is

S/n	Data element label	Description and definition
		being reported on.
K25	Disaggregation	The stratification values within the group which will track the disaggregation of each indicator (e.g., column I of annex C).
K26	Disaggregation group meaning	Indicates the overall strata or disaggregation which is being represented in the report (e.g., by gender, by region, by age group, etc.).
K27	Disaggregation measures	An individual grouping of population and measures for the specified stratification. For example, if the stratification value is "by-gender", then there would be a "male" or "female" stratum.
K28	Disaggregation measure identifier/meaning	The type or value of this stratum represents (male, female, region 1, dose 3, etc.).
K29	Disaggregation measure population	A description of the population which makes up the stratification value.
K30	Disaggregation numerator	The count of individual objects (persons, doses, etc.) which were used as the numerator for the disaggregation score.
K31	Disaggregation denominator	The count of individual objects (persons, doses, etc.) which were used as the denominator for disaggregation score.
K32	Disaggregated score	The computed score for this disaggregation. For example -
K33		Report indicator: coverage.
K34		Measure: BCG vaccination coverage.
K35		Population numerator: All BCG doses given for period.
K36		Population denominator: Population of surviving infants. Note: BCG and Td will use live birth as target group.
K37		Disaggregation grouping: By gender.
K38		Disaggregation measure meaning: Male.
K39		Disaggregation population numerator: Number of males given BCG.
K40		Disaggregation population denominator: Number of surviving infant males.

S/n	Data element label	Description and definition
K41		Disaggregation score: Number of males given BCG/number of surviving infant males.

Decision support logic

The table below describes the National Vaccination Schedule for Tanzania. This will form the basis of the decision support logic for administering vaccinations.

Age	Vaccine
Birth or first contact	BCG
	OPV 0
Six weeks	OPV 1
	DPT-HepB – Hib1
	PCV 1
	Rota 1
Ten weeks	OPV 2
	DPT-HepB – Hib2
	PCV 2
	Rota 2
Fourteen weeks	OPV 3
	DPT-HepB – Hib3
	PCV 3
	Rota 3
	IPV
Nine months	Measles-Rubella1
18 months	Measles-Rubella 2
First contact	TT1
One month after the first dose	TT2
Six months after the second dose	TT3
One year after the third dose	TT4
One year after the fourth dose	TT5
14 years	HPV1
Six months after first dose	HPV2

9. Indicators

This section details indicators and performance metrics that would be aggregated from core data elements identified in each process. The list in this table is a minimum set of indicators that can be aggregated for decision-making, performance metrics, and subnational and national reporting based on data collected from individual-level, routine health systems.

Indicator code	Indicator name	Numerator		Denominator		Definition
		Definition	Computation	Definition	Computation	
01	Proportion of outreach sessions conducted per planned.	Number of outreach session conducted.	COUNT of outreach sessions conducted.	Total number of planned outreach sessions.	COUNT of total outreach sessions planned.	Percent of outreach sessions conducted against total planned outreach sessions that period.
02	Proportion of vaccination session conducted per planned.	Number of fixed sessions conducted.	COUNT of fixed sessions conducted.	Total number of planned fixed sessions.	COUNT of total fixed sessions planned.	Percent fixed vaccination sessions conducted against planned sessions during the period.
03	Proportion of babies born alive.	Number of newborns alive.	COUNT of newborns alive.	Total number of newborns.	COUNT of all newborns who have been born.	Percent of newborns alive during the period.
04	Proportion of facilities registered.	Number of facilities registered.	COUNT of facilities registered.	Total number of facility information received for registry.	COUNT of all facility information received for registry.	Percent of facilities registered during the period.
05	Proportion of HF with adequate vaccines.	Number of HF with adequate vaccine stock (stock greater than	COUNT of immunization vaccines supplied.	Number of immunization vaccines to achieve the 100 percent target in the	COUNT of immunization vaccines if stock is fully supplied.	Percent adequacy of routine immunization vaccine supply

		0).		districts.		against the 100 percent target.
06	Proportion of HF that submitted timely monthly reports.	Number of HF that submitted timely reports to the district level during the period.	COUNT of HF that submitted timely monthly reports.	Total number of HF that submitted monthly reports.	COUNT of all the HF that submitted reports.	Percent of HF that submitted timely reports to the district level during the period.
07	Proportion of HF that submitted complete monthly reports.	Number of HF that submitted complete monthly reports.	COUNT of HF that submitted complete monthly reports.	Total number of HF that submitted complete monthly reports.	COUNT of all HF that submitted complete report.	Percent of HF that submitted complete reports to the district level during the period.
08	Proportion of HF that submitted timely reports in VIMS.	Number of HF that submitted timely reports in VIMS.	COUNT of HF that submitted timely reports in VIMS.	Total number of HF that submitted reports in VIMS.	COUNT of all HF that submitted reports in VIMS.	Percent of HF that submitted timely data reports in VIMS during the period.
09	Proportion of HF that submitted complete reports in VIMS.	Number of HF that submitted complete reports in VIMS.	COUNT of HF that submitted complete reports in VIMS.	Total number of HF that submitted complete reports in VIMS.	COUNT of HF that submitted complete reports in VIMS.	Percent of HF that submitted complete data in VIMS during the period.
10	Dropout of Diphtheria, Pertussis, and Tetanus (DTP1-DTP3).	Number vaccinated with DTP1.	COUNT of number children vaccinated with DTP1.	Number vaccinated with DTP3.	COUNT of number vaccinated with DTP3.	Percent dropout rate of DTP1-DTP3. FORMULA :

						((DTP1 - DTP3)/DTP1)*100
11	Dropout of DTP1-MR2.	Number vaccinated with DTP1.	COUNT of number vaccinated with DTP1.	Number vaccinated with MR2.	COUNT of number vaccinated with MR2.	Percent dropout rate of DTP1-MR2. FORMULA : ((DTP1 - MR2)/DTP1)*100
12	Dropout of HPV1-HPV2.	Number vaccinated with HPV1.	COUNT of number vaccinated with HPV1.	Number vaccinated with HPV2.	COUNT of number vaccinated with HPV2.	Percent dropout rate of HPV1-HPV2. FORMULA : ((HPV1 - HPV2)/HPV1)*100
13	Dropout of MCV1-MCV2.	Number vaccinated with MCV1.	COUNT of number vaccinated with MCV1.	Number vaccinated with MCV2.	COUNT of number vaccinated with MCV2.	Percent dropout rate of MCV1-MCV2. FORMULA : ((MCV1 - MCV2)/MCV1)*100
14	Proportion of children vaccinated with the first dose of Pentavalent.	Number vaccinated with DTP1.	COUNT of number vaccinated with DTP1.	Number of surviving infants.	COUNT of number of surviving infants.	Percent coverage of Penta-1 FORMULA

						: (DTP1/Sur viving infants)*10 0
15	Proportion of children Vaccinated with 3rd dose of Pentavalent.	Number vaccinated with DTP3.	COUNT of number vaccinated with DTP3.	Number of surviving infants.	COUNT of number of surviving infants.	Percent coverage of Penta-3. FORMULA : (DTP3/Sur viving infants)*10 0
16	Proportion of children vaccinated with the first dose of measles containing vaccine.	Number vaccinated with MCV1.	COUNT of number vaccinated with MCV1.	Number of surviving infants.	COUNT of number of surviving infants.	Percent coverage of MCV1. FORMULA : (MCV1/Su riving infants)*10 0
17	Proportion of children vaccinated with the second dose of measles contained vaccine.	Number vaccinated with MCV2.	COUNT of number vaccinated with MCV2.	Number of surviving infants of previous year.	COUNT of number of surviving infants of previous year.	Percent coverage of MCV2. FORMULA : (MCV2/Su riving infants of previous year)*100
18	Proportion of girls of target age vaccinated with one dose of HPV.	Number vaccinated with HPV1.	COUNT of number vaccinated with HPV1.	Number of girls of 14 years old.	COUNT of number of girls of 14 years old.	Percent coverage of HPV1. FORMULA

						: (HPV1/girls of 14 years old age)*100
19	Proportion of AEFI cases reported and investigated.	Number of AEFI cases investigated .	COUNT number of AEFI cases investigated.	Number of AEFI cases reported.	COUNT number of AEFI cases reported.	Percent of AEFI investigated. FORMULA : AEFI case investigated/AEFI cases reported)* 100
20	Proportion of pregnant mothers vaccinated with two or more doses of tetanus contained vaccine.	Number of pregnant women vaccinated with Td2+.	COUNT number of pregnant women vaccinated with Td2+.	Number of pregnant women.	COUNT number of pregnant women.	Percent coverage of Td2+. FORMULA : (pregnant women vaccinated with Td2+/Total pregnant women)*100
21	Proportion of districts achieving DTP3 coverage of greater than or equal to 90 percent.	Number of districts achieving DTP3 coverage of greater than or equal to 90 percent.	COUNT of districts achieving DTP3 coverage of greater than or equal to 90 percent.	Number of districts in the country.	COUNT of districts in the country.	Percent of districts with coverage Penta-3. FORMULA : (districts

						achieving DTP3 coverage of =>90%/(Total number of districts)*100
22	Vaccines wastage.	Number of vaccine Immunized	COUNT of all Immunized vaccine	#of usable doses plus #of doses received at the beginning of the period minus #of usable doses in stock at the end of the period	COUNT of #of usable doses plus #of doses received at the beginning of the period minus #of usable doses in stock at the end of the period	Percent vaccines wastage rates.
23	Proportion of HF with adequate COVID-19 vaccines per target population.	Number of HF with adequate COVID-19 vaccine.	COUNT of adequate COVID-19 vaccine.	Total target COVID-19 vaccine for 70 percent of target population	COUNT of total adequacy of vaccine in a target population.	Percent adequacy of vaccine supply against the 70 percent target population.
24	Proportion of districts with adequate COVID-19 vaccines per target population.	Number of districts with adequate COVID-19 vaccines in the target population.	COUNT of districts with adequate COVID-19 vaccines in a target population.	Total target COVID-19 vaccine in a target population.	Count of all adequacy of COVID-19 vaccine.	Percent adequacy of vaccine stock supply against the 70 percent target population in the districts.
25	Proportion of districts with adequate COVID-19 Injection syringes per target	Number of districts with adequate COVID-19 injection syringes.	COUNT of adequate syringes for COVID-19 in target population.	Total syringes for COVID-19 planned for the target population.	COUNT of syringes in a target population.	Percent adequacy of injection syringes against the 70% target population

	population.					in the districts.
26	Proportion of COVID-19 vaccination sessions conducted per planned.	Number of COVID-19 sessions conducted.	COUNT of COVID-19 sessions conducted.	Total number of planned COVID-19 sessions.	COUNT of total COVID-19 sessions planned.	Percent of COVID-19 vaccination sessions conducted against planned sessions during the period.
27	Proportion of HF that submitted timely monthly reports.	Number of HF that submitted timely reports to national level during the period.	COUNT of HF that submitted timely reports.	Total number of HF that submitted reports.	COUNT of all the HF that submitted reports.	Percent of HF that submitted timely reports to national level during the period.
28	Proportion of HF that detected and completely filled AEFI CIF for submission.	Number of HF that completely filled AEFI CIF.	COUNT of HF that completely filled AEFI cases Investigate.	Number of HF that reported AEFI cases.	COUNT of HF AEFI cases reported.	Percent of AEFI CIF submitted.
29	Proportion of HF that submitted complete monthly COVID-19 reports.	Number of HF that submitted complete COVID-19 reports in VIMS.	COUNT of HF that submitted complete COVID 19 reports in VIMS.	Total number of HF that submitted complete COVID-19 reports in VIMS.	COUNT of HF that submitted complete COVID-19 reports in VIMS.	Percent of HF that submitted complete COVID-19 data in VIMS during the period.
30	Dropout of CV1-CV2 by HF.	Number of individual vaccinated with CV1.	COUNT of number of individual vaccinated with CV1.	Total # of individual vaccinated with CV2 in HF.	COUNT of # of individual vaccinated with CV2 in a HF	Percent dropout rate of CV1-CV2 by HF. FORMULA : ((CV1 -

						CV2)/CV1) *100
31	Dropout of CV1-CV2 by districts.	#of individual vaccinated with CV1.	COUNT of number of individual vaccinated with CV1.	COUNT of all individual vaccinated with CV2 by district	COUNT of number vaccinated with CV2.	Percent dropout rate of CV1-CV2 by district. FORMULA : ((CV1 - CV2)/CV1) *100
32	Percent of COVID-19 vaccines absorption rate.	#Of vaccine administered at the certain period.	COUNT of number of vaccine received.	Total #of vaccine received at certain period.	COUNT of number of total vaccine received	Percent of COVID-19 absorption .
33	COVID-19 vaccine utilization.	#of people vaccinated with CV19.	COUNT of number of people vaccinated with CV19.	COUNT of total number of people vaccinated with CV19.	COUNT of total number of people vaccinated with CV19	%COVID-19 vaccine utilization rate.
34	Proportion of eligible population vaccinated with at least one dose of COVID-19 vaccine.	Number of target population of age =>18 years vaccinated with CV1.	COUNT number of Target population of age =>18 years vaccinated with CV1.	Number of Target population of ALL age =>18 years.	COUNT number Target population of ALL age =>18 years.	% Coverage of CV-1.
35	Proportion of eligible population with a completed COVID-19 vaccination schedule.	Number of target population (18 years or older) that are vaccinated with the last dose of the COVID-19 vaccine per schedule.	COUNT of target population (18 years or older) that are vaccinated with the last dose of the COVID-19 vaccine per schedule.	Number of total target population (18 years or older).	COUNT of total target population (18 years or older).	Percent coverage of target population that are fully vaccinated against COVID-19.
36	Proportion of	Number of	COUNT of	Number of	COUNT of	Percent of

	council reached target for COVID-19 vaccination.	council vaccinated COVID-19 vaccine to 70 percent or more of the eligible population.	council vaccinated COVID-19 vaccine to 70 percent or more of the eligible population.	council in the country.	council in the country.	CV19 coverage above 70% of the eligible population
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10. System requirements

10.1 Functional Requirements

These are the requirements that the end user specifically demands as features that the system should offer and represent or stated in the form of input to be given to the system, the operation performed, and the output expected. They are basically the requirements stated by the user which one can see directly in the final product. Generally, functional requirements specify what the system should do. The functional requirements based on the business process are as follows:

Req. ID	Task	Entity/role	Requirement (the system should...)
01	Define criteria	HCW, CHW	Allow user to select reminder/recall parameters. May include but not limited to: Age, vaccination schedule, geographic area, and event trigger.
02	Define criteria	System	Have the ability to associate a client with a facility/site to generate a provider-based reminder/recall.
03	Define criteria	System	Have ability to validate data against the vaccination schedule (Note: Can use the vaccination schedule to best schedule reminders/recall for series vaccinations, etc.).
04	Select notification method	HCW, CHW	Allow user to select one or more notification methods (e.g., text message, email, CHW home visits, etc.).
05	Select notification method	HCW, CHW	Have the ability to maintain the client's preferred contact method.
06	Generate list of clients	System	Have the ability to produce a list of clients according to user-defined parameters.
07	Generate list of clients	System	Have the ability to print the list of clients.
08	Generate list of clients	System	Have the ability to display the date the reminder/recall notice was sent to a client.
09	Generate list of clients	System	Have the ability to display a type of notification indicator per client record (e.g., due or defaulter).

Req. ID	Task	Entity/role	Requirement (the system should...)
10	Generate list of clients	System	Have ability to track the number of reminder/recall attempts (i.e., per patient and total).
11	Generate list of clients	System	Prevent all records given an inactive or deceased status from being included in the list of clients for reminder/recall.
12	Send notifications	System	Have the ability to generate electronic notifications.
13	Send notifications	System	Have ability to send electronic notifications depending on the client's age and vaccination schedule. E.g., Reminder on Td vaccine scheduled above five yrs.
14	Send notifications	System	Send reminder/recall notification to client or designated health worker e.g., via CHW, HCW (the notification should contain a list of all clients who are due for vaccination).
15	Track client	System	Have the ability to assign CHW to a client.
16	Track client	System	Have the ability to generate and send a list of defaulted/overdue clients to CHW.
17	Track client	CHW	Enable CHW to interact directly with the system to submit feedback after follow up.
18	Update client information and/or status	System	Have ability to track notification attempts and log back to a client's record.
19	Update client information and/or status	System	Have the ability to maintain an audit log of the changes and history.
20	Update client information and/or status	System	Have ability to update client records with tracking information in the TImR.
21	Update client information and/or status	System	Have ability to edit, update, and override client information such as change of address (moved permanently or temporarily).
22	Client is due for vaccination	System	Produce a report that identifies all children due for vaccination within the next month. The inputs to this report should be the national vaccination schedule (rules based on each antigen), and the individual's vaccine record.
23	Confirm vaccination dates and outreach schedule dates	System	Validate the vaccination dates for all facilities in the next month (outreach and fixed).
24	Confirm vaccination	System	Provide a means to update the vaccination schedule

Req. ID	Task	Entity/role	Requirement (the system should...)
	dates and outreach schedule dates		(e.g., with national holidays).
25	Does the client have a phone?	System	Identify if the client due for a vaccination has a phone number on the record.
26	Generate reminder message	System	Generate a pre-recorded reminder message for the client who is due a vaccination. The message can indicate the date and location of the upcoming vaccination schedule (outreach and fixed).
27	Generate reminder to CHW	System	Determine the CHW responsible for the area in which the client due for vaccination resides.
28	Generate reminder to CHW	System	Send a list of all clients (that the CHW is responsible for) that are due for vaccination.
29	Determine if vaccinations were missed	System	Display a list of clients who missed their vaccination for each antigen.
30	Determine if vaccinations were missed	System admin	Allow the user or ministry to specify vaccination schedule and thresholds for a client to qualify as requiring follow-up.
31	Determine if vaccinations were missed	HCW	Allow the user to print a list of clients requiring follow-up.
32	Determine if vaccinations were missed	HCW	Allow the user to export a list for follow-up.
33	Record information to follow-up	System	Extract location and personal information.
34	Record information to follow-up	System	Categorize defaulter information by location and CHW.
35	Plan for follow- up at facility sessions or during outreach	Authorized system users	Display a list of planned outreach and vaccinations sessions.
36	Send client information to CHW or mother/caregiver	System	Send list of missing clients by email or SMS to CHW. Note: Checking point (the number of the reminders sent to clients and CHW comments, the number of reminders equal to or over five).
37	Send client information to CHW or mother/caregiver	System	Send recall SMS to mother/caregiver.
38	Ensure child is	CHW	Mark located client for future follow-up.

Req. ID	Task	Entity/role	Requirement (the system should...)
	vaccinated		
39	Record the reason	HCW, CHW	Allow the user to record reason: either permanent reason for not finding child or reason vaccination was missed.
40	Create new record	HCW, CHW	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.
41	Create new record	HCW, CHW	Prompt the user to save when navigating away from registration without saving.
42	Create new record	HCW, CHW	Display a child summary page to enter child weight or immunizations once the information is saved.
43	Create new record	HCW, CHW	Generate a vaccination schedule based on child date of birth after registration.
44	Update client record	HCW, CHW	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.
45	Update client record	HCW, CHW	Provide the ability to update the child registration information.
46	Receive facility information	TimR staff/system	Have ability to receive facility information from multiple sources (e.g., automatically or manually in multiple formats).
47	Validate HFR	TimR staff/system	Have ability to interface with HFR's database to validate if the facility is already registered in the HFR (Note: If a facility is registered in the HFR, then the facility information should be verified for accuracy and/or updated in the TimR).
48	Validate HFR	TimR staff/system	Have ability to flag any facilities that are registered in the TimR that are not in the HFR.
49	Validate HFR	TimR staff/system	Have ability to validate HFR with TimR master list.
50	Does facility information match?	TimR staff/system	Have ability to update TimR master facility registration information with information from the HFR.
51	Update/add new facility	Facility staff	Have ability to provide a temporary unique ID to facilities not listed in the HFR.
52	Update/add new facility	Facility staff	Have ability to add new facilities to TimR master registration list not listed in the HFR.

Req. ID	Task	Entity/role	Requirement (the system should...)
53	Update/add new facility	Facility staff	Have ability to link the HFR ID with TimR ID as the same record (Note: Reference table used to show the translation of records [e.g., when records are merged, it maintains a reference of the old/expired/obsolete record ID numbers and references the new ID number]).
54	Update/add new facility	Facility staff	Have the ability to send notification of new facilities to the HFR manager.
55	Update/add new facility	Facility staff	Have the ability to update facility information not captured in the HFR.
56	Update/add new facility	Facility staff	Have the ability to keep an audit log of change history when any facility information is changed and saved (e.g., include date/time stamp).
57	Verify information for additional data	TimR staff/system	Have the ability to prompt users to accept changes to TimR master registration list.
58	Verify information for additional data	TimR Staff/System	Have the ability to verify that all required fields are complete.
59	Verify information for additional data	TimR staff/system	Have the ability to notify users of incomplete mandatory fields.
60	Validate HFR	TimR staff/system	Have the ability to flag facilities as temporary.
61	Update/add new facility	TimR staff/system	Have the ability to convert temporary facilities to permanent facilities.
62	Information complete?	TimR staff/system	Have the ability to verify that all required facility information is complete.
63	Information complete?	TimR staff/system	Have the ability to generate an exception report.
64	Information complete?	TimR staff/system	Have the ability to generate reports of missing information.
65	Information complete?	TimR staff/system	Have the ability to generate email to defined groups
66	Request additional information	TimR staff/system	Have the ability to support the process of receiving information.
67	Create/update facility record	TimR staff/system	Have ability to audit facility data changes with date/time stamp "last updated".
68	Create/update facility record	TimR staff/system	Have ability to collect total number of facility data changes and report to selected groups
69	Generate unique	TimR staff/system	Have the ability to generate a unique TimR ID.

Req. ID	Task	Entity/role	Requirement (the system should...)
	TimR ID		
70	Send facility registration notification and TimR ID	TimR staff/system	Have ability to send TimR registration notification with TimR ID (e.g., SMS, mail, email).
71	Send facility registration notification and TimR ID	TimR staff/system	Have ability to insert/include instructions of how to use TimR ID (e.g., reporting requisition).
72	Receive registration information	Facility staff	Allow users to send/acknowledge confirmation of receipt of the registration notification.
73	Review register to determine estimates of vaccine needed	HCW	Identify all clients due (or overdue) for vaccination by the next clinic date.
74	Review register to determine estimates of vaccine needed	HCW	Sort the list by antigen.
75	Review register to determine estimates of vaccine needed	HCW	Provide range estimates for vaccine needs based on historical data (high and low ranges).
76	Record details on planning sheet	HCW	Print list of necessary antigens and accessories (syringes, diluent, etc.) based on projected need.
77	Sufficient stock in immediate location?	HCW	Identify the stock at the facility.
78	Sufficient stock within facility?	HCW	Compare the list of needed antigens to the stock on hand and indicate if there is sufficient stock.
79	Sufficient stock in immediate location?	HCW	Show the actual numbers of each antigen in stock.
80	Order additional stock	HCW	Allow the user to generate a stock request based on the information provided.
81	Order additional stock	HCW	Allow the user to change the number of each antigen as needed (using the shortage as a guideline).
82	Order additional stock	HCW	Provide feedback for stock that is not available for ordering (back orders).
83	Order additional stock	HCW	Indicate that the order has been processed.

Req. ID	Task	Entity/role	Requirement (the system should...)
84	Order additional stock	HCW	Provide any relevant details for the order fulfillment (such as time of day to expect delivery or any special instructions).
85	Order additional stock	HCW	Provide means to include some mandatory user feedback, such as stock on hand, reason for order and Location.
86	Get needed stock	HCW	Provide a printed list of (antigen) stock order to be fulfilled.
87	Record stock taken	HCW	Allow bar code reading of stock taken.
88	Record stock taken	HCW	Record stock removed from cold storage and taken to facility
89	Record stock taken	HCW	Maintain a tally of stock available at each location (cold fridge at fixed session, outreach).
90	Assemble all needed materials for clinic	HCW	Provide a facility materials checklist.
91	Does the patient have a record?	HCW	Allow the user to search for the client given some demographic information.
92	Does the patient have a record?	HCW	As a result of the search, return all potential matches.
93	Does the patient have a record?	HCW	Allow for searching and matching on partial information (such as partial birth dates).
94	Does the patient have a record?	HCW	Allow searching for children based on family relationships or demographics.
95	Does the patient have a record?	HCW	Allow a system administrator to configure search parameters: what fields are mandatory, when partial information is acceptable, etc.
96	Does the patient have a record?	HCW	Allow searching with wild cards.
97	Does the patient have a record?	HCW	Allow the user to find patient records using QR/barcodes/Unique ID.
98	Does the patient have a record?	HCW	Include results that look or sound similar to the search term (fuzzy logic).
99	Start child health card	HCW	There will be a need for the clients to have their own paper record for some time. The child health book contains much more information than just immunizations and will require a much broader and more comprehensive solution to replace. In addition, it will serve as the paper back-up for patients and

Req. ID	Task	Entity/role	Requirement (the system should...)
			families as they rarely have online access to information.
100	Enter into vaccination log/register/ system	HCW	Allow the user to enter all necessary registration data. Note: Include place of domicile and allow registration for catchment and in-service area.
101	Enter into vaccination log/register/ system	HCW	Allow family relations to be modeled by cross-referencing patient data. The mother and father field would thus refer to other records in the patient database.
102	Enter into vaccination log/register/system	HCW	Allow the user to select the place of birth from a list as defined by the system administrator.
103	Enter into vaccination log/register/system	HCW	Allow the user to select the health facility of the patient from a list as defined by the system administrator.
104	Enter into vaccination log/register/system	HCW	Validate that a patient does not exist before adding a new record. (All added activities must be preceded by a search).
105	Enter into vaccination log/register/system	HCW	Enforce minimal data set to allow for a new registration.
10	Enter into vaccination log/register/system	HCW	Enforce all mandatory dataset for a new registration
107	Enter into vaccination log/register/system	HCW	Uniquely identify every person.
108	Enter into vaccination log/register/system	HWC	Provide a mechanism to prevent unwanted duplication of records (e.g., the system warns if a child is registered with same name and DOB).
109	Enter into vaccination log/register/system	HCW	Provide a means to handle duplicates (such as merging records).
110	Enter into vaccination log/register/ system	HCW	Allow for remote/offline access and update of patient records (via mobile device).
111	Find patient in register as well as obtaining the child health booklet	HCW	Allow the system administrator to configure what information and what data will be returned to determine a match.

Req. ID	Task	Entity/role	Requirement (the system should...)
112	Find patient in register as well as obtaining the child health booklet	HCW	Allow users to modify or update appropriate patient data as needed.
113	Review record to determine appropriate action/care	HCW	Allow user to be certain the record belongs to the subject of care (this means it contains enough information/demographics/unique ID, etc.).
114	Review record to determine appropriate action/care	System	Provide a history of previous care.
115	Review record to determine appropriate action/care	System	Contain contact information. Note: When client is under 18, use parents/guardian contact information.
116	Record relevant information	HCW	Update patient's vaccination record with all relevant information (date, dose, lot number, antigen).
117	Record relevant information	HCW	Allow user to record additional doses, even those that are not included in the national vaccination schedule (PIRI, campaigns).
118	Record relevant information	HCW	Allow user to record other vaccinations that are not included in the national vaccination schedule.
119	Does the information belong on the client record?	HCW	Allow space to record any significant observations such as nutrition status that may be specific to that client.
120	Find appropriate general record/ledger	HCW	Allow for the recording of non-client-specific data, such as counts of antigens given.
121	Find appropriate general record/ledger	System	Allow for the reporting of aggregate data from the individual data to suit reporting needs.
122	Query client record	HCW	Search if client is already in system (using at least two identifiers).
123	Query client record	HCW	Require a user to search if a patient is already in the system prior to starting a new vaccination record entry.
124	Query client record	System admin	Allow a system administrator to configure or set if a search must happen in advance of allowing a new

Req. ID	Task	Entity/role	Requirement (the system should...)
			entry.
125	Query client record	HCW	Read client information from a bar code/QR code/patient ID and retrieve patient information.
126	Does client need vaccine?	HCW	Allow the user to customize vaccine protocol.
127	Does client need vaccine?	HCW	Be able to determine vaccine required by looking at age of client, vaccines already given, and vaccine protocol.
128	Does client need vaccine?	HCW	Display vaccine(s) already given and vaccines due according to vaccine protocol.
129	Is required vaccine available?	HCW	Display availability of vaccines stock.
130	Is required vaccine available?	HCW	Warn the user if required vaccine is out of stock.
131	Inform client of next vaccine date	HCW	Display due date of the next vaccine.
132	Update record	HCW	Allow the user to review antigen information (e.g., batch number, expiry date, VVM status).
133	Update record	HCW	Allow user to select appropriate antigen at start session.
134	Update record	HCW	Update stock record. Note: Update stock daily at the end of session.
135	Update record	HCW	Alert user for stockout during vaccination session.
136	Update record	HCW	Allow user to add stock to out of stock vaccine/syringe/without finishing the session.
137	Inform next visit	HCW	Display date of the next vaccine/due date.
138	Select patient records for evaluation	System	Have ability to automatically identify new patient records as possible duplicates.
139	Select patient records for evaluation	System	Have ability to automatically identify existing patient records as duplicates.
140	Select patient records for evaluation	System	Have ability to prompt user of possible duplicate record prior to saving new record.
141	Select patient records for	System	Automatically flag duplicate records.

Req. ID	Task	Entity/role	Requirement (the system should...)
	evaluation		
142	Select patient records for evaluation	System	Have ability to schedule batching of duplicate record process.
143	Evaluate records	System	Support a rule-based algorithm to evaluate duplicate records.
144	Evaluate records	System	Have ability to generate a report of like IDs/confidence ratings. Note: Possible duplicates: name, address, quality data, reliable information, etc. Filter out missing/invalid value/data.
145	Evaluate records	System	Allow rules to be easily editable by TIRM staff.
146	Manual review?	System	Flag duplicate records that require manual review.
147	Manual review?	System	Have ability to combine two or more duplicate records according to business rules. Note: Business rules should define which criteria to use to merge records (e.g., what information to keep from the duplicates).
148	Manual review?	System	Automatically flag duplicate clients.
149	Perform manual review	User	Have ability to alert user of records pending for manual review.
150	Perform manual review	User	Allow user to view records simultaneously for decision to merge records.
151	Perform manual review	User	Allow user to navigate the system while reviewing possible duplicates.
152	Perform manual review	User	Have ability to plan and organize projects/tasks/assignments (e.g., task management, assign statuses like "completed" or "high priority", etc.).
153	Can records be merged?	System	Have ability to determine if records have appropriate criteria in order to merge (e.g., personal identifying data to watch).
154	Merge record	System	Allow user to select data elements to merge into a consolidated record. Note: Could access additional source of data to validate information (e.g., ask the person, look up in another database).

Req. ID	Task	Entity/role	Requirement (the system should...)
155	Merge record	System	Support an audit trail when records are merged.
156	Merge record	System	Have ability to produce and access a cross-reference listing of pre- and post-merged records (i.e., a list that shows the old patient record information with the corresponding converted new patient record).
157	Merge record	System	Have ability to “undo merge”.
159	Mark as “not duplicate” or pending	System	Allow user to flag record as “not a duplicate” Note: The system could believe records are duplicates, but they are not.
160	Mark as “not duplicate” or pending	System	Have ability to prevent matching for the same pair of records that have been flagged as “not a duplicate”.
161	Mark as “not duplicate” or pending	System	Allow user to manually flag a record as pending for manual review (e.g., not enough information).
162	Mark as “not duplicate” or pending	System	Have functionality to determine what pair of records is “not a duplicate of” (i.e., record 123 is a duplicate of record 456 and vice versa).
163	Identify groups of vaccination events for evaluation	System	Have ability to prompt the user that the new vaccine is a duplicate.
164	Identify groups of vaccination events for evaluation	System	Have ability to generate a list of possible client vaccine duplicates.
165	Identify groups of vaccination events for evaluation	System	Have ability to manually initiate duplicate search process.
166	Identify groups of vaccination events for evaluation	System	Have ability to automate duplicate search process.
167	Identify groups of vaccination events for evaluation	System	Allow users to manually flag duplicate events.
168	Identify groups of vaccination events for evaluation	System	Have ability to display to the end user the vaccine type, manufacturer, administration date, eligibility, and administrator who entered the dose for manual vaccine de-duplication review.
169	Evaluate vaccine event records	System	Support a rules-based algorithm to evaluate duplicate events.

Req. ID	Task	Entity/role	Requirement (the system should...)
170	Evaluate vaccine event records	System	Support probabilistic algorithm to determine and flag when duplicate events need manual review.
171	Evaluate vaccine event records	System	Allow rules to be easily editable by DIVO's/IVO's (add, remove, modify) when authorized.
172	Duplicate events?	System	Allow user to manually flag events for manual review.
173	Duplicate events?	System	Have ability to alert user of events pending for manual review.
174	Duplicate events?	System	Allow user to view events and event details simultaneously for decision to merge (i.e., two or more).
175	Duplicate events?	System	Allow user to navigate the system while reviewing possible duplicates (optional).
176	Select the Most accurate/ suitable Event record	System	Have ability to automatically select the most accurate/suitable vaccination event to be used as the (primary or master) record.
177	Update vaccine event records	System	Allow user to select data elements to merge into a consolidated event record.
178	Update vaccine event records	System	Have ability to combine two or more duplicate event records according to business rules.
179	Update vaccine event records	System	Support an audit trail when event records are merged.
180	Update vaccine event records	System	Have ability to retain "pre-merged" event records.
181	Update vaccine event records	System	Have ability to generate an audit list of vaccination events that are automatically merged.
182	Update vaccine event records	System	Allow user to delete a duplicate vaccine event while still maintaining audit record.
183	Generate report of duplicates	System	Automatically schedule routine reports to run at a specific time.
184	Generate report of duplicates	System	Allow for the restriction of confidential personal identifiable information.
185	Manage inventory	User	Be able to enter stock on hand by lot number.
186	Manage inventory	User	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.).
187	Manage inventory	System	Allow the user to enable and disable lot numbers that

Req. ID	Task	Entity/role	Requirement (the system should...)
			are being used in the health facility.
188	Manage inventory	System	Allow the user to confirm receiving stock by lot number that has been distributed to a facility from the district vaccine store.
189	Manage inventory	User	Be able to create stock requisition to bring the facility back to the maximum stock level.
190	Manage inventory	System	Alert the user if stock is going below or approaching re-order level.
191	Manage inventory	System	Allow the user to enter stock consumed by other target groups (e.g., Td)
192	Manage inventory	System	Estimate stock need based on post consumption data, population, and minimum quantity threshold.
193	Define parameters	System, immunization provider, and other partners	Allow user to select parameters (e.g., time, age, administrative level, health facility, service area, vaccine grouping, vaccine dose count, other program codes, etc.).
194	Define parameters	System, immunization provider, and other partners	Allow user to select report output parameters (e.g., display options, summary vs. detail report, sort options, alphanumeric vs. date, etc.).
195	Define parameters	System, immunization provider, and other partners	Allow user to choose a report-generation time frame (i.e., run now or set the time for later).
196	Define parameters	System, immunization provider, and other partners	Have ability to save parameters as “public” to allow other users to generate the same report using the same parameters.
197	Define parameters	System, immunization provider, and other partners	Have ability to modify/delete saved “public” parameters.
198	Define parameters	System, immunization provider, and other partners	Have ability for system to determine if the report can be immediately generated or if it must be delayed based on size and generate a message “report processing” (i.e., based on types of criteria, size of data, etc.).
199	Define parameters	System, immunization provider, and other	Have ability to prompt user to confirm the generation of a report at a later time if required.

Req. ID	Task	Entity/role	Requirement (the system should...)
		partners	
200	Generate report	System, immunization provider, and other partners	Have ability to save, display, or print report.
201	Generate report	System, immunization provider, and other partners	Have ability to export reports in multiple formats (i.e., text delimited file, excel, PDF, CSV, statistical analysis software).
202	Generate report	System, immunization provider, and other partners	Allow user to delete a report and track on audit log for customized reports.
203	Generate report	System, immunization provider, and other partners	Allow user to select data elements within a report Note: Allows the user to modify report based on the audience.
204	Generate report	System, immunization provider, and other partners	Automatically schedule routine reports to run at a specific time.
205	Generate report	System, immunization provider, and other partners	Allow for the restriction of some predefined data such as duplicate records.
206	Generate report	System	Have ability to generate the report based on the parameters set.
207	Report acceptable	System, immunization provider, and other partners	Allow user to return to and modify report criteria.
208	Analyze	System, immunization provider, and other partners	Have ability to verify that the report is in the correct format.
209	Analyze	System, immunization provider, and other partners	Have ability to send report by email per user specification.
210	Analyze	System, immunization	Have ability to export data in selected file formats.

Req. ID	Task	Entity/role	Requirement (the system should...)
		provider, and other partners	
211	Analyze	System, immunization provider, and other partners	Allow user to configure report displays.
212	Analyze	System	Ability to generate different report views i.e., tabular, charts and maps.

10.2 Non-Functional Requirements

These describe how a system should behave and what limits there are on its functionality. Non-functional requirements cover all the remaining requirements which are not covered by the functional requirements. They specify criteria that judge the operation of a system, rather than specific behaviors.

Req. ID	Category	Requirement (the system should...)
213	General	Prompt the user to save when navigating away from an editor new registration screen and require user to confirm changes if data was modified.
214	General	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.
215	General	Provide meaningful alerts to the users; these alerts should be configurable by an administrator rather than hard coded.
216	General	Alert for ongoing and completed processes rather than running invisibly in the background with no feedback to the user.
217	General	Be able to roll back a transaction if the full update was not successfully completed.
218	General	Have the ability to generate a report of missing information in fields for data cleaning.
219	General	Have informative error messages.
220	General	Be able to work offline for weeks and synchronize with the central database in the background once online.
221	General	Be accompanied by a well-structured user manual.
222	General	Provide a unique version number for each revision.

223	General	Be designed to be flexible enough to accommodate the necessary changes in the future.
224	Confidentiality	Provide access for authorized users.
225	Confidentiality	Provide the ability for allowed users to view confidential data.
226	Confidentiality	Prevent remembering username and password.
227	Confidentiality	Log out the user after a specified time of inactivity.
228	Confidentiality	Provide encrypted communication between components.
229	Authentication	Notify the user to change their password the first time they log in.
230	Authentication	Adhere to complex password requirements.
231	Authentication	Provide a mechanism to allow the user to securely change their password.
232	Authentication	Allow the user to reset their password in a secure manner.
233	Authentication	Lock the user out after a specified number of wrong password attempts.
234	Authentication	Notify the user if their account is locked due to wrong password attempts.
235	Authentication	Provide role-based access to the system.
236	Audit trail and logs	Log system log-ins and log-outs.
237	Audit trail and logs	Record all authentication violations.
238	Audit trail and logs	Log all activities performed by the user.
239	Audit trail and logs	Log access to views of individual client records
240	Audit trail and logs	Log access to data summaries, reports, analysis and visualization features.
241	Audit trail and logs	Log exchange of data with other systems.
242	Audit trail and logs	Generate analysis of the usage of different system features and reports.
243	General	Provide a unique version number for each revision.
244	General	Be designed to be flexible enough to accommodate the necessary

		changes in the future.
245	User management	Allow user with permission to create a new user and temporary password.
246	User management	Provide role-based access.
247	User management	Allow user to login into the system using userID and password.
248	User management	Allow roles to be associated with specific administrative levels (District, Region and National)
249	User management	Allow admin user to assign roles to other users.
250	User management	Allow the user to change their own password.
251	User management	Prevent the same user from logging in to multiple devices simultaneously.
252	User management	Notify the user to regularly change their password.
253	Scalability	Be scalable to accommodate new demands.
254	Usability	Be user friendly for people with low computer literacy.
255	Usability	Provide informative error messages and tooltips.
256	Usability	Alert the user when navigating away from the form without saving.
257	Usability	Support real time data entry validation and feedback to prevent data entry errors from being recorded.
258	Usability	Simplify data recording through predefined drop-down or searchable lists, radio buttons, check boxes.
259	Usability	Support multiple languages (i.e., Swahili and English).
260	Usability	Use industry standard user interface practices and apply them in a consistent manner throughout the system.
261	Usability	Be easy to learn and intuitive to enable user to navigate between pages.
264	Interoperability	Exchange data with other approved systems.
265	Interoperability	Exchange data through open application program interface (API) with existing health information system such as VIMs, UCS among other

		relevant information systems.
267	Capacity	Be able to support more than 7,000 facilities.
268	Capacity	Be able to accommodate 9,000 concurrent users.
269	Maintenance	Maintain all data after update.

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