

Digital Solutions for Malaria Elimination

Software Requirements Document v1.1

May 2018



UiO • University of Oslo



REVISION HISTORY

Revision	Revision Date	Comment
0.1	Jan 30, 2018	Document created
0.2	Jan 31, 2018	Initial version based on desk review of documentation
0.3	Mar 8, 2018	Revised to include challenges and user stories from first two countries and edits from grant partners
0.4	Mar 14, 2018	Revised to include feedback from grant partners
0.5	Mar 24, 2018	Revised to include requirements and user stories from third country and feedback from grant partners
0.6	Mar 28, 2018	Revised to include feedback from grant partners
0.7	Mar 29, 2018	First draft released for external review
0.8	Apr 17, 2018	Revised with feedback from external reviewers remotely and through a two day in-person meeting at WHO in Geneva on April 4-5. Revisions include new use cases for Treatment and Supervision, updates to process flow diagrams and narratives, new user stories, and a streamlined organization of requirements.
0.9	Apr 24, 2018	Revised with additional feedback from grant partners
1.0	May 3, 2018	First public version published
1.1	May 7, 2018	Updated to include priorities for user stories

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TERMS AND DEFINITIONS

Term or Abbreviation	Definition
Active Case Detection (ACD)	Detection by health workers of malaria cases in the community and in households ¹
Active Focus	A focus with ongoing transmission where indigenous cases have been detected within the current calendar year ²
Anopheles	A genus of mosquito that commonly transmit parasites of the genus Plasmodium, which cause malaria in humans in endemic areas ³
Breeding Sites	A place or set of circumstances suitable for or favorable to growth and development of mosquitoes ⁴
Case	A confirmed occurrence of malaria infection in a person ⁵
CHAI	Clinton Health Access Initiative
Cleared Focus	A focus with no local transmission for more than 3 years which is no longer considered residual non-active (3 years and only imported or/and relapsing or recrudescence cases or/and induced cases occur in the current calendar year) ⁶
Entomological Data	Data collected from the study of insects ⁷
Epidemiological Data	Data collected on the distribution, patterns, and determinants of health characteristics and health events (such as diseases) in populations ⁸

¹ Malaria Surveillance, Monitoring & Evaluation: A Reference Manual (2018)

² Malaria Surveillance, Monitoring & Evaluation: A Reference Manual (2018)

³ <https://en.wikipedia.org/wiki/Anopheles>

⁴ <https://www.merriam-webster.com/dictionary/breeding>

⁵ <http://www.who.int/malaria/mpac/mpac-sept2015-terminology-annex1.pdf>

⁶ Malaria Surveillance, Monitoring & Evaluation: A Reference Manual (2018)

⁷ https://www.researchgate.net/publication/262450744_Training_Manual_on_Malaria_Entomology

⁸ https://www.researchgate.net/publication/262450744_Training_Manual_on_Malaria_Entomology

Term or Abbreviation	Definition
Focus	A defined, circumscribed area situated in a currently or formerly malarious area that contains the epidemiological and ecological factors necessary for malaria transmission ⁹
Gametocytes	The sexually reproductive form of the malaria parasite which circulate in the blood of the host and are picked up by the mosquito when it takes a blood meal ¹⁰
Geo-registry	A database used to host, maintain, update and openly share master lists of geographic objects core to public health (e.g., health facilities, administrative units, villages, households) and their relationships, together with their associated data, including geography stored in a Geographic Information System (GIS) readable format ¹¹
Geographic Objects	Locations in a spatial database, which can be as simple as polygons and lines or more complex, representing households, landmarks, and cities ¹²
Geospatial Data	Information about a physical object that can be represented by numerical values in a geographic coordinate system ¹³
Imported Case	Case that is due to mosquito-borne transmission and is acquired outside the area in which it was detected, outside the elimination area, and in a known malarious area to which the patient has travelled ¹⁴
Index Case	The first documented patient in the onset of an epidemiological investigation ¹⁵

⁹ Malaria Surveillance, Monitoring & Evaluation: A Reference Manual (2018)

¹⁰ <http://www.malaria.com/questions/gametocytes-definition>

¹¹ HIS geo-enabling: Guidance on the establishment of a common geo-registry for the simultaneous hosting, maintenance, update and sharing of master lists core to public health (<https://drive.google.com/drive/folders/0B6enNobOP9SZU0I3WHZ3a1pUenM>)

¹² https://en.wikipedia.org/wiki/Geographic_Object

¹³ <https://en.wikipedia.org/wiki/Geospatial>

¹⁴ Malaria Surveillance, Monitoring & Evaluation: A Reference Manual (2018)

¹⁵ https://en.wikipedia.org/wiki/Index_case

Term or Abbreviation	Definition
Induced Case	Case of malaria acquired through artificial means (e.g., blood transfusion, common syringes, or malariotherapy) ¹⁶
Layers	Organization of data in a GIS software in themes that allows data to be input as separate categories and overlaid based on analysis requirements ¹⁷
Locally Acquired Case	Case that is due to mosquito-borne transmission and is acquired within the area of investigation (e.g., country, district, focus) ¹⁸
Locally Acquired Indigenous Case	Any case contracted locally, with no strong evidence of a direct link to an imported case ¹⁹
Locally Acquired Introduced Case	Any case contracted locally, with strong epidemiological evidence linking it directly to a known imported case or a first-generation case contracted from an imported case (i.e., the mosquito was infected by an imported-case patient) ²⁰
NMCP	National Malaria Control Program
OGC WMS	The Open Geospatial Consortium Web Map Service standard which specifies the interface and parameters to dynamically request maps from a server ²¹
Passive Case Detection (PCD)	Detection of malaria cases among people who go to a health facility or a CHW on their own initiative to get treatment, usually for fever ²²

¹⁶ <https://www.cdc.gov/nndss/conditions/malaria/case-definition/2014/>

¹⁷ http://planet.botany.uwc.ac.za/nisl/gis/gis_primer/page_29.htm

¹⁸ Malaria Surveillance, Monitoring & Evaluation: A Reference Manual (2018)

¹⁹ Malaria Surveillance, Monitoring & Evaluation: A Reference Manual (2018)

²⁰ Malaria Surveillance, Monitoring & Evaluation: A Reference Manual (2018)

²¹ <http://www.opengeospatial.org/standards/wms/introduction>

²² Malaria Surveillance, Monitoring & Evaluation: A Reference Manual (2018)

Term or Abbreviation	Definition
Proactive Case Detection (PACD)	Detection undertaken in populations that have limited access to facilities or inadequate health-seeking behavior and in high-risk groups (e.g., remote and migrant populations, refugees, armed forces, forest workers, long-distance drivers) ²³
Rapid Diagnostic Test (RDT)	A medical diagnostic test that is quick and easy to perform, suitable for preliminary or emergency medical screening and for use in medical facilities with limited resources ²⁴
Reactive Case Detection (RACD)	Detection undertaken in response to an index case, the epidemiological characteristics of which trigger additional ACD, in which a household or a population potentially linked to the case is tested or screened for symptoms and tested before treatment ²⁵
Recrudescence Case	Recurrence of malaria symptoms after a period of remission or quiescence, sometimes synonymous with relapse ²⁶
Residual Non-Active Focus	Transmission interrupted recently (1–3 years previously) or when the last indigenous case was detected in the previous 1-3 calendar years ²⁷
UiO	University of Oslo
Vector Tiles	Packets of geographic data, packaged into predefined, roughly square-shaped "tiles" for transfer over the web ²⁸
WHO	World Health Organization

²³ Malaria Surveillance, Monitoring & Evaluation: A Reference Manual (2018)

²⁴ Malaria Surveillance, Monitoring & Evaluation: A Reference Manual (2018)

²⁵ Malaria Surveillance, Monitoring & Evaluation: A Reference Manual (2018)

²⁶ Malaria Surveillance, Monitoring & Evaluation: A Reference Manual (2018)

²⁷ Malaria Surveillance, Monitoring & Evaluation: A Reference Manual (2018)

²⁸ https://en.wikipedia.org/wiki/Vector_tiles

SECTION 1: BACKGROUND & INTRODUCTION

Overview

The surveillance system is the backbone of malaria elimination programs, providing information on where parasites can be found in people, where transmission is occurring, how interventions should be targeted, and whether regions are progressing towards elimination goals.

The World Health Organization (WHO) *Malaria Surveillance, Monitoring & Evaluation: A Reference Manual* (2018) states:

Countries in which there has been no indigenous malaria case for at least the past 3 consecutive years and that have the surveillance systems necessary to prove that this is the case and the capacity to prevent reestablishment of transmission can apply to WHO for certification of malaria elimination. Gaining such certification involves a review of national documentation and field visits to recent transmission foci to verify that there have been no indigenous malaria cases.

Countries face substantial operational and technical challenges in implementing a surveillance system to facilitate malaria elimination and ultimately achieve this certification — specifically, moving from aggregate malaria reporting systems to individual case-based reporting and, in parallel, from passive surveillance systems to systems that include active measures such as case detection and investigation.

To provide countries with a **comprehensive malaria information system**, a consortium of programmatic and technical partners, including the Clinton Health Access Initiative (CHAI), the University of Oslo (UiO), Vital Wave, and the WHO, has come together to **enhance DHIS2** (the de facto health management information system and malaria surveillance platform in many countries), **update and develop mobile tools to address identified gaps**, and **roll out these tools** in priority countries. This work is funded by a Digital Solutions for Malaria Elimination grant awarded by the Bill & Melinda Gates Foundation.

The consortium's technical approach focuses on ensuring the availability of a strong information system that can act as a repository and dashboard for the full range of malaria data collected by different systems and can provide effective mobile interfaces to facilitate health worker workflows and the collection of timely and high-quality data. To this end:

1. A set of critical improvements will be made to DHIS2 that will enable it to (a) serve as a central repository for linked malaria data across all elimination activities, (b) facilitate action-oriented, visually appropriate, and easy-to-understand analytics

through flexible and interactive dashboards, and (c) allow more flexible configuration of data collection forms by integrating spatial data collection and nonlinear workflows.

2. Mobile technology providers will be selected to update or create mobile tools addressing the gaps that hinder malaria elimination strategies.

To ensure that the updated DHIS2 and mobile platforms are sustainable, relevant to malaria program needs, and rapidly adopted to achieve near-term elimination successes, the consortium's operational approach involves

1. an initial discovery phase to engage with national malaria programs, the WHO, surveillance tool users, malaria experts, technology experts, and other stakeholders to refine the process flows and related features of malaria elimination and provide a foundational list of requirements that can be used for technical development;
2. the development and field testing of generic applications that can serve multiple country contexts; and
3. a progressive, government-led rollout of the new tools across countries, including training users, building capacity, and ensuring national program ownership.

Purpose

The *Software Requirements Document* proposes technical solutions in response to challenges observed in malaria surveillance activities during the discovery phase. It includes a detailed set of **use cases** defining malaria elimination program **process flows**, software **requirements** to address current identified challenges, and **prioritized features** described from the perspective of various end users of the malaria information system. Each use case illustrates how digital tools can be used to achieve specific steps in the malaria surveillance continuum, including passive case detection and notification, field case investigation, focus investigation, routine and reactive interventions, and supervision.

The use cases detailed in Section 2 are informed by the WHO's *Malaria Surveillance, Monitoring & Evaluation* reference manual, as well as country-specific discovery across Mesoamerica and Hispaniola, Sub-Saharan Africa, and the Greater Mekong Subregion.

Note that the use cases do not describe full malaria surveillance processes in detail, but instead highlight processes that may benefit from technical solutions. The WHO's *Malaria Surveillance, Monitoring & Evaluation: A Reference Manual* (2018) should be referenced for complete details on malaria surveillance processes.

Priority countries — Cambodia, Laos, Botswana, Mozambique, Namibia, South Africa, Zimbabwe, Haiti, and Honduras — have been selected to represent variability in geography, malaria program activities, and tools (web-based and mobile software) currently in use by malaria programs. Additionally, Zimbabwe, Laos, Haiti, and Honduras were selected for in-country discovery visits to add additional detail and context to the use cases. These discovery visits included in-person interviews with malaria staff at all levels, field visits to elimination districts, and shadowing the use of existing tools with the objective to (a) understand context, challenges, and gaps of the surveillance system rollout, (b) understand surveillance and intervention workflows, and (c) explore variability between geographies and types of users and health facilities.

The software requirements detailed in Section 3 describe new software features to address identified gaps by enhancing existing digital tools or creating new common goods (e.g., open-source software libraries) that can be adopted and integrated into existing digital tools. Note that the document focuses specifically on gaps identified in discovery and may not cover all software requirements needed for a full malaria information system, especially those already supported by existing tools. Also note that this document is a living document that may be updated with new requirements and user stories over time.

This document will be used by

1. technology organizations to develop functionalities for DHIS2, mobile tools, and common goods with investment from the Digital Solutions for Malaria Elimination grant; and
2. other technology organizations not affiliated with the grant who may benefit from referencing use cases or requirements documentation in their work.

The process flows in this document are not to be used as a reference guide for malaria processes by programs. They are a reference for software developers only.

Relevant reference documents from the WHO:

1. [Malaria Surveillance, Monitoring & Evaluation: A Reference Manual \(2018\)](#)
2. [A Framework for Malaria Elimination \(2017\)](#)
3. [Indoor Residual Spraying: An Operational Manual for Indoor Residual Spraying \(IRS\) for Malaria Transmission Control and Elimination \(Second Edition, 2015\)](#)

SECTION 2: USE CASES & PROCESS FLOWS

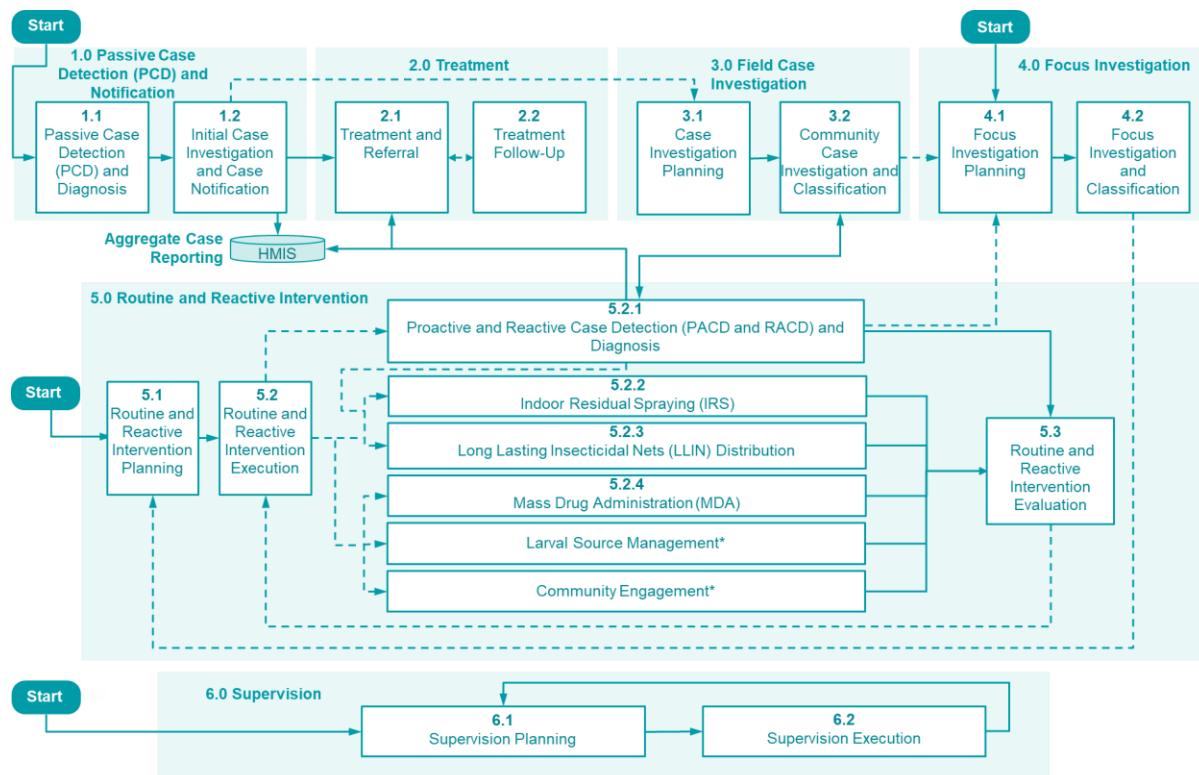
This section details malaria elimination use cases and process flows, describing broad objectives, actors, frequency of occurrence, and any variability between countries. The content in this section serves as an operational reference point for the detailed requirements found in Section 3.

Note that the content of this section has been informed by the WHO's *Malaria Surveillance, Monitoring & Evaluation* reference manual as well as country-specific discovery. It does not cover all malaria processes comprehensively but instead serves as a reference point for designing technology for specific use cases.

Use Case Summary

The following summary diagram provides a high-level reference for the various use cases within the malaria elimination continuum. Please refer to individual use case narratives to understand the full extent of the processes and variability across countries. Full-page process flow diagrams can be found in Appendix A.

High-Level Use Case Summary



Use Case Processes and Descriptions

The following table is a high-level description of the use cases and the respective subprocesses. Only a subset of prioritized malaria response interventions are detailed in the current version of this document, reflecting the high-priority gaps observed during the discovery phase.

#	Sub #	Name	Description
1.0		Passive Case Detection (PCD) and Notification	Identify, test, diagnose, and notify district when a confirmed case of malaria presents in the facility or to a community health worker (CHW).
	1.1	Passive Case Detection (PCD) and Diagnosis	Test and diagnose a suspected case of malaria, and report both positive and negative diagnoses.
	1.2	Initial Case Investigation and Case Notification	Conduct initial investigation of case detected, classify case (where possible), and notify appropriate persons of confirmed case of malaria.
2.0		Treatment	Treat confirmed case of malaria or refer to another facility for treatment, and follow up with case after treatment to ensure compliance and complete cure.
	2.1	Treatment and Referral	Treat confirmed case of malaria using standard treatment regimen, or refer to another facility for treatment.
	2.2	Treatment Follow-Up	Follow up with case at specified intervals after treatment to ensure compliance with treatment and complete cure.
3.0		Case Investigation	Determine whether an infection was acquired locally or imported, and identify factors that may lead to onward transmission.
	3.1	Case Investigation Planning	Review notification information, and plan logistics for case investigation.

#	Sub #	Name	Description
	3.2	Community Case Investigation and Classification	Conduct field-based work at the household or in the community to collect information on travel history, infection history, and any other information necessary to classify the index case as locally acquired or imported.
4.0		Focus Investigation	Identify the main features of a location, including the populations at greatest risk, the rates of infection, the distribution of vectors responsible for malaria transmission, and the underlying conditions that support it.
	4.1	Focus Investigation Planning	Review case surveillance, entomological surveillance, vector control, social and behavior change communication, operational research, and previous foci investigation data, and plan logistics for focus investigation.
	4.2	Focus Investigation and Classification	Describe the areas where malaria was transmitted and delineate the population at risk when a case of locally acquired malaria has been detected.
5.0		Routine and Reactive Intervention	Plan, execute, and evaluate interventions to interrupt the transmission of malaria and prevent reestablishment of transmission in malaria elimination areas.
	5.1	Routine and Reactive Intervention Planning	In consultation with experts and in response to the results of prior investigations, prepare (1) an intervention response plan or (2) a routine response plan as part of the annual or more frequent program planning.
	5.2	Routine and Reactive Intervention Execution	Carry out response intervention based on plans developed.

#	Sub #	Name	Description
	5.2.1	Proactive and Reactive Case Detection (PACD and RACD) and Diagnosis	Detect malaria cases in the community and in households, and sometimes among population groups who are considered by health workers to be at high risk.
	5.2.2	Indoor Residual Spraying (IRS)	Apply residual insecticide to potential malaria-vector resting surfaces in targeted houses or structures.
	5.2.3	Long Lasting Insecticidal Nets (LLIN) Distribution	Distribute LLINs to members of the population susceptible to malaria to achieve universal coverage, whereby every person living in a malarious area sleeps under an insecticide-treated net (ITN) or preferably an LLIN.
	5.2.4	Mass Drug Administration (MDA)	Administer a full therapeutic course of antimalarial medicine (irrespective of the presence of symptoms or infection) to every member of a defined population or person living in a defined geographical area (except for those for which the medicine is contraindicated) at approximately the same time and often at repeated intervals.
	5.3	Routine and Reactive Intervention Evaluation	Evaluate the coverage, operations, and impact of interventions conducted.
	6.0	Supervision	Ensure that all malaria-related activities are performed appropriately, at the right frequency, and in line with the country guidelines.
	6.1	Supervision Planning	Review surveillance, case management, and intervention data based on data trends from the facilities and CHWs. Schedule supervision visits based on data review or

#	Sub #	Name	Description
			routine program plans, prepare checklists, and finalize logistics.
	6.2	Supervision Execution	Conduct supervision visits to cross-check data and address underperforming topics with health facility staff and CHWs. Prepare ad hoc, monthly, or quarterly feedback and share with the health facilities and CHWs.

Use Case Actors

An actor, as defined in this document, is any role played by a person who is directly or indirectly involved in carrying out steps to achieve the objectives of a use case. These actors are referenced within each use case narrative. While the titles and functionality of actors may vary between countries, the table below captures the most common roles.

Actor	Description and Capacities
National Malaria Control Program (NMCP) Director	Provides technical leadership through the coordination of all malaria-related activities in the country.
NMCP Surveillance Officer	Plans, implements, manages, and monitors malaria surveillance activities in the country.
NMCP Vector Control Officer	Interprets vector data received from regions/provinces to develop and adapt new strategies to decrease and ultimately interrupt malaria transmission in the country.
NMCP Case Management Officer	Coordinates the country program action plan for case management.
HMIS Officer or M&E Officer	Monitors and evaluates implementation of program initiatives and interventions, performs routine monitoring of data quality, and creates dashboards and reports.
System Administrators	Provides technical support for other actors, troubleshoots system issues, and configures and upgrades the system. Note: In some countries, the HMIS Officer, M&E Officer, or an implementing partner may also play some or all of these roles.
Malaria Drug Supply Chain Management Staff	Plans, implements, manages, and controls the sourcing, procurement, distribution, and logistics management of malaria commodities in the country, and coordinates with District and Facility Pharmacists.
Epidemiologist	Collects and analyzes data to determine the causes of malaria within the region/province, including data from patient records, aggregate reports, observations, interviews, surveys, and blood samples. Can be based at national, regional/provincial, or district levels.
Entomologist	Examines vector-borne disease prevention, surveillance, and control data within the district. Can be based at national, regional/provincial, or district levels.

Actor	Description and Capacities
Regional/Provincial Malaria Surveillance Officer	Plans, implements, manages, and monitors malaria surveillance activities for the region/province.
Regional/Provincial Malaria Vector Control Officer	Collects and interprets vector data within the region/province and works with the NMCP Vector Control Officer to develop and adapt new strategies to decrease and ultimately interrupt malaria transmission.
Regional/Provincial Data Manager	Aggregates data from districts and health facilities, sends reports to NMCP staff, and provides feedback to districts and health facilities.
District-level Person in Charge of Malaria Activity	Coordinates all malaria-related activities in the district.
District Pharmacist	Manages drug storage at the district level and drug distribution to health facilities within the district.
Laboratory Technician	Processes and reads blood-test slides with a microscope to confirm a diagnosis of malaria and reports the findings.
District HMIS Officer	Monitors and evaluates implementation of program initiatives and interventions within the district.
District Environmental Health Technician (EHT)	Conducts case and focus investigations, and assists other actors in the enforcement of environmental health compliance measures.
Health Facility Staff	Provides essential services that promote health, prevent diseases, and deliver healthcare services to individuals, families, and communities.
Health Facility Pharmacist	Manages drug storage at the health facility and dispenses drugs to patients.
Indoor Residual Spraying (IRS) Team	Conducts IRS at the community level. Consists of IRS team leader and spray operators.
Community Health Worker (CHW)	Provides basic healthcare services to community members.
Volunteer Distributors	Supports the dispensing of drugs during MDA campaigns and distribution of LLINs during campaigns.

Use Case Term Definitions

The terms below define and describe the different characteristics presented in use cases narratives.

Definitions	
End Objective	A SMART (specific, measurable, achievable, realistic, and time-bound) description of what the use case will achieve.
Location	The specific environment where the use case will be carried out.
Subprocesses	Subcomponents into which the high-level use case is split.
Variability	Any part of the process that might change depending on different country or program context.
Frequency	How often the use case will be executed.
Data Collected	Data elements that are collected and used when carrying out the steps in the use case.
Primary Actors	Actors directly involved in carrying out the steps in each process flow to achieve use case objectives.
Secondary Actors	Actors who play a supporting role in helping the primary actor achieve the use case objectives and who may receive or act on data generated from the steps conducted by the primary actor.

Use Cases

1.0: Passive Case Detection (PCD) and Notification

End Objective

Identify, test, diagnose, and notify district when a confirmed case of malaria presents in the facility or to a CHW. Initial case investigation is completed, and appropriate persons at the district or facility level receive a timely notification from the health provider who detected the case and has access to enough information to plan the field case investigation or other intervention within the required time frame, typically within 48-72 hours after notification.

Location

Conducted in a community or a health facility with potentially unreliable mobile data connectivity and access to power.

Subprocesses

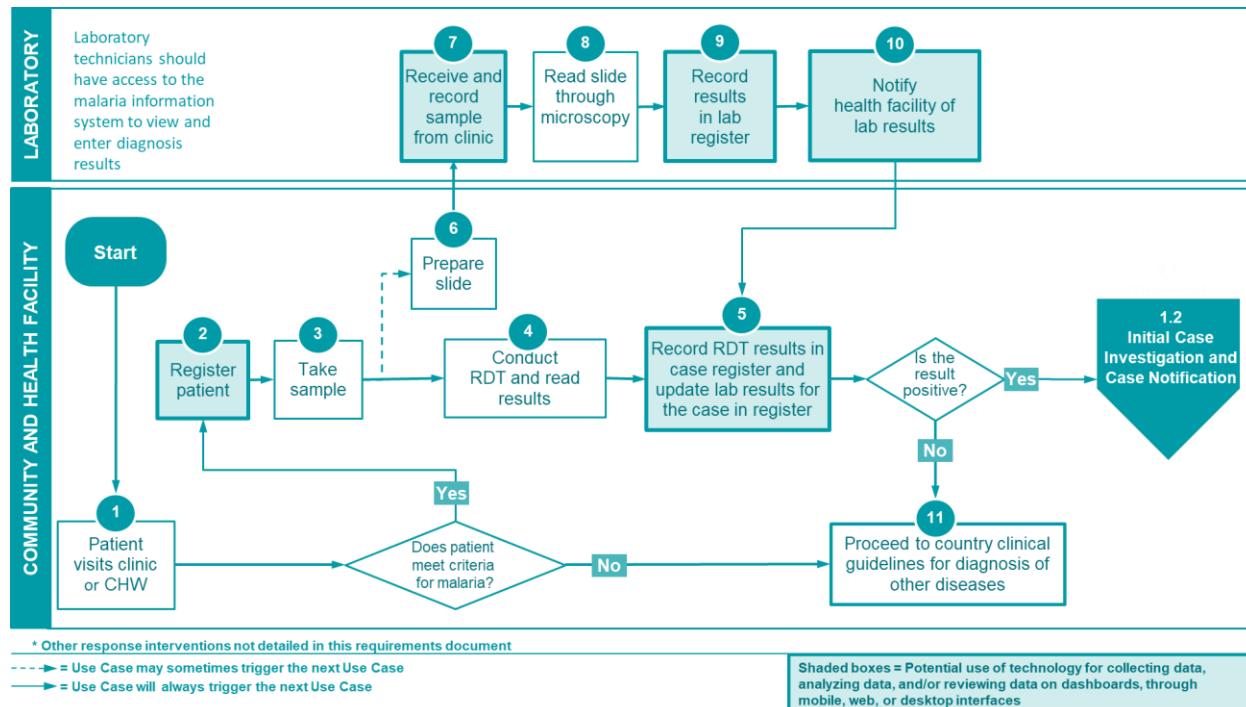
- 1.1 Passive Case Detection (PCD) and Diagnosis
- 1.2 Initial Case Investigation and Case Notification

Variability

- Timing: Most countries require case notification to occur immediately after a case is detected, while some countries require notification within 24 hours.
- Recording negative tests: Some countries require cases that test negative for malaria also be reported.
- Notification mechanism: Several methods are used for notification in different countries, including in-person, phone call, SMS, email, mobile app, desktop app, and paper forms.
- Actors: In some countries, EHTs at the facilities are notified; in other countries, district-level EHTs are notified.
- Methodology: In some countries, EHTs or CHWs have access to mobile tools to guide decision making for PCD, while others rely on training or knowledge alone to conduct the process.

1.1: Passive Case Detection (PCD) and Diagnosis

Test and diagnose a suspected case of malaria, and report both positive and negative diagnoses.



Frequency

PCD occurs in an ad hoc fashion when a patient presents at a health facility or to a CHW.

Data Collected

- Mode of case detection: PCD at health facility or by CHW
- Name and demographics of patient
- Information on household, including geospatial identifying information
- Information on risk factors, such as occupation
- Date blood taken
- Type of testing and results: species and, where possible, stage, density, and presence of gametocytes

Primary Actors

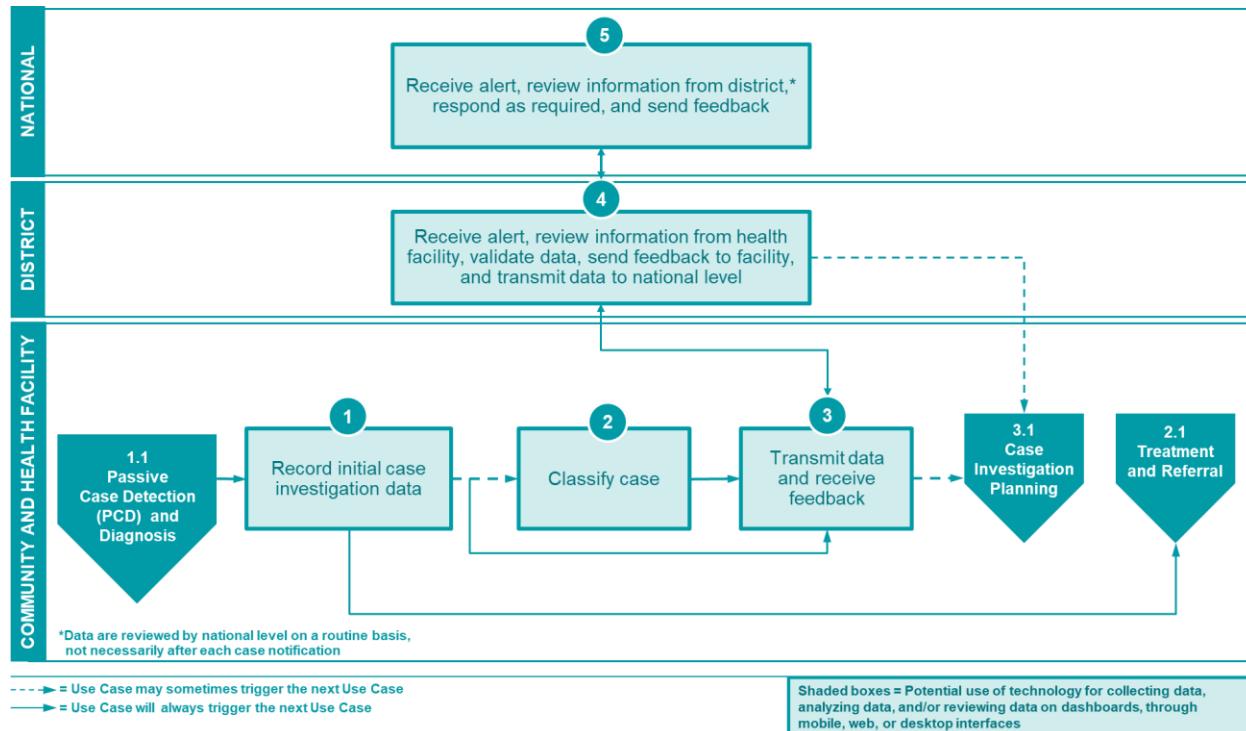
- Health facility staff
- CHWs
- Laboratory technicians

Secondary Actors

- District-level person in charge of malaria activity

1.2: Initial Case Investigation and Case Notification

Conduct initial investigation of case detected, classify case (where possible), and notify appropriate persons of confirmed case of malaria.



Frequency

Case notification timing varies by country and typically occurs immediately after a confirmed malaria case has been detected. Some countries only require notification within 24 hours.

Data Collected

- Name and demographics of patient
- Village or neighborhood and district of residence
- Date of malaria testing
- Type of test: microscopy or rapid diagnostic test (RDT)
- Diagnosis: confirmed severe or uncomplicated malaria
- *Plasmodium* species
- Referral details, if patient is referred
- Travel history
- Case classification

Primary Actors

- Health facility staff
- CHWs

Secondary Actors

- District-level person in charge of malaria activity
- District EHT
- Regional Malaria Surveillance Officer
- NMCP Surveillance Officer
- NMCP Case Management Officer

2.0: Treatment

End Objective

Treat confirmed case of malaria or refer to another facility for treatment, and follow up case after treatment to ensure compliance and complete cure. The efficacy of the antimalarial drugs used for treatment of parasite infection should also be monitored regularly. Data from entomological and drug efficacy surveillance should be interpreted in conjunction with epidemiological data as a basis for program decisions.

Location

Conducted in a community or a health facility with potentially unreliable mobile data connectivity and access to power.

Subprocesses

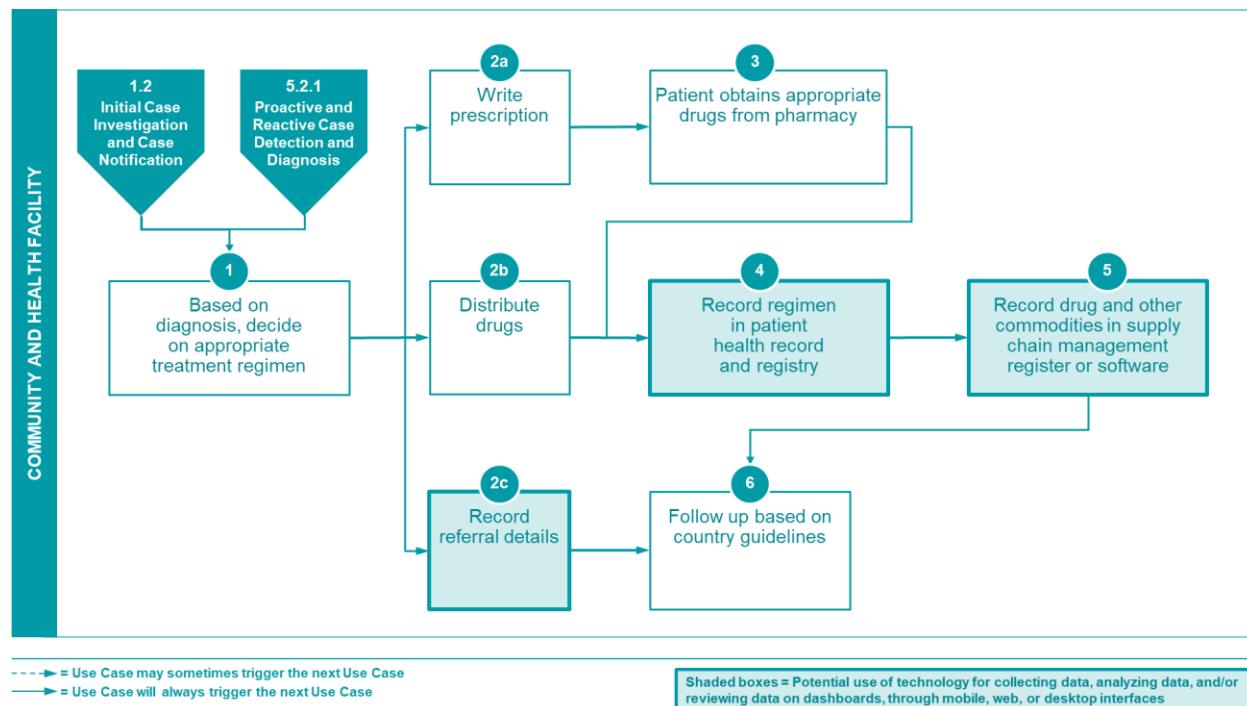
- 2.1 Treatment and Referral
- 2.2 Treatment Follow-Up

Variability

- Timing: Frequency of follow-up varies based on the type of drug administered and country guidelines.
- Monitoring response: In some countries, depending on the species and treatment administered, additional patient information may be collected. At a minimum, all infected individuals should receive a clinical consultation and parasitological evaluation on day 0 and on the last day of follow-up (e.g., on day 28, day 42, or the day of treatment failure).

2.1: Treatment and Referral

Treat confirmed case of malaria using standard treatment regimen, or refer to another facility for treatment.



Frequency

Treatment occurs immediately after a suspected case of malaria is confirmed through testing and diagnosis.

Data Collected

- Name and demographics of patient
- Prescription and dosage
- Referral hospital or clinic
- Date of referral
- Reason for referral

Primary Actors

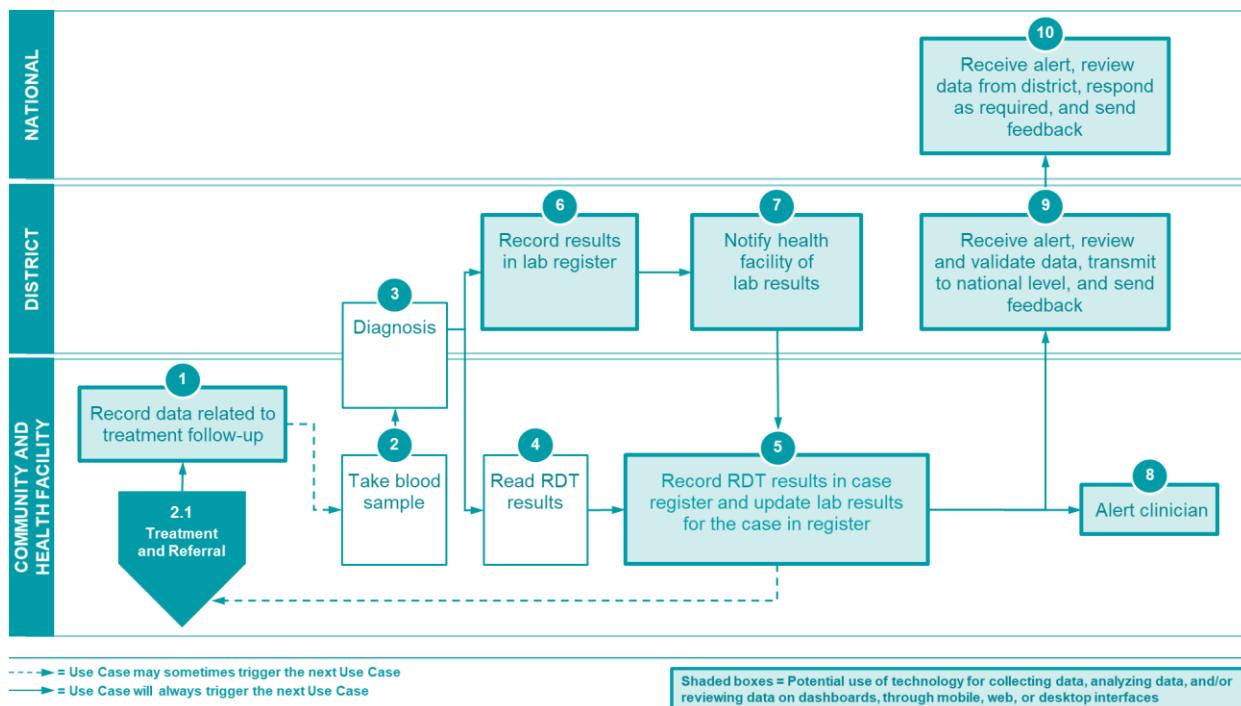
- Health facility staff
- CHWs

Secondary Actors

- Malaria drug supply chain management staff
- Health facility pharmacist

2.2: Treatment Follow-Up

Follow up with case at specified intervals after treatment to ensure compliance with treatment and complete cure. This is important in order for countries to classify cases as recrudescent.²⁹



Frequency

Case follow-up is done after PCD, RACD, and/or PACD at intervals based on type of drug administered.

Data Collected

- Patient diagnosis
- Molecular analysis, where possible
- Treatment administered
- Information on efficacy of first- and second-line treatments
- Classification of responses to treatment³⁰

Primary Actors

- Health facility staff
- District-level person in charge of malaria activity
- Laboratory technician
- CHWs

²⁹ Malaria Surveillance, Monitoring & Evaluation: A Reference Manual (2018) page 47

³⁰ Malaria Surveillance, Monitoring & Evaluation: A Reference Manual (2018) page 72

Secondary Actors

- Regional Malaria Surveillance Officer
- NMCP Surveillance Officer
- NMCP Case Management Officer

3.0: Case Investigation

End Objective

Determine whether an infection was acquired locally or imported, and identify factors that may lead to onward transmission. Case investigation is closely interconnected with detection and focus investigation — together these are important surveillance activities to determine the source of infection and classify cases and foci, ultimately informing an appropriate response.

Location

- Case investigation planning is conducted at the district or regional/provincial level, with reasonably good internet connectivity, and sometimes at the facility, with potentially unreliable mobile data connectivity and access to power.
- Community case investigation and classification is conducted in a community with potentially unreliable mobile data connectivity and access to power.

Subprocesses

- 3.1 Case Investigation Planning
- 3.2 Community Case Investigation and Classification

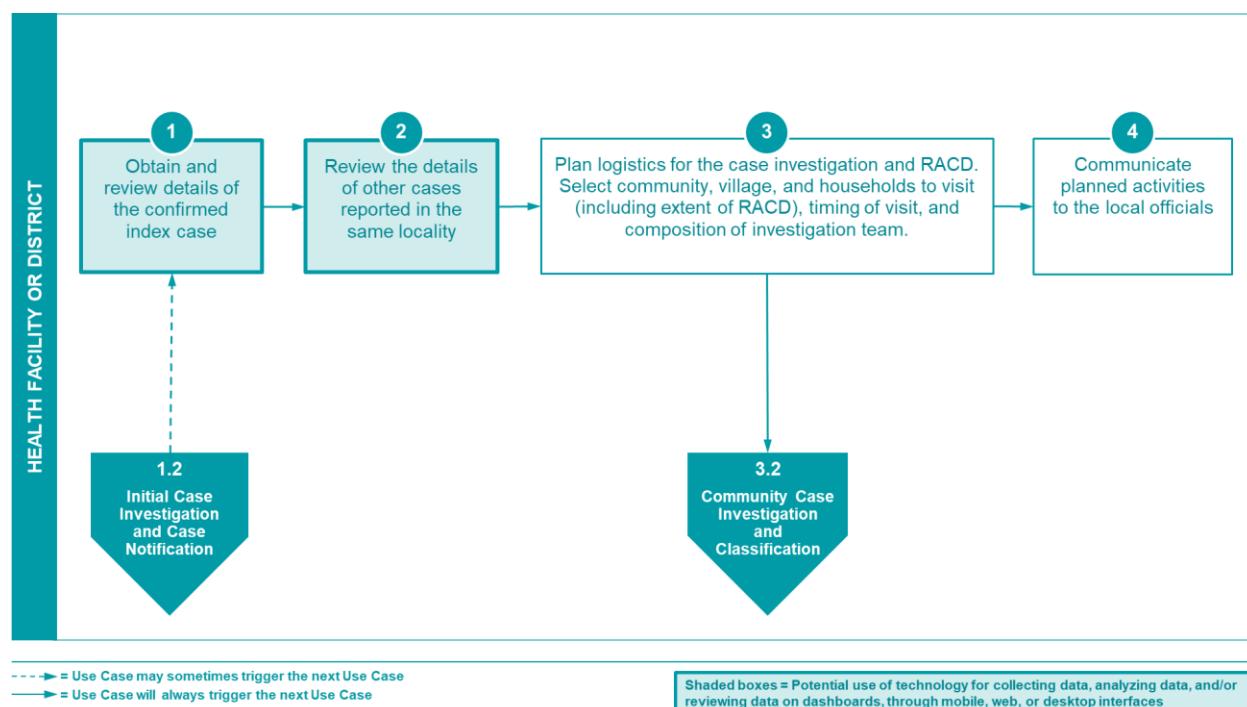
Variability

- Timing: Case investigation in the community following case notification varies across countries. The majority of countries do this 48-72 hours of case notification, and a few do it within 7 days of case notification.
- Location:
 - After notification, an initial case investigation is typically conducted at the point of care where the case is detected. In this situation, steps associated with case investigation planning are abbreviated, such that case investigation will start immediately. This may be followed by field-based case investigation and classification by a case investigation team if there is a reactive case detection protocol in place. Field-based case investigation is typically only done when there are few cases (e.g., no more than three cases per week per investigation team), though it may also be done in response to an outbreak or a rare unexpected case.
 - Case classification can be done on-site at a health facility or in the community or off-site from the district level.
- Actors: Teams conducting case investigation and classification differ across countries. District- and regional/provincial-level staff conduct case investigation planning, execution, and classification in some countries, while facility-level staff may do this in others.
- Access: In some countries, it is difficult to conduct case investigation in the community due to poor road access, especially during the rainy season.

- Planning: Case investigation planning is sometimes done as part of focus investigation planning.
- Case classification: Case classification is normally based on the case investigation details, but it may sometimes be delayed until the focus investigation is complete if the case investigation information is inconclusive. If the case classification is still inconclusive after the focus investigation is complete, then the case is classified as indigenous.
- Data collected:
 - The definition of "recent" in recent travel history varies depending on specific country guidelines. WHO guidelines suggest collecting travel history within or outside the country to malaria-endemic settings for the past two weeks, six months, and one year.
 - The location of a case should not automatically be assumed to be the person's household.

3.1: Case Investigation Planning

Review notification information, and plan logistics for case investigation. If a new case occurs outside a known active focus, the case investigation occurs as a part of a focus investigation. However, if a new case occurs within a known active focus, then the case investigation data will simply be used to update the focus record, given that focus investigation details would already be available from prior investigations. As case investigation typically happens at the point of care, case investigation planning may be abbreviated. However, in some cases, investigation may need to happen in the community, usually if investigation could not be completed at the point of care or if an RACD protocol is in place. In these situations, case investigation planning will need to plan for logistics and resources to conduct an investigation at the household level or within the community.



Frequency

Case investigation planning is done after notification of an index malaria case.

Data Collected

- Names of investigation team members
- Location of households within the selected communities or villages
- Transportation and other logistics costs

Primary Actors

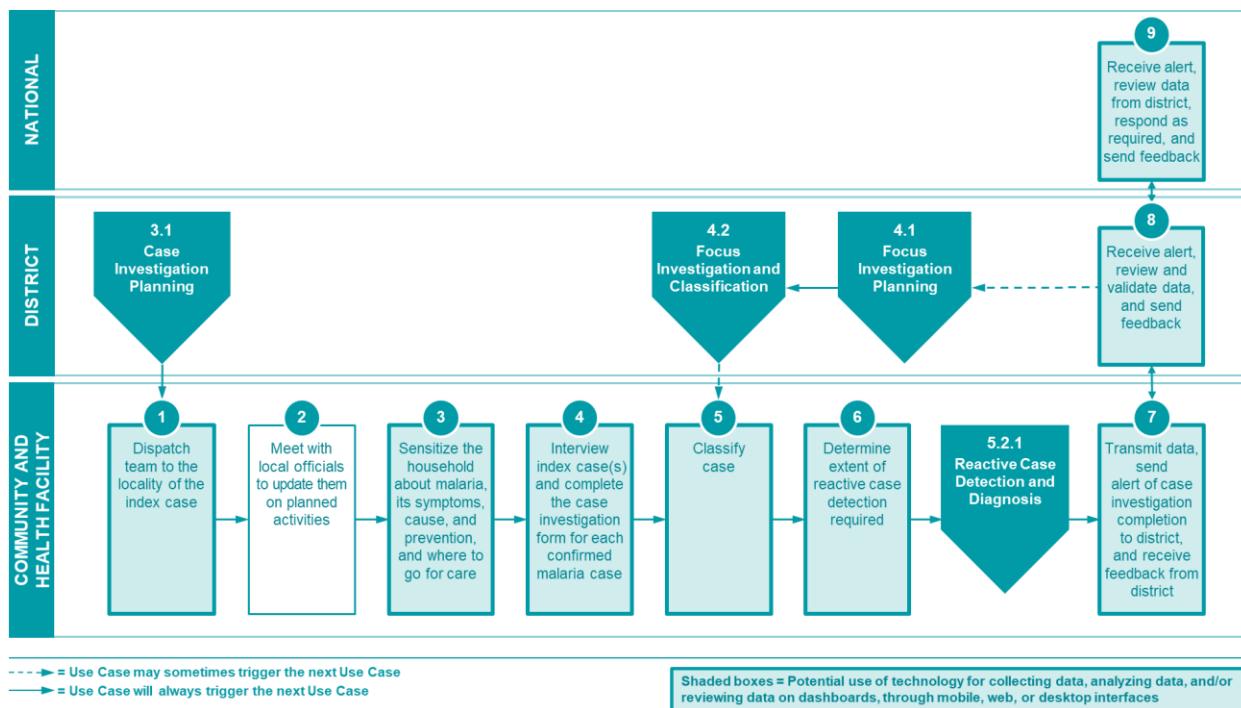
- District EHTs
- District-level person in charge of malaria activity

Secondary Actors

- Health facility staff
- Epidemiologist
- CHWs

3.2: Community Case Investigation and Classification

Conduct field-based work at the household or in the community to collect information on travel history, infection history, and any other information necessary to classify the index case as locally acquired or imported. Identify the factors for infection and where the case has been infected. This index case investigation leads to case classification, which may be followed by RACD and classification of subsequent cases detected.



Frequency

Community case investigation and classification is done after the planning is completed and households in selected communities and villages are identified.

Data Collected³¹

- Location of income-generating activities
- History of the current illness, including diagnostic test results and treatment
- *Plasmodium* species
- Recent travel history within and outside the country and to other malaria-endemic settings
- Details of travel companions
- Occurrence of blood transfusion within past three months
- Possible origin of malaria infection with GPS coordinates, if possible
- Previous history of malaria, if any

³¹ Information related to any intervention that is performed during Community Case Investigation and Classification (3.2) should be integrated into the mobile tool used for Routine and Reactive Intervention Execution (5.2)

- Recent contact with known imported case(s)
- Case classification
- Use of preventive interventions

Primary Actors

- Health facility staff
- District-level person in charge of malaria activity
- Laboratory technicians
- Epidemiologist
- CHWs

Secondary Actors

- Regional Malaria Surveillance Officer
- NMCP Surveillance Officer
- NMCP Case Management Officer

4.0: Focus Investigation

End Objective

Identify the main features of a location, including the populations at greatest risk, the rates of infection, the distribution of vectors responsible for malaria transmission, and the underlying conditions that support it. The delineation of foci boundaries precedes the implementation of RACD and focus investigation. This planning activity is usually conducted in the central national or district office for the entire administrative area (e.g., region/province, country). Relevant data about PCD, entomology, topography, accessibility, settlements, and population all contribute to the delineation of foci boundaries. Focus boundaries should not be redefined frequently to enable consistent tracking of cases and foci. Revision of focus boundaries should be done only in the event this will improve operational activities.

Location

- Focus investigation planning is conducted by an investigation team that may be located at regional/provincial, district, sub-district, or health facility levels where mobile data and internet connectivity ranges from potentially unreliable to reasonably good.
- Focus investigation and classification is conducted at the health facility and community levels with potentially unreliable mobile data connectivity and access to power. Some desk review of historical data may also occur at the district or regional/provincial level.

Subprocesses

- 4.1 Focus Investigation Planning
- 4.2 Focus Investigation and Classification

Variability

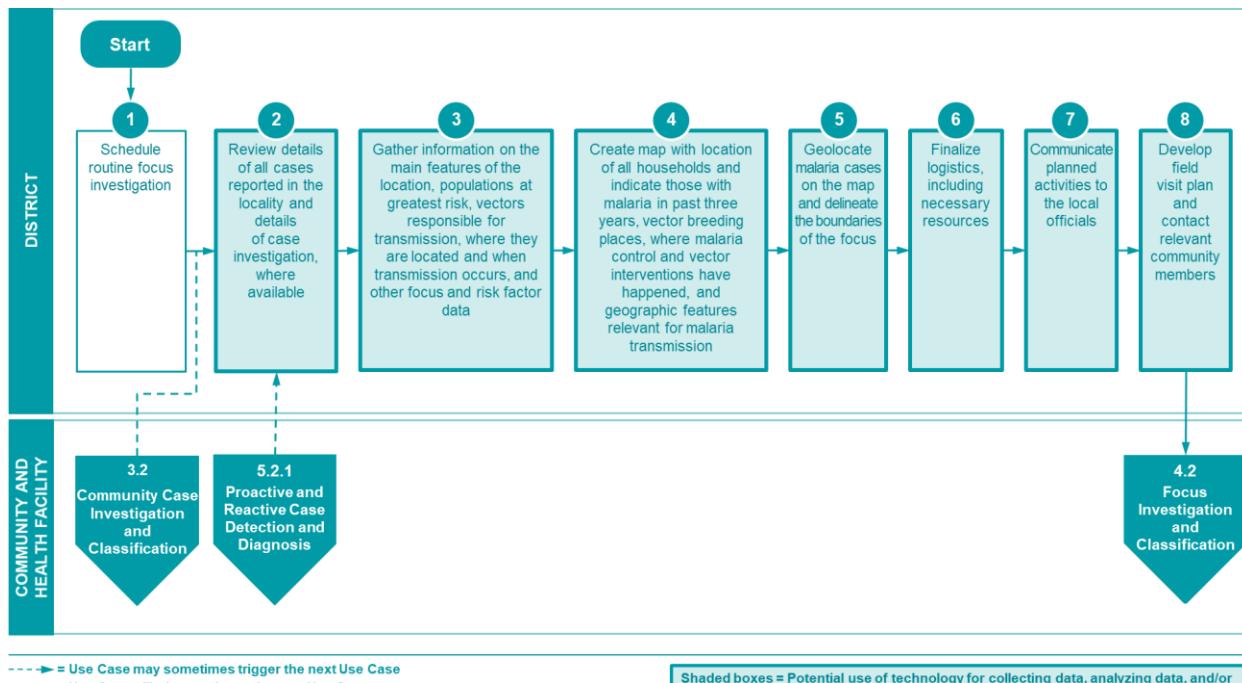
- Location:
 - Definition of foci area boundary varies. Some countries define this as an administrative unit, such as a village or community.
 - Foci boundaries do not typically change over time, except in certain rare cases, including when (a) the focus is determined to be too large to be investigated by a focus investigation team within one or two days or (b) an administrative unit boundary is changed, which would result in a focus being split across two administrative units.
- Actors: Some countries have focus investigators at the district or health facility. Others have a focus investigation team constantly in reach but not necessarily embedded in the community.

- Timing: Investigation timing varies for focus type, case class, and parasite species³². Focus class is typically reviewed at end of the year, but indigenous cases in residual non-active and cleared foci require immediate reclassification to active.
- Data collected:
 - Depending on the availability of tools, investigators may record or view historical data on the location, altitude, and geographic coordinates of households.
 - Epidemiological data is only collected if RACD or PACD was not conducted in the focus.
 - Some countries may not be able to genotype the parasites in all infected individuals in order to define recrudescence. This classification is only important for countries with very few cases who are nearing elimination, in which case follow-up protocols are in place. For operational purposes, it may be sufficient to consider a case as recrudescent if the episode of malaria is due to the same species as the first episode and occurred within 30 days for *P. falciparum* (60 days for *P. vivax*) of documented noncompliance with treatment with the first-line medicine.
- Triggers: Focus investigation triggers vary, and investigations can be conducted
 - to determine causes of an unusual increase in cases,
 - following the identification of an unusual parasite in the focus, or
 - following the identification of a local case in a residual non-active or cleared focus.
- Activities:
 - Focus investigations may include case investigations at the household and active case detection in the community, but they do not have to. Investigations may just be implemented to understand intervention coverage and entomological and environmental determinants of transmission.
 - In some countries entomological surveillance will be conducted during case investigation if there is no recent and reliable data from sentinel sites and if entomological staff is part of case investigation team.

³²Malaria Surveillance, Monitoring & Evaluation: A Reference Manual (2018) page 60

4.1: Focus Investigation Planning

Review case surveillance, entomological surveillance, vector control, social and behavior change communication, operational research, and previous foci investigation data, and plan logistics for focus investigation. This is critical to determine the appropriate response to the drivers of transmission in the focus of interest.



Frequency

- Routine focus investigations are conducted in all types of foci at least once a year to inform classification and reclassification. Investigations could be combined with cycles of IRS or during other intervention activities.
- In active foci in which RACD led to a focus investigation within the last month, there is no need for additional focus investigation, unless the case is caused by a rare parasite or in response to above-normal increase in cases.
- If RACD in response to an index case is implemented and a focus investigation is required, it should be completed rapidly, for example within seven days of case notification. In most situations, focus investigations can be combined with case investigations.

Data Collected

- Geographical map of focus and its limits
- Details of populations at greatest risk within the target focus area
- Size of general population and number of houses
- Administrative map of houses, health facilities, and other structures, as well as access routes within the focus

- Population characteristics in relation to vulnerability within the focus: migration patterns, presence and numbers of temporary workers, typical travel histories
- Total number of malaria cases, by species, reported within the focus during the past five years
- Results of malaria surveys, including active case detection within the focus during the past five years
- Dynamics of the focus status during the past five years: active focus versus residual non-active focus versus cleared focus
- Types and dates of vector control and other preventive measures applied within the focus during the past five years
- Transportation and other logistics costs

Primary Actors

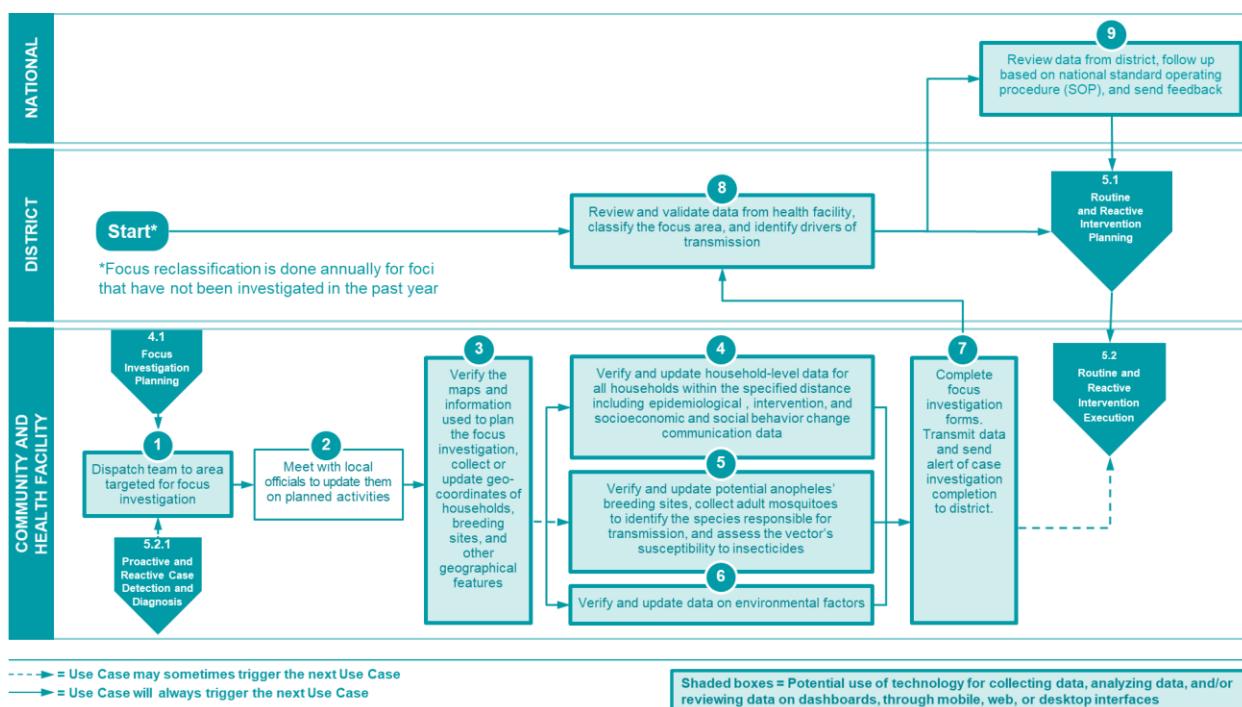
- Health facility staff
- District-level person in charge of malaria activity
- District EHT
- Entomologist

Secondary Actors

- Health facility staff
- Laboratory technicians
- CHWs

4.2: Focus Investigation and Classification

Describe the areas where malaria was transmitted and delineate the population at risk when a case of locally acquired malaria has been detected. A focus classification³³ or reclassification happens immediately on appearance of indigenous cases in residual non-active or cleared foci or at the end of a year. This must involve a field-based case investigation (not an initial case investigation) for all cases reported in that community. Once a new or relapsed case is classified as local in a focus currently classified as non-active residual or cleared, classification of the focus should be changed to active; this means that the transmission in the focus has been reestablished.



Frequency

- If an investigation was undertaken in an active focus recently, it may not be necessary to conduct a full focus investigation reactively to an index case, although case investigations and RACD may still be done.
- If a new malaria case in an active focus indicates the emergence of a new species of parasite, or multiple cases continue to be detected, then another full case and foci investigation is implemented.
- If a focus investigation necessitates RACD, it should be completed rapidly, for

³³ Focus classification is dependent on classification of cases within the focus and not on the focus investigation being conducted. Focus investigation may be required in order to accurately classify a case.
See Malaria Surveillance, Monitoring & Evaluation: A Reference Manual (2018) page 53

example within seven days of case notification.

Data Collected³⁴

- Relation of the focus to the malaria case that prompted the focus investigation, in time, space, and circumstance
- Location and total number of households, with number of inhabitants, in which malaria cases were registered within the focus
- Household epidemiological, socioeconomic, and social behavior change and communication data
- Distribution of parasites: species, number, and location of infections identified
- Distribution of vector species within the focus: principal and secondary malaria vectors and their behavior, including breeding sites with presence or absence of larvae
- Type of environment in relation to receptivity (urban or rural population, altitude, main geographical features, environmental changes as a result of development, and original and current endemicity) and vulnerability (refugees or close proximity to endemic areas within the country or across international borders) within the focus
- Linkages to data collected during treatment follow-up should be included. Some locally acquired cases may be recrudescent or relapsing and thus not indicate ongoing local transmission.

Primary Actors

- Health facility staff
- District-level person in charge of malaria activity
- Laboratory technicians
- Epidemiologist
- Entomologist
- District EHT
- CHWs

Secondary Actors

- District-level person in charge of malaria activity
- Regional/Provincial Malaria Surveillance Officer
- NMCP Surveillance Officer
- NMCP Case Management Officer

³⁴ Information related to any reactive intervention that is performed during Focus Case Investigation and Classification (4.2) should be integrated into the mobile tool used for Routine and Reactive Intervention Execution (5.2). If existing entomological and environmental data in steps 4, 5, and 6 in the process flow are stored electronically, these should be integrated into the mobile tool where it will be verified and updated. If the existing data is only available on paper, the mobile tool should allow the user to enter relevant entomological and environmental data points directly into the mobile tool electronically. The actors in these steps are expected to bring the existing data on paper forms with them to the field during the investigation.

5.0: Routine and Reactive Intervention

End Objective

Plan, execute, and evaluate interventions to interrupt the transmission of malaria and prevent reestablishment of transmission in malaria elimination areas. The majority of interventions are planned according to a regular schedule and are thus routine. Reactive interventions may also be conducted as supplementary measures (e.g., IRS, LLIN, treatment) while teams are already visiting households during RACD.

Location

- Routine and reactive intervention planning and intervention evaluation is conducted at the district or regional/provincial level with reasonably good internet connectivity.
- Routine and reactive intervention execution is conducted in a community with potentially unreliable mobile data connectivity and access to power.

Subprocesses

- 5.1 Routine and Reactive Intervention Planning
- 5.2 Routine and Reactive Intervention Execution*
 - 5.2.1 Proactive and Reactive Case Detection (PACD and RACD) and Diagnosis
 - 5.2.2 Indoor Residual Spraying (IRS)
 - 5.2.3 Long Lasting Insecticidal Nets (LLIN) Distribution
 - 5.2.4 Mass Drug Administration (MDA)
- 5.3 Routine and Reactive Intervention Evaluation

*Routine and Reactive Intervention Execution has its own unique subprocesses.

Variability

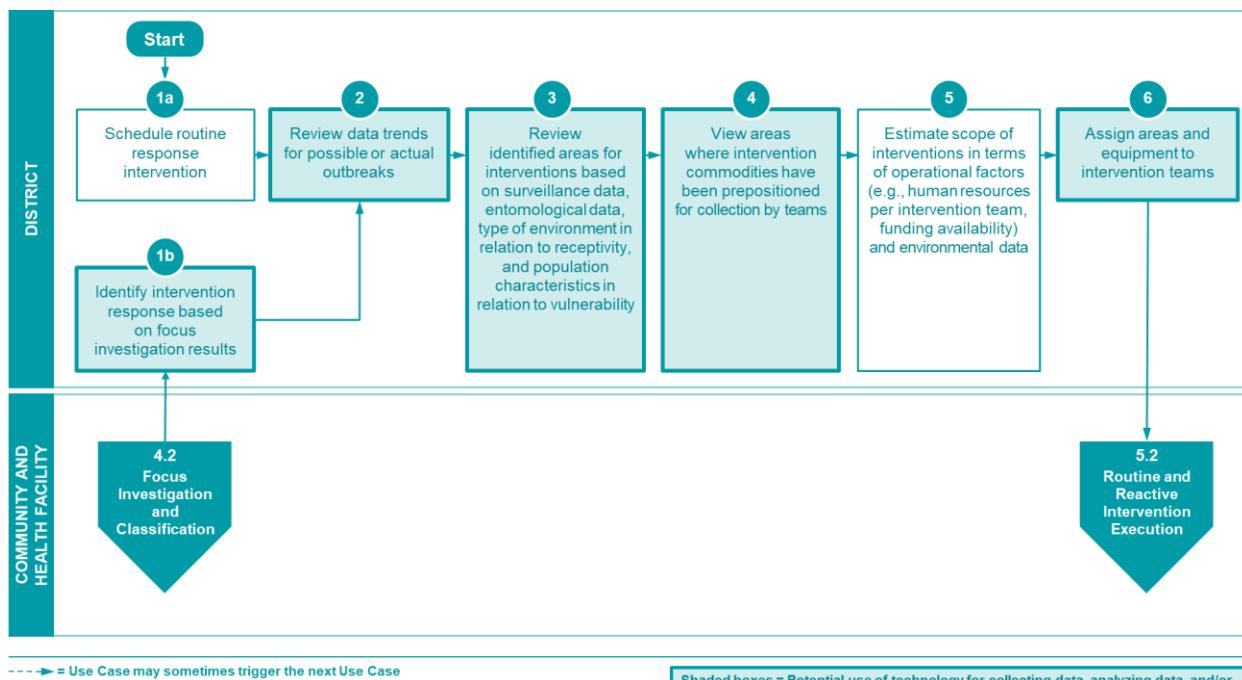
- Location: Countries may define target areas for intervention in different ways: district, village, or region.
- Timing: Routine interventions vary in frequency, with some interventions conducted every six months while others are done annually. Reactive interventions are conducted during or after PACD or RACD in response to information collected during PACD or RACD. For instance, if a household no longer has a functional LLIN, one is provided.
- Planning: Routine and reactive interventions may be planned at the district level in some countries, while other countries do this at the regional/provincial level.
- Intervention type: The type of intervention varies depending on availability of resources across and within countries.
- Extent: The extent of RACD conducted in the community varies across countries: in some countries only within the index household, in others within a 100-meter

radius of the index case, and in still others within a 500-meter radius. In general, the extent of RACD is largely determined by

- resources available,
- knowledge of breeding sites,
- presence of abundant anopheline vectors and other ecological and climatic factors that favor malaria transmission,
- proximity to a malarious area or frequent influx of infected individuals or groups or infective anophelines, and
- epidemiological factors.
- Determinants:
 - The ecological and epidemiological determinants (topography, altitude, presence of permanent water bodies, temperature, humidity, and rainfall) may vary across countries and impact when and where IRS is conducted.
 - The target groups for LLIN coverage depend upon the local malaria transmission ecology.
- Frequency: The frequency of MDA differs by seasonal population movements, accessibility to remote settings (some areas may not be accessible during the rainy season), and periods of low transmission.
- Monitoring and evaluation:
 - Indicators used to evaluate interventions vary by intervention activity and by country.
 - Actors monitoring and evaluating interventions can vary at the district and regional levels.
- Triggers: Focus investigation and classification only leads to reactive intervention if the focus is determined to have local transmission.

5.1: Routine and Reactive Intervention Planning

In consultation with experts and in response to the results of prior investigations, prepare (1) an intervention response plan or (2) a routine response plan as part of the annual or more frequent program planning. In both cases, data trends are reviewed for an outbreak or an outbreak alert.



Frequency

- Routine intervention periods vary. Some interventions are conducted seasonally during peak transmission periods, and frequency may vary in different areas.
- Reactive interventions are typically conducted in response to a focus investigation.

Data Collected

- Target areas for interventions
- Population characteristics in identified target areas
- Relevant focus investigation results
- Number and names of intervention team members
- Details of required equipment
- Transportation and other logistics costs
- Access routes to be used for intervention

Primary Actors

- District-level person in charge of malaria activity
- NMCP Surveillance Officer
- NMCP Vector Control Officer

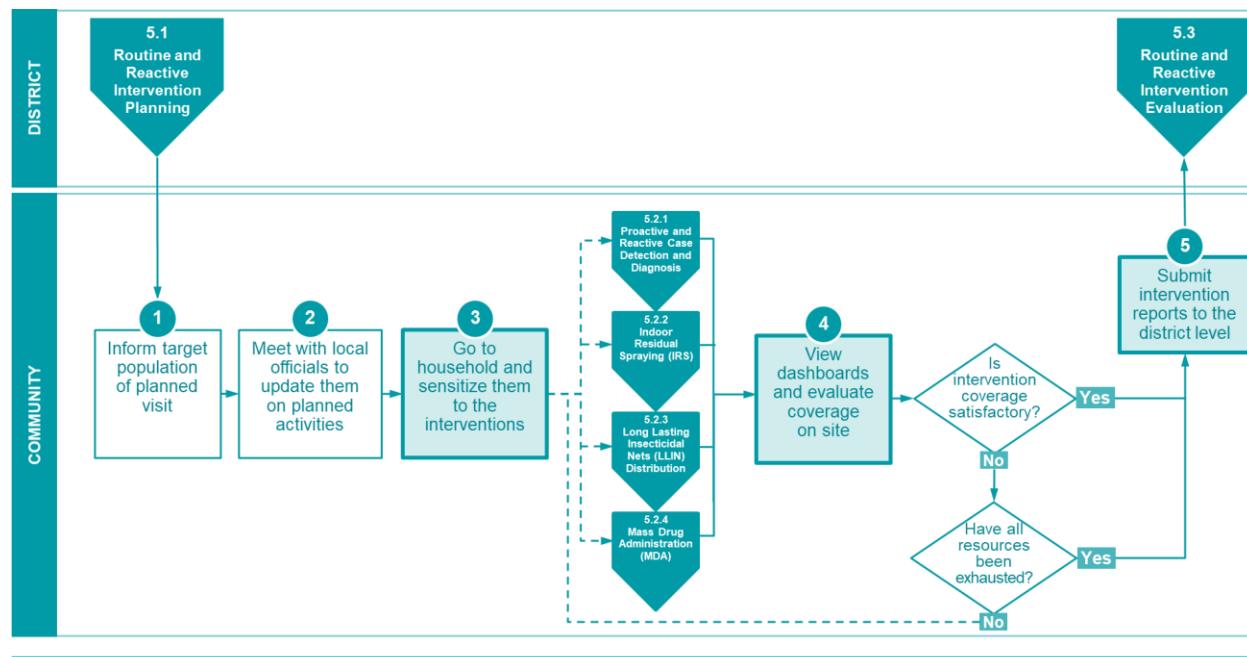
- Regional Malaria Surveillance Officer
- Regional Malaria Vector Control Officer

Secondary Actors

- Health facility staff
- CHWs
- IRS team leader
- Spray operators
- Volunteer distributors
- Malaria drug supply chain management staff

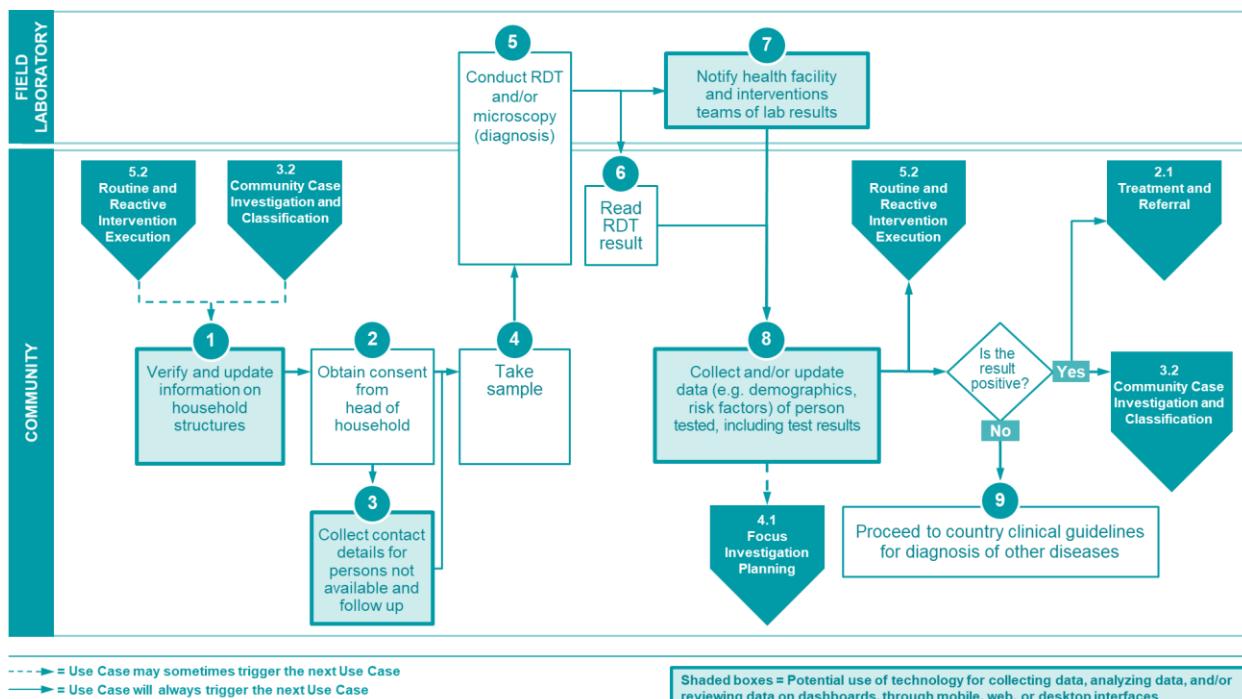
5.2: Routine and Reactive Intervention Execution

Carry out an intervention based on plans developed. The frequency, data collected, and actors for each type of intervention vary and are further specified in the Routine and Reactive Intervention Execution subprocesses (5.2.1–5.2.4) that follow. However, several steps conducted at the beginning and end of each intervention are common across all interventions. These common steps are included in the Routine and Reactive Intervention Execution (5.2) process flow below.



5.2.1: Proactive and Reactive Case Detection (PACD and RACD) and Diagnosis

Detect malaria cases in the community and in households, and sometimes among population groups who are considered by health workers to be at high risk. PACD and RACD can be conducted as fever screening followed by parasitological examination, or as direct parasitological examination of the target population, and may include immediate reactive interventions such as LLIN and IRS.



Frequency

Frequency varies depending on the type of active case detection:

- Reactive case detection (RACD) is triggered by the identification and notification of an index case and may happen as a part of case investigation if an RACD protocol is in place in-country. After the investigation and classification of the index case, RACD may be implemented within the household of the index case, over a radius around the household, or within the whole focus. RACD may be undertaken for the following reasons:
 - to investigate an outbreak (an above-normal number of index cases) in any type of focus;
 - to ensure high coverage of case managed in an active focus;
 - to investigate a focus where an unusual parasite has emerged, which was either previously eliminated or is new to the focus;

- d. to identify locally acquired or imported cases in residual non-active or cleared but receptive foci;
 - e. to reclassify cases (and eventually foci) from active to residual non-active or cleared; or
 - f. to verify that elimination has been achieved locally, regionally, or nationally.
2. Proactive case detection (PACD) is undertaken in populations that have limited access to facilities or inadequate health-seeking behavior, or in high risk groups such as remote or migrant populations, refugees, armed forces, forest workers, and long-distance drivers. PACD is not prompted by an index case and is done regularly at specific times, mainly during transmission season.

Data Collected

- Mode of case detection: PACD or RACD
- Identification number of the household
- Head of the household demographics
- Information on risk factors, such as occupation
- Information on household, including geospatial identifying information
- Names and demographics of tested household members
- Date blood taken
- Type of testing and results: species and, where possible, stage, density, and presence of gametocytes

Primary Actors

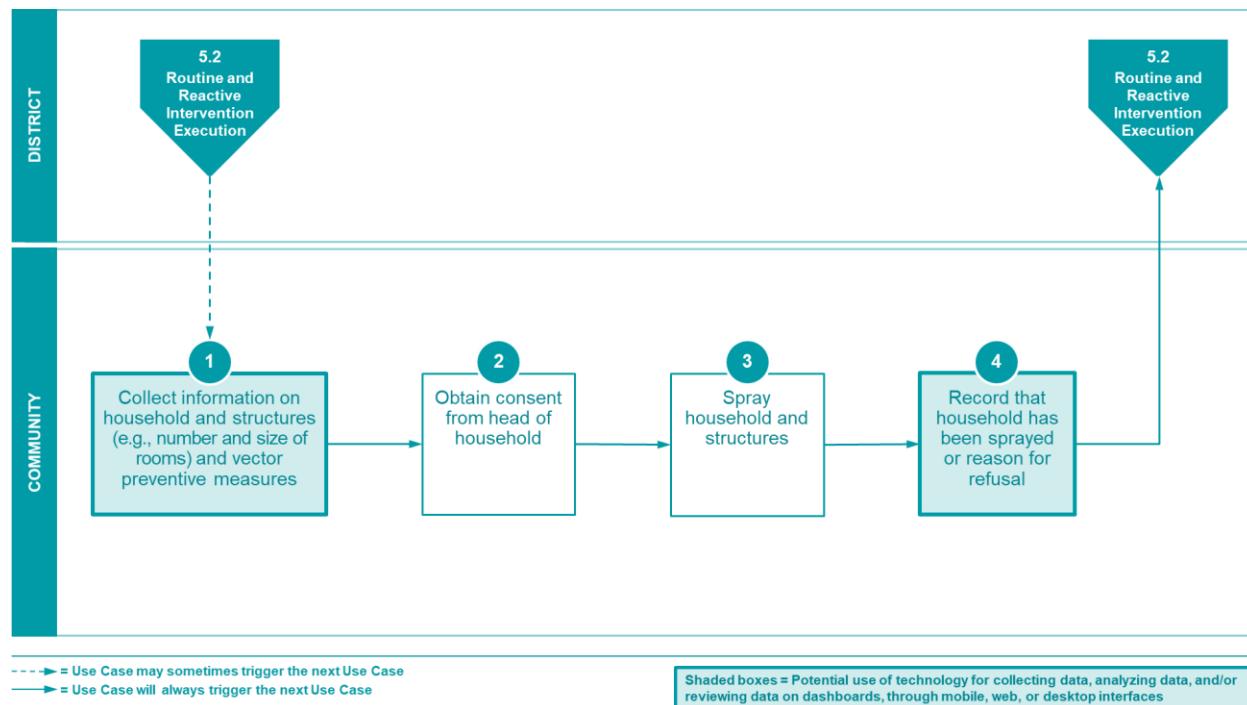
- Health facility staff
- CHWs
- Laboratory technicians

Secondary Actors

- District-level person in charge of malaria activity

5.2.2: Indoor Residual Spraying (IRS)

Apply residual insecticide to potential malaria-vector resting surfaces in targeted houses or structures. The objective of IRS is to reduce, and ultimately interrupt, malaria transmission by reducing vector survivorship, density, and human-vector contact in a manner that is safe for human health and not harmful to the environment.



Frequency

IRS is typically conducted once a year before the onset of peak transmission season. It is usually not operationally feasible to conduct more than two rounds of IRS in one year. IRS can also be conducted reactively in response to local transmission in a focus.

Primary Actors

- IRS team leader
- Spray operators

Secondary Actors

- NMCP Vector Control Officer
- Regional Malaria Vector Control Officer

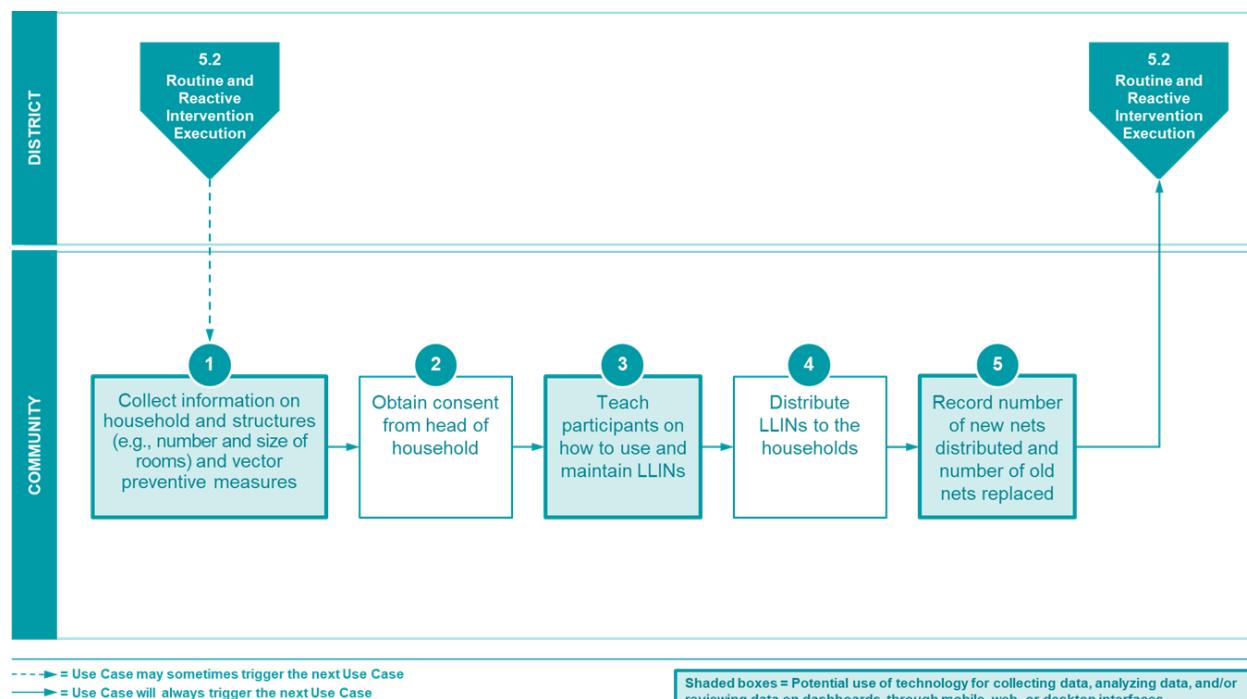
Data Collected

- Location identification, family name, address, and geocode
- A good description of the type of structure, including the wall types
- Number of residents
- Number of mosquito nets available

- Number of rooms/units sprayed and unsprayed
- Reason if unsprayed (e.g., locked or refused)
- Name of insecticide used
- Number of charges/sachets used
- Number of sachets returned empty

5.2.3: Long Lasting Insecticidal Nets (LLIN) Distribution

Distribute LLINs to members of the population susceptible to malaria to achieve universal coverage, whereby every person living in a malarious area sleeps under an insecticide-treated net (ITN) or preferably a long lasting insecticidal net (LLIN). To achieve and sustain universal coverage, each NMCP should develop its own LLIN distribution strategy, based on analyzing the context of its local opportunities and constraints and identifying a combination of distribution channels.



Frequency

- To maintain universal coverage, countries should apply a combination of mass distribution campaigns and continuous distribution channels.
 - Mass distribution campaigns should be repeated at an interval of no more than three years unless there is reliable observational evidence that a longer interval could be appropriate (e.g., if routine distribution through other health program channels is maintaining high coverage or nets are lasting longer).

-
- Continuous³⁵ distribution channels should be functional before, during, and after the mass distribution campaigns to avoid any gap in universal access to LLINs.
 - Periodic top-up campaigns — where community workers visit each household, replace only those nets that have been lost, and leave in place those that are still in good condition — are not recommended at present. Countries are recommended to consider topping-up if 40% or more of the target population have LLINs that are more than two years old.

Primary Actors

- CHWs
- Health facility staff
- Volunteer distributors

Secondary Actors

- NMCP Vector Control Officer
- Regional Malaria Vector Control Officer

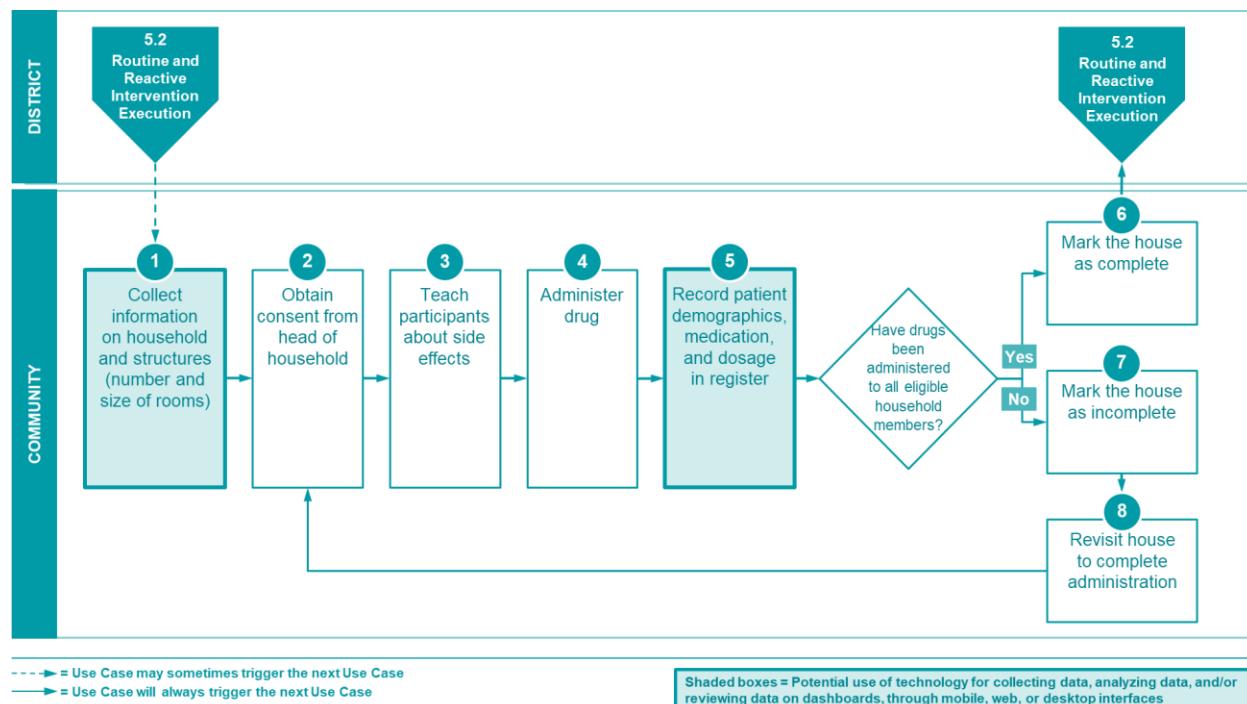
Data Collected

- Location identification, family name, address, and geocode
- Number of residents in household
- Number of households with at least one ITN or LLIN
- Number of members of household with access to an ITN or LLIN in the house
- Number of persons reporting having slept last night under an ITN or LLIN
- Number of under-five children reporting having slept last night under an ITN or LLIN

³⁵ The term “continuous” is used to describe distribution systems that deliver nets continuously and without interruption over time, as opposed to campaigns which deliver a consignment of nets to a defined target population in a single, time-limited operation. “Routine” distribution systems deliver nets along with other routine health services.

5.2.4: Mass Drug Administration (MDA)

Administer a full therapeutic course of antimalarial medicine (irrespective of the presence of symptoms or infection) to every member of a defined population or person living in a defined geographical area (except for those for which the medicine is contraindicated) at approximately the same time and often at repeated intervals.



Frequency

- In an area with seasonal transmission, an MDA campaign is executed during the low-transmission season when the number of parasites is lowest. Timing also takes into consideration seasonal movements of the population in and out of the target area.
- Multiple rounds of MDA at regular intervals are recommended, although there is insufficient evidence at present to establish the optimal number and timing of rounds. Most MDA campaigns for *P. falciparum* malaria have consisted of two or three rounds at monthly intervals.

Data Collected

- List of people in household, ideally with age and sex by family; otherwise, number of people per family
- Daily tally sheet with stock management (medicines, pregnancy tests, and other consumables) per distribution team
- Record of each person or family treated, excluded, refused, or not found

Primary Actors

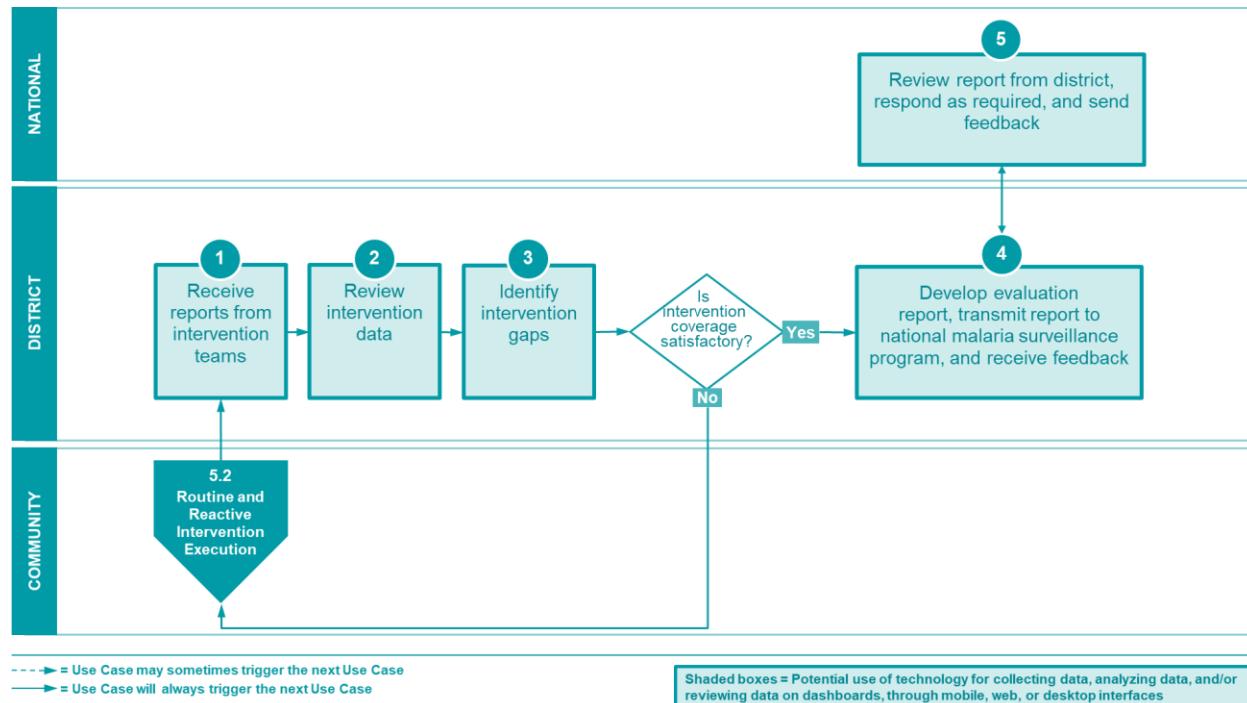
- CHWs
- Volunteer distributors
- Malaria drug supply chain management staff

Secondary Actors

- NMCP Surveillance Officer
- Regional Malaria Surveillance Officer
- District-level person in charge of malaria activity

5.3: Routine and Reactive Intervention Evaluation

Evaluate the coverage, operations, and impact of interventions conducted.



Frequency

- The timing of routine and reactive intervention evaluation varies by the type of intervention conducted.
- The quality of IRS spraying is monitored immediately after spraying and once a month thereafter during the expected duration of residual efficacy of the insecticide formulation.

Primary Actors

- Regional Malaria Vector Control Officer
- IRS team leader

Secondary Actors

- NMCP Vector Control Officer

Data Collected

- Specific indicators based on intervention conducted

6.0: Supervision

End Objective

Ensure that all malaria-related activities are performed appropriately, at the right frequency, and in line with the country guidelines. This is achieved by building an information system to ensure the completeness of reporting, thorough analysis, discussion of data, and follow-up of recommended actions.

Location

- Supervision planning typically happens at the district or regional/provincial level with reasonably good internet connectivity.
- Supervision execution typically is conducted at the health facility and community levels with potentially unreliable mobile data connectivity and access to power.

Subprocesses

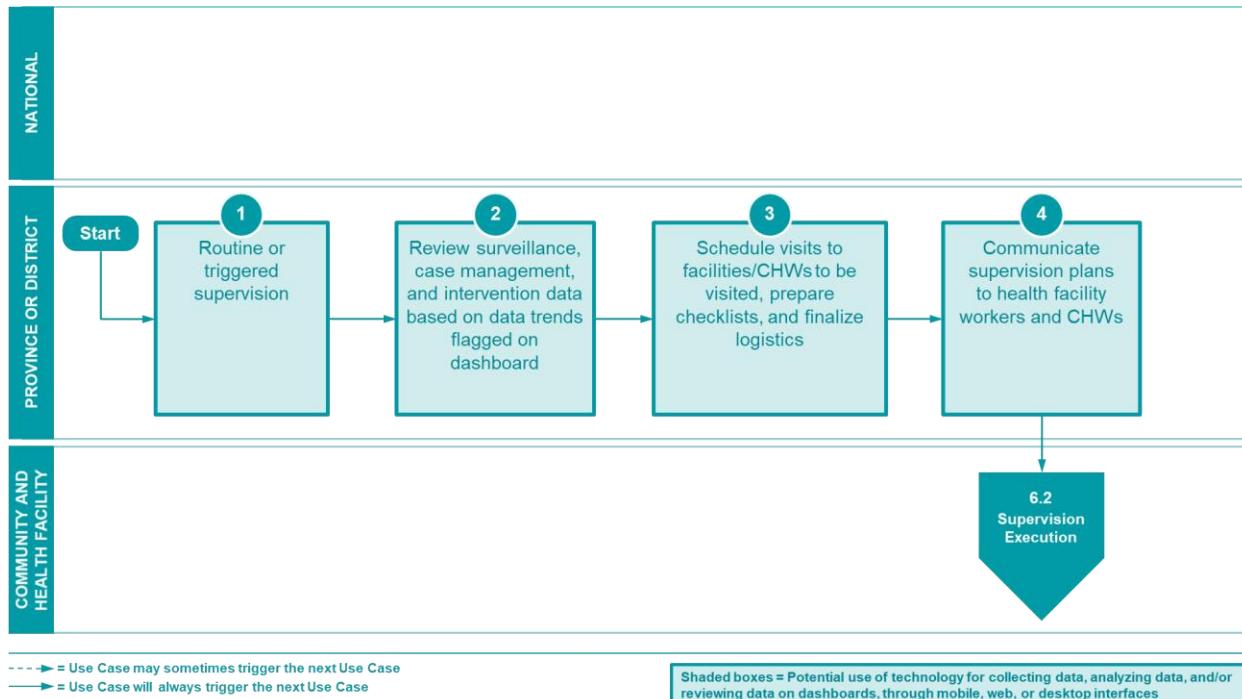
- 6.1 Supervision Planning
- 6.2 Supervision Execution

Variability:

- Planning: For routine activities, planning happens at district or regional/provincial level; minimal planning for intervention campaigns might happen at the community level.
- Frequency: This may be ad hoc, weekly, or monthly depending on the country NMCP plans.
- Data collected: Supervision checklists differ by country. Individuals supervised may have multiple roles, and supervision may be designed to cover activities for other programs in addition to malaria.
- Triggers: Supervision is triggered by programmatic data (e.g., incomplete reporting, late reporting, inconsistent data trends) or based on a predetermined frequency.
- Feedback provided: The outcomes of supervision visits may vary by country and role of the purpose of the visit (e.g., on-the-job retraining, providing a performance score or report card, awarding an incentive). The timing and mode with which feedback is provided may also vary (e.g., immediately in person, sometime after the visit by phone, shared routinely in monthly staff meetings).

6.1: Supervision Planning

Review surveillance, case management, and intervention data based on data trends from the facilities and CHWs. Schedule supervision visits based on data review or routine program plans, prepare checklists, and finalize logistics.



Frequency:

- Conducted ad hoc based on programmatic data or a predetermined frequency based on program plans

Primary Actors:

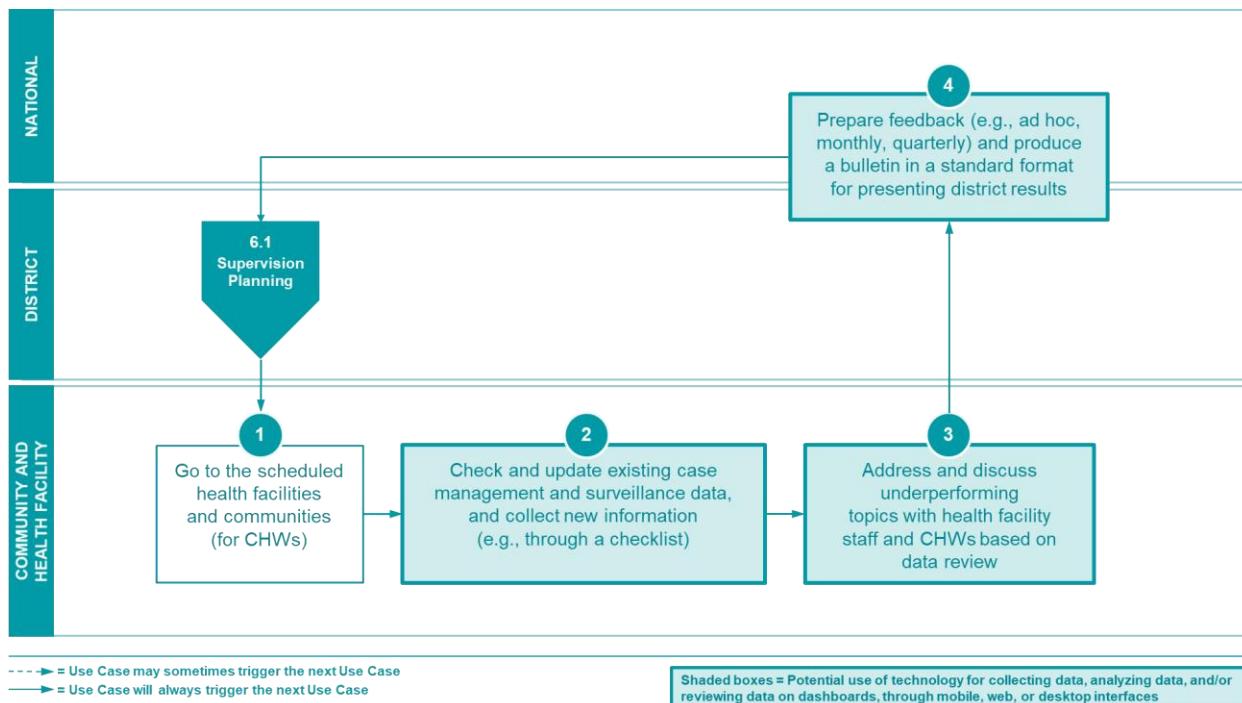
- NMCP Surveillance Officer
- NMCP Vector Control Officer
- NMCP Case Management Officer
- Regional/Provincial Malaria Surveillance Officer
- Regional/Provincial Malaria Vector Control Officer
- Regional/Provincial Data Manager
- District-level person in charge of malaria activity

Secondary Actors:

- District EHT
- Health facility staff
- CHWs
- IRS team

6.2: Supervision Execution

Conduct supervision visits to cross-check data and address underperforming topics with health facility staff and CHWs. Prepare ad hoc, monthly, or quarterly feedback and share with the health facilities and CHWs. Feedback should reflect data submitted by health facilities or CHWs, comparisons with other facilities or CHWs in the same administrative unit, summary statistics for the administrative unit as a whole, and any clarifications or other responses from the facility or CHW which may have been collected during supervision visit. A bulletin may also be produced in a standard format for presenting district results and comparisons of health facilities.

**Frequency:**

- Conducted ad hoc based on programmatic data or a predetermined frequency based on program plans

Primary Actors:

- District-level person in charge of malaria activity
- District EHT
- Health facility staff
- CHWs
- IRS team

Secondary Actors:

- NMCP Surveillance Officer

- NMCP Vector Control Officer
- NMCP Case Management Officer
- Regional/Provincial Malaria Surveillance Officer
- Regional/Provincial Malaria Vector Control Officer
- Regional/Provincial Data Manager

SECTION 3: REQUIREMENTS & USER STORIES

This section presents a series of system requirements designed to address current challenges in malaria elimination processes reported during the discovery phase by end users, technical partners, and other implementing organizations. The requirements are not meant to represent end-to-end system requirements for malaria elimination use cases, and focus primarily on addressing missing functionality and improvements required in existing digital tools used regularly today by malaria and other health programs.

The requirements are grouped into eight **categories**: usability, data inputs, data outputs, task management, data and app management, integrations, geospatial widget, and DHIS2 enhancements.

Each requirement addresses a particular **challenge** that impacts one or more **use cases** and one or more **tools**. Tools impacted are:

- **Mobile app:** The application used in the field on a mobile device, potentially offline. Mobile app requirements may also imply requirements for the underlying mobile app server, where all records generated and used by the mobile app and web interface are stored.
- **Geospatial widget:** A set of common code libraries used by the mobile app to capture and use geographical information.
- **Web interface:** The web interface is used at a facility or office on a web-enabled mobile device or a desktop computer with at least intermittent internet connectivity. Web interface requirements may also imply requirements for the underlying mobile app server, where all records generated and used by the mobile app or web interface are stored.
- **DHIS2:** The de facto national HMIS system and the ultimate recipient of individual or aggregate record data with which the mobile app server will be integrated.

It is assumed that all tools referenced in this section are generally configurable, including the ability to configure data fields, forms, dashboards, and user access roles to meet variable user needs in each country.

Each requirement contains **user stories** which are simple descriptions of how **actors** (i.e., end users) wish to use the tools to accomplish a step in the use case. As the actors performing the action in a user story may vary by country, actors are described in general terms based on how they interact with the system. Actors referenced in this section are:

- **Health service provider:** A person typically based at a health facility or in the community who provides healthcare services to community members (e.g., health facility staff, CHW).
- **Deployed worker:** A person typically based at a facility or district who is deployed to a community for investigation or intervention activities (e.g., EHT, entomologist, IRS team).
- **Supervisor:** A person based at a health facility or district, regional/provincial, or national office who reviews data for supervisory purposes to provide feedback and support to health service providers and deployed workers (e.g., regional/provincial Malaria Surveillance Officer, district-level person in charge of malaria activity).
- **Program manager:** A person typically based at a district, regional/provincial, or national office who reviews data for management, planning, or M&E purposes (e.g., NMCP Surveillance Officer, regional/provincial Malaria Surveillance Officer, district-level person in charge of malaria activity).
- **Data manager:** A person typically based at a district, regional/provincial, or national office with specific malaria program knowledge who is responsible for managing data (regional/provincial data manager, district HMIS Officer).
- **System administrator:** A person typically based at a district, regional/provincial, or national office who is responsible for managing the software or hardware infrastructure and providing tech support to users.

Each user story describes a feature that is prioritized based on (1) the perspective of malaria surveillance program implementation teams and (2) perceived frequency by which a related challenge was voiced or observed during the discovery phase. For the purposes of this document the priority levels are defined as:

- **Critical:** Tool is unusable without this feature. It is a failed first release if not included (target release: 2018).
- **Minimum Viable Product (MVP):** This feature should be included in the initial release in order to increase early adoption and test key assumptions about usage (target release: 2018).
- **Must have:** This feature should be included for the system to be considered fully functional (target release: late 2018-early 2019).
- **Should have:** This feature should be included for the system to be considered a robust surveillance toolkit (late 2019-2020).
- **Could have:** This feature would be useful but can be tabled for further discussion.

For some requirements, user stories may be more relevant to one of the tools over others. For example, in a requirement where both the mobile app and web interface are specified, a user story might only be performed on the web interface, depending on the context. User stories are designed to be discussed in detail with software developers to clarify any ambiguities, prioritize feature development, and schedule to software development cycles in consultation with end users during the development phase.

Requirements Summary

A: Usability

- A1: Improved user interface (UI)
- A2: User-friendly data entry
- A3: Simplified application login and password recovery
- A4: UI language translation

B: Data Inputs – Data Submission, Integrity, and Relationships

- B1: Establishing and updating relationships between different types of records
- B2: Visualizing relationships
- B3: Identify, merge, and deactivate duplicate records
- B4: Reporting zero records

C: Data Outputs – Analytics and Notifications

- C1: Sending basic alerts and notifications
- C2: Establishing contextual algorithms for automated classifications and notifications
- C3: Field activity analytics
- C4: Alternative methods for accessing dashboards and reports
- C5: System usage analytics

D: Task Management

- D1: Creating and assigning tasks
- D2: Viewing tasks

E: Data and App Management

- E1: Remote data management
- E2: Delete unnecessary data stored on device
- E3: Automated sync after interrupted network connection
- E4: Selective sync of data

F: Integrations

- F1: Adopting geospatial widget code libraries
- F2: Integrating with external systems
- F3: Importing data from or exporting data to external systems

G: Geospatial Widget

- G1: Collection of geographic object data
- G2: Generation and modification of geographic boundaries
- G3: Visualization of geographic information

H: DHIS2 Enhancements

- H1: Improved DHIS2-specific UI
- H2: DHIS2 web functionality for low connectivity
- H3: DHIS2 dashboards and visualization functionality
- H4: DHIS2 analytics functionality
- H5: Impact of DHIS2 upgrades and backwards-compatible data schema

Requirements

A: Usability

A1: Improved user interface (UI)

Use Case(s) Impacted	All		
Tool(s) Impacted	Mobile app, Web interface		
Challenge Description	<p>Users, particularly at the community and health facility level, are not familiar or comfortable with technology and struggle with navigating apps and completing data entry.</p> <p>Additionally, due to the low number of cases found in elimination settings, users forget how to use the app or struggle with data completion.</p>		
Root Cause(s)	<ul style="list-style-type: none">Infrequent use of systems due to few malaria cases in elimination areas.Navigation of technology interface may not be intuitive for users who do not use the system regularly.		
Desired Outcomes	<ul style="list-style-type: none">The UI is intuitive enough to guide the user to complete tasks and interpret the indicators on the dashboard without significant training.Staff collecting and reporting data know how to register malaria cases and record case and focus investigation data even if cases are infrequent.		
#	User Stories	Actor(s)	Priority
A1.1	Adding a fit-for-purpose launch-page menu: I want the first thing I see to be a menu, which can be customized by the system administrator to fit my needs, with my most common options displayed as text, icons, or images (e.g., Enter data, Review data, Approve data, View maps, and View analytics), so I can easily find them on the interface, especially in low literacy environments.	Health service provider Deployed worker Program manager Supervisor Data manager	Minimum Viable Product
A1.2	Simplifying UI and UI navigation: I want a UI that is text-light and minimizes the number of steps for me	Health service provider Deployed worker	Critical

	to complete a task, so it is easier for me to navigate the system.	Program manager Supervisor Data manager	
A1.3	Representing data display with images and color: I want different data and data fields to be displayed in colors, icons, or images, which can be customized by the system administrator to fit my needs (e.g., gender options configured as male and female icons or images, color-coded age groups, incomplete data fields highlighted).	Health service provider Deployed worker Program manager Supervisor Data manager	Must have
A1.4	Providing a user guide: I want access to clear step-by-step guidance (e.g., audio guide, demo, pop-up instructions) on how to complete my tasks, because I often forget how to navigate the system due to infrequent use.	Health service provider Deployed worker	Must have

A2: User-friendly data entry

Use Case(s) Impacted	All		
Tool(s) Impacted	Mobile app, Web interface		
Challenge Description	The format of data entry fields, forms, and views is not controlled by local system administrators and can be confusing for data entry users, creating messy data. Some error messages are too long and complex to be understood. Additionally, users cannot easily switch between forms or views to consult related data during activities.		
Root Cause(s)	<ul style="list-style-type: none"> • Limitation of current tools. • Non-user-centric design for error messages and other UI elements. 		
Desired Outcome	<ul style="list-style-type: none"> • System administrators have the ability to auto-format certain fields (e.g., adding hyphens to phone numbers, always making inputs in all caps) and build lists from commonly entered data to ensure consistency in data inputs. • Error messages can easily be understood by a layperson. • Users are supported in data entry through drop-downs, autocomplete, and reduction of free-text entry in order to reduce barrier to use. • Users can easily switch between forms or views to consult related data. 		
#	User Stories	Actor(s)	Priority
A2.1	Increasing font size: I want to be able to increase the font size on the mobile app so I can view and enter data comfortably.	Health service provider Deployed worker Supervisor	Minimum Viable Product
A2.2	Specifying mandatory and optional data fields: I want to specify which data fields are mandatory and optional for each use case, so users can easily identify completed forms based on mandatory fields entered and plan activities to complete missing data fields.	Program manager Data manager	Minimum Viable Product
A2.3	Configuring cascading drop-downs: I want to see cascading drop-downs to reduce the number of	Health service provider Deployed worker	Critical

	options in subsequent drop-downs (e.g., an initial drop-down for region, which filters the options in the subsequent drop-down for districts, which further filters the options in the subsequent drop-down for village), especially for locations as the number of lower-level administrative units is high and can be difficult to find in a large drop-down.	Program manager Supervisor	
A2.4	Restricting data format: I want to specify the type and format of data for selected data fields (e.g., all upper-case characters, a specific format of characters and numbers for foci names, validating entered IDs against ID format of the national system) in order to ensure uniformity of how the data appears in the system, and for easy identification and sorting for other users.	Data manager System administrator	Should have
A2.5	Auto-formatting fields: I want certain fields to be auto-formatted (e.g., phone numbers contain dashes at designated intervals) as I enter data into those fields and when I view data, in order to ensure I am entering the right data and to ensure uniformity of how the data appears in the system.	Health service provider Deployed worker Supervisor	Must have
A2.6	Allowing auto-complete in free-text fields: For select free-text response fields, I want the app to auto-complete fields with data that I previously entered as options to select instead of having to enter values each time (e.g., free-text entry of village or locality name where a master locality or village list is not available), in order to simplify data entry and ensure consistency in spellings.	Health service provider Deployed worker Supervisor	Minimum Viable Product
A2.7	Building lists from compiled free-text data: I want to build lists automatically over time when entering data (e.g., village names, localities) so that I can eventually have the option to approve these lists and replace free-text fields with drop-down or multiple-select fields to improve ease and quality of data collection.	Data manager System administrator	Must have
A2.8	Entering start and end dates for events: I want to be able to easily add multiple sets of data within a record (e.g., enter multiple sets of start dates, end dates, and locations for multiple travel events reported during a case investigation) in an easy and intuitive manner so the detail in the record	Health service provider Deployed worker Supervisor	Minimum Viable Product

	(e.g., travel history) is comprehensive.		
A2.9	Allowing flexible date entry for select fields: I want to be able to select dates from a drop-down for dates, months, and years, instead of using a calendar-based interface to select dates, so I can enter data in the way that is most comfortable to me.	Health service provider Deployed worker Supervisor	Must have
A2.10	Simplifying error messages: I want error messages to be simple to understand, even if I do not have technical expertise, so I know how to troubleshoot the error or communicate it to someone who does.	Health service provider Deployed worker Program manager Supervisor Data manager	Minimum Viable Product
A2.11	Timing error message appearance: I want to only see an error message after I have completed entering data in a field.	Health service provider Deployed worker Supervisor	Minimum Viable Product
A2.12	Toggling between records: I want to be able to toggle between different records (e.g., all case records linked to a focus) so I can easily view and update data for multiple related records.	Health service provider Deployed worker Supervisor	Must have

A3: Simplified application login and password recovery

Use Case(s) Impacted	All
Tool(s) Impacted	Mobile app, Web interface
Challenge Description	HMIS, IT, and help desk staff report receiving an overwhelming number of user calls for login assistance and password recovery.
Root Cause(s)	<ul style="list-style-type: none"> Users do not understand what the username is and sometimes enter their emails, first names, or other non-login information. Users forget their passwords and do not have easy access to email to recover passwords.
Desired Outcome	Provide more channels for password recovery and more options for logging into the app.

#	User Stories	Actors(s)	Priority
A3.1	Creating multiple password recovery channels: I want the password recovery process to include channels beside email, such as SMS or USSD, so I can log in when I do not have access to my email.	Health service provider Deployed worker Program manager Supervisor Data manager	Minimum Viable Product
A3.2	Allowing multiple login channels: I want to have more than one way to authenticate (e.g., using other commonly used platforms' login credentials, QR code, or auto-completion of last logged in username) to make login more user friendly.	Health service provider Deployed worker Program manager Supervisor Data manager	Must have
A3.3	Allowing single sign-on: I want to use one login to authenticate across multiple platforms using single sign-on or another authentication protocol so I have fewer login credentials to remember.	Health service provider Deployed worker Program manager Supervisor Data manager	Could have

A4: UI language translation

Use Case(s) Impacted	All		
Tool(s) Impacted	Mobile app, Web interface		
Challenge Description	System variables and error messages cannot be fully translated into the local language. Calendar, buttons such as Sync, Next, and Cancel, and some other data remain in English.		
Root Cause(s)	<ul style="list-style-type: none">Text for core features (e.g., menu options) cannot be translated in system configuration.Platforms that allow translation may have confusing or unfamiliar approval processes for translations.		
Desired Outcome	All text displayed in the UI is translatable and displayed in a user-chosen language.		
#	User Stories	Actor(s)	Priority
A4.1	Translating all system variables: I want a user interface to edit and translate all system variables (including error messages), UI elements, and indicators into another language, so no user-facing data remain in a language that an end user does not understand.	System administrator	Minimum Viable Product

B: Data Inputs – Data Submission, Integrity, and Relationships**B1: Establishing and updating relationships between different types of records**

Use Case(s) Impacted	Community Case Investigation and Classification (3.2) Focus Investigation and Classification (4.2) Routine and Reactive Intervention Planning (5.1) Routine and Reactive Intervention Execution (5.2)		
Tool(s) Impacted	Mobile app, Web interface, DHIS2		
Challenge Description	Records do not always share clear hierarchical or chronological relationships. Unclear or unestablished relationships between records creates limitations in analysis.		
Root Cause(s)	<ul style="list-style-type: none">Some records (e.g., foci) evolve over time, while other records (e.g., routine interventions) are point-in-time events, which introduces complexity in maintaining accurate representations of relationships, as they too may evolve over time.Intervention, focus, and case records do not necessarily have clear hierarchical relationships (based on geographical boundaries or organizational units), making it difficult to capture the nature of their relationships in a systematic way.Interventions are sometimes routinely planned and are not conducted reactive to specific case or focus investigations. As a result, intervention data are not directly linked to specific cases or foci.		
Desired Outcome	Relationships are established between different types of records and can be modified over time.		
#	User Stories	Actor(s)	Priority

B1.1	<p>Entering relationships between data points: I want to establish a relationship between the following types of records (regardless of when the record is created) based on my understanding of context, so I can later visualize and analyze a subset of records based on their relationship type. For example, I want relationships between:</p> <ul style="list-style-type: none"> • an index case record to related case records for whom the index case was the likely vector for transmission, • a case record to an intervention record when they are associated with the same household, • a focus record to case records or intervention records that are geographically situated within or near the focus boundary, or • an index case record to a breeding site record that is geographically proximate. 	Health service provider Deployed worker Program manager Data manager	Minimum Viable Product
B1.2	<p>Building complex relationship trees: I want to create complex links and relationship trees between records (e.g., situations when an index case is linked to someone in the family, who in turn is linked to someone in that family member's workplace) to accurately and comprehensively denote how records are related.</p>	Health service provider Deployed worker Program manager Data manager	Minimum Viable Product
B1.3	<p>Prepopulating new records using related existing records: I want to automatically trigger the creation of a new record based on data from other records (e.g., create an intervention record and add household data from a case record) so that I am prompted to complete any necessary follow-up records.</p>	Health service provider Deployed worker	Should have
B1.4	<p>Suggesting relationships based on proximity: When creating a new record, I want to click on a button and see a list of relevant, nearby geographic objects and boundaries (e.g., foci, households, breeding sites) and be able to select one to establish a relationship between my record and that object or boundary (e.g., select the focus and establish a link between the focus and a new case detected passively at a facility) to ensure that the new record is adequately linked to other records for analysis.</p>	Health service provider Deployed worker Program manager Data manager	Should have

B1.5	Updating relationships between cases: I want to update record relationships if certain relationships are determined to be incorrectly linked to ensure accuracy can be ensured retrospectively.	Health service provider Deployed worker Program manager Data manager	Minimum Viable Product
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B2: Visualizing relationships

Use Case(s) Impacted	Community Case Investigation and Classification (3.2) Focus Investigation and Classification (4.2) Routine and Reactive Intervention Planning (5.1) Routine and Reactive Intervention Execution (5.2)		
Tool(s) Impacted	Web interface, DHIS2		
Challenge Description	Users cannot add or view the relationship between index cases and related cases during case investigation. This can lead to inaccurate portrayal of transmission chains, which in turn can lead to misinformed intervention planning.		
Root Cause(s)	<ul style="list-style-type: none">System limitations that do not allow relationships between index and related cases to be modified after time of entry.System limitations that do not allow visualization of relationships.		
Desired Outcome	Relationships between records such as registered and displayed visually for a user and can be updated or viewed after the initial investigation.		
#	User Stories	Actor(s)	Priority
B2.1	Visualizing a summary of relationships: I want to see a table or visual that describes links and relationship trees between records (e.g., a table showing index case, number of related cases in the same household, and number of related cases outside the household).	Health service provider Deployed worker Program manager Supervisor Data manager	Minimum Viable Product

B3: Identify, merge, and deactivate duplicate records

Use Case(s) Impacted	Passive Case Detection (PCD) and Diagnosis (1.1) Initial Case Investigation and Case Notification (1.2) Case Investigation Planning (3.1) Community Case Investigation and Classification (3.2)
Tool(s) Impacted	Mobile app, Web interface, DHIS2
Challenge Description	Multiple case records may be created erroneously due to technology-related issues, user confusion, or when a patient presents at multiple health facilities for treatment.
Root Cause(s)	<ul style="list-style-type: none"> Users assume it's necessary to enter the information again when the synchronization with the server fails. The system does not validate data points other than the case record ID to identify potential duplicates (e.g., name, date of birth, phone). Users may create a record multiple times without searching for a record.
Desired Outcomes	<ul style="list-style-type: none"> Duplicate records are prevented by ensuring each new record is unique and registered only once. Duplicate records are easily identified and deactivated and/or merged.

#	User Stories	Actor(s)	Priority
B3.1	Proposing record matches before creating a new record: Before creating a new record offline, I want the system to automatically search for and propose potential record matches as I enter case data using several data points (e.g., name, ID, address) in order to minimize the creation of duplicate records. This should not require the user to actively search for a case and will require some amount of data to be stored locally on the device to be searched again.	Health service provider Deployed worker	Must have
B3.2	Identifying potential duplicate records on mobile while online: When I create a new record while online, or sync a record that I created while previously offline, I want the system to search the records stored in the central system database to identify and suggest potential record matches using several data points (e.g., name, ID, address) to minimize creation of duplicate records (e.g., identify	Health service provider Deployed worker	Must have

	if a case has been registered at another facility).		
B3.3	Viewing and filtering to identify duplicate records: Using the web interface online, I want to view and filter records by their attributes so I can easily identify duplicates for removal.	Program manager Supervisor Data manager System administrator	Minimum Viable Product
B3.4	Flagging duplicate records: Using the web interface online or the mobile app offline, I want to flag a duplicate record for someone else (e.g., system administrator, data manager) to delete or merge later, to ensure that it does not get included in any analyses or reports.	Health service provider Deployed worker	Minimum Viable Product
B3.5	Deactivating duplicate records: Using the web interface online, I want to deactivate a duplicate record, record the unique record for which it was a duplicate, and manually enter any pertinent data into the unique record, to ensure that the duplicate record does not get included in any analyses or reports.	Program manager Supervisor Data manager System administrator	Minimum Viable Product
B3.6	Merging duplicate records: When using the web interface online to deactivate a duplicate record, I want to record the unique record for which it was a duplicate and be prompted to choose which data points from the duplicate record should be saved into the unique record, so that I do not have to manually enter pertinent data into the unique record.	Program manager Supervisor Data manager System administrator	Should have

B4: Reporting zero records

Use Case(s) Impacted	Initial Case Investigation and Case Notification (1.2)		
Tool(s) Impacted	Mobile app, Web interface		
Challenge Description	Data entry does not include a mechanism for reporting zero cases of malaria.		
Root Cause(s)	<ul style="list-style-type: none">System limitations.		
Desired Outcome	Data can be entered for reporting facilities that do not see any cases of malaria.		
#	User Stories	Actor(s)	Priority
B4.1	Reporting zero cases: I want to report zero cases of malaria at a specified frequency (e.g., every Monday by 12 pm) to ensure that data submitted accurately reflects that no cases were detected as opposed to the possibility that data submitted was incomplete.	Health service provider Deployed worker	Critical
B4.2	UI for submitting negative cases: I want to easily submit negative cases, especially in the circumstances where I am mostly using the application to follow up on positive cases as opposed to logging negative cases. For example, some users push back on inclusion of negative cases because of reporting burden.	Health service provider Deployed worker	Minimum Viable Product

C: Data Outputs – Analytics and Notifications**C1: Sending basic alerts and notifications**

Use Case(s) Impacted	Initial Case Investigation and Case Notification (1.2) Community Case Investigation and Classification (3.2)		
Tool(s) Impacted	Mobile app, Web interface, DHIS2		
Challenge Description	Important indications visible in the data (e.g., possible outbreak, reclassification of cases required due to new data submitted) must be identified by system users manually before action can be taken.		
Root Cause(s)	<ul style="list-style-type: none"> • System limitations. 		
Desired Outcome	Administrators can configure automated alerts to appropriate users so the system automatically interprets data and sends alerts based on preconfigured rules (e.g., if a data point passes a threshold or task is incomplete after due date).		
#	User Stories	Actor(s)	Priority
C1.1	Submitting notifications offline: I want to be notified if limited internet connectivity is preventing an urgent notification from being submitted and be provided with alternate means of submitting a notification (e.g., SMS, QR code) to ensure the notification is received in time to take action.	Health service provider Deployed worker	Minimum Viable Product
C1.2	Creating a notification when there are key data changes: I want to be notified automatically when a record within my administrative area (e.g., facility, district, region/province) is updated with a key new data value (e.g., case classification change from imported to local, change in malaria species, new positive case), so I can be aware of key activities that may need a further action within my purview.	Program manager	Must have
C1.3	Creating a notification to complete overdue tasks: I want to be notified automatically (and be able to enable or disable future notifications like these) when one of my tasks or one of my workers' tasks is overdue based on predefined due dates (e.g., when an annual focus investigation is overdue).	Health service provider Deployed worker Program manager Supervisor	Minimum Viable Product

C1.4	Creating a notification of completed tasks: I want to be notified automatically (and be able to enable or disable future notifications like these) when specific tasks are completed by my workers (e.g., when a case investigation is completed and the data has been submitted for review).	Program manager Supervisor	Must have
C1.5	Sending or scheduling a notification manually: I want to send or schedule a notification manually to myself or others as a reminder to carry out specific tasks (e.g., when to start case investigations, when to proceed to focus investigations in that area).	Health service provider Deployed worker Program manager Supervisor	Should have

C2: Establishing contextual algorithms for automated classifications and notifications

Use Case(s) Impacted	Case Investigation Planning (3.1) Community Case Investigation and Classification (3.2) Focus Investigation Planning (4.1) Focus Investigation and Classification (4.2) Routine and Reactive Intervention Planning (5.1)
Tool(s) Impacted	Mobile app, Web interface, DHIS2
Challenge Description	Users are not automatically guided on how to reclassify cases or notified on outbreaks based on data trends. Users rely on their existing knowledge of the process (which may have changed) and understanding of the data trends, which can lead to inaccurate classification of cases and foci, which in turn can lead to misinformed intervention planning.
Root Cause(s)	<ul style="list-style-type: none"> System limitations that do not allow configuration of simple algorithms for case and focus classification. System limitations that do not allow configuration of simple algorithms for notification of outbreaks.
Desired Outcomes	<ul style="list-style-type: none"> Algorithms are configured to guide users on timing of investigations and classification of cases and foci.

#	User Stories	Actor(s)	Priority
C2.1	<p>Setting outbreak alerts using static thresholds: I want to configure an outbreak alert and notification for myself and other users if the number of cases in a specified area surpasses a predefined, static threshold (e.g., three cases detected in a focus in one week) so we can take immediate action. The outbreak threshold must be configurable for each district, since these thresholds will vary between districts. (See Malaria Surveillance, Monitoring & Evaluation: A Reference Manual (2018) pages 115-119.)</p>	Program manager Data manager System administrator	Must have
C2.2	<p>Setting outbreak alerts using relative thresholds: I want to configure an outbreak alert and notification for myself and other users if the number of cases in a specified area surpasses a</p>	Program manager Data manager System administrator	Should have

	predefined, relative threshold (e.g., 10% or higher increase in cases detected in a district this month relative to the number of cases detected last month) so we can take immediate action. (See Malaria Surveillance, Monitoring & Evaluation: A Reference Manual (2018) pages 115-119.)		
C2.3	Notifying when case and focus investigations should begin: I want to configure rules to notify me and other users when, based on predefined levels of caseloads detected in a specific area, a case investigation should be started and when to proceed to focus investigations in that area.	Program manager	Must have
C2.4	Notifying when and where RACD should commence: I want to configure rules to trigger a notification on the mobile app that RACD should be conducted based on my country guidelines, accompanied by a short message explaining the RACD protocol based on the location of the index case, to help workers determine where RACD should be conducted and to what extent. For example, RACD should be conducted for: <ul style="list-style-type: none"> • all households within a radius of 1 km of the index household for rural areas, • households within a radius of 500 m of the index household for urban areas, or • 12 households surrounding the index household. 	Program manager	Could have
C2.5	Automating case classification: I want to configure program rules to suggest or automatically populate case classification based on information from the case. (See Malaria Surveillance, Monitoring & Evaluation: A Reference Manual (2018) pages 48-51.)	Program manager Data manager System administrator	Must have
C2.6	Classifying foci using case data: I want to configure rules to suggest or automatically populate foci classification based on information from other records. For example, a simple set of rules could be: <ul style="list-style-type: none"> • Foci classification = Cleared IF no local case within last three years 	Program manager, Data manager, System administrator	Could have

	<ul style="list-style-type: none">• Foci classification = Non-active, residual IF local cases recorded only within one to three years ago• Foci classification = Active IF local cases recorded in current calendar year		
C2.7	Creating a notification to reclassify a focus based on data from a case classification: I want to configure an outbreak alert and notification for myself and other users if a case is classified as local in a focus currently classified as non-active residual or cleared, so I know that transmission has been reestablished in the focus and can immediately change the focus classification to active.	Program manager Data manager System administrator	Must have

C3: Field activity analytics

Use Case(s) Impacted	Initial Case Investigation and Case Notification (1.2) Case Investigation Planning (3.1) Focus Investigation Planning (4.1) Routine and Reactive Intervention Planning (5.1)		
Tool(s) Impacted	Mobile app		
Challenge Description	Lack of analytics on the mobile app prevents users from viewing their progress and performance and the timeliness of surveillance activities.		
Root Cause(s)	<ul style="list-style-type: none"> Mobile app does not show analytics for data entry users. 		
Desired Outcome	Mobile app displays analytics with simple, easy-to-read visuals that can be used while in the field.		
#	User Stories	Actor(s)	Priority
C3.1	Creating case report: I want to be able to create a report that contains all information related to a specific case (e.g., case notification, case investigation, contact tracing, any interventions done at the household of the case, entomological surveillance done as a result of the case), in order to see if a case was fully followed through.	Health service provider Deployed worker Program manager Supervisor Data manager	Minimum Viable Product
C3.2	Displaying dashboards with caseloads in a specific area: I want to view a basic dashboard that flags when caseloads reach predefined thresholds in a specific area so I know when to start case investigations and when to proceed to focus investigations in that area.	Program manager	Should have
C3.3	Timestamping dashboard data: I want all dashboards to display the date of the latest data that was used to create this dashboard, so I know how old the data is and can judge if the dashboard is still valid.	Health service provider Deployed worker Program manager Supervisor Data manager	Must have
C3.4	Downloading dashboard: I want to view a basic dashboard on my mobile app (downloaded to the device when I was last online), so I can make decisions based on larger quantities of data that	Health service provider Deployed worker Supervisor	Minimum Viable Product

	have been analyzed centrally, summarized into an easy-to-understand dashboard, and stored locally on my device for quick reference while in the field.		
C3.5	Instant offline dashboard: I want to view a basic dashboard on my mobile app, generated offline using only data stored on my device (e.g., number recently detected cases for which I am responsible that are pending investigation or classification), so I can make decisions based on data that I have collected in the field while offline.	Health service provider Deployed worker Supervisor	Should have

C4: Alternative methods for accessing dashboards and reports

Use Case(s) Impacted	All		
Tool(s) Impacted	Mobile app		
Challenge Description	Field-based users are unable to view and edit dashboards or reports, which are housed online and thus do not adequately review or use data.		
Root Cause(s)	<ul style="list-style-type: none">Users are busy with tasks in the field and do not have time to login to information systems on their computers in the office to review and use data.Users do not have stable internet access to view dashboards or reports online.Data review is not widely practiced as users only focus on data reporting.		
Desired Outcome	User can review data or receive snapshots of preconfigured reports and dashboards through other mechanisms. Users have access to data that can guide immediate decisions or follow-up.		
#	User Stories	Actor(s)	Priority
C4.1	Sharing dashboards through mobile apps: I want to click on a dashboard and share it, triggering my mobile phone to send an image of the dashboard to another person through existing phone apps (e.g., WhatsApp, SMS).	Health service provider Deployed worker Program manager Supervisor Data manager	Should have

C5: System usage analytics

Use Case(s) Impacted	All		
Tool(s) Impacted	Web interface		
Challenge Description	Analytics on technology usage are often unavailable. These analytics are important to monitor performance of both the users and the technology platform as a whole, both of which can be used to inform supervision of users, configuration, and system improvements.		
Root Cause(s)	<ul style="list-style-type: none"> Analytics on usage of technical platforms are often unavailable. Existing user analytics are difficult to access and visualize to inform decision making. 		
Desired Outcome	Analytics on usage of the system are available for decision making on supervision and system improvements.		
#	User Stories	Actor(s)	Priority
C5.1	Analyzing system crash rate: I want to see user analytics on system crash rate to identify how often the user experiences an unexpected system exit.	System administrator	Minimum Viable Product
C5.2	Analyzing system latency: I want to see user analytics on system latency identifying round-trip time from request to response.	System administrator	Should have
C5.3	Analyzing data sync function: I want to see user analytics on data sync frequency for mobile app users to identify time between data entry and data sync for all forms.	System administrator	Must have
C5.4	Analyzing active users: I want to see user analytics on active users, specifically looking at number of unique user sign-ons in a designated length of time (e.g., week, month, quarter).	System administrator	Must have
C5.5	Analyzing error rate: I want to see user analytics on error rates, identifying frequency that users encounter an error. This should be configurable by user and a designated length of time (e.g., week, month, quarter).	System administrator	Should have

C5.6	Analyzing session length: I want to see user analytics on session length, looking at average time between opening and closing of the system as a proxy for how long a user is spending on the system. This should be configurable by user and a designated length of time (e.g., week, month, quarter).	System administrator	Should have
C5.7	Analyzing session intervals: I want to see user analytics on session interval, looking at average length of time between sessions as a proxy for how often users are accessing the system. This should be configurable by user and a designated length of time (e.g., week, month, quarter).	System administrator	Must have
C5.8	Analyzing page and object hits: I want to see user analytics on page and object hits, such as counts of page views per user dashboard tab, counts of messages sent, counts of feedback submitted, counts of interpretations written, counts of clicks on "Run data validation" button. This should be configurable by user and a designated length of time (e.g., week, month, quarter).	System administrator	Should have
C5.9	Analyzing reporting time: I want to see user analytics on reporting time, such as average length of time to complete data entry for any mobile forms. This should be configurable by user and form type (e.g., defining what constitutes a complete form).	System administrator	Should have
C5.10	Analyzing internet data usage: I want to see user analytics on internet data usage per user.	System administrator	Should have
C5.11	Analyzing reporting lag: I want to see user analytics on reporting lag, specifically looking at time between initial event and entry into the system, and time between a program due date and corresponding data entry.	System administrator	Minimum Viable Product
C5.12	Tracking form version: I want to be able to see a list of users and the version of each form they are using, to ensure that all users upgrade to the latest version of a form.	System administrator	Must have

D: Task Management

D1: Creating and assigning tasks

Use Case(s) Impacted	Case Investigation Planning (3.1) Focus Investigation Planning (4.1) Routine and Reactive Intervention Planning (5.1)
Tool(s) Impacted	Mobile app, Web interface, DHIS2
Challenge Description	Task workload cannot readily be created or reassigned, limiting the ability of users or supervisors to monitor task completion or optimize resources.
Root Cause(s)	<ul style="list-style-type: none"> Inability to create and manage tasks across users or organizational units.
Desired Outcomes	<ul style="list-style-type: none"> Users and supervisors can create and share tasks. Supervisors can assign or reassign tasks (including those in progress) to other workers. Task lists are kept up to date and relevant.

#	User Stories	Actor(s)	Priority
D1.1	Creating a task: I want to create a task (e.g., a case investigation, focus investigation, intervention) and specify the details of the task (e.g., owner, task type, linked records, location, due date, notes).	Program manager Supervisor	Must have
D1.2	Creating task rules: I want to set rules for when the system automatically creates and assigns tasks, so I can customize task creation to fit local standard operating procedures. For example: <ul style="list-style-type: none"> Create a task to conduct a case investigation when a new case is detected, and assign it to the person responsible for case investigations at that facility Create a task for records that are missing forms or have forms with incomplete data, and assign it to the person who created the record. 	Program manager System administrator	Must have
D1.3	Reassigning tasks: I want to reassign tasks from one health worker to another (or to myself) to	Program manager Supervisor	Should have

	balance workload between workers.	System administrator	
D1.4	Sharing tasks between users: I want to be able to share data with my team members performing tasks together in close proximity, via web, Bluetooth, or other hardware-to-hardware sharing mechanisms. This will be important to accommodate splitting of households or tasks that may happen ad hoc for certain large-scale activities (e.g., ad hoc splitting households for IRS in a village).	Deployed worker	Could have
D1.5	Setting expiration for tasks: I want to configure tasks to expire after a specific amount of time, depending on the type of task, so that task lists do not continue to include old tasks that are no longer relevant or cannot be completed.	Program manager System administrator	Could have

D2: Viewing tasks

Use Case(s) Impacted	Case Investigation Planning (3.1) Focus Investigation Planning (4.1) Routine and Reactive Intervention Planning (5.1)
Tool(s) Impacted	Mobile app, Web interface, DHIS2
Challenge Description	Tasks may be missed, or data collection forms may only be partially completed, due to variability in where and when tasks involving data collection are conducted (e.g., a case investigation form started at a health facility cannot be completed until a visit to a household is conducted). It is difficult to view these tasks and properly prioritize them in order to maximize coverage and productivity.
Root Cause(s)	<ul style="list-style-type: none"> It can be difficult for a user to identify missing data points that need to be addressed without going through each record. No automatic or manual interface exists for prioritizing tasks based on different data points such as time, distance, or record completion status. High workload increases likelihood that users may skip tasks or some questions on forms.
Desired Outcome	Users can easily see which tasks are outstanding and prioritize tasks.

#	User Stories	Actor(s)	Priority
D2.1	Viewing a list of tasks with due dates: I want to see a list of tasks that I need to perform and when, based on the type of task (e.g., list of case investigations, list of forms with missing data), so I can review and plan for completing these tasks.	Health service provider Deployed worker	Minimum Viable Product
D2.2	Viewing a list of tasks for follow-up in the field: I want to see a list of tasks that need field-based follow-up and when follow-up should be done, so I can plan for logistics for completing these tasks.	Deployed worker	Minimum Viable Product
D2.3	Sorting tasks by preconfigured variables: I want to view a list of tasks that are pending, sortable by preconfigured variables such as task type, due date, and location, so I can prioritize my tasks accordingly.	Health service provider Deployed worker	Must have
D2.4	Viewing all task across organizational units: I	Health service provider	Must have

	want to see a single list of all my tasks (e.g., cases that need follow-up) across all organizational units for which I am responsible (instead of having to select organizational unit first and seeing the tasks that pertain only to that unit), so that I can prioritize how I will manage my tasks.	Deployed worker	
D2.5	Viewing tasks for all workers: I want to view a list of tasks and completion rate for all workers that I supervise, so I can understand workload across workers.	Program manager Supervisor	Must have
D2.6	Viewing geographic distribution of tasks from all workers: I want to see on a map-based interface while online with the locations (e.g., households, communities) that my workers need to visit to complete their tasks, using different colors for tasks and workers, so that I can understand the geographic distribution of tasks.	Program manager Supervisor	Must have

E: Data and App Management

E1: Remote data management

Use Case(s) Impacted	All		
Tool(s) Impacted	Web interface		
Challenge Description	Users do not have the ability to remotely delete or manage data and apps, which can be a security risk.		
Root Cause(s)	<ul style="list-style-type: none">• Limitation of current tools.		
Desired Outcome	System administrators can delete data remotely, encrypt a database, lock apps, or lock records from editing by user or after a predetermined time period.		
#	User Stories	Actor(s)	Priority
E1.1	Encrypting database remotely: I want to delete data remotely or encrypt a database remotely to protect data security.	Data manager System administrator	Minimum Viable Product
E1.2	Locking records: I want to be able to lock individual records (e.g., a specific case record) or types of records (e.g., all focus records) from being viewed or edited by specific users, groups of users, or all users to prevent unauthorized access to data or editing of data.	Data manager System administrator	Must have
E1.3	Locking application: I want to be able to lock a mobile app from being altered or deleted to protect data security.	Data manager System administrator	Minimum Viable Product
E1.4	Tagging data with user and device IDs: I want to assign every user and device used with a unique ID that will allow the data entered by a user on a device to be tracked to that user or device.	Data manager System administrator	Should have

E2: Delete unnecessary data stored on device

Use Case(s) Impacted	All		
Tool(s) Impacted	Mobile app		
Challenge Description	When devices are old and accumulate a lot of events, users would like to delete synced data to improve device performance. They cannot do this while offline because it will log them out.		
Root Cause(s)	<ul style="list-style-type: none">Current system limitations.		
Desired Outcome	Users can delete the unnecessary data stored locally in device memory or cache, without being logged out, to free up storage space.		
#	User Stories	Actor(s)	Priority
E2.1	Deleting the cache without being logged out: I want to free up space on my device by deleting the cache without being logged out, so that I can continue to work in the field if my device runs out of storage space.	Health service provider Deployed worker Supervisor	Must have

E3: Automated sync after interrupted network connection

Use Case(s) Impacted	All		
Tool(s) Impacted	Mobile app		
Challenge Description	Data upload does not automatically complete when network connectivity is interrupted and reestablished during data sync.		
Root Cause(s)	<ul style="list-style-type: none">System limitations.		
Desired Outcome	The app completes the upload of data when network connection is reestablished, without user intervention.		
#	User Stories	Actor(s)	Priority
E3.1	Syncing automatically: I want the system to automatically complete a data upload if network connection is lost and then reestablished, so I do not need to always check that my data is synced or have to sync it again manually.	Health service provider Deployed worker	Critical

E4: Selective sync of data

Use Case(s) Impacted	Passive Case Detection (PCD) and Diagnosis (1.1) Initial Case Investigation and Case Notification (1.2) Case Investigation and Classification (3.2)		
Tool(s) Impacted	Web interface		
Challenge Description	Data security is at risk by syncing all data elements, including personally identifiable information (PII) to levels of the health system where PII is not necessarily needed. PII is often only needed at the facility level to do case follow-up and is not needed for analysis at higher levels.		
Root Cause(s)	<ul style="list-style-type: none">System limitations.		
Desired Outcome	Users should have permission bundles for specific data points that should be synced. Some users should not receive or view data points such as PII.		
#	User Stories	Actor(s)	Priority
E4.1	Selective syncing of data: I want to select which data points will be synced to which users, specifically being able to omit PII from being synced for certain types of users in order to protect patient privacy.	Data manager System administrator	Should have

F: Integrations**F1: Adopting geospatial widget code libraries**

Use Case(s) Impacted	Case Investigation Planning (3.1) Community Case Investigation and Classification (3.2) Focus Investigation Planning (4.1) Focus Investigation and Classification (4.2) Routine and Reactive Intervention Planning (5.1) Routine and Reactive Intervention Execution (5.2)		
Tool(s) Impacted	Mobile app, Geospatial widget		
Challenge Description	The ability to interact with geospatial data through a map-based interface is seldom supported by existing mobile apps. The need for this ability is shared across multiple malaria surveillance use cases.		
Root Cause(s)	<ul style="list-style-type: none"> Mobile app does not natively support a map-based interface to interact with geographic objects or boundaries. 		
Desired Outcomes	<ul style="list-style-type: none"> The mobile app can adopt geospatial widget libraries, scheduled for development by the Digital Solutions for Malaria Elimination Community of Practice, through compilation or reference. 		
#	User Stories	Actor(s)	Priority
F1.1	Adopting widget code libraries into mobile app: The mobile app should have the ability to compile or reference the geospatial widget code libraries with the appropriate permissions by adopting the code libraries into the mobile app code base.	System administrator	Must have
F1.2	Fetching geospatial data from geo-registry: The mobile app should be able to make calls to the geospatial widget to fetch standardized geospatial data (e.g., pulling geographic objects, boundaries, other reference data) from a common geo-registry in a standard format (e.g., OGC WMS, OGC WFS, Vector tiles) when internet connection is available, and store it locally for use within the widget.	System administrator	Must have
F1.3	Establishing links between geospatial data and records: The mobile app should be able to associate unique IDs and other relevant metadata fetched by	System administrator	Should have

	the geospatial widget about geographic objects and boundaries to mobile app records (e.g., cases, foci) stored locally on the device, to establish a link between malaria-specific record data and standardized-format geospatial data.		
F1.4	Passing mobile app and record metadata to widget: The mobile app should be able to pass metadata linked to geographic objects or boundaries (e.g., icon sets, allowable actions or menu options, names to display) from the app to the widget for display and use within the widget.	System administrator	Should have
F1.5	Pushing geospatial data back to geo-registry: The mobile app should be able to make calls to the geospatial widget to push new or updated geospatial data back to the geo-registry in a standard format (e.g., OGC WFS) when internet connection is available, where they will be validated according to the governance processes established for the geo-registry.	System administrator	Must have

F2: Integrating with external systems

Use Case(s) Impacted	All		
Tool(s) Impacted	Web interface, DHIS2		
Challenge Description	<p>Data important to surveillance may be collected, used, or managed by other external systems (e.g., a national ID system, a common geo-registry that contains a master list of health facilities, households, or other data, or laboratory information systems). Integration with these systems is not always straightforward or possible.</p> <p>Additionally, data from mobile systems will need to eventually flow to the national HMIS backend system used by the country (DHIS2) and may need to flow into other systems as well.</p>		
Root Cause(s)	<ul style="list-style-type: none"> System limitations. 		
Desired Outcome	<ul style="list-style-type: none"> The mobile system and DHIS2 should be integrated with other existing external systems that may be used to capture or manage data important to surveillance. The mobile system should be integrated with DHIS2, with all needed data points flowing into DHIS2 for consumption by other users in the surveillance ecosystem. 		
#	User Stories	Actor(s)	Priority
F2.1	Integrating with DHIS2: I need all data collected through mobile tools to flow into DHIS2 so that it can be captured in the national health information system and be used by non-mobile users in the malaria surveillance ecosystem for oversight and analysis (e.g., district offices, central government).	Program manager Data manager System administrator	Critical
F2.2	Accessing DHIS2 data model via API for integration: I want a full export of the entire DHIS2 data model for an instance of DHIS2 via the DHIS2 API so I can understand how various data elements are related to each other. It currently	Data manager System administrator	Must have

	takes numerous individual API requests to fetch metadata from the DHIS2 API and manual effort to understand how data are related to each other, making integration a challenge.		
F2.3	Integrating with common geo-registry: I want to establish an API connection with a common geo-registry to request geospatial data (e.g., geographic objects, geographic boundaries) from master lists in the geo-registry in a standard format (e.g., OGC WMS, OGC WFS, Vector tiles) that can be used in map-based analytics or dashboards in DHIS2 or other web interfaces.	Data manager System administrator	Must have
F2.4	Integration with other Unique Identification (UID) systems: I want to integrate with a national ID system or electronic medical record system and pre-populate patient information based on records from other systems.	Program manager Data manager System administrator	Should have
F2.5	Integration with laboratory systems: I want to integrate with a laboratory information management system to obtain up-to-date test results.	Deployed Field Worker Program manager Data manager System administrator	Could have
F2.6	Integration with interoperability layers: I want to integrate with an interoperability layer (i.e. middleware system) to allow data to be exchanged more broadly with any interoperable system connected to a larger health information system architecture. This may require the adoption of standardized data dictionaries.	Data manager System administrator	Should have

F3: Importing data from or exporting data to external systems

Use Case(s) Impacted	All		
Tool(s) Impacted	Web interface, DHIS2		
Challenge Description	Data important to surveillance may be collected or used by other external systems (e.g., geographic information systems, databases including census data or other relevant survey data or country statistics, or a notification system that receives notifications through SMS or telephone lines). Importing data from or exporting data to external systems is not always straightforward or possible.		
Root Cause(s)	<ul style="list-style-type: none"> System limitations. 		
Desired Outcome	<ul style="list-style-type: none"> System administrators can import data from and export data to other sources and use this data to update records in order to ensure accuracy and completeness. 		
#	User Stories	Actor(s)	Priority
F3.1	Importing vector shapes: I want to be able to import vector shape files into the system to visualize these on the map (e.g., shape files for administrative units, breeding sites, boundaries).	Program manager Data manager System administrator	Minimum Viable Product
F3.2	Importing coordinates: I want to be able to import a list of coordinates of geographic objects (e.g., households, landmarks,) from an .xls or .csv file so I can import legacy data into the system and visualize these on a map.	Program manager Data manager System administrator	Critical
F3.3	Exporting geospatial data: I want to be able to export geospatial data from a selected area on the map in standard formats (shapefile, KML, GeoJSON, and Mb Tiles), so I can review and share this data outside of the tool I am using.	Program manager Data manager System administrator	Must have
F3.4	Importing data from other sources: I want to be able to import data from other sources (telephone hotlines, SMS systems, or Excel sheets) periodically to capture surveillance data that may be stored in	Program manager Data manager System administrator	Must have

	other systems.		
F3.5	Importing data on coverage targets: I want to import data on coverage targets from other sources (e.g., list of target households from household enumeration databases, data on households within geographic boundaries from administrative units) and use these numbers to measure progress towards intervention coverage targets. If these data are not available, coverage targets should allow manual entry by actors with appropriate permission.	Program manager Data manager System administrator	Should have
F3.6	Validating data against imported data: I want to configure the system to perform data validation and duplication checks when I import data from another source, flagging any issues for me to resolve.	Program manager Data manager System administrator	Could have

G: Geospatial Widget

G1: Collection of geographic object data

Use Case(s) Impacted	Case Investigation Planning (3.1) Community Case Investigation and Classification (3.2) Focus Investigation Planning (4.1) Focus Investigation and Classification (4.2) Routine and Reactive Intervention Planning (5.1) Routine and Reactive Intervention Execution (5.2)		
Tool(s) Impacted	All		
Challenge Description	Users are unable to collect or associate data to geographic objects or boundaries independently from collecting geographic coordinates and storing them as data points in program-specific records. This makes it difficult for geographic data to be used more systematically for analysis, planning, and investigation while in the field.		
Root Cause(s)	<ul style="list-style-type: none">• No interactive map interface on app.• Some users are not able to understand or read a map as presented in most apps (e.g., Google maps).		
Desired Outcome	Apps contain digital maps that can easily be created and updated with relevant geographic objects and boundaries.		
#	User Stories	Actor(s)	Priority
G1.1	Creating record of a geographic object with GPS: I want to create a record of the geographic object at my location (e.g., household, community center, breeding site, river, other landmark) using my device's Global Navigation Satellite System (GNSS) receiver (e.g., GPS) and record its geographic coordinates, so this object can be displayed on a map.	Deployed worker	Must have
G1.2	Creating a geographic record without GPS: I want to create a record of a geographic object (e.g., household, community center, other landmark) by tapping or clicking a location on the map, so that I can create records even when I am not at the geographic location of the object (e.g., identifying the location of a malaria case visually based on the proximity to relevant geospatial	Deployed worker	Must have

	features or landmarks such as plantations, villages, or health centers).		
G1.3	Passive recording of route: I want my route to be recorded passively using my device's GNSS receiver while I am in the community conducting an activity (e.g., investigation, intervention) and stored on the device so that this data, along with other data including my start and end time, can be used to analyze and optimize routes to be taken for future activities.	Deployed worker	Should have
G1.4	Downloading geographic objects and reference data: I want to specify a geographic area on the map (e.g., by panning to a location and adjusting the zoom) when I have network connectivity and download all relevant geographic objects for a specified time period (e.g., all cases over and breeding site records updated over the past three years) and reference data (e.g., vector-based map, satellite imagery, other geographical layers), so I have access to this data while in the field and potentially without network connectivity.	Deployed worker	Must have
G1.5	Adding information to a geographic object: I want to add information to a geographic object (e.g., type of object such as household, case, plantation, health center) while creating a record of a geographic object, so that I accurately report the type of object to be displayed on the map, not just the location.	Deployed worker	Must have
G1.6	Opening a menu of actions by clicking on a case on a map: I want to tap on a case displayed on the map and trigger the mobile app to open a menu of actions for that case (e.g., click on a case and view and option to add relationship, add forms), to allow me to view or collect additional data for that case so I can easily ensure I update the right case.	Deployed worker	Must have

G2: Generation and modification of geographic boundaries

Use Case(s) Impacted	Focus Investigation Planning (4.1) Focus Investigation and Classification (4.2)		
Tool(s) Impacted	All		
Challenge Description	Users draw boundaries for foci, breeding sites, and other areas of interest by hand on paper maps, which can be difficult to use in the field and to maintain, analyze, and update regularly.		
Root Cause(s)	<ul style="list-style-type: none"> • Lack of resources or capacity to use mapping tools such as ArcGIS more widely. • Lack of resources to import data collected on paper or in mobile app to desktop-based mapping software such as ArcGIS. 		
Desired Outcomes	<ul style="list-style-type: none"> • Users can generate boundaries on maps automatically via an electronic system to ensure that all previously recorded geographic objects are included and accurately placed on the map. • Users can update maps via mobile app. 		
#	User Stories	Actor(s)	Priority
G2.1	Defining a focus area using administrative units: I want the option to define a focus area to have the same geographic boundary as an administrative unit (e.g., village), so it is easy to establish foci boundaries without drawing them.	Program manager	Minimum Viable Product
G2.2	Drawing and updating geographic boundaries: I want to draw and update the geographic boundaries associated with records (e.g., foci, breeding sites) on a map flexibly, as free-hand-drawn polygons that are not restricted to administrative unit boundaries.	Deployed worker Program manager	Should have
G2.3	Drawing and updating geographic boundaries using GPS: I want to draw and/or update the geographic boundaries associated with records (e.g., foci, breeding sites) by walking around the perimeter of the geographic object, using my device's Global Navigation Satellite System (GNSS) receiver (e.g., GPS) to record its geographic	Deployed worker	Should have

	boundaries.		
G2.4	Splitting polygons: I want to draw a line across a polygon and have it split into two separate polygons (e.g., if it is determined that a focus should be split into two foci for operational reasons), after which I would be prompted to establish new relationships between any records that were associated to the old polygon (e.g., choose to assign cases from old focus to either of the new foci).	Deployed worker Program manager	Should have

G3: Visualization of geographic information

Use Case(s) Impacted	Case Investigation Planning (3.1) Community Case Investigation and Classification (3.2) Focus Investigation Planning (4.1) Focus Investigation and Classification (4.2) Routine and Reactive Intervention Planning (5.1) Routine and Reactive Intervention Execution (5.2)		
Tool(s) Impacted	All		
Challenge Description	Users are unable to view data linked to specific geographic objects (e.g., health facilities, villages, households, cases, breeding sites, foci) on a map.		
Root Cause(s)	<ul style="list-style-type: none"> • No interactive map interface on app. 		
Desired Outcome	Users have access to interactive maps linked to geographic objects and can view and update objects on the map while they are in the field.		
#	User Stories	Actor(s)	Priority
G3.1	View high resolution map: I want to view map imagery at a high enough resolution to identify buildings, households, and other features in order to use the map for navigation purposes while in a community. This means that map imagery at the required resolution must be able to be stored locally on the device.	Deployed worker	Must have
G3.2	Displaying my current location: I want to see my location on a map represented as a colored dot with an indication of the direction I am facing, in order to understand where I am on the map and navigate myself for tasks.	Deployed worker	Should have
G3.3	Displaying data related to all geographic objects: I want to display data related to all geographical objects (e.g., cases, households, breeding sites, landmarks, interventions conducted) on a map in one view, so I have an overview of data within an area (e.g., focus) and I can adequately classify records, plan for investigations and interventions, and navigate the	Deployed worker Program manager	Minimum Viable Product

	area more efficiently while in the field, or incentivize the communities to participate in malaria elimination activities.		
G3.4	Generating and viewing a map with foci boundaries and related data: I want the system to generate a map displaying foci boundaries and cases or other non-case records (e.g., IRS or LLIN intervention campaigns) so I do not have to generate the map manually.	Deployed worker Program manager	Must have
G3.5	Displaying data on select geographic objects on a map: I want to click on an object on the map (e.g., household) and see relevant data about that object (e.g., case investigation data) displayed on the map itself, so I have access to relevant information about a case or focus area when I am in the field or planning for investigations.	Deployed worker Program manager	Must have
G3.6	Displaying geographic objects with styled formatting: I want to display geographic objects in a selected geographic area on the map, represented as different colors and appropriate icons, so I can easily identify the type of geographic objects (e.g., landmarks, households, health facilities, breeding sites).	Deployed worker Program manager	Must have
G3.7	Color-code cases on a map: I want to display cases as different colors based on specified data points associated with the cases (e.g. classification), so I can easily understand the characteristics of cases in a selected geographic area.	Deployed worker Program manager	Must have
G3.8	Filter cases on a map: I want to set filters on a map to display cases based on specified data points associated with the cases (e.g., date investigated, species, treatment).	Deployed worker Program manager	Must have
G3.9	Displaying circle of configurable radius: I want to click a button to display a circle of configurable radius (e.g., 100 m, 1 km) around an object on the map, so that I can plan activities related to geographic proximity (e.g., identifying cases related to an index case, breeding site investigation).	Deployed worker	Could have

G3.10	Displaying relationships between index cases and introduced cases: I want to view the location of all cases in an area, with a visual representation (e.g., arrows, lines) of the relationship between each index case and introduced cases related to each index case.	Deployed worker Program manager	Should have
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H: DHIS2 Enhancements**H1: Improved DHIS2-specific UI**

Use Case(s) Impacted	All		
Tool(s) Impacted	DHIS2		
Challenge Description	Users need to toggle through many forms and go through many clicks to access the data forms they need.		
Root Cause(s)	<ul style="list-style-type: none"> Users do not necessarily know the difference between whether their form is aggregate, event capture, or tracker data and will go between categories to try to find their forms. Users have to click through multiple filters to get to the form that they want. 		
Desired Outcome	Users can quickly find the data form they are looking for so as to reduce the barrier to entry.		
#	User Stories	Actor(s)	Priority
H1.1	Consolidating data entry pages: I want to consolidate the three categories of data entry pages (aggregate, event capture, and tracker) and rename forms to find the form I'm looking for (e.g., to see a drop-down of all forms that can be accessed versus having to toggle between categories to find the form I need).	Program manager Data manager	Critical
H1.2	Reducing clicks to get to data entry pages: I want to reduce the number of clicks it takes to get to the data entry page to reduce the barrier of starting data entry (e.g., improve the organizational unit selection if a user has access to multiple organizational units, add shortcuts that open a form with an organizational unit already selected instead of selecting it from the tree).	Health service provider Deployed worker Program manager Data manager	Minimum Viable Product
H1.3	Accessing DHIS2 app icons: I want to be able to see DHIS2 app icons on the Pivot Table, Visualization, and other DHIS2 app pages, so I can	Program manager Data manager	Critical

	easily select a new DHIS2 app without needing to return to the home page.		
H1.4	Displaying different data elements in web and Android: I want DHIS2 program rules to show different data elements in web from Android, as mobile users sometimes enter additional data points that would not be captured during web data entry (e.g. GPS coordinates of a household which may only be relevant when capturing data on Android app in the field).	Program manager Data manager	Must have
H1.5	Opening links on a new page or tab: I want the default action when I click a link to be opening the link in a new page or tab, so that I can continue to refer to my previous page as needed. For example, when I click on "View in Visualizer App" on a visual on the dashboard, the chart should open in the Visualizer App on a new page or tab.	Program manager Data manager	Minimum Viable Product
H1.6	Renaming DHIS2 terminology: I want to rename key terminology in DHIS2 so it is easier for an end user to understand these terms (e.g., rename "Create relationship" to "Add Related Case" or "Add Breeding Site").	System administrator	Must have

H2: DHIS2 web functionality for low connectivity

Use Case(s) Impacted	All		
Tool(s) Impacted	DHIS2		
Challenge Description	The data entry page takes a long time to load, more than five minutes in some cases. Users get frustrated and do not enter data or enter incorrect or incomplete data.		
Root Cause(s)	<ul style="list-style-type: none"> Poor offline capability in DHIS2, which affects the speed with which data entry pages are loaded when network connectivity is low. Currently, offline functionality exists once you open a form but requires a user to first complete several steps online. Users at the district level do not have enough connectivity to navigate through all those steps, and it takes five to ten minutes to load a form with their current signal strength. 		
Desired Outcome	DHIS2 web interface has improved capability with low connectivity, and data entry can be completed easily even when there is little or no internet connectivity.		
#	User Stories	Actor(s)	Priority
H2.1	Opening DHIS2 in low connectivity: I want to open and navigate to different parts of DHIS2 on the web interface in a timely manner when there is little or no internet connectivity.	Program manager Supervisor Data manager	Must have
H2.2	Entering data in DHIS2 in low connectivity: I want to easily and quickly enter data on the DHIS2 web interface when there is little or no internet connectivity so I can submit timely data.	Program manager Supervisor Data manager	Critical
H2.3	Accessing dashboards in low connectivity: I want to access some elements of the dashboard offline and have the full dashboard be navigable offline after initial loading.	Program manager Supervisor Data manager	Must have

H3: DHIS2 dashboards and visualization functionality

Use Case(s) Impacted	All		
Tool(s) Impacted	DHIS2		
Challenge Description	DHIS2 dashboards are not flexible enough to allow for the analysis and visualization needed by program officers.		
Root Cause(s)	<ul style="list-style-type: none"> • DHIS2 limitations. 		
Desired Outcome	Visuals are displayed using simple and easy-to-understand pictorials that can be interpreted by users.		
#	User Stories	Actor(s)	Priority
H3.1	<p>Creating a trend-line chart: I want to add multiple chart types on the same analytics object (e.g., bar chart with trend line or bar chart with line graph) in order to strengthen analytics. For example, I want to view a trend line for reporting rates over a bar chart for case count, so I can think about how much data I am actually seeing before I draw conclusions.</p>	Program manager Supervisor Data manager	Critical
H3.2	<p>Visualizing events based on program stage completion: I want to be able to visualize a list of events based on program stage completion for an individual case. For example:</p> <ul style="list-style-type: none"> • For each case, I want to be able to see the case notification, registration, and investigation around that case to see how a list of events may relate to each other. • I want to see the individual cases in an event report that have been notified but not yet investigated. 	Program manager Supervisor Data manager	Minimum Viable Product
H3.3	<p>Creating a multi-axis chart: I want to add a second axis to a chart to plot a different dataset on the second axis so I can visualize correlation between two related datasets (e.g., the number of</p>	Program manager Supervisor Data manager	Must have

	RDT kits distributed to facilities by month on first axis, the number malaria cases detected in these facilities by month on second axis).		
H3.4	Visualizing time periods as categories and series: I want to select periods as both categories and series in visualizer, to compare cases per month across several years.	Program manager Supervisor Data manager	Must have

H4: DHIS2 analytics functionality

Use Case(s) Impacted	All		
Tool(s) Impacted	DHIS2		
Challenge Description	DHIS2 analytics are not flexible and simple enough to allow for the analysis needed by program officers.		
Root Cause(s)	<ul style="list-style-type: none"> • DHIS2 limitations. 		
Desired Outcome	Users have user-friendly toolkits to analyze data.		
#	User Stories	Actor(s)	Priority
H4.1	Creating indicators in pivot tables: I want to generate and manage simple calculations and indicators within DHIS2 pivot tables without administrative access so I can do my own data analyses within DHIS2 without relying on the administrator.	Program manager Supervisor Data manager	Must have
H4.2	Time filter for dashboards: I want to filter by time period in order to assess changes over time for data in DHIS2 dashboards.	Program manager Supervisor Data manager	Minimum Viable Product
H4.3	Adding charts with individual filters: I want to add charts to DHIS2 dashboards that have their own individual filters.	Program manager Supervisor Data manager	Must have
H4.4	Linking events affecting data elements and indicators across programs: I want to link event programs so that an event from Program A can change an indicator or data element of Program B. For example, if test and treatment numbers change, I want this to affect stock levels for RDT and artemisinin-based combination therapy stock indicators.	Program manager Supervisor Data manager	Could have
H4.5	Summarizing org unit counts: I want to see a table that summarizes counts of organization units (e.g. health facilities, hospitals, districts) for	Program manager Supervisor Data manager	Must have

	resource assessment in different organizational units.		
H4.6	Viewing indicator data dictionary: I want to view how an indicator is defined when reviewing an indicator on the dashboard or in a pivot table, through an automated data dictionary or other means (e.g., hover text, information button), so I can interpret the indicator easily.	Program manager Supervisor Data manager	Minimum Viable Product
H4.7	Printing indicator data dictionary: I want to be able to print a data dictionary, providing an overview of all data elements and indicator calculations in the system, so I can understand how indicators are generated and the data that is being collected in the system.	Program manager Supervisor Data manager	Minimum Viable Product
H4.8	Viewing data analysis in one place: I want to see the data analysis and visualization web apps in one place, not separated by pivot table (mostly for aggregate), data visualizer (for aggregate), event visualizer (event and tracker data), and event reports (event and tracker data), instead of having to toggle between these.	Program manager Supervisor Data manager	Minimum Viable Product
H4.9	Viewing maps alongside other analysis: I want to see the maps app alongside data visualization and other analysis apps to be able to navigate to any apps analysis using the same method.	Program manager Supervisor Data manager	Should have
H4.10	Animating multiple maps: I want to generate within the same GIS window a set of the same maps for different time periods using the same indicators and organizational unit. For example, I should be able to generate four maps in the same layer showing outbreak spread. Right now, this kind of display is only available through the dashboard and is not flexible.	Program manager Supervisor Data manager	Should have
H4.11	Reporting completeness with changing denominator: I want report completeness to take into account a changing denominator over time. Report completeness is currently calculated as: Number of Reports Submitted/Number of Reporting facilities. Currently, the denominator does not stay static	Program manager Supervisor Data manager	Minimum Viable Product

	for a certain time period and is always using the latest count, so report completeness varies over time. (If number of reporting facilities in Jan 2017 is 50 and reports submitted are 40 we will see an 80% rate in Jan 2017, but in July 2018 we might have 60 reporting facilities, so the reporting rate for Jan 2017 recalculates to 67%).		
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H5: Impact of DHIS2 upgrades and backwards-compatible data schema

Use Case(s) Impacted	All		
Tool(s) Impacted	DHIS2		
Challenge Description	<p>DHIS2 version upgrades break the API and standard reports built using the API. For example:</p> <ul style="list-style-type: none">• Currently, every time a user moves to a new version, some of the API parameters used to make calls or responses change, breaking the web apps.• Users who attempt to export data using event reports from a previous version of DHIS2 into an upgraded version experience problems with the names of the data elements changing. The data element is shown as a code (UID) and not a name, therefore making it difficult to import the data.• Minor version upgrades (e.g., 2.24 to 2.25) result in substantive changes to the API, requiring integrated applications to adjust and incurring additional development cost and release cycles to end users.		
Root Cause(s)	<ul style="list-style-type: none">• DHIS2 does not maintain the links to the APIs and standard reports during version upgrades.• DHIS2 upgrades create conflicting differences in data schemas that make it difficult to map data from an older version schema to a new one.• Undocumented changes sometimes occur in the source code that only reveal themselves in the API through extensive trial and error testing.		
Desired Outcomes	<ul style="list-style-type: none">• Standard reports and APIs work without fail after DHIS2 upgrades.• Users have an easy-to-use interface to update the API (e.g., standard reports), and other dependencies are available after version upgrade.		
#	User Stories	Actor(s)	Priority

H5.1	Improve API versioning and communication: I want to improve the API versioning and communication through Open API so that the user knows what version of the API the system needs to interact with (e.g., the user can specify they want to make a call to the API endpoint as it was in version 2.25).	System administrator	Minimum Viable Product
H5.2	View incompatibilities when applying system updates: I want to see a list of incompatibilities when applying system and API updates to know what to test for and check to prevent data disruptions.	System administrator	Should have