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Regional Malaria Elimination Initiative Colombia

Baseline Measurement (2020)

August 2020

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Acronyms

BMGF - Bill & Melinda Gates Foundation
CAPI - Computer-assisted personal interview
CHAI - Clinton Health Access Initiative
COMISCA - Council of Ministers of Central America and the Dominican Republic
CSF - Carlos Slim Foundation
DTI-R - Detection, Diagnosis, Treatment, Investigation, and Response
EMR - Electronic medical record
ETV - *Enfermedades Transmitidas por Vectores* (Vector-borne diseases)
ICD - International Classification of Diseases
IDB - Inter-American Development Bank
IHME - Institute for Health Metrics and Evaluation
IRS - Indoor residual spraying
ITN - Long-lasting insecticide-treated nets
LQAS - Lot Quality Assurance Sampling
MRR - Medical record review
PAHO - Pan American Health Organization
RBA - Results-based aid
RDT - Rapid diagnostic test
RIPS - *Registro Individual de Prestación de Servicios de Salud*
RMEI - Regional Malaria Elimination Initiative
SIVIGILA - *Sistema Nacional de Vigilancia en Salud Pública* (National public health surveillance system)
TBF - Thick blood film
UI - *Unidad Informadora* (Informing Unit)
UND - Department or District notification unit
UNM - Municipality notification unit
UPGD - *Unidad Primaria Generadora de Datos* (Primary Data Generating Units)

Executive summary

Introduction

The Regional Malaria Elimination Initiative (RMEI) is a regional public-private partnership administered by the Inter-American Development Bank (IDB) seeking to accelerate progress toward malaria elimination in Mesoamerica, the Dominican Republic, and Colombia. The Initiative focuses its resources on integrating evidence-based interventions aimed at reducing to zero the number of malaria cases in participating countries. The Institute for Health Metrics and Evaluation (IHME) is the independent external evaluator for the Initiative.

RMEI baseline measurement

The RMEI baseline measurement was designed to measure the status of key indicators to capture performance along the trajectory of the “Detection, Diagnosis, Treatment, Investigation, and Response (DTI-R)” management strategy. These include the supply of inputs for diagnosis and treatment, the proportion of suspected cases tested for malaria, the timeliness of detection and treatment of confirmed cases, the frequency and quality of reporting of cases and laboratory production, and the coverage of vector control interventions carried out in households at risk of infection.

IHME designed survey instruments based on the Initiative indicator manual and findings from the fact-finding visit to distinct points of the health system in Colombia, with input from the Ministry of Health. The measurement included a health facility survey consisting of interview, observation, and records review components and a Lot Quality Assurance Sampled (LQAS) household survey in the catchment area of selected health facilities. The health facility survey sample was selected among eligible primary care facilities in malaria focus areas of Colombia. Secondary care facilities (hospitals) and department/ district ETV units associated with selected primary care facilities in the public health service network were included in the sample to capture inter-facility pipelines for patient care (e.g., referrals), malaria diagnosis (e.g., thick blood film slides sent away for diagnosis by facilities without a laboratory), and notification and surveillance.

Data collection completed for the Colombia baseline measurement is summarized in Table E1. The information sought as a part of the measurement varied by facility type.

Table E1: Colombia data collection summary

Point of data collection	Number completed	Measurement completed
Primary care health facilities with malaria microscopy or RDT and private laboratories	36	Health facility questionnaire and observation
		Medical record review of suspected cases of malaria (not applicable for private labs as they do not store medical records)
		Record review of confirmed cases of malaria
		Treatment stock
		Laboratory supplies/reports
		Household measurement in catchment area
Hospitals	5	Health facility questionnaire and observation
		Medical record review of suspected cases of malaria
		Record review of confirmed cases of malaria
		Treatment stock
		Laboratory supplies/reports

Point of data collection	Number completed	Measurement completed
Suspected malaria cases reviewed	*264*	
Department/ district office of Enfermedades Transmitidas por Vectores (ETV)	3	Aggregate case and laboratory production reporting
		Record review of confirmed cases of malaria
		Stock of treatment and diagnostic supplies
Confirmed malaria cases reviewed	*103*	
Department/ district reference laboratory	2	Laboratory supplies and reporting
		Laboratory certification and quality control
Communities	24	Coverage of vector control interventions
		Fever cases with malaria test
		Treatment of confirmed malaria cases
Households interviewed	*646*	

Summary of results

Malaria prevention

In order to protect the populations most at risk of malaria infection, the public health system in Colombia conducts vector control interventions such as the distribution of long-lasting insecticide-treated mosquito nets (ITNs) and the application of insecticide to interior walls of dwellings through indoor residual spraying (IRS). These activities may be carried out as part of an intervention plan based on the risk of transmission in a given zone, or in response to a recent malaria case or outbreak. Coverage of vector control interventions was measured in the LQAS survey. The interview respondent in each household was asked whether the interior walls of the home were sprayed with insecticide to protect against mosquitoes during the year prior to the day of the survey. Respondents were also asked how many treated and untreated mosquito nets their household owned. In the case they owned nets, interviewers recorded a detailed roster of which household member slept under each net the previous night. Individuals were considered to be protected when IRS had been applied to their home in the last year or when they slept under an ITN the night before the survey. Household members who did not sleep in the home the night before the survey and visitors to the household the night before the survey were excluded from the calculation. Table E2 shows intervention coverage according to the expectation in each community.

Table E2: Individuals protected by vector control measures (IRS or ITN), LQAS survey

Vector control reported	Communities	Used treated net	House sprayed
Nets	4	31.4%	1.8%
Spray	4	24.9%	6.3%
Both	2	48.2%	13%
None	14	26.4%	20%

Detection of malaria cases

In order to detect and treat malaria, facilities must have certain basic supplies and equipment on hand. During the health facility observation, survey personnel sought to observe each of these basic inputs according to the facility type. Equipment was checked to see if it was functioning. Stock of laboratory reagents and malaria medications was reviewed for the three months prior to the date of the survey to check for stockouts. Table E3 shows the results for each category of supplies for eligible facilities.

Table E3: Stock of inputs for malaria service provision, health facility observation

	N	n	%	95% CI
Antimalarial medications	42	4	9.5	(3 - 23)
Sampling and biosafety equipment	42	25	59.5	(44 - 74)
Sample submission forms	42	23	54.8	(39 - 69)
Rapid diagnostic tests (RDTs) for onsite testing	10	6	60	(29 - 85)
Microscopy equipment	23	15	65.2	(43 - 82)
Equipment for staining and testing	23	17	73.9	(52 - 88)
Reagents for staining	23	8	34.8	(18 - 57)
Units with all required equipment and medications	**43**	**2**	**4.7**	**(1 - 18)**

The measurement sought to estimate the proportion of suspected malaria cases receiving a test from two different sources: the community survey and the medical record review in health facilities that provide primary care services. During the household interview, respondents were asked if each member of the household had experienced a fever in the two weeks prior to the survey. Each individual reporting a fever was asked about the presence of concurrent respiratory, urinary, and skin symptoms that suggest the fever was caused by a condition other than malaria infection. Respondents reporting these symptoms were not considered to meet the case definition for suspected malaria and were excluded from the indicator calculation. Respondents meeting the case definition were asked if they received a blood test from any medical provider during the illness. Those reporting a blood draw were considered to have received a malaria test.

The medical record review provides a comparable indicator of passive case detection as measured in health facilities. A sample of attentions for patients presenting with fever or other eligible diagnoses was drawn from registries from the calendar year 2018. Survey personnel sought to observe all records available in the facility for each selected attention, such as medical charts, attention sheets, and laboratory records, and extracted information related to the illness episode. Cases that did not meet the suspected case definition for malaria because they had one of a list of exclusion diagnoses presumed to cause the fever were excluded from the calculation. Cases meeting the suspected case definition for malaria were checked for any evidence that a malaria test, whether rapid diagnostic test (RDT) or thick blood film (TBF), was ordered or carried out. Many health facilities that were expected to have medical records for suspected case review did not store medical records on site or did not have a method to sample fever cases, so significantly fewer medical records for suspected malaria cases were encountered in primary care facilities than expected.

The results of both case detection indicators are shown in Table E4.

Table E4: Suspected malaria cases with test, LQAS survey and medical record review

	N	n	%	95% CI
Fevers with any blood sample (LQAS survey)	144	68	47.2	(31 - 64)
Suspected case with malaria test (medical record review)	254	98	38.6	(33 - 45)

Diagnosis of malaria cases

The RMEI baseline measurement also included a review of confirmed cases of malaria based on the case notification and investigation forms available at primary care units, secondary care units, and department/ district ETV units. Physical copies of confirmed case reports were only found at three facilities in the sample, so significantly fewer confirmed cases were collected than expected based on Colombia Ministry of Health surveillance data from 2018. The indicator for timely diagnosis of malaria compares the date of initiation of fever or other symptoms with the date of diagnosis (if the patient received both an RDT and a TBF, the indicator was calculated using the earlier diagnosis date) as shown in Table E5. Cases with diagnosis two days or less after symptom initiation are considered to have timely

diagnosis. Cases with fever/symptom initiation date or diagnosis date not registered are not considered to have timely treatment initiation.

Table E5: Diagnosis within two days, Confirmed case review

	N	n	%	95% CI
Cases diagnosed within 48 hours of onset	100	21	21	(14 - 30)
3 days	100	14	14	(8 - 22)
4-5 days	100	25	25	(17 - 35)
6-7 days	100	7	7	(3 - 14)
Over 7 days	100	8	8	(4 - 15)
Indicator result: Cases diagnosed within 48 hours of onset*	100	21	21	(14 - 30)

*Three cases excluded due to suspected inscription/data entry error (<-7 day or >30 day window)

Treatment of malaria cases

The review of confirmed malaria cases also captured all available information about malaria treatment administered to patients from case notification forms or treatment logs. The indicator for timely treatment of malaria compares the date of diagnosis (if the patient received both an RDT and a TBF, the indicator is calculated using the earlier diagnosis date) with the date of treatment initiation (Table E6). Cases for which the first dose of the treatment corresponding to the malaria diagnosis was given one day or less after diagnosis are considered to have timely treatment initiation. Cases with diagnosis date, treatment initiation date, or *Plasmodium* species not registered are not considered to have timely treatment initiation.

Table E6: Treatment within one day, Confirmed case review

	N	n	%	95% CI
Correct treatment administered for species	103	91	88.3	(80 - 93)
First dose treatment within 24 hours of diagnosis*	102	72	70.6	(61 - 79)
Correct treatment administered within 24 hours of diagnosis*	102	64	62.7	(53 - 72)

*One case excluded due to suspected inscription/data entry error (<-7 day or >30 day window)

Malaria reporting and surveillance

The RMEI health facility survey included a review of malaria case and laboratory production reports and laboratory quality control reports from the year 2018 to measure adherence of each facility to reporting and quality control standards as defined through the Initiative. Field personnel conducted an audit of all malaria case reports from 2018 stored at primary and secondary level facilities in the sample. They then sought to observe all 12 monthly reports or all 52 weekly reports for the year 2018. Next, surveyors sought to find the reports corresponding to a randomly selected month (or 4 weeks), and captured detailed information from this report, such as the number of malaria cases reported (or whether zero cases were reported) and the date sent or received as listed on the report (or as listed in a logbook of official correspondence sent and received in facilities that use such a book). An analogous process was completed for laboratory production reports and reports of the indirect quality control (slide cross-checking) exercise in facilities with microscopic diagnostic capacity. A report of the 2018 annual direct quality control (slide panel) exercise with feedback from the reference laboratory was also sought in each facility with malaria microscopy, and a report of external microscopy certification from the Pan American Health Organization (PAHO) was sought in the department/ district reference laboratories. The external microscopy certification from PAHO was observed at the department reference laboratory in Chocó for the year 2018.

The results for reports from the year 2018 complete with quality standards are shown in Table E8.

Table E8: Reporting for malaria surveillance and diagnosis quality control, health facility observation

	N	n	%	95% CI
Malaria case reporting to standard	23	0	0	(-)
Laboratory production reporting to standard	23	4	17.4	(6 - 39)
Facilities passing direct quality control (DQC) component	22	7	31.8	(16 - 54)
Facilities passing indirect quality control (IDQC) component	22	1	4.5	(1 - 28)

Key findings

The results of the Colombia baseline measurement suggest several opportunities for RMEI to strengthen practices on the trajectory to malaria elimination. First, even when activities like treatment of malaria patients or laboratory quality control are conducted to standard, a sufficient record of the activity carried out is not always maintained at the relevant health facility, which complicates measurement of performance and timeliness. Enhancing record keeping will thus lead to improved results that better reflect high-quality work carried out on the ground. Electronic systems have improved information availability, but in order to be effective, these systems must account for the strengths and weaknesses of existing paper-based systems.

The measurement found evidence of local and regional variation in practices for malaria detection and notification. While different strategies may be necessary in zones with different levels of malaria transmission or risk, it is important to ensure a shared understanding of goals and adherence to standard at the local level when such standards have been established. Furthermore, this understanding of the strategy and the role of each contributor must extend beyond the malaria and vector control programs and diagnosis networks to include primary health care providers who play an increasingly important role in detection and management of cases as Colombia draws closer to malaria elimination.

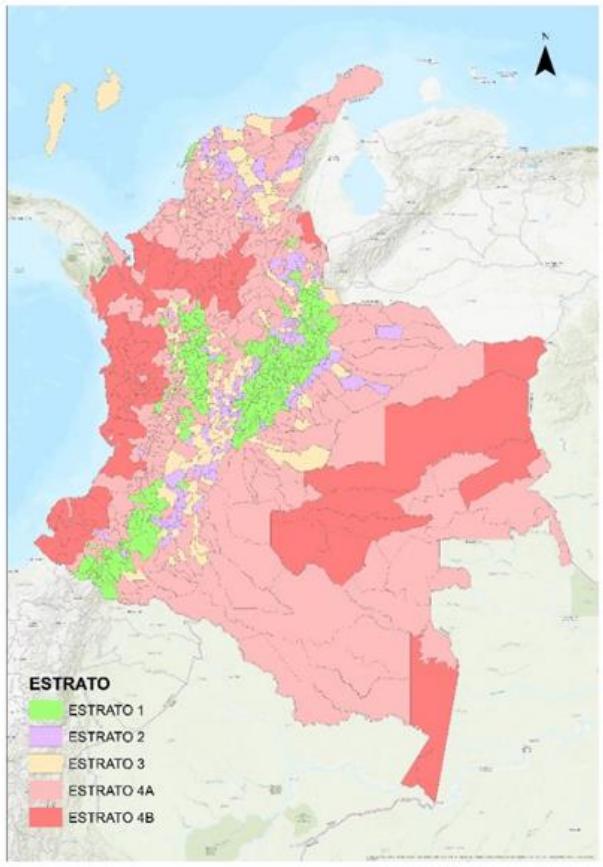
Chapter 1: Introduction

1.1 Overview

The Regional Malaria Elimination Initiative (RMEI) is a regional public-private partnership administered by the Inter-American Development Bank (IDB) seeking to accelerate progress toward malaria elimination in Mesoamerica, the Dominican Republic, and Colombia. One of its defining features is the application of a results-based aid (RBA) model that relies on performance measurement and enhanced transparency and accountability. The Initiative focuses its resources on integrating evidence-based interventions aimed at reducing to zero the number of malaria cases in participating countries. RMEI is funded by the Bill & Melinda Gates Foundation (BMGF), the Global Fund to Fight AIDS, Tuberculosis and Malaria, the Carlos Slim Foundation (CSF) and each of the participating country governments. The Initiative is implemented in close coordination with the Pan American Health Organization (PAHO), the Council of Ministers of Central America and the Dominican Republic (COMISCA), the Project Mesoamerica, the Clinton Health Access Initiative (CHAI), and other regional partners. The Institute for Health Metrics and Evaluation (IHME) is the independent external evaluator.

Interventions aim to build on the malaria control and elimination activities ongoing for several decades in Colombia, and harness partnerships with PAHO, CHAI, and the Global Fund. RMEI's approach seeks to eliminate malaria in humans, the main reservoir of the parasite, through surveillance and "Detection, Diagnosis, Treatment, Investigation, and Response (DTI-R)" interventions. A hallmark intervention of the Initiative, as many countries in the region enter the elimination phase of their malaria programs, was to carry out micro-stratification of geographic areas vulnerable and receptive to malaria transmission. In Colombia, active, residual, and inactive foci were defined, and each municipality was assigned to a stratum 1 through 5, as seen in Figure 1.1. This exercise was completed prior to the baseline measurement and served as a basis for defining the study area and selecting the sample. Municipalities will be redefined with updated stratum classification in subsequent points in the Initiative as their level of importation risk and number of autochthonous cases evolves. The malaria program in Colombia carries out household-level vector control interventions such as indoor residual spraying (IRS) and distribution of long-lasting insecticide-treated nets (ITNs) which are to be expanded and monitored as a part of the Initiative. Other interventions focus on providing training, disseminating standards for clinical care, improving record-keeping with medical providers in the study area, and improving surveillance capacity by reviewing existing practices, expanding use of digital information systems, and standardizing reporting for case detection.

Figure 1.1: Colombia malaria stratification: national



Stratum 1: Non-receptive
Stratum 2: Receptive, no autochthonous cases, no risk of importation
Stratum 3: Receptive, risk of importation, no autochthonous cases
Stratum 4 (4A): Receptive, presence of autochthonous cases
Stratum 5 (4B): Receptive, presence of autochthonous cases

Map prepared by RMEI-Colombia operations team.
Sources: Esri, Garmin, Intermap, increment P Corp., GEBCO, USGS, NPS, RCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong). © OpenStreetMap contributors, and the GIS User Community

After national stratification was completed, 12 municipalities were selected to participate in the Initiative. Table 1.1 shows the municipalities selected and their assigned stratum. The stratum definitions and distributions within the selected Initiative municipalities can be seen in Table 1.2.

Table 1.1: Colombia malaria stratification: Initiative municipalities

Department/ District	Municipality	Stratum
Buenaventura	Buenaventura	5
Chocó	Acandí	4
	Atrato	5
	Bagado	5
	Jurado	4
	Lloró	5
	Medio Atrato	5
	Quibdó	5
	Río Quito	5
	Riosucio	5
	Unguía	4
Nariño	Tumaco	5

Table 1.2: Colombia malaria stratification: Definition and distribution of strata within the RMEI study area

Stratum	Number of municipalities	Definition
1	0	Non-receptive
2	0	Receptive, no autochthonous cases, no risk of importation
3	0	Receptive, risk of importation, no autochthonous cases
4	3	Receptive, presence of autochthonous cases
5	9	Receptive, presence of autochthonous cases

According to Colombia national public health surveillance (SIVIGILA) data provided by the Ministry of Health, malaria cases declined from 2010 until 2014, but have increased since 2015. Though transmission persists in several regions, case increase is largely due to increased transmission along the western coast of the country. In 2018, the reference year for the baseline measurement, SIVIGILA data shows that Colombia had 62,398 confirmed cases of malaria and the RMEI study region had 11,267 confirmed cases of malaria. Colombia has historically depended on a vertically integrated malaria program that operates in close coordination with programs for other vector-transmitted diseases. Malaria detection and case management activities, however, are closely horizontally integrated within the public and private primary care systems in Colombia, an important advantage for the country while transitioning to the malaria elimination phase, when strategy increasingly relies on passive detection of cases at health facilities and treatment and follow-up care provided through the primary care system.

1.2 Components of the RMEI baseline measurement

The objective of the RMEI baseline measurement is to compile a detailed picture of malaria health services in each participating country, including information about readiness to eliminate malaria through the support of the Initiative. The measurement is designed around a set of indicators that participating countries and implementation partners negotiate as part of RMEI to capture performance along the trajectory of the DTI-R management strategy. These include the supply of inputs for diagnosis and treatment, the proportion of suspected cases tested for malaria, the timeliness of detection and treatment of confirmed cases, the frequency and quality of reporting of cases and laboratory production, and the coverage of vector control interventions carried out in households at risk of infection. Indicators for Colombia are listed in full in Appendices A and B. Subsequent measurement rounds will assess whether countries are reaching the indicator targets set through the Initiative and evaluate the results of specific interventions.

The baseline measurement includes a health facility survey (interview and observation), a review of medical records for suspected and confirmed cases of malaria, and a household survey conducted in communities served by health facilities in the sample. This report summarizes the data and findings of the RMEI baseline measurement conducted by IHME.

The health facility survey involves the following components:

- an interview with the administrator of the facility about the services provided there (general facility characteristics, infrastructure, and human resource composition, supply logistics, infection control, and provision of services related to malaria diagnosis and treatment),
- an observation of supplies, equipment, and pharmaceutical stock present in the facility,
- an observation of laboratory supplies and equipment, laboratory production and case notification reports in facilities with malaria diagnostic capacity,
- a review of medical records of suspected malaria cases (case definition detailed in Chapter 6),
- a review of paper case notification forms for confirmed malaria cases.

The facility survey, observation, and record review is designed to collect information on facility preparedness for detecting and treating malaria cases, as well as the quantity and quality of malaria care services provided in the baseline time period. Importantly, health facility data collection captures changes

produced by interventions at the level of the health services access point, which may foretell changes in population health outcomes.

The household survey is designed to collect information on malaria detection, prevention practices, and knowledge in malaria focus areas of Colombia from a randomly selected group of households in each surveyed community. Respondents are asked questions about their background, dwelling conditions, knowledge and use of behaviors to prevent malaria, illness and care-seeking history, and other questions that will be helpful to policy makers and administrators in controlling and seeking to eliminate malaria. Community data collection permits the observation of health status, knowledge of malaria, access to health care, and uptake of interventions and practices that prevent malaria infection.

1.3 Fact-finding and data collection scope

In order to refine the survey instruments and prepare for sample selection and data collection, IHME and IDB conducted a joint multi-day fact-finding visit in three regions of Colombia in July 2019. During the exploratory visit, the team visited a range of health facilities and microscopy posts in endemic and non-endemic areas. The goal of the visit was to learn:

- the local practices for detection and treatment of malaria
- the structure of the health system for malaria care
- the procedures for case notification and channels for data reporting
- the nature of community and prevention activities
- the sources of subnational variation in systems or service provision.

The trip also helped to define sampling methodology and framed expectations about measurement challenges for each indicator, insufficient data availability, and potential gaps in systems and procedures that must be addressed in order to meet Initiative targets and to reach malaria elimination.

The set of indicators defined and negotiated for the baseline measurement necessitates data collection at several distinct points of the health system. The findings from the fact-finding visit determined the points of service visited to measure the indicators, the sources of information reviewed at each unit, and the sample size dedicated to each type of unit. In Colombia, the sample includes primary care facilities, microscopy posts, private laboratories, hospitals, department/ district administrative units, and department/ district reference laboratories. Private laboratories provide testing services, but do not provide other healthcare services or keep medical records, so patients are referred to other health facilities if testing indicates the patient requires care. A point of care critical to systems of malaria detection and treatment in Colombia is the microscopy post (*"puesto de microscopia"*). These posts are staffed by *microscopistas* who provide fever screening and malaria testing via microscopy and RDTs, as well as lead information campaigns, out of their own homes or around their communities. *Microscopistas* can be volunteers, public employees for the Ministry of Health, or private staff providing testing services for a small fee. Larger health posts may be associated with hospitals where they request malaria treatment and send records or reports, but most microscopy posts refer positive malaria cases to the closest health facility where the patient can receive treatment. These posts, which provide care to rural communities without access to health facilities, and private laboratories were included in the baseline Colombia measurement and were selected as a primary care facility.

The measurement includes public and private primary care facilities and hospitals, but excludes police and military health facilities. Households within the catchment area of primary care facilities selected to the sample were interviewed for the community survey. Table 1.3 shows the information collected at each point.

Table 1.3: Points of data collection for baseline measurement

Type of health unit	Information collected
Ambulatory health facilities with malaria microscopy or RDT and private laboratories	Health facility questionnaire and observation
	Medical record review of suspected cases of malaria (not applicable for private labs as they do not store medical records)
	Record review of confirmed cases of malaria
	Treatment stock
	Laboratory supplies/reports
	Household measurement in catchment area
Hospitals	Health facility questionnaire and observation
	Medical record review of suspected cases of malaria
	Record review of confirmed cases of malaria
	Treatment stock
	Laboratory supplies/reports
Department/ district office of Enfermedades Transmitidas por Vectores (ETV)	Aggregate case and laboratory production reporting
	Record review of confirmed cases of malaria
	Treatment stock
Department/ district reference laboratory	Laboratory supplies and reporting
	Laboratory certification and quality control
Households	Coverage of vector control interventions
	Fever cases with malaria test
	Treatment of confirmed malaria cases

Chapter 2: Survey Methodology

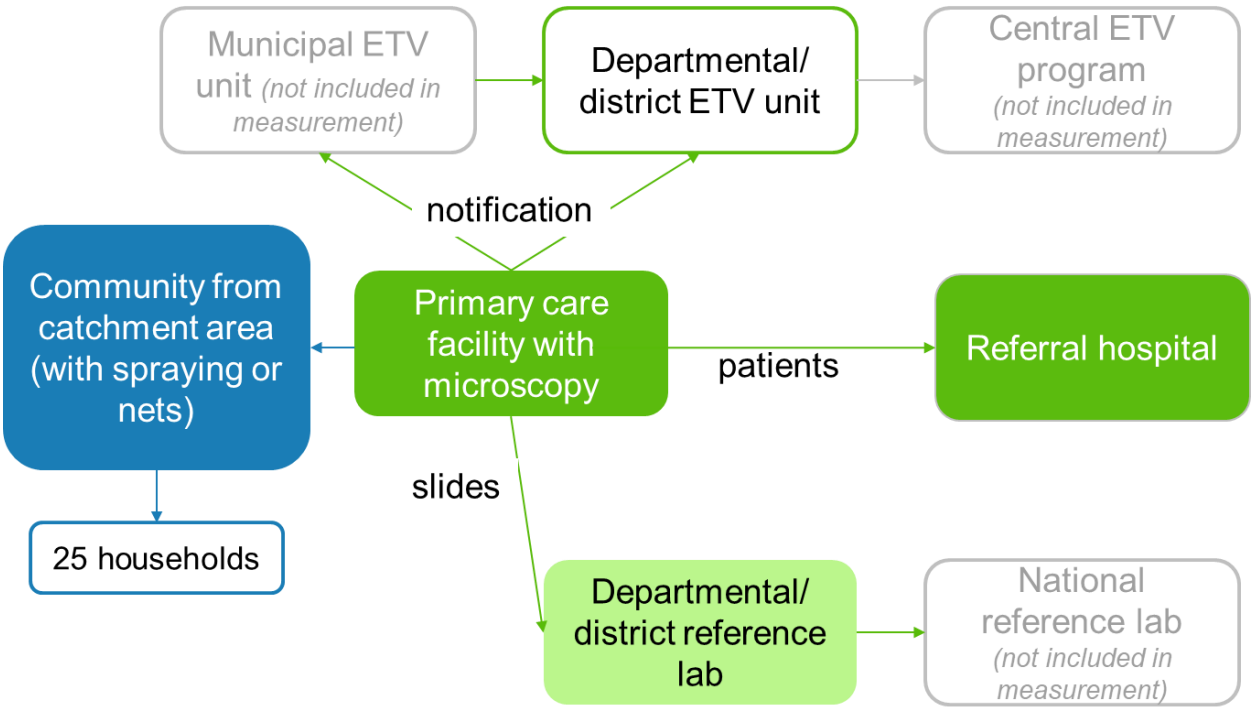
2.1 Sample selection and description

The RMEI baseline measurement aims to measure performance of the health system in zones that play an important role in malaria prevention, detection, and treatment. Since malaria activities are more intensive in endemic and vulnerable areas, the sample is targeted towards presenting representative estimates for the focus area identified for interventions through the Initiative. In Colombia, the RMEI study area is made up of 12 municipalities in the departments of Chocó and Nariño and the district of Buenaventura (see municipalities in Table 1.1). These three regions are located on the western coast of Colombia and combined have thousands of cases of malaria each year.

Since the Initiative aims to eliminate malaria in Mesoamerica, Northern Colombia, and the Dominican Republic, its success depends on reducing the burden in zones with high malaria transmission. We expect to return to some of these zones in future measurement rounds to monitor changes in practice. In Colombia, the sample is made up of facilities and communities in malaria strata 4 and 5 (with current malaria transmission).

The set of indicators defined and negotiated for the baseline measurement necessitates data collection at several distinct points of the health system. To draw the sample, we selected a primary care facility (*"puesto de microscopia," "laboratorio privado," "puesto de salud,"* and *"centro de salud"*) at random as the primary sampling unit, and then selected the other health services linked with it in malaria service provision, such as hospitals, reference laboratories, and administrative units responsible for notification and reporting, as depicted in Figure 2.1. In Colombia, the sample includes public and private primary care facilities and hospitals, but excludes police and military health facilities. The communities selected for the household survey are within the catchment areas of the selected primary care facilities.

Figure 2.1: RMEI-Colombia baseline health system structure



2.1.1 Health facility sample selection

In Colombia, malaria stratification was completed at the municipality level. Public and private primary care facilities in the municipalities targeted for RMEI were eligible to enter the sampling frame, with priority to facilities serving communities with vector control measures (ITN distribution or IRS) implemented. All eligible facilities in the facility lists provided by the Colombia Ministry of Health had diagnostic capacity by malaria microscopy or rapid diagnostic tests (RDTs), so the sample was selected without any stratification.

The sampling frame was built based on referral networks and facility lists provided by the Colombia Ministry of Health. Each health facility eligible to be selected for the sample was assigned based on its municipality to a malaria stratum 4 or 5 (stratum classification based on the number of malaria cases reported in the past three years). Each administrative unit (*"sede departmental/distrital de Enfermedades Transmitidas por Vectores (ETV)"*) was assigned to the maximum stratum found in its service area, which was stratum 5 in all three cases.

The initial sampling frame for the health facility survey is the list of facilities that provide primary care services for malaria and have diagnostic capacity (microscopy or RDT). In order to ensure necessary information is captured for all indicators, for each selected facility we included the ancillary units from the reporting chain (department/ district ETV units, department/ district reference labs, and referral hospitals) with certainty. For example, once a local-level ambulatory facility was selected at random, several related units were identified for inclusion. These include the hospital to which it refers severe malaria cases, the reference laboratory responsible for its microscopy quality control, and the department/ district ETV unit responsible for vector control interventions in the area. More detail on sample selection procedures and sample size considerations is in Appendix C. This sample selection strategy minimizes the need for sample stratification while maximizing the opportunity to track care and surveillance activities from the point of service to the central level, and thus to identify gaps in malaria service provision and surveillance.

2.1.2 Interruptions during data collection

Prior to the start of data collection, we were informed of a strike of employees of all public health units in Quibdó, Chocó. This strike continued throughout the data collection period. The field team working in the region completed interviews at private health units in the sample, which were not affected by the strike, as well as at some public units. Data collection at other selected public units was deferred while awaiting the end of the strike, which was not resolved before data collection was suspended. This affected the composition of types of units completed in the Quibdó region.

Due to the spread of 2019-nCov (Covid-19) through Colombia during baseline data collection and nationally implemented interventions to prevent further spread of the disease, data collection was suspended before all health facilities and communities in the sample were surveyed. The first intervention implemented by the Ministry of Health was a travel restriction to ethnic and indigenous communities on March 16, 2020, so the field team was unable to travel to rural health units that served these communities. A week later on March 20, the Colombia Ministry of Health implemented a national quarantine that halted all data collection for the baseline measurement.

Three municipalities in the sample were in stratum 4, but were not completed due to the early conclusion of data collection. These municipalities were all remote and near the Panama border, so they were reserved until the end of data collection. Without these communities, the sample represents stratum 5 alone.

The planned health facility sample and units that were completed are shown in Table 2.1. Only 46 health facilities were visited before suspension of data collection due to Covid-19. Three ETV units and two reference laboratories were visited, but data collection was not completed there and follow-up visits were pending when field activities had to be suspended. One health facility that was recorded as a private primary care unit in the Ministry of Health documentation was determined to be a private hospital during data collection.

Table 2.1: Health facility sample: planned and completed

Type of unit	Number planned	Number surveyed
Primary care facility with diagnostic capabilities (microscopy/ RDT)	32 public	24 public[1]
	14 private	12 private[2]
Hospital	8 public	4 public[3]
	0 private	1 private[4]
Department/ district ETV	3	3[5]
Department/ district reference laboratory	3	2[6]
Total	**60**	**46**

[1]Five public primary level facilities were partially completed when data collection was suspended.
[2]Four private primary level facilities were partially completed when data collection was suspended.
[3]Two public hospitals were partially completed when data collection was suspended.
[4]One private hospital was partially completed when data collection was suspended.
[5]Two ETV units were partially completed when data collection was suspended.
[6]Two reference labs were partially completed when data collection was suspended.

2.1.3 Substitutions within the health facility sample

We kept all remaining units in the sampling frame after the initial selection as backup facilities in case sampled facilities cannot be interviewed due to security or logistic concerns. When replacement is required, we replace with a facility of the same level, with the same diagnostic capacity, and within the same municipality or a neighboring municipality when possible. If substitutes are not available in the same municipality, we replace with a randomly selected facility from the same malaria stratum.

During the training, the Ministry of Health representatives reviewed the original facility list used for the sample and informed us of multiple units that had closed since we were provided the sampling documentation. One of those units was in the sample and was replaced. Seven other units were replaced during data collection when the field team discovered they were not functioning. For one non-functioning unit in Chocó, the replacement was provided after the field team had completed the Lot Quality Assurance Sampling (LQAS) survey in the associated community. In order to match community data to a completed facility, the community survey was also carried out in the catchment area of the replacement facility. Data from both communities were used in analyses.

In total, four health units were replaced due to security concerns. Two rural facilities in Lloró, Chocó were replaced after ETV personnel down-river informed the team that the river they needed to travel was patrolled by armed groups. All of the rural health units in this municipality were accessed along the same river, so replacements for these units were provided in neighboring municipalities. Two rural units in Buenaventura were replaced for separate security reasons. One primary unit was only accessible by boat and was unsafe due to patrolling armed groups. The other unit was a hospital, which was in a community with multiple recent attacks on visitors and security personnel. There was no hospital in this region to use as a replacement, so a primary level facility was selected as a replacement. Also in Buenaventura, one facility that was labeled as a private primary level facility in Ministry of Health documentation was discovered by the field team to operate as a hospital, so despite one hospital being replaced with a primary level facility in Buenaventura, there was no change in total number of hospitals in the sample due to this reclassification.

As discussed in the previous section, “Interruptions during data collection”, there were many events that affected completion of data collection in the facilities selected to the original sample. One unit in Quibdó, Chocó was affected by both the strike in public facilities and a travel restriction to ethnic and indigenous communities that was implemented due to Covid-19. This rural and difficult to access health unit was replaced after the travel restriction was implemented but before data collection was curtailed.

Two facilities selected as replacements in Chocó needed to be substituted a second time. One facility was not functioning and one facility was unsafe due to armed groups. These two units are not included in Table 2.2, which shows the reason replacements were provided for the original sample.

Table 2.2: Replacements to the health facility sample

Department/ district	Reason for replacement	Number of units
Buenaventura	Security concerns	2
	Non-functioning unit	1
Chocó	Security concerns	2
	Non-functioning unit	4
	Unable to access	1
Nariño	Non-functioning unit	3
Total		**13**

2.1.4 Community and household sample selection

One community was selected for the LQAS household survey from the catchment area of each of the 32 primary care facilities selected to the facility sample. Health facilities were first selected to have associated LQAS surveys based on known vector control interventions according to documentation provided by the Ministry of Health. If any communities in the catchment area had received vector control interventions, a community was selected at random among those with interventions. If no communities received interventions or the intervention status of all communities was unknown, a community in the catchment area was selected at random. As a part of the sample, field staff were provided a random starting point and a skip interval for systematic selection of households calculated based on the number of households or population within the community (according to documentation provided by the Ministry of Health).

Along with the selected community, two backup communities were provided for each primary care facility selected for the LQAS survey. These replacements were only to be used in cases when the selected community was inaccessible or there were security concerns. Twenty-four communities were visited for LQAS data collection prior to the early termination of data collection due to Covid-19 (seen in Table 2.3), of which seven were replaced with a backup community due to security or logistical concerns. Up to four additional communities have complete data, but it is unknown whether the households represent the first selected community or a field substitution because of the suspension of data collection.

Twenty-five households in each surveyed community were selected systematically for the interview using field random sampling techniques. The random sampling unit was the dwelling, and all households living in a selected dwelling were eligible for the survey. The interview was responded by the head of household or another adult member of the household knowledgeable about household characteristics. Absent and refused households were replaced with a randomly selected alternate household. Revisits to selected households are not part of the LQAS survey protocol; any selected household that could not be completed the day of the survey was replaced with an alternate.

The LQAS household sample included 32 communities throughout the two departments and one district included in the Initiative. Due to the spread of Covid-19 and subsequent halt to data collection due to national quarantine in Colombia, not all of the communities in the sample were completed during the baseline measurement. Table 2.3 shows the number of communities planned in the sample and completed or partially completed by department. The visit results among selected and replacement households are shown in Table 2.4.

Table 2.3: Community surveys planned and visited

Department/ District	# communities planned	# communities visited
Buenanventura	3	3[1]
Chocó	21	13[2]
Nariño	8	8
Total	**32**	**24**

[1]One community in Buenaventura had fewer than 25 completed households submitted.
[2]Three communities in Chocó had fewer than 25 completed households submitted.

Table 2.4: Result in households selected for survey, unweighted proportions

	N	n	%	95% CI
Status of selected and replacement households				
Complete	646	591	91.5	(89 - 93)
Members absent	646	36	5.6	(4 - 8)
Unoccupied dwelling	646	10	1.5	(1 - 3)
Refused	646	9	1.4	(1 - 3)

2.1.5 Confirmed case record review sample selection

For confirmed cases of malaria, the sample was designed to include review of confirmed cases from 2018 in health facilities registered as UPGD (*"Unidad Primaria Generadora de Datos"*), hospitals, and department/ district ETV units. Field staff collected information from all documents available at the unit, including case notification forms, lab records, and treatment follow-up forms. Table 2.5 shows the estimated number of cases expected at each department/ district in the sample (based on counts of cases by facility in the malaria surveillance data provided to IHME by Ministry of Health), the quota of cases budgeted (allocated proportional to the total number of cases in each department/ district), and the number of case reviews completed during data collection. Since data collection was nearly two-thirds complete when suspended, the number of reviews completed fell far short of the expectation due to problems with availability of the records in selected facilities. It is also important to note that not only did the number of reviews fall short of the expectations overall, but no paper records were found at the rural facilities visited. The only confirmed cases found were from urban units.

Table 2.5: Confirmed case collection

Department/ District	Confirmed cases according to stratification documentation	Confirmed cases quota	Confirmed cases captured during collection
Buenanventura	1113	21	25
Chocó	7992	670	77
Nariño	2162	209	1
Total	**11267**	**900**	**103**

It was anticipated that collection of confirmed case information would be dependent on the facility type and access to SIVIGILA (*"Sistema Nacional de Vigilancia en Salud Pública"*), the Colombia national public health surveillance system. UI (*"Unidad Informadora"*) facilities do not store records or report to the SIVIGILA system, so they send their confirmed case notification forms to an associated facility for electronic data entry. The budgeted quota of confirmed cases was allocated among UPGD facilities (classified according to facility lists received from the Ministry of Health) selected to the sample only to increase the likelihood of meeting the quota (since UI facilities were not expected to store confirmed case paperwork). Despite this precaution, 18 facilities that were marked as UPGD did not store confirmed case reports on site and did not have access to electronic databases. Eight other facilities did not have records adequate for review of confirmed cases due to lack of malaria diagnosis on-site and inaccessibility, destruction, or lack of completion of confirmed case reports. Two health facilities without confirmed case review were pending revisit when data collection was suspended due to Covid-19.

Early in data collection, it was discovered that malaria case notification forms from that year in Buenaventura were not available on paper. Since it was expected that no confirmed cases would be collected in Buenaventura, the quota of confirmed cases was increased for eligible facilities in Chocó and Nariño. Table 2.6 shows the counts of health facilities where review of confirmed cases of malaria was completed. More detail on issues experienced during confirmed case collection is in Appendix C.

Table 2.6: Health facilities with confirmed case collection

	#
Heath facilities planned to complete record review for confirmed cases of malaria	39
Health facilities visited with assigned confirmed record review quota	29
Records reviewed: Quota met	1
Records reviewed: Quota not met	2
No records reviewed	26*

*Two health facilities without confirmed case review were pending revisit when data collection was suspended due to Covid-19.

2.1.6 Suspected case medical record review sample selection

For suspected cases of malaria (fever and other complaints and diagnoses meeting the case definition), a random sample of eligible attentions from 2018 was selected for medical record review (MRR). The total budgeted quota of record reviews was divided equally among the primary care facilities and hospitals selected to the sample.

Eligible attentions were identified in-facility using attention registries and/or the electronic insurance database RIPS (*"Registro Individual de Prestación de Servicios de Salud"*). The sample was selected for full review using a systematic manual sampling technique as detailed in Appendix C. Field staff collected information from all documents available at the health facility, including daily attention registries, medical records or attention forms, and lab records. Table 2.7 shows the total number of suspected cases reviewed (254), the number of cases selected based on diagnosis or principal complaint but found to be ineligible based on final diagnosis (13), and the cases selected and requested at facilities for which no paperwork could be located for review (11).

Table 2.7: Suspected case collection

	#
Total suspected cases selected for review	278
Suspected cases selected but could not be located for review	11
All suspected cases screened for eligibility	267
Ineligible suspected cases discarded	13
Eligible suspected cases collected	254

It was expected that many UI units would not have medical records and other documentation on-site to complete MRR for suspected cases of malaria. Also, private laboratories are UPGD facilities and report confirmed cases of malaria, but only perform testing and do not store medical records, so it was expected that no medical records would be found at these facilities. Despite these expectations, UI facilities and private laboratories were given the same quota as UPGD facilities for suspected cases of malaria on the possibility that a fever log or other documentation might be available to review. Also, early in data collection, it was discovered that due to a software change and malfunction during 2018 in Buenaventura, medical records from that year in Buenaventura were not available electronically. Therefore, only paper records could be reviewed in Buenaventura. Table 2.8 shows the counts of health facilities where MRR for suspected cases of malaria was completed.

As shown in Table 2.8, 35 facilities were expected to complete suspected case review, but 31 of those facilities could not meet the quota of suspected cases of malaria. Field personnel were unable to review any suspected case records in 24 facilities. Eight health facilities had no registries that could be used for systematic manual sampling of records from 2018 (neither physical logbook nor electronic database), so in these facilities, a convenience sample of 45 records was selected and reviewed for eligibility. Using this method of sampling, only three of the eight facilities had any cases eligible for review. Seventeen facilities did not store medical records (physical nor electronic) on-site, so no medical record review was possible. In four facilities, the field team reviewed all eligible records from the year 2018, but the total of eligible cases found was below the quota. Finally, one facility stored records from 2018, but they were

inaccessible on the day of the survey. Two health facilities without suspected case review were pending revisit when data collection was suspended due to Covid-19.

Table 2.8: Health facilities with suspected case collection

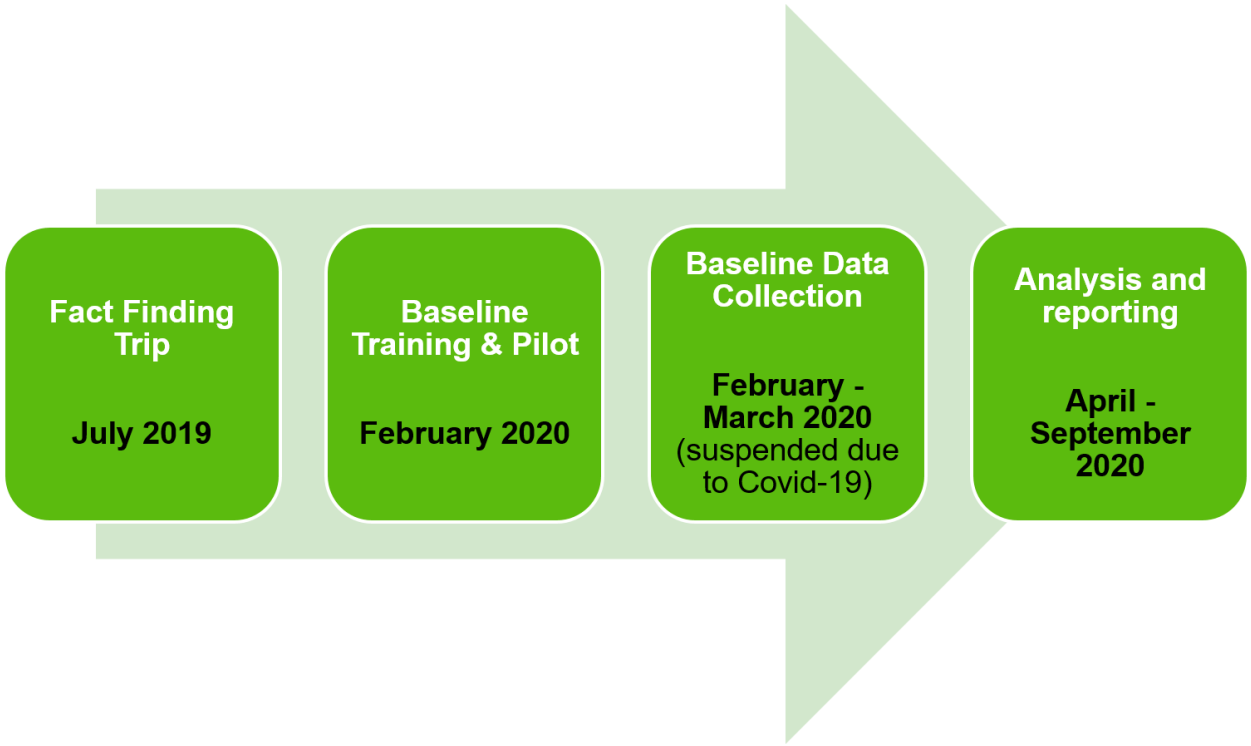
	#
Heath facilities planned to complete MRR for suspected cases of malaria	53
Health facilities visited with assigned suspected MRR quota	35
Records reviewed: Quota met	4
Records reviewed: Quota not met	7
No records reviewed	24*

*Two health facilities without suspected case review were pending revisit when data collection was suspended due to Covid-19.

2.2 Survey implementation

In Colombia, baseline data was collected in February and March 2020. Data collection was halted due to country-wide intervention measures implemented by the government to combat Covid-19. The timeline of baseline measurement activities is shown in Figure 2.2.

Figure 2.2: RMEI-Colombia baseline timeline



2.2.1 Data collection instruments

Questionnaires were initially developed in English, and then translated to Spanish. To best reflect the issues most relevant to the region under study and the local language, we revised the Spanish-language questionnaires following input from key stakeholders and at the conclusion of the pilot studies (described below). Study areas included a substantial proportion of indigenous populations, many of them also Spanish speakers. In order to allow the participation of non-Spanish speakers in the survey, the data collection team was prepared to contract local interpreters proficient in Portuguese, Criollo/ kriol, Awá pit, Chamí, Catío, Emberá, Epéra pedée, Nasa yuwe, Pasto/ Castellano, and Wounaan as required. In the baseline, 1% of interviews were conducted in Emberá and 0.8% were conducted in Emberá and Spanish.

All surveys were conducted using a computer-assisted personal interview (CAPI), programmed using SurveyCTO and installed onto tablets. CAPI supports skip patterns, inter-question answer consistency, and data entry ranges. CAPI reduces survey time by prompting only relevant questions, maintains a logical answering pattern across different questions, decreases data entry errors, and permits rapid data verification remotely. Field team leaders monitored the implementation of the survey and reported feedback. Data collection using CAPI allowed data to be transferred instantaneously once a survey was completed via a secure link to IHME. IHME monitored collected data on a continuous basis and provided feedback. Suggestions, surveyor feedback, and any modifications were incorporated into the survey instruments and readily transmitted to the field.

2.2.2 Survey content

The health facility survey includes several modules. An interview with the facility director records information about facility characteristics, services provided, and personnel employed by the facility. Observation modules are organized by room or category to facilitate visits to the rooms where care is provided to patients, the pharmacy, the laboratory, and other areas.

The MRR Module is a format for capturing the data recorded in a patient's medical chart, including from the clinical provider's notes or from malaria testing or notification forms that may be stored with or apart from the record. The MRR is not an interview, but a data collection method where the surveyor reviews the record and transfers the relevant information into the digital form. The questionnaire is filled out once per medical record selected to the sample of suspected malaria cases or to the sample of confirmed malaria cases. The Quotas Module is used to capture information about the manual sample selection process in each facility.

The households selected to the LQAS survey sample are visited and interviewed using a Household Questionnaire. The Household Questionnaire includes a listing of basic demographic information for household members, and collects information on housing characteristics such as type of water source, sanitation facilities, quality of flooring, ownership of durable goods, and ownership and use of mosquito nets. The household questionnaire records knowledge and practices for malaria prevention, as well as history of recent illness for all members of the household. The LQAS survey also includes a summary module filled once per community that includes GPS coordinates of the community (GPS waypoints are not collected at the household level to protect respondent confidentiality) and totals of households visited and surveyed.

2.2.3 Training and supervision of data collectors

IHME led training sessions and pilot surveys in health facilities and households in Colombia between February 24 and February 29, 2020. The local agency contracted for data collection in Colombia, Grupo iDIES, Fundación Universidad del Valle/ Consult Exp S.A, hired eight healthcare professionals and four field supervisors who we trained to conduct surveys in households and health facilities and to review medical records. The training included content of each survey, proper conduct of the survey, in-depth review of the instrument, and hands-on training on the CAPI software, as well as interview practice among participants. Surveyors participated in a two-day pilot where they applied the health facility questionnaire, conducted observation exercises, and practiced medical record sampling and review for suspected and confirmed cases of malaria, as well as household sample selection and interviews. Representatives from IHME, IDB, and the Colombia Ministry of Health provided oversight during pilot exercises. IHME and Grupo iDIES, Fundación Universidad del Valle/ Consult Exp S.A held debriefing and re-training sessions with surveyors post-pilot and provided continued training during the first week of data collection in communities and health facilities. Grupo iDIES, Fundación Universidad del Valle/ Consult Exp S.A continued providing retraining throughout data collection to maintain homogeneity and quality standards of the data collection teams over time. Over the launch of data collection from March 2-6, 2020, an IHME staff member observed active household and health facility data collection and provided feedback to data collectors.

2.2.4 Data analysis and report writing

IHME conducted data analysis using STATA versions 14 and 15 and R versions 3 and 4. This report provides data summaries for the baseline measurement in health facilities and households in Colombia. The estimates from the household surveys are weighted by the inverse probability of selection (see details in Appendix C) and account for clustering in variance calculations, except where explicitly noted otherwise. IHME calculated RMEI indicators in accordance with the Indicator Manual provided by IDB and previously negotiated with the Colombia Ministry of Health.

2.2.5 Ethical considerations

The study received authorization from by the Colombia Ministry of Health to conduct data collection in health facilities and by local authorities to collect data in communities. The study was approved, receiving non-human subjects research determination by the Institutional Review Board of the University of Washington given that no personally identifiable information was collected as a part of any of the survey modules. All respondents to the household survey, and the senior responsible staff member at participating health facilities, signed informed consent forms prior to data collection. Signed consent forms were collected and managed by Grupo iDIES, Fundación Universidad del Valle/ Consult Exp S.A, the in-country data collection partner and this information was not transmitted to IHME for privacy reasons

Chapter 3: Malaria Knowledge, Attitudes, and Practices in Household Survey

This chapter provides a descriptive summary of basic demographic, socioeconomic, and environmental characteristics, as well as knowledge and behaviors for malaria prevention, of the households interviewed for the RMEI-Colombia baseline LQAS Survey in households. As noted in Chapter 2, the household measurement in Colombia was conducted entirely in malaria stratum 5. All estimates reported in this chapter are weighted by the inverse probability of selection (see details in Appendix C) and account for clustering in variance calculations, except where otherwise noted. For this reason, many proportions reported are not equal to the ratio of numerator to denominator.

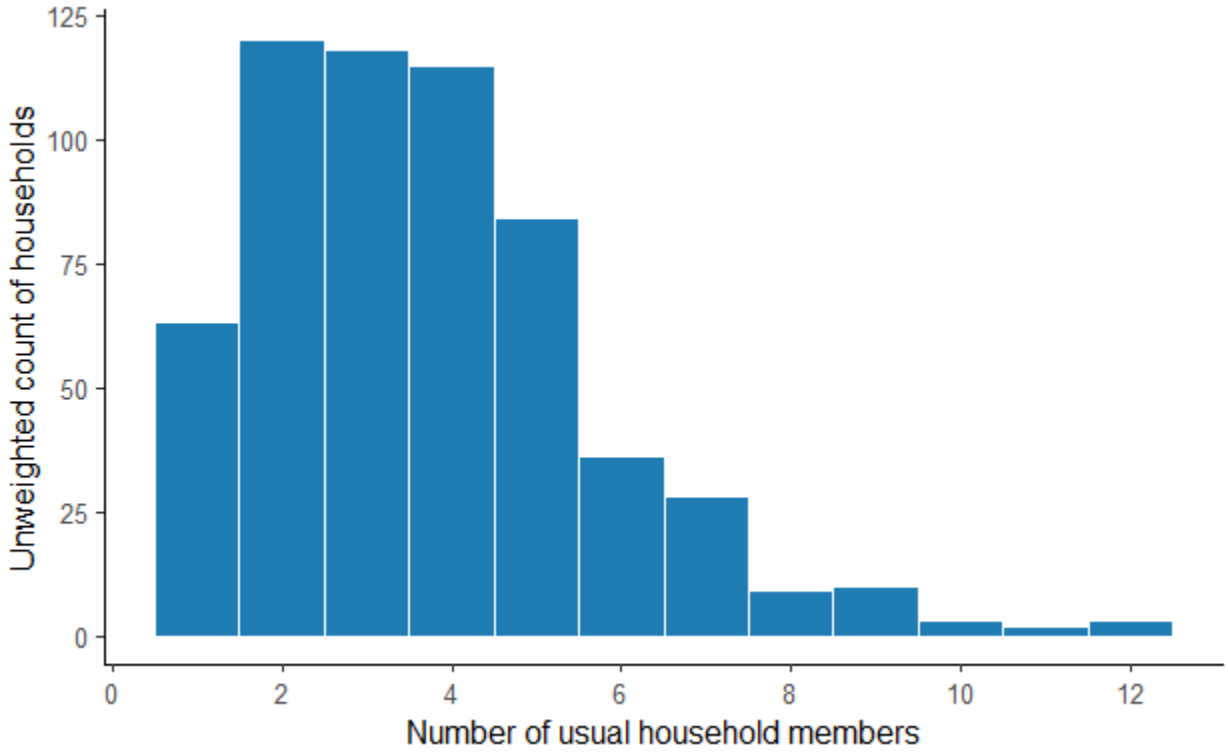
3.1 Characteristics of participating households

This section includes results for composition of surveyed households, physical characteristics of dwellings they inhabit, household assets, and proximity to health facilities.

3.1.1 Household composition and household member characteristics

A total of 591 households in the Colombia baseline survey completed the interview. The unweighted distribution of the number of members by household is shown in Figure 3.1. The survey sample for Colombia has a median household size of 3 and an unweighted average household size of 3.7.

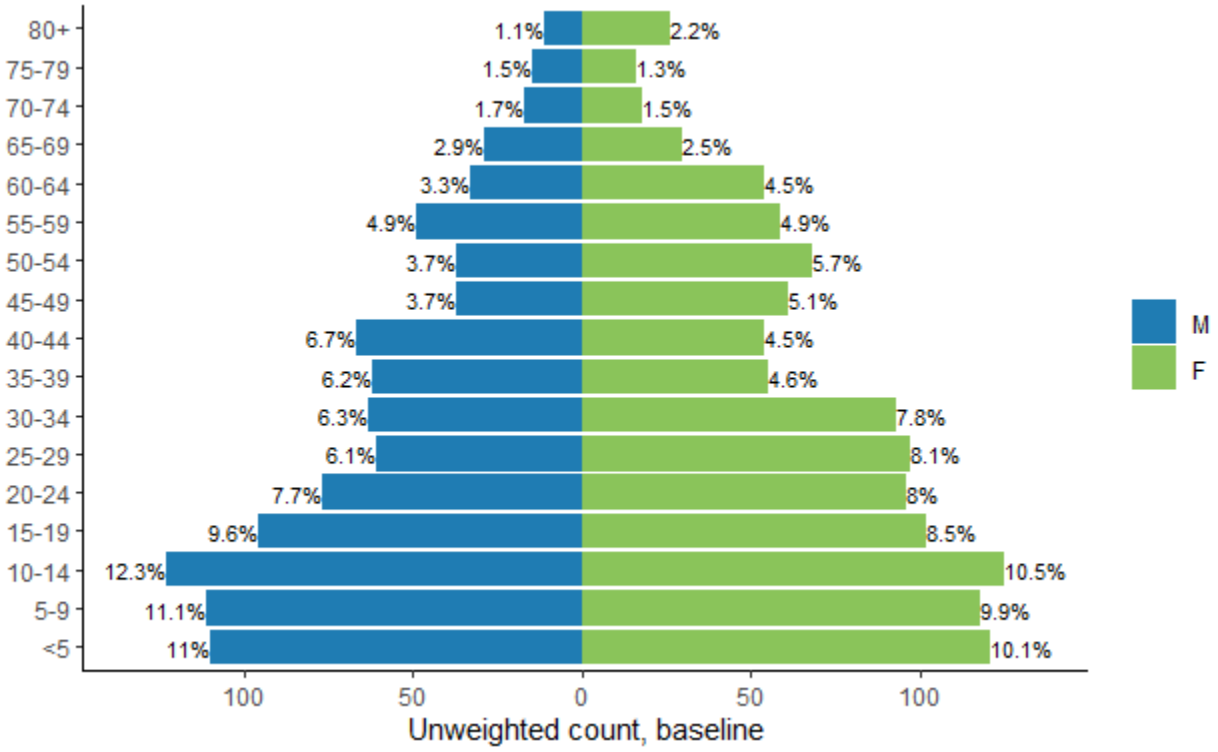
Figure 3.1: Household size, unweighted percent distribution



The unweighted distribution of the de facto household population in the surveyed households in Colombia by five-year age groups and by sex is shown in Figure 3.2. Colombia has a larger proportion of its population in the younger age groups than in the older age groups. Figure 3.2 indicates that in the baseline, 32% of the population in the baseline is under age 15 years, more than half (60%) of the

population is in the economically productive age range (15-64), and the remaining 8% is age 65 and above.

Figure 3.2: Age and sex of household sample, unweighted percent distribution of usual members by 5-year age groups



The respondent was asked to indicate education level, languages spoken, and ethnic identity for all usual household members aged 15 or older. Respondents could indicate multiple languages spoken or ethnic identities. The results are shown in Table 3.1, Table 3.2, and Table 3.3 respectively. In Colombia, 8% of household members had no formal schooling, and 27.9% completed only primary education. One-hundred percent speak Spanish and 1% speak Emberá. Ninety percent identify as ethnically Afrocolombiano.

Table 3.1: Education of household members age 15 and older

	N	n	%	95% CI
Education level of household members age 15 and older				
No schooling or pre-school only	1483	134	8	(6 - 10)
Primary	1483	494	27.9	(23 - 33)
Secondary	1483	740	55.2	(52 - 58)
University	1483	91	7.3	(5 - 12)
Specialty	1483	6	0.5	(0 - 3)
Masters	1483	2	0.1	(0 - 0)
Don't know	1483	16	1	(0 - 2)

Table 3.2: Languages spoken by household members age 15 and older

	N	n	%	95% CI
Languages spoken by household members age 15 and older				
Spanish	1483	1451	99.5	(98 - 100)
Emberá	1483	52	1	(0 - 3)
English	1483	6	0.1	(0 - 1)
Catío	1483	1	0	(-)

Table 3.3: Indigeneity of household members age 15 and older

	N	n	%	95% CI
Indigenous group affiliation of household members age 15 and older				
Afrocolombiano	1483	1277	90.1	(84 - 94)
None	1483	144	8.4	(5 - 14)
Emberá / Chocó	1483	5	0.1	(0 - 0)
Awá	1483	1	0	(-)
Other	1483	9	0.4	(0 - 2)
Don't know	1483	1	0.2	(0 - 1)

3.1.2 Dwelling characteristics

The quality of building materials used in houses is related to malaria protection for those living within. Dwellings that offer more protection have no slits or gaps where mosquitoes can enter, glassed or screened-in windows, and closed eaves. Field personnel observed building materials as a part of the survey. In Colombia, as seen in Table 3.4, Table 3.5, and Table 3.6, most homes are built with walls of cement block, sheet metal (zinc/alucin) roofs, and cement sheet/board floors.

Table 3.4: Exterior wall material as observed

	N	n	%	95% CI
Main material of exterior walls of dwelling				
Cement block	591	181	33.7	(20 - 51)
Plywood	591	238	27.6	(17 - 41)
Polished wood	591	88	19.1	(10 - 34)
Brick/covered adobe	591	47	12.7	(7 - 21)
Stone with lime/cement	591	10	2	(1 - 7)
Prefabricated material	591	7	2	(0 - 9)
Uncovered adobe	591	4	1.3	(0 - 4)
Cardboard/waste material	591	1	0.4	(0 - 3)
No walls	591	3	0.1	(0 - 0)
Palm/bamboo	591	4	0.1	(0 - 1)
Quarry stone	591	2	0	(-)
Other	591	6	1.1	(0 - 3)

Table 3.5: Roofing material as observed

	N	n	%	95% CI
Main material of roof of dwelling				
Sheet metal (zinc/Alucin)	591	443	68.6	(52 - 81)
Cement fiber/asbestos sheet	591	46	11.3	(6 - 21)
Concrete	591	46	9.4	(5 - 16)
Wood planks	591	30	5.7	(3 - 11)
Clay tile	591	6	2.2	(0 - 14)

	N	n	%	95% CI
Cement tile	591	8	0.8	(0 - 5)
Thatch/palm leaf/cane	591	5	0.1	(0 - 1)
Other	591	7	1.9	(1 - 6)

Table 3.6: Flooring material as observed

	N	n	%	95% CI
Main material of floor of dwelling				
Cement sheet/board	591	235	55.5	(35 - 74)
Parquet or polished wood	591	86	17.6	(7 - 37)
Wood planks	591	156	14	(8 - 24)
Ceramic tiles	591	52	7.8	(5 - 13)
Cement brick or tile	591	30	2.6	(1 - 9)
Earth/sand	591	15	1.7	(0 - 6)
Mud brick	591	1	0.4	(0 - 3)
"Embarrada"	591	5	0.2	(0 - 2)
Granite/stone	591	1	0	(-)
Other	591	10	0.2	(0 - 2)

Many houses (69.1%) have open roof eaves. Most have no glass in windows (55.7%), screens in windows (95.7%), nor screens in doors (99.5%).

Table 3.7: Open or closed roof eave as observed

	N	n	%	95% CI
Open gap between wall and roof eave	588	433	69.1	(54 - 81)

Table 3.8: Glass in windows as observed

	N	n	%	95% CI
Do windows have glass panes?				
None	591	385	55.7	(43 - 68)
Yes, in all windows	591	139	33	(20 - 49)
Yes, but only in some windows	591	40	7.9	(5 - 12)
There are no windows in the house	591	27	3.4	(1 - 8)

Table 3.9: Screens in windows as observed

	N	n	%	95% CI
Do windows have screens?				
None	591	560	95.7	(91 - 98)
There are no windows in the house	591	22	2.5	(1 - 7)
Yes, in all windows	591	5	1.2	(0 - 4)
Yes, but only in some windows	591	4	0.6	(0 - 2)

Table 3.10: Screens in doors as observed

	N	n	%	95% CI
Do doors have screens?				
None	591	583	99.5	(98 - 100)
Yes, but only in some doors	591	8	0.5	(0 - 2)

Aedes mosquitoes, which spread arboviruses like dengue, zika, and chikungunya, breed in small deposits of water like puddles, flowerpots, and old tires. *Anopheles* mosquitoes, which spread malaria, breed in

water bodies like lagoons, rivers, and canals. After the interview, field personnel observed the surroundings of each surveyed dwelling for potential breeding areas. Table 3.11 shows that while 43.9% of homes had clean surroundings without standing water on the day of the survey, 7.3% had natural water bodies within or bordering the yard.

Table 3.11: Maintenance of dwelling surroundings as observed

	N	n	%	95% CI
Status of yard/surroundings of dwelling				
Clean, no trash or standing water	591	236	43.9	(33 - 55)
Yes, puddles	591	154	28.1	(18 - 40)
Trash, tires, or other refuse present, but no standing water	591	189	19.7	(10 - 36)
Yes, water collected in trash, tires, or other small containers	591	33	8.3	(5 - 14)
Yes, pond or other natural water body	591	75	7.3	(3 - 15)
Other	591	14	2.1	(1 - 5)

Table 3.12 shows the principal water source of the household as reported by the respondent; 46% of households depend on rainwater and 33.4% of households have water piped to their house. The most common type of sanitation facility is a pour flush toilet (68.1% of households), as seen in Table 3.13.

Table 3.12: Principal water source

	N	n	%	95% CI
Main source of drinking water				
Rainwater	591	321	46	(25 - 68)
Piped into dwelling	591	135	33.4	(14 - 60)
Surface water (river/dam/lake/pond/stream/canal/irrigation channel)	591	65	9.6	(4 - 23)
Protected dug well	591	22	4.4	(2 - 11)
Tube well or borehole	591	15	2.3	(1 - 6)
Unprotected dug well	591	12	1.2	(0 - 4)
Piped to yard/plot	591	2	0.8	(0 - 5)
Bottled water	591	4	0.8	(0 - 3)
Unprotected spring	591	10	0.7	(0 - 4)
Tanker truck	591	1	0.4	(0 - 3)
Protected spring	591	2	0	(-)
Other	591	2	0.4	(0 - 2)

Table 3.13: Type of sanitation facility used

	N	n	%	95% CI
Type of toilet used				
Pour flush toilet	591	338	68.1	(60 - 75)
Flush toilet	591	126	21.6	(14 - 32)
No facility/bush/field	591	114	7.2	(4 - 12)
Pit latrine	591	3	1.1	(0 - 3)
Other	591	10	2	(1 - 5)

Each respondent was asked which fuels they usually use for cooking (some households use more than one fuel type), and the results are shown in Table 3.14. Most households do their cooking in the house (Table 3.15).

Table 3.14: Cooking fuel source

	N	n	%	95% CI
Principal cooking fuel				
Gas tank	591	483	89.9	(85 - 94)
Wood	591	160	14.1	(8 - 25)
Electricity	591	51	7	(4 - 12)
No food cooked in household	591	7	1.9	(1 - 4)
Charcoal	591	3	0.8	(0 - 3)
Straw/shrubs/grass	591	0	0	(-)
Agricultural crop	591	0	0	(-)
Other	591	0	0	(-)

Table 3.15: Cooking location

	N	n	%	95% CI
Where cooking is done				
In the house	584	542	96.2	(93 - 98)
Outdoors	584	23	2.7	(1 - 6)
In a separate building	584	17	1.1	(0 - 3)
Other	584	2	0	(-)

3.1.3 Household wealth

Ownership of farmland and livestock, along with possession of durable consumer goods, indicate a household's socioeconomic status. Respondents were asked how many of each listed item the household (or household members) possessed. Table 3.16 and Table 3.17 show the proportion of households with at least one of each item. Many households (98.6%) have electricity. Of the 102 households that own livestock, most own poultry (78.2% of households, as in Table 3.17). Table 3.18 shows the proportion of households with agricultural land.

Table 3.16: Household assets

	N	n	%	95% CI
Electricity	590	564	98.6	(96 - 99)
Radio	591	148	24.7	(19 - 31)
Sound system	591	225	43.2	(36 - 51)
Television	591	471	84.6	(78 - 90)
Home telephone	591	8	1.5	(0 - 4)
Mobile phone	591	498	89.7	(85 - 93)
Refrigerator	591	423	80	(72 - 86)
Washing machine	591	316	54.7	(43 - 66)
Computer	591	60	13.4	(7 - 25)
Electric fan	591	284	54	(40 - 67)
Air conditioner	591	5	1	(0 - 3)
Watch	591	253	43.2	(35 - 52)
Guitar	591	9	2.5	(1 - 7)
Bike	591	107	22.7	(18 - 29)
Motorcycle or scooter	591	118	23.4	(16 - 32)
Animal-drawn cart	591	3	0.4	(0 - 2)
Car	591	20	4.4	(3 - 6)
Truck	591	4	0.9	(0 - 3)
Motor boat	591	70	7.5	(4 - 13)

	N	n	%	95% CI
Bank account	589	147	29.5	(20 - 41)

Table 3.17: Livestock ownership

	N	n	%	95% CI
Cattle	102	5	10	(2 - 34)
Horses, donkeys or mules	102	6	10.3	(3 - 30)
Goats or sheep	102	1	2.4	(0 - 16)
Chickens or other poultry	102	88	78.2	(57 - 91)
Pigs	102	13	13.7	(6 - 30)

Table 3.18: Ownership of agricultural land

	N	n	%	95% CI
Does any member of the household own, rent, or share agricultural land?				
No	591	415	73.5	(62 - 83)
Yes, own	591	163	24.9	(17 - 35)
Yes, rent	591	4	0.6	(0 - 3)
Yes, share	591	6	0.4	(0 - 1)
Don't know	591	3	0.6	(0 - 2)

As a part of the interview, respondents estimated their monthly household income (including money earned by all members of the household and received from other sources such as public benefits or remittances). Though some households are hesitant to report their income, the estimates as reported are shown in Table 3.19.

Table 3.19: Monthly household income, all sources

	N	n	%	95% CI
Monthly household income, Colombian Peso (COP)				
Less than 50,000 pesos	591	71	8.8	(6 - 14)
50,001 - 100,000 pesos	591	181	28.7	(20 - 40)
150,001 - 300,000 pesos	591	110	20.7	(17 - 25)
300,001 - 450,000 pesos	591	44	8.1	(5 - 12)
450,001 - 600,000 pesos	591	50	11.7	(9 - 16)
600,001 - 750,000 pesos	591	26	4	(2 - 7)
750,001 - 900,000 pesos	591	15	3.3	(2 - 5)
900,001 - 1,050,000 pesos	591	10	2.2	(1 - 7)
More than 1,050,000 pesos	591	16	4.1	(2 - 10)
Don't know	591	56	6.7	(4 - 11)
Decline to respond	591	12	1.7	(1 - 5)

The interview also asked respondents the distance (km) to the health facility nearest their home. Long distances and travel times to health establishments can discourage households in remote locations from seeking medical care. Figure 3.3 shows the unweighted distribution of distances reported in the survey. Figure 3.4 shows the unweighted distribution of travel time (minutes) reported in the survey. The survey sample for Colombia has an unweighted average distance of 0.8 kilometers and an unweighted average travel time of 1 minutes by usual mode of travel to the nearest health facility.

Figure 3.3: Distance to nearest health facility, unweighted percent distribution

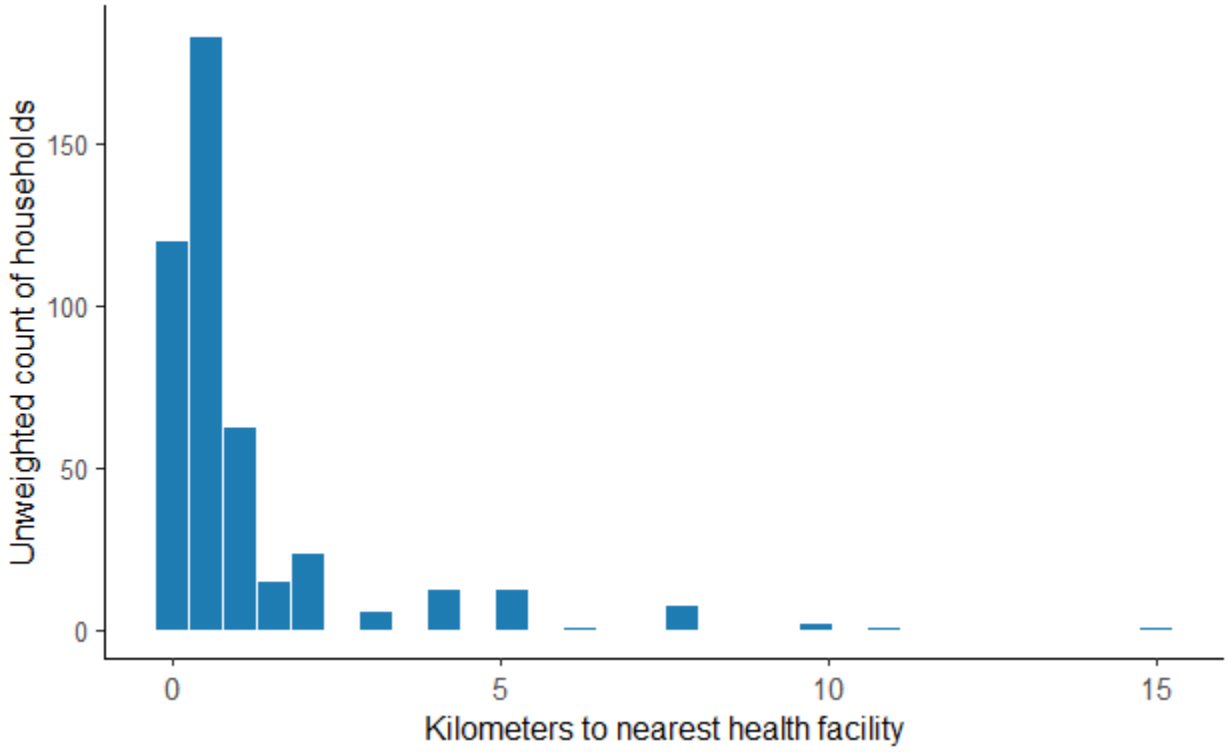
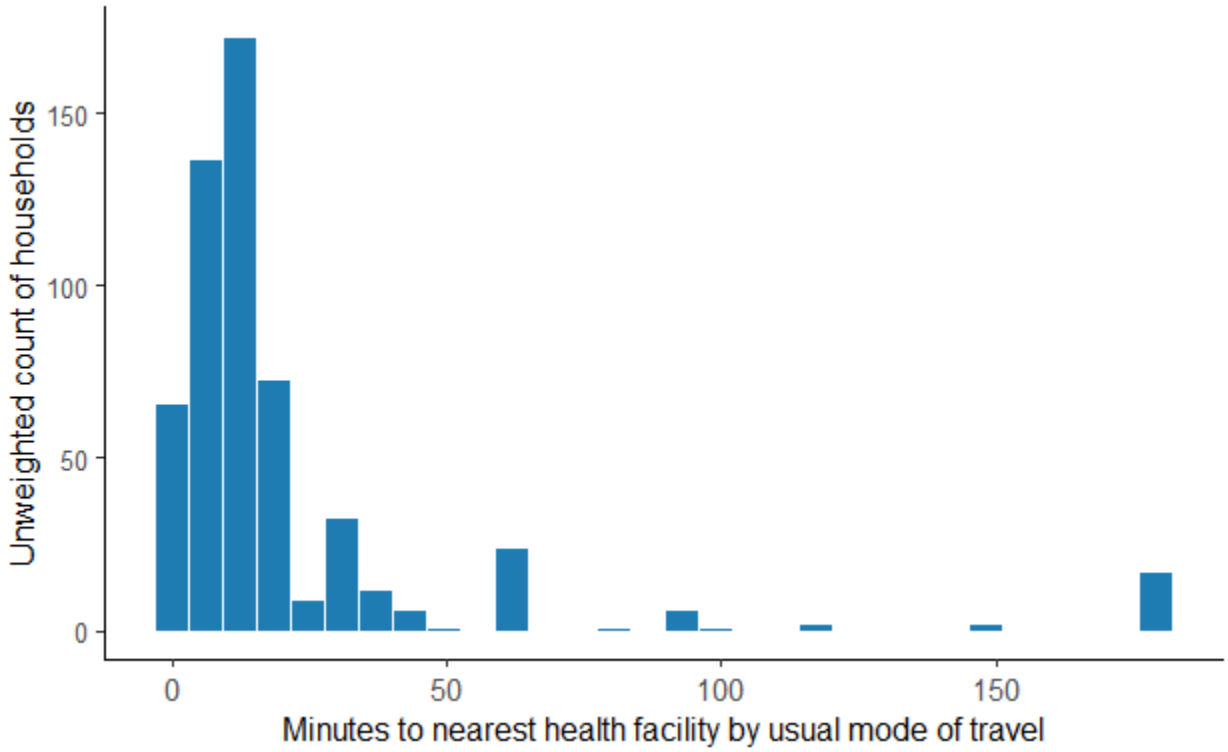


Figure 3.4: Travel time to nearest health facility, unweighted percent distribution



Respondents were asked which insurance type was used by the household. Respondents could indicate multiple insurance types if different family members were covered under different insurance plans. Subsidiado insurance was used by 81.9% of households in the RMEI-Colombia Initiative area, as seen in Table 3.20.

Table 3.20: Insurance coverage

	N	n	%	95% CI
What type of health insurance does this home have?				
Subsidiado	591	470	81.9	(73 - 88)
Contributivo	591	78	17.9	(11 - 29)
Sisben	591	30	0.6	(0 - 3)
Régimen Especial Ejército	591	2	0.4	(0 - 3)
Barrios Unidos	591	1	0.2	(0 - 1)
Comparta	591	1	0.1	(0 - 1)
Don't know	591	15	0.9	(0 - 3)

3.2 Malaria knowledge

Respondents were asked a series of questions to assess their knowledge about malaria causes and prevention strategies. This section summarizes the results.

3.2.1 Disease knowledge

As Table 3.21 shows, most respondents had heard of malaria before (95.3%). Respondents were asked the cause of malaria (Table 3.22) and the mode of transmission of malaria (Table 3.23) and interviewers could register more than one response. Most respondents are aware of the role of mosquitoes in malaria transmission.

Table 3.21: Malaria awareness

	N	n	%	95% CI
Heard of illness called malaria	584	534	95.3	(92 - 97)

Table 3.22: Knowledge of cause of malaria

	N	n	%	95% CI
In your opinion, what causes malaria?				
Mosquito bites	534	482	90.2	(85 - 94)
Dirty surroundings	534	24	4.6	(3 - 8)
Stagnant water	534	27	4.5	(3 - 7)
Anopheles mosquito bite	534	12	1.9	(1 - 4)
Weedy surroundings	534	10	1.7	(1 - 4)
Eating dirty food/drinking dirty water	534	3	0.4	(0 - 2)
Working in the forest or the fields	534	2	0.1	(0 - 0)
Other	534	6	0.7	(0 - 2)
Don't know	534	27	5.9	(4 - 9)

Table 3.23: Knowledge of malaria transmission

	N	n	%	95% CI
How is malaria transmitted?				
By mosquitoes	534	489	90.4	(87 - 93)
Stagnant water	534	18	3.5	(2 - 6)
Passes from one person to another	534	5	0.5	(0 - 2)

	N	n	%	95% CI
Contaminated air	534	2	0.5	(0 - 2)
Poor personal hygiene	534	2	0.1	(0 - 0)
Eating dirty food/drinking dirty water	534	2	0.1	(0 - 0)
Other	534	1	0.4	(0 - 3)
Don't know	534	37	8.1	(6 - 11)

Respondents were also asked the main sign or symptom of malaria and more than one response could be registered (Table 3.24). Many respondents recognize fever as a key symptom. Throughout the question series about malaria knowledge, however, there were some respondents who indicated they did not know how to respond to the questions, as displayed in the tables. Table 3.25 shows the combinations of symptoms that are most common during a malaria illness, which were not commonly reported together by respondents.

Table 3.24: Knowledge of malaria symptoms

	N	n	%	95% CI
Main sign or symptom of malaria known				
Fever	534	472	87.1	(80 - 92)
Headache	534	391	68.1	(59 - 76)
Chills	534	367	61.4	(49 - 73)
Body ache or joint pain	534	129	21.7	(15 - 31)
Nausea and vomiting	534	73	13.8	(10 - 18)
Body weakness	534	40	6.6	(5 - 9)
Diarrhea	534	20	4	(3 - 6)
Loss of appetite	534	20	2.5	(1 - 5)
Dizziness	534	13	1	(0 - 2)
Sweating	534	3	0.9	(0 - 4)
Pale eyes or skin	534	3	0.3	(0 - 1)
Other	534	3	0.4	(0 - 2)
Don't know	534	25	5.8	(3 - 10)

Table 3.25: Multiple common symptoms of malaria known

	N	n	%	95% CI
Fever and chills	534	339	63.5	(59 - 67)
Fever and sweating	534	3	0.6	(0 - 2)
Fever, chills, and sweating	534	3	0.6	(0 - 2)

Respondents were asked how many people in their own community they knew who had had malaria during the last year. Forty-four percent did not report to know anyone who had malaria in the last year (Table 3.26).

Table 3.26: Knowledge of community transmission

	N	n	%	95% CI
In your community, during the last year, how many people do you know who had a case of malaria?				
None	534	179	43.7	(29 - 60)
One person	534	36	9.2	(6 - 14)
2-4 people	534	53	8.1	(4 - 16)
5-10 people	534	65	7.6	(3 - 16)
11-100 people	534	92	12.5	(5 - 26)
More than 100 people	534	17	2	(1 - 7)

	N	n	%	95% CI
Don't know	534	92	16.9	(12 - 24)

3.2.2 Knowledge of malaria messages

Malaria programs and public health systems carry out education campaigns to help people who live in areas with malaria transmission know how to protect themselves from the disease, and what to do if they become sick. Respondents were asked to list the messages they had heard about malaria in the last year, and interviewers sorted their answers among the available responses in the survey. In all, 19% had heard messages about malaria during the last year. Of those who had heard messages, the specific information heard is detailed in Table 3.27. Some of the responses indicate that people may confuse messages about preventing dengue or other arboviruses with malaria prevention messages. However, many had learned to seek medical attention for fevers and about using a mosquito net.

Next, respondents were asked to indicate whether or not they had heard malaria messages from each source in a list of media. The sources and the proportion of those who had heard messages through each, among respondents who had heard any messages about malaria in the past year, are in Table 3.28.

Table 3.27: Malaria messages heard in last year

	N	n	%	95% CI
Messages seen or heard in last year				
If have fever go to health facility	118	58	45.9	(38 - 54)
Eliminate breeding sites/clean up trash	118	29	29.7	(20 - 42)
Nets are used to protect from mosquitoes	118	27	20.9	(15 - 28)
Sleep under a net every night to protect yourself against malaria	118	14	12.4	(5 - 26)
Sleep under an insecticide-treated mosquito net	118	17	10.1	(4 - 23)
Malaria kills	118	7	5.1	(2 - 15)
Anopheles mosquitoes transmit malaria by biting people at night	118	3	4.3	(1 - 15)
Always test before treating malaria	118	6	3.5	(1 - 10)
Treatment for severe malaria is available free of charge	118	1	2.2	(0 - 13)
Nets are being distributed free of charge	118	1	1	(0 - 8)
Wash nets only when they are dirty	118	2	0.2	(0 - 1)
Other	118	9	5.3	(2 - 14)
Don't know	118	7	8.9	(5 - 16)

Table 3.28: Source of malaria messages

Source of messages, among those who heard them	N	n	%	95% CI
On the radio	118	19	17	(12 - 24)
On TV	118	45	48.3	(33 - 64)
On a poster or billboard	118	34	17.2	(7 - 36)
From a community health worker	118	18	10.2	(4 - 23)
From personnel at a health facility	118	24	20.8	(15 - 28)
At a community event	118	15	6.2	(2 - 16)
At school	118	5	0.6	(0 - 2)
On the internet or social media	118	6	2.6	(0 - 13)
Somewhere else	118	3	5.3	(2 - 16)

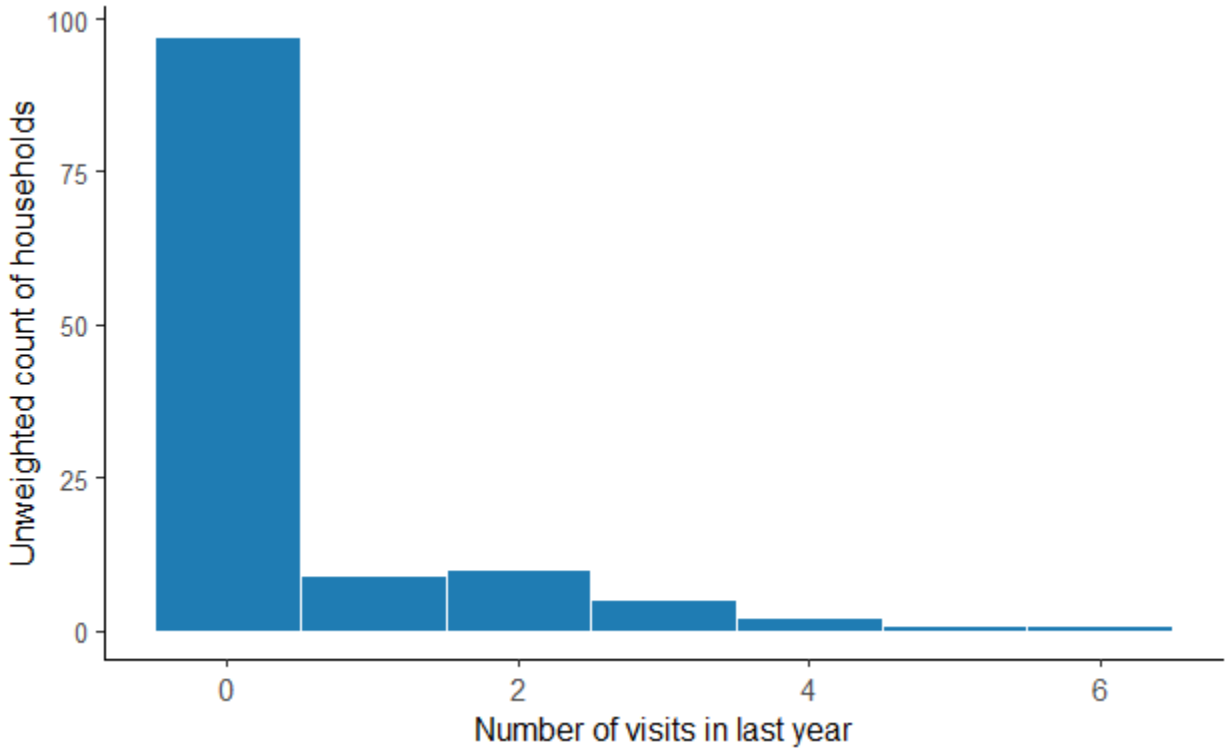
3.2.3 Knowledge of community resources

A key component of malaria detection in many regions in Colombia are health personnel who provide outreach and care within the community, such as microscopists (*microscopistas*) and health promoters (*promotores de salud*). These community health workers work in the community to carry out malaria detection activities such as screening, testing (microscopy and RDT), and referring patients to health facilities or to community-based vector control technicians. They also sometimes oversee malaria treatment after a malaria case has been confirmed. In the Colombia baseline survey, 14.3% of households know of a community health worker in their community. Of those who knew of a community health worker, 26.3% reported receiving a home visit by that individual during the year before the date of the survey (Table 3.29). The number of visits received from the community health worker is shown in Figure 3.5.

Table 3.29: Knowledge of community health workers

	N	n	%	95% CI
Know of a community health worker (health promoter/ microscopist) in own community	526	128	14.3	(7 - 27)
Visited by community health worker (health promoter/ microscopist) in last year	126	30	26.3	(13 - 47)

Figure 3.5: Number of visits from community health workers in last year



Malaria testing and treatment is provided free of charge through the Ministry of Health in Colombia, and 84.5% of respondents are aware of this benefit (Table 3.30). Because cost and knowledge of where services are available may be barriers to seeking care, the survey asked respondents where someone could access testing and treatment. Respondents could indicate multiple health facility types they knew provided the service, and interviewers classified them according to the options in the survey. A majority of households knew that they could seek malaria care at public primary care facilities (Table 3.31, Table 3.32). Knowledge of community health workers by department is shown in Table 3.33. The baseline

measurement was not designed to produce representative estimates at the department level, so results by province should be interpreted with discretion.

Table 3.30: Knowledge of free-of-cost malaria healthcare

	N	n	%	95% CI
Aware malaria diagnosis and treatment are provided free by the government	511	442	84.5	(80 - 88)

Table 3.31: Knowledge of where to go for malaria testing

	N	n	%	95% CI
Where can someone go to be tested for malaria?				
Public Sector: Government primary level health center	534	310	57.5	(44 - 70)
Public Sector: Government hospital	534	104	24.8	(15 - 39)
Other public sector	534	98	21.6	(12 - 35)
Private medical sector: Private hospital/clinic	534	40	11.5	(4 - 30)
Public Sector: Health promoter/Community Health Worker	534	78	7.2	(2 - 19)
Private medical sector: Private doctor	534	2	0.2	(0 - 1)
Private medical sector: Pharmacy	534	1	0.1	(0 - 1)
Other private sector	534	1	0	(-)
Traditional healer	534	1	0	(-)
Other	534	25	5.5	(2 - 12)
Don't know	534	9	2.3	(1 - 5)

Table 3.32: Knowledge of where to go for malaria treatment

	N	n	%	95% CI
Where can someone receive treatment for malaria?				
Public Sector: Government primary level health center	522	289	53.1	(39 - 66)
Public Sector: Government hospital	522	143	33.9	(21 - 49)
Other public sector	522	102	21.1	(14 - 31)
Private medical sector: Private hospital/clinic	522	35	11.4	(4 - 29)
Public Sector: Health promoter/Community Health Worker	522	63	5.5	(2 - 15)
Private medical sector: Pharmacy	522	6	1.7	(1 - 3)
Traditional healer	522	1	0.4	(0 - 3)
Private medical sector: Private doctor	522	1	0.2	(0 - 2)
Other private sector	522	1	0.2	(0 - 1)
Other	522	15	3.3	(1 - 7)
Don't know	522	7	1.5	(1 - 3)

Table 3.33: Knowledge of community health worker by department

	N	n	%	95% CI
Buenaventura (3 communities)				
Know of community health worker (health promoter/ microscopist) in own community	66	11	18.2	(9 - 33)
Visited by community health worker (health promoter/ microscopist) in last year	11	5	61.1	(50 - 71)
community health worker (health promoter/ microscopist) conduct testing for malaria	71	0	0	(-)
community health worker (health promoter/ microscopist) promoter provide treatment for malaria	69	0	0	(-)
Chocó (13 communities)				
Know of community health worker (health promoter/ microscopist) in own community	271	70	15.9	(7 - 33)
Visited by community health worker (health promoter/ microscopist) in last year	68	18	17.9	(8 - 37)
community health worker (health promoter/ microscopist) conduct testing for malaria	271	38	5.6	(2 - 17)
community health worker (health promoter/ microscopist) promoter provide treatment for malaria	264	34	4.9	(1 - 17)
Nariño (8 communities)				
Know of community health worker (health promoter/ microscopist) in own community	189	47	12.2	(3 - 39)
Visited by community health worker (health promoter/ microscopist) in last year	47	7	13.7	(4 - 35)
community health worker (health promoter/ microscopist) conduct testing for malaria	192	40	10.8	(3 - 36)
community health worker (health promoter/ microscopist) promoter provide treatment for malaria	189	29	7.9	(2 - 28)

3.3 Risk factors for malaria

Certain lifestyles, professions, and living conditions raise an individual's risk for malaria infection. Traveling may expose people to infection if they move from an area with relatively less malaria transmission, to an area with more transmission. Travel by individuals also raises the risk that malaria transmission could be re-introduced to receptive areas where it has been interrupted. Some households reported members who migrated for work (Table 3.34), either seasonally (29.7%) or weekly (12.8%). Among individuals in surveyed households, 25.8% reported travel outside the community in the last two weeks (Table 3.35). According to respondents, most household members did not participate in any of the risk activities listed in Table 3.36 in the two months prior to the survey.

Table 3.34: Temporal migration within surveyed households

	N	n	%	95% CI
At least one member migrates seasonally	591	189	29.7	(26 - 34)
At least one member migrates weekly	591	71	12.8	(8 - 19)

Table 3.35: Recent travel by individuals in surveyed households

	N	n	%	95% CI
Individual traveled outside community in last 2 weeks	2190	570	25.8	(20 - 33)

Table 3.36: Exposure to risky activities in the last two months by individuals in surveyed households

	N	n	%	95% CI
Individuals participating in malaria risk activities				
None of these	2191	1427	75	(68 - 81)
Cultivating crops or working in the fields	2191	499	16.1	(11 - 23)
Working in fishing	2191	253	5.3	(3 - 10)
Working in trade	2191	95	3.9	(2 - 7)
Working in a mine	2191	116	2.7	(1 - 6)
Gathering firewood in the forest	2191	134	2.7	(1 - 5)
Working in timber/lumber industries in the forest	2191	60	2	(1 - 4)
Collecting shellfish	2191	21	1.1	(0 - 3)
Sleeping outdoors overnight	2191	13	0.4	(0 - 1)
Producing charcoal	2191	2	0.2	(0 - 1)
Don't know	2191	1	0	(-)

Respondents were also asked what can be done to protect against malaria (Table 3.37), and what practices they follow in their own households (Table 3.38). The respondent replied in free form, and the interviewer classified the answers according to the options in the survey. The responses show evidence of some conflation of malaria prevention measures with arbovirus prevention measures, though many responses also referred to use of mosquito nets or other practices that protect against all mosquito vectors. Only 5.1% of households said they do not use any malaria prevention measures at home.

Table 3.37: Protective measures known by household

	N	n	%	95% CI
Methods known to protect against malaria				
Sleep under a mosquito net	497	307	70.4	(59 - 80)
Eliminate mosquito breeding areas (tires, bottles, or others)	497	190	33.3	(28 - 39)
Fumigate or spray house with insecticides	497	108	29.9	(19 - 44)
Keep house surroundings clean	497	76	14	(9 - 22)
Fill in puddles (stagnant water)	497	55	11	(6 - 20)
Clean water storage tanks with bleach	497	40	8.4	(5 - 14)
Use insect repellent	497	42	8.3	(6 - 12)
Cut the grass around the house	497	47	5.5	(3 - 11)
Avoid mosquito bites	497	17	4.1	(2 - 7)
Add bleach temephos (Abate) to the water tank	497	18	3.3	(2 - 6)
Use mosquito coils	497	5	1.6	(0 - 8)
Sleep under an insecticide-treated mosquito net	497	9	0.9	(0 - 3)
Take preventive medication	497	4	0.6	(0 - 3)
Can't be prevented	497	2	0.5	(0 - 3)
Put mosquito screens on the windows	497	5	0.5	(0 - 2)
Other	497	16	3.7	(2 - 8)
Don't know	497	25	6.3	(4 - 11)

Table 3.38: Protective measures used by household

	N	n	%	95% CI
Primary methods used in household to protect against malaria				
Sleep under a mosquito net	497	296	69.4	(58 - 79)
Fumigate or spray house with insecticides	497	97	25.7	(18 - 36)
Eliminate mosquito breeding areas (tires, bottles, or others)	497	164	24.8	(20 - 31)
Keep house surroundings clean	497	72	13.5	(9 - 20)
Fill in puddles (stagnant water)	497	44	7.6	(4 - 13)
Use insect repellent	497	30	7.5	(4 - 13)
Clean water storage tanks with bleach	497	37	7.3	(5 - 11)
Does nothing to protect from malaria	497	31	5.1	(3 - 9)
Cut the grass around the house	497	33	4.5	(2 - 10)
Avoid mosquito bites	497	14	3.6	(2 - 6)
Use mosquito coils	497	9	2.6	(1 - 8)
Add bleach or temephos (Abate) to the water tank	497	12	2.4	(1 - 5)
Sleep under an insecticide-treated mosquito net	497	11	1.6	(1 - 4)
Put mosquito screens on the windows	497	4	0.9	(0 - 5)
Organize community cleaning work days	497	5	0.8	(0 - 2)
Take preventive medication	497	3	0.2	(0 - 1)
Other	497	51	14.8	(8 - 25)
Don't know	497	6	1.2	(0 - 5)

Chapter 4: Vector control activities

This chapter provides a descriptive summary of vector control measures used in the households selected for the RMEI-Colombia Baseline LQAS Survey. Chapter 2, the household measurement in Colombia was conducted entirely in malaria stratum 5. All estimates reported in this chapter are weighted by the inverse probability of selection (see details in Appendix C) and account for clustering in variance calculations, except where otherwise noted. For this reason, many proportions reported are not equal to the ratio of numerator to denominator.

4.1 Vector control measures carried out in Colombia households

Vector control plans in Colombia included offering IRS and ITN measures to households in various communities in malaria-endemic areas. The interventions are usually planned for each year as a part of the annual malaria strategy with input from local and central level vector control technicians and funding partners. Interventions are planned and budgeted to cover a full community at the same time, with a set goal for acceptance or uptake rate. Intervention plans can sometimes be dynamic to malaria transmission, for example in the case of reactive measures to a new outbreak.

In Colombia, the community sample was designed to capture data from 32 communities, prioritizing communities with vector control measures implemented during 2018. Health facilities were listed for selection to the sample based multiple factors, primarily on whether interventions were carried out in the communities in their service area according to data received from the central-level Ministry of Health. According to those data, 166 communities across 11 municipalities should have received spraying, and 190 communities across 9 municipalities should have received net distribution. However, because the intervention data are organized by locality and not by health facility, and because the health service network received from the Ministry of Health did not include the names of the localities served by each health facility, the pairing of the intervention data to corresponding health facilities in the service network had to rely on matches of locality name or mapping via name-based online searches. This was the best available method but known to be imperfect. Twenty facilities in the sample were matched to communities with reported interventions.

Over the course of data collection, multiple of the communities in the original sample were replaced due to health facility substitutions and security concerns about accessing the selected community. After these substitutions were taken into consideration, it was expected that 17 communities would have vector control interventions. Due to the early suspension of data collection due to Covid-19, only 24 communities from the sample were completed. Of the completed communities, only 10 had vector control activities, according to the Ministry of Health documentation.

Table 4.1: Community sample composition

Vector control reported	Communities in original sample	Using substituted communities	Communities surveyed
Nets	9	8	4
Spray	8	6	4
Both	3	3	2
None	12	15	14

4.2 Mosquito net use

As a part of the interview, respondents were asked how many mosquito nets their household owns. Then, for each net reported, the interviewer requested to observe the net (noting the brand and condition in the survey) and went through a series of questions about each net, including where it came from, how it is cared for, and who used the net the previous night. In the case that the respondent declined to show the net, questions on net brand and condition were asked to the respondent directly.

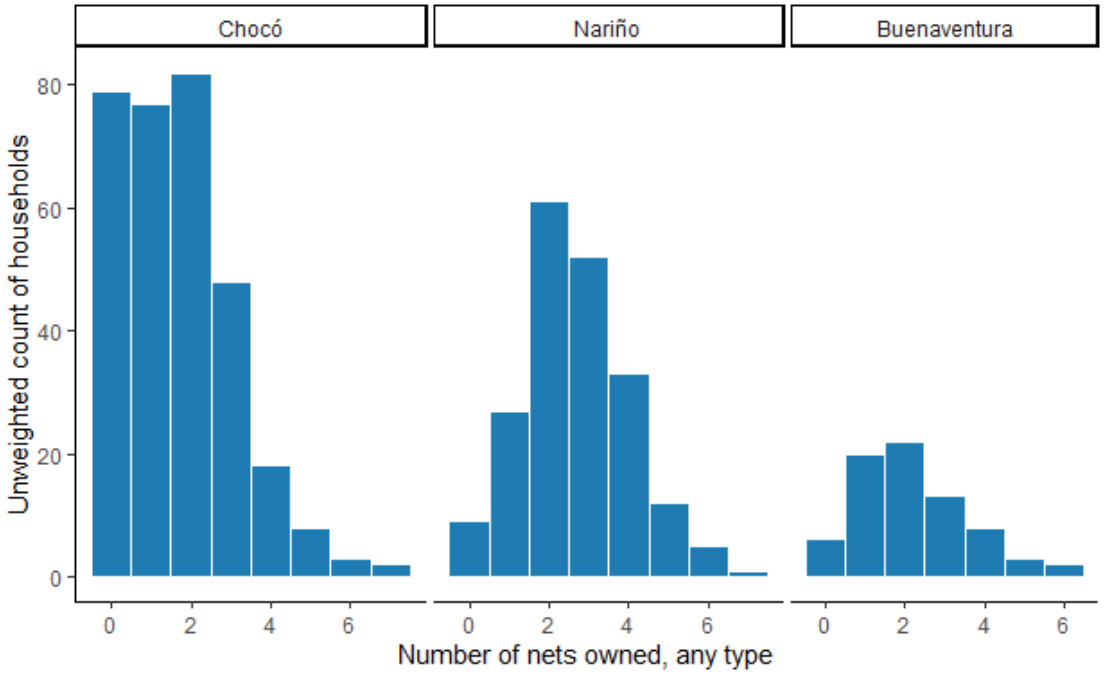
4.2.1 Ownership of nets by surveyed households

As Table 4.2 shows, 87.5% of households own at least one treated or untreated mosquito net. The number of nets owned (regardless of type) is shown by department/ district in Figure 4.1. The baseline measurement was not designed to produce representative estimates at the department/ district level, so results by department/ district should be interpreted with discretion.

Table 4.2: Ownership of mosquito nets by households

	N	n	%	95% CI
Households with at least one mosquito net	590	497	87.5	(76 - 94)

Figure 4.1: Number of nets owned by households within each department/ district, unweighted count



Respondents were asked where they obtained each mosquito net. As shown in Table 4.3, most nets treated with insecticide were obtained from vector control personnel, in a facility or in the community. Most untreated nets were purchased in a store (89.7%, in Table 4.4).

Table 4.3: Source of insecticide-treated nets

	N	n	%	95% CI
Source of net				
Vector control or malaria program	480	418	87.1	(84 - 90)
Government health facility	480	29	6	(4 - 9)
Community health worker (health promoter/ microscopist)	480	3	0.6	(0 - 2)
Shop/market	480	3	0.6	(0 - 2)
Other	480	8	1.7	(1 - 3)
Don't know	480	19	4	(3 - 6)

Table 4.4: Source of untreated nets

	N	n	%	95% CI
Source of net				
Shop/market	747	670	89.7	(87 - 92)
Other	747	24	3.2	(2 - 5)
Don't know	747	53	7.1	(5 - 9)

In addition to the insecticide treatment wearing off after a period of years, the fabric of mosquito nets also deteriorates over time and is prone to damage. A net with holes, especially large holes, does not protect as well as an intact net. The condition of nets observed directly by field personnel is shown in Table 4.5, and the condition of nets that respondents declined to show to field personnel is shown in Table 4.6.

Table 4.5: Condition of observed nets

	N	n	%	95% CI
Condition of mosquito net as observed				
No holes	1000	644	64.4	(61 - 67)
Only thumb-sized holes	1000	302	30.2	(27 - 33)
At least one fist or head-sized hole	1000	46	4.6	(3 - 6)
Net never used	1000	8	0.8	(0 - 2)

Table 4.6: Reported condition of nets not observed

	N	n	%	95% CI
Condition of mosquito net as reported				
No holes	227	122	53.7	(47 - 60)
Only thumb-sized holes	227	71	31.3	(26 - 38)
At least one fist or head-sized hole	227	17	7.5	(5 - 12)
Net never used	227	3	1.3	(0 - 4)
Don't know	227	14	6.2	(4 - 10)

Insecticide-treated nets should be washed infrequently, and should not be dried in direct sunlight, which goes against common housekeeping practices in the region. Figure 4.2 shows how many times insecticide-treated nets have been washed since acquired (if more than 20 times, 20 is indicated). Table 4.7 shows how the respondent reported drying each net after washing.

Figure 4.2: Care of insecticide-treated nets - washing (unweighted count)

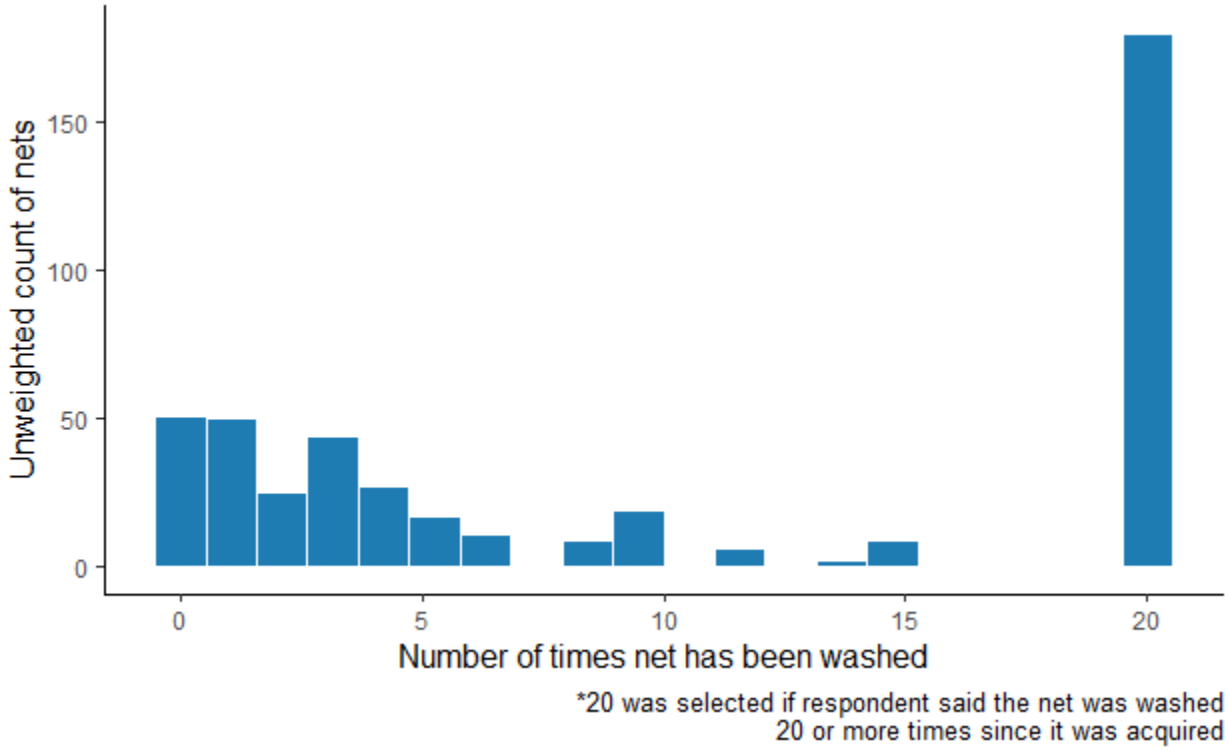


Table 4.7: Care of insecticide-treated nets - drying

	N	n	%	95% CI
Method of drying net				
In the sun	400	300	75	(71 - 79)
In the shade	400	91	22.8	(19 - 27)
Indoors	400	8	2	(1 - 4)
In a dryer	400	0	0	(-)
Don't know	400	1	0.3	(0 - 2)

4.2.2 Use of nets by individuals in surveyed households

In order for the household to be fully protected, all household members should sleep under an insecticide-treated net for the entire night. Table 4.8 shows the reported use of nets on the night prior to the survey. Among all usual household members who slept in the house the previous night, 28.8% were reported to have slept under a mosquito net treated with insecticide. Among children under age 5 who were usual members of the household and slept there the previous night, 29.1% were reported to have slept under a net treated with insecticide.

Table 4.8: Use of net for sleeping previous night

	N	n	%	95% CI
Total				
Slept under treated net	2103	606	28.8	(16 - 47)
Slept under untreated net	2103	972	50.7	(34 - 67)
Under 5				
Slept under treated net	228	70	29.1	(16 - 47)
Slept under untreated net	228	114	54.9	(36 - 72)
Pregnant				
Slept under treated net	23	1	0.9	(0 - 8)
Slept under untreated net	23	9	42.2	(15 - 74)
Reported usually sleeping under net during pregnancy	19	11	49.6	(18 - 82)

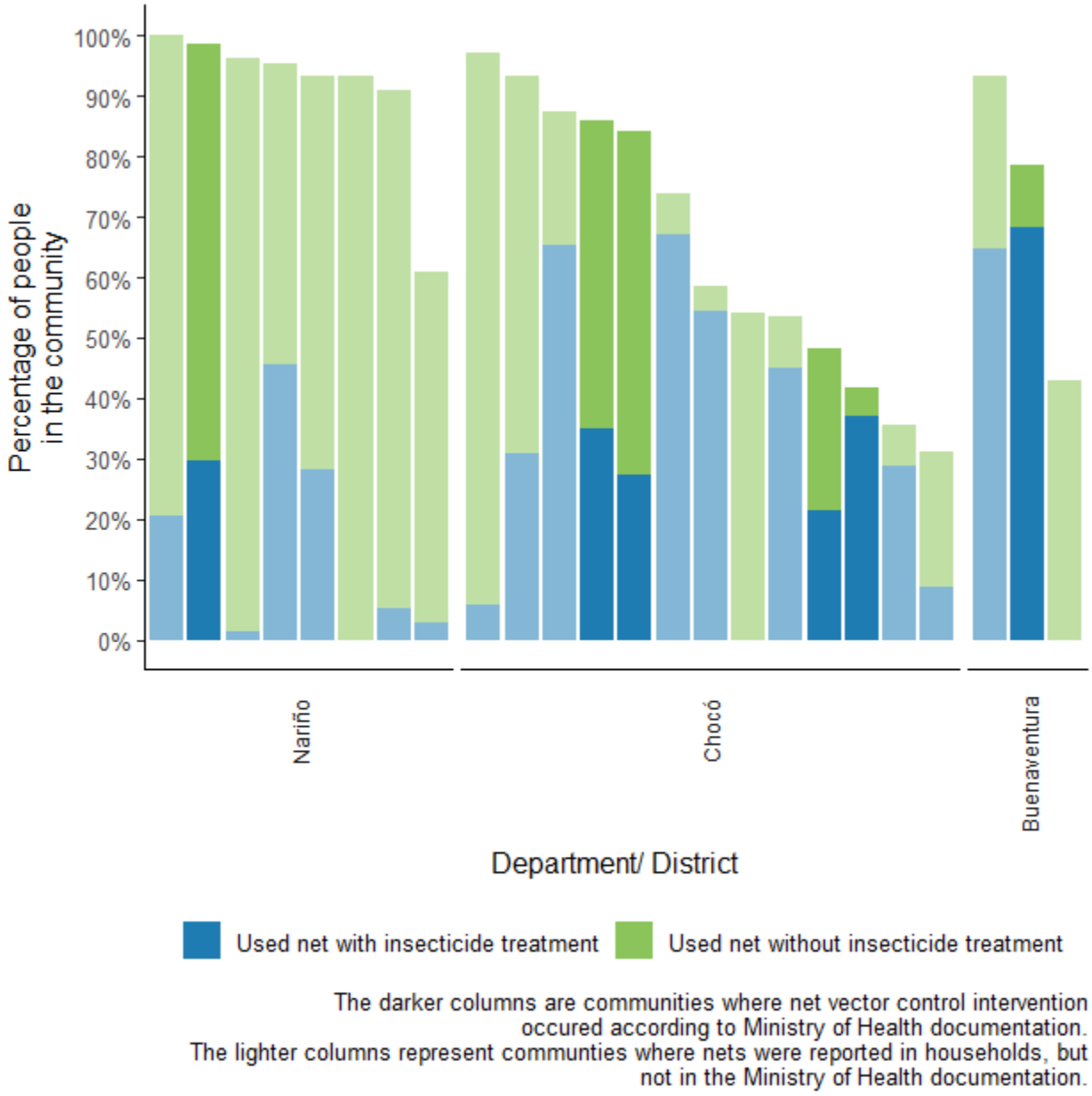
When households had nets that were not used the previous night, or reported that not all household members slept under a net, they were asked why they do not sleep under a mosquito net. The reasons given are shown in Table 4.9. Most frequently, households reported they did not have enough mosquito nets for all members to use. When respondents specified an “other” response, they often claimed they do not like mosquito nets or did not need them without explaining why.

Table 4.9: Reasons for not using net

	N	n	%	95% CI
Reasons for not sleeping under mosquito net				
Extra net/more nets available than sleeping areas	192	54	37.8	(28 - 49)
Too hot	192	62	29.7	(20 - 42)
Saving net for later	192	25	15.5	(9 - 26)
Don't have enough nets	192	15	6.5	(3 - 13)
No mosquitoes	192	10	2.8	(1 - 7)
Usual user(s) did not sleep here last night	192	8	1.8	(0 - 7)
It is bad for the skin, it causes irritation	192	7	1.4	(0 - 6)
Not necessary, using fan instead	192	3	1.4	(0 - 7)
Net too expensive	192	2	1.2	(0 - 7)
Feel closed in/afraid	192	1	1.1	(0 - 8)
Net too old/torn	192	1	1.1	(0 - 8)
No malaria now	192	3	0.9	(0 - 5)
Don't like smell/insecticide is too strong	192	1	0	(-)
Other	192	18	6.5	(3 - 14)
Don't know	192	4	2.3	(0 - 14)

Figure 4.3 shows by department the proportion of individuals who slept in the household the previous night using a mosquito net in each of the communities surveyed. The communities expected to receive the net intervention are highlighted in darker colors. In Colombia, the communities that received the net intervention, according to documentation provided by the Ministry of Health, had comparable levels of insecticide-treated net use as in communities that were not expected to receive the intervention. Untreated net use is notable in some communities.

Figure 4.3: Net use by department/ district and community



4.3 Indoor Residual Spraying

The other key vector control intervention of the Initiative is to offer to spray the interior walls of the dwelling against mosquitoes (usually with deltamethrin or a comparable insecticide). Insecticide application is usually carried out by staff or contractors of the vector control program every 4 to 6 months during the intervention time frame. The interviewer asked respondents if their household had been offered insecticide application to the interior of the dwelling during the last year. As seen in Table 4.10, 15.4% of households were offered IRS, and spraying was carried out in 88.4% of the households where it was offered. The interviewer also asked to see evidence of the most recent spray application, such as a sticker, house card, or chalk mark left by the vector control personnel. Such evidence was observed in

only 16.3% of households that received IRS. The response “don’t know” was given to the question about observing evidence of IRS completion in one household.

Table 4.10: Households offered and accepting spraying

	N	n	%	95% CI
Offered indoor residual spraying	584	85	15.4	(9 - 26)
Accepted indoor residual spraying	85	75	88.4	(76 - 95)
Evidence observed (card, sticker, mark)	74	14	16.3	(9 - 27)

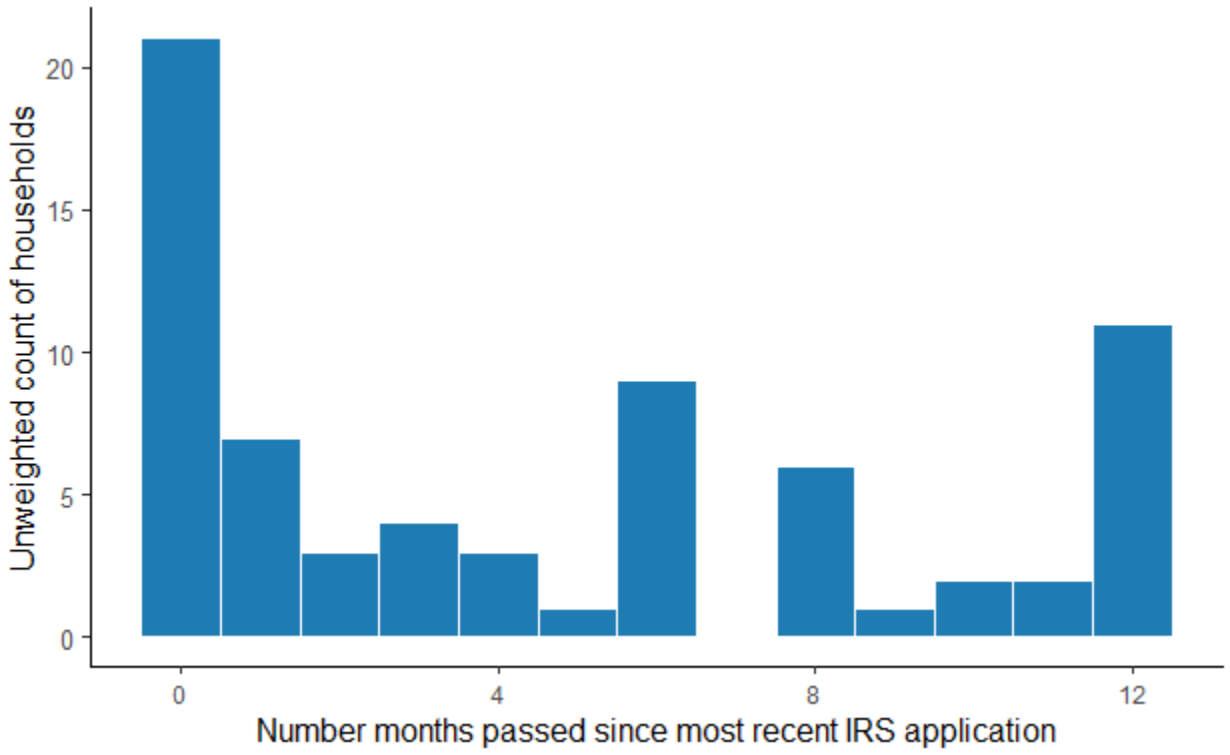
Respondents were asked what agency conducted the most recent spraying. Figure 4.4 shows that IRS coverage was provided to most households by the vector control program (41.8%) and private companies (38.6%).

Table 4.11: Agency that conducted spraying

	N	n	%	95% CI
Agency that conducted IRS				
Vector control or malaria program	75	49	41.8	(14 - 75)
Private company	75	15	38.6	(12 - 75)
Other	75	2	4.1	(1 - 15)
Don't know	75	9	15.5	(5 - 40)

Respondents were asked how long ago the most recent spraying occurred. The results in Figure 4.5 suggest that spraying is carried out at least every six months in most cases.

Figure 4.5: Number of months since most recent spraying occurred, unweighted count



Respondents who were offered IRS, but whose house was not sprayed, were asked why the spraying was not carried out, an uncommon circumstance. The results are shown in Table 4.12. Some “other”

responses given included not having money to pay for the service (when provided by a private company) and they accepted the service, but the employees never returned to complete the spraying.

Table 4.12: Reasons for not accepting spraying

	N	n	%	95% CI
Reason house was not sprayed				
Causes ill health effects	10	1	7.5	(1 - 47)
Dangerous for children	10	1	7.5	(1 - 47)
Other	10	9	92.5	(53 - 99)

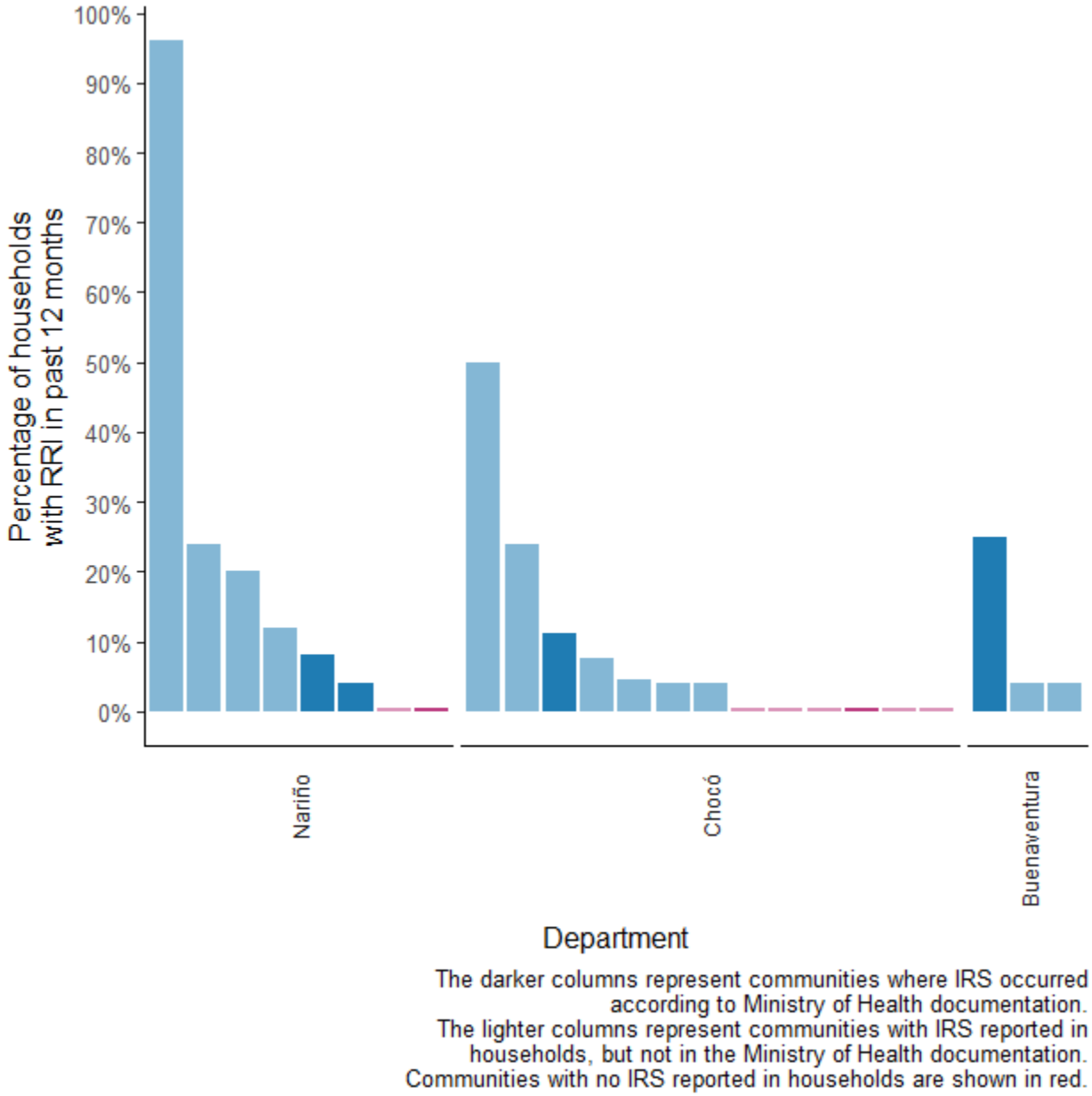
Households receiving IRS were asked whether they washed, painted, or plastered any walls since the most recent application (which diminishes the effectiveness of the insecticide), as shown in Table 4.13.

Table 4.13: Post-spraying practices

	N	n	%	95% CI
Walls painted since last IRS	75	10	15.3	(7 - 31)
Walls washed since last IRS	75	12	18.2	(9 - 34)
Walls plastered since last IRS	75	4	4.8	(1 - 17)

Figure 4.6 shows by department the proportion of households that received IRS in each of the communities surveyed. The communities expected to receive the IRS intervention according to documentation provided by the Ministry of Health are highlighted in darker colors. The measured coverage of IRS is quite high in some communities not expected to receive it, and below 50% in all communities that were expected to receive it. A few factors could contribute to this mismatch: IRS may have been planned for certain communities, but not carried out before the survey took place; IRS may have been carried out in the community, but longer than 12 months before the date of the survey; or respondents may have confused IRS with other insecticide interventions such as fogging (though application to interior walls was emphasized in the conduct of the survey).

Figure 4.6: Indoor residual spraying by department/ district and community



4.4 Indicator 6.01: Vector control coverage

Individual-level coverage by one of the two interventions was negotiated as an indicator for RMEI. The indicator is measured on the subset of usual household members who slept in the house the night prior to the survey (because net use is measured for the night prior to the survey) in the communities identified at the local level as targeted for vector control interventions. Individuals are considered covered if they slept under an insecticide-treated net the previous night, or if their home had indoor residual spraying applied within the last 12 months, regardless of which intervention was planned for the community where they reside (there was evidence of both types of interventions in 2 target communities, as seen in Table 4.14). Table 4.15 shows the indicator results, with 40.3% of individual usual household members in target communities covered by one of the two interventions.

Table 4.14: Vector control received by reported intervention

Vector control reported	Communities surveyed	Used treated net	House sprayed
Nets	4	31.4%	1.8%
Spray	4	24.9%	6.3%
Both	2	48.2%	13%
None	14	26.4%	20%

Table 4.15: Vector control indicator

	N	n	%	95% CI
Usual household members in vector control communities who slept in house last night	914	846	93.9	(90 - 96)
Slept under insecticide treated net	846	274	37.1	(16 - 65)
House sprayed with mosquito treatment past 12 months	841	53	10	(4 - 25)
Omitted from household spraying calculations due to 'do not know' responses	846	5	0.5	(0 - 2)
'DK' responses included in indicator because they slept under treated net	5	3	78.8	(21 - 98)
Received either vector control to standard	844	292	40.3	(18 - 68)

Chapter 5: Malaria Diagnostic Capacity

This chapter provides a descriptive summary of the health facilities surveyed for the RMEI-Colombia baseline Heath Facility Survey and the malaria diagnostic services they provide.

5.1 Characteristics of health facility sample

As previously described, the health facility sample included 60 facilities of various types. Due to the spread of Covid-19 and subsequent halt to data collection due to national quarantine in Colombia, not all of the facilities in the sample were completed during the baseline measurement. Table 5.1 shows the number of facilities planned in the sample and completed by facility type. Thirty-six of the surveyed facilities provide primary level care, and 5 are secondary level services, though they may also provide primary attention as demanded. The remaining facilities in the sample are vector control units: ETV units (*"sede departmental/distrital de Enfermedades Transmitidas por Vectores"*) that manage stock, active case detection, reporting, and malaria programming for the entire department/ district. The measurement included reference labs for each department/ district with certainty.

Table 5.1: Health facility survey sample by facility type

	Facility Type	Number planned	Number completed
Primary care	Microscopy post	16	9
	Primary care center	26	22
	Private laboratory	4	5
Secondary care	Hospital	8	5
Administrative unit/ Reference Lab	Malaria Program Office (District)	1	1
	Malaria Program Office (Department)	2	2
	Reference Laboratory	3	2
Total		**60**	**46**

The health facility interview includes questions about services provided in the facility as summarized in this chapter. The facility director or other responsible party (e.g., the head doctor in an ambulatory facility, the administrative or medical director of a hospital, and the head of surveillance or vector control programs at a department/ district ETV unit). When conducting the survey, interviewers are trained to emphasize that all questions need not be answered by a single respondent and encourage the primary respondent to invite colleagues who know the topic best to contribute to answering for each section (e.g., human resources personnel, head of nursing, laboratory staff).

All attention facilities in the sample provided services from Monday through Friday. A smaller number were open on the weekends (Table 5.3). Twenty-nine percent of primary care units and 100% of secondary care units had services open 24 hours (Table 5.4).

Table 5.3: Workweek of facility

	N	n	%	95% CI
Primary care units: Days of the week service is provided				
Monday	34	34	100	(-)
Tuesday	34	34	100	(-)
Wednesday	34	34	100	(-)
Thursday	34	34	100	(-)
Friday	34	34	100	(-)
Saturday	34	20	58.8	(41 - 74)
Sunday	34	9	26.5	(14 - 44)
Secondary care units: Days of the week service is provided				
Monday	5	5	100	(-)

	N	n	%	95% CI
Tuesday	5	5	100	(-)
Wednesday	5	5	100	(-)
Thursday	5	5	100	(-)
Friday	5	5	100	(-)
Saturday	5	5	100	(-)
Sunday	5	5	100	(-)

Table 5.4: Hours of operation

	N	n	%	95% CI
Primary care units: Hours of operation				
Open less than 24 hours	34	24	70.6	(53 - 84)
Open 24 hours	34	10	29.4	(16 - 47)
Secondary care units: Hours of operation				
Open 24 hours	5	5	100	(-)

Survey respondents indicated the type and number of personnel employed at the health facility. Table 5.5 shows the proportion of facilities that employ at least one of each personnel type. Microscopy posts and private laboratories employed fewer types of personnel than other primary care facilities and secondary care facilities, and most commonly employed nurses (auxiliary or registered) and laboratory personnel (microscopist or microbiologist). Physicians are employed at 80% of primary level facilities and at all secondary level facilities. In terms of laboratory diagnosis at primary care facilities, microbiologists are employed at 30%, microscopists for malaria are employed at 35%, and lab technicians at 25% of primary care units. Only 10% of primary level facilities employ epidemiology personnel, and 15% employ other statistics personnel, important functions for malaria notification and reporting.

Table 5.5: Facility personnel

	N	n	%	95% CI
Microscopy posts				
General physician	9	1	11.1	(1 - 52)
Auxiliary nurse	9	5	55.6	(24 - 83)
Registered nurse	9	1	11.1	(1 - 52)
Microscopist	9	8	88.9	(48 - 99)
Private laboratories				
Pharmacist	5	1	20	(3 - 71)
Auxiliary nurse	5	3	60	(19 - 91)
Registered nurse	5	1	20	(3 - 71)
Microbiologist (laboratory)	5	5	100	(-)
Microscopist	5	1	20	(3 - 71)
Lab technician	5	1	20	(3 - 71)
Dispenser at pharmacy	5	1	20	(3 - 71)
Primary care units (excluding microscopy posts and private laboratories)				
General physician	20	16	80	(56 - 93)
Pediatrician	20	1	5	(1 - 30)
Nutritionist /dietician	20	1	5	(1 - 30)
Pharmacist	20	7	35	(17 - 58)
Auxiliary nurse	20	19	95	(70 - 99)
Practical nurse	20	1	5	(1 - 30)
Registered nurse	20	16	80	(56 - 93)

	N	n	%	95% CI
Social worker	20	5	25	(10 - 49)
Microbiologist (laboratory)	20	6	30	(14 - 54)
Microscopist	20	7	35	(17 - 58)
Lab technician	20	5	25	(10 - 49)
Dispenser at pharmacy	20	6	30	(14 - 54)
Epidemiology personnel	20	2	10	(2 - 34)
Other personnel specific for statistics and reporting	20	3	15	(5 - 39)
Secondary care units				
General physician	5	5	100	(-)
Pediatrician	5	4	80	(29 - 97)
Nutritionist /dietician	5	4	80	(29 - 97)
Pharmacist	5	5	100	(-)
Auxiliary nurse	5	4	80	(29 - 97)
Practical nurse	5	1	20	(3 - 71)
Registered nurse	5	5	100	(-)
Social worker	5	4	80	(29 - 97)
Microbiologist (laboratory)	5	5	100	(-)
Microscopist	5	2	40	(9 - 81)
Lab technician	5	5	100	(-)
Dispenser at pharmacy	5	4	80	(29 - 97)
Epidemiology personnel	5	5	100	(-)
Other personnel specific for statistics and reporting	5	5	100	(-)
Department/ district ETV units				
Microbiologist (laboratory)	3	2	66.7	(14 - 96)
Microscopist	3	1	33.3	(4 - 86)
Epidemiology personnel	3	2	66.7	(14 - 96)
Other personnel specific for statistics and reporting	3	1	33.3	(4 - 86)

5.2 Rapid diagnostic tests

Rapid diagnostic tests (RDT) are used in Colombia in order to shorten the wait for a malaria test result, particularly in health facilities without microscopic diagnosis. The RDT is a cassette-type test prepared with a drop of capillary blood and the result is ready within an hour. The rapid tests procured in Colombia distinguish between *P. falciparum* and *P. vivax* malaria infections. When a blood sample is taken for an RDT, a thick blood film (TBF) slide is routinely prepared for microscopic diagnosis as well, since the rapid test does not measure parasite density and may not detect mixed infections as effectively. The slide may be examined at the facility where the patient sought care, or may be sent to a facility with a lab for examination.

5.2.1 Rapid diagnostic test practices

In Colombia, 19.4% of primary care facilities store RDTs, and 25% provide testing with RDTs (Table 5.6). In 29.4% of primary care facilities, personnel test with RDTs inside the facility, and personnel conduct testing in the community in 22.6% of facilities (Table 5.7). Testing in the community is most often conducted daily (33.3% of facilities that conduct testing in the community), as shown in Table 5.8. Due to skip logic in the survey module, private laboratories were not asked whether RDT testing was performed by health facility personnel in the community.

Table 5.6: Rapid diagnostic testing according to interview and observation

	N	n	%	95% CI
Primary care units				
Unit stores RDTs	36	7	19.4	(9 - 36)
Unit conducts RDT testing	36	9	25	(13 - 42)
Secondary care units				
Unit stores RDTs	5	0	0	(-)
Unit conducts RDT testing	5	1	20	(3 - 71)
Department/ district ETV units				
Unit stores RDTs	3	2	66.7	(14 - 96)
Unit conducts RDT testing	3	1	33.3	(4 - 86)

Table 5.7: Rapid diagnostic testing practices (interview)

	N	n	%	95% CI
Primary care units				
Do health personnel perform rapid diagnostic testing for malaria in this facility?	34	10	29.4	(16 - 47)
Do health personnel in this facility perform rapid diagnostic testing for malaria in the community?	31	7	22.6	(11 - 41)
Secondary care units				
Do health personnel perform rapid diagnostic testing for malaria in this facility?	5	2	40	(9 - 81)
Do health personnel in this facility perform rapid diagnostic testing for malaria in the community?	5	2	40	(9 - 81)
Department/ district ETV units				
Do health personnel perform rapid diagnostic testing for malaria in this facility?	3	0	0	(-)
Do health personnel in this facility perform rapid diagnostic testing for malaria in the community?	3	3	100	(-)

Table 5.8: Community rapid diagnostic testing frequency

	N	n	%	95% CI
Frequency of rapid diagnostic testing in the community				
Daily	12	4	33.3	(13 - 64)
At least once per week	12	1	8.3	(1 - 43)
At least once per month	12	2	16.7	(4 - 49)
At least once per quarter	12	2	16.7	(4 - 49)
Other	12	3	25	(8 - 56)

Respondents at facilities that reported using both RDTs and microscopic diagnosis methods were asked which of the two methods are more commonly used. While 16.7% of facilities reported using both RDT and microscopy routinely for the same patient, 75% reported taking only a TBF sample routinely (Table 5.9).

Table 5.9: More commonly used testing method among facilities that report use of both RDTs and microscopy

	N	n	%	95% CI
For malaria diagnosis, is it most common to take a thick blood film only, use an RDT only, or take both samples (thick blood film and RDT) for diagnosis?				
Only thick blood film used more commonly	12	9	75	(44 - 92)
Both RDT and thick blood film: Samples are routinely taken for both tests at the same time	12	2	16.7	(4 - 49)
Only RDT used more commonly	12	1	8.3	(1 - 43)

Respondents at facilities that reported using both RDTs and microscopic diagnosis methods were asked if they must wait for confirmation with microscopic diagnosis before beginning malaria treatment. According to the norm, treatment can be initiated with a positive RDT diagnosis. However, 66.7% of primary care facilities and 33.3% of secondary care facilities that used RDTs reported that they require confirmation by TBF examination in order to start treatment (Table 5.10).

Table 5.10: Microscopy confirmation of RDT results, attention units conducting RDT

	N	n	%	95% CI
Do you require a positive thick blood film test as confirmation after a positive RDT to start malaria treatment?				
Primary care units	9	6	66.7	(32 - 89)
Secondary care units	3	1	33.3	(4 - 86)

5.2.2 Rapid diagnostic testing as measured in medical record review

The health facility survey included a medical record review of confirmed cases of malaria to evaluate diagnosis and case management practices, and a review of suspected cases of malaria (patients presenting with fever). Chapters 6 and 7 discuss the results in detail. The review captured whether each case from the year 2018 included in the sample received a rapid diagnostic test based on patient charts, attention registries, and lab records at selected health facilities (for suspected cases) as well as case notification forms (for confirmed cases). As seen in Table 5.11, 1.9% of confirmed cases reviewed had evidence of an RDT, and 1.2% of suspected cases reviewed had evidence of receiving an RDT.

Table 5.11: Rapid diagnostic testing observed in medical record review

	N	n	%	95% CI
RDT observed in record				
Confirmed cases	103	2	1.9	(0 - 7)
Suspected cases	254	3	1.2	(0 - 4)

5.2.3 Stock of rapid diagnostic testing inputs

The health facility survey included an observation by field personnel of inputs and equipment for malaria diagnosis. The recommended *P. falciparum* + *P. vivax* card test was observed in 20% of primary care facilities. No rapid tests were observed the day of the survey in 80% of primary care facilities (Table 5.12).

Table 5.12: Rapid diagnostic test supply observed

	N	n	%	95% CI
Primary care units				
P. falciparum rapid detection card equipment observed	35	7	20	(10 - 37)
P. falciparum + P. vivax rapid detection card equipment observed	35	7	20	(10 - 37)
None of these rapid detection cards observed	35	28	80	(63 - 90)
Secondary care units				
None of these rapid detection cards observed	5	5	100	(-)

	N	n	%	95% CI
Department/ district ETV units				
P. falciparum rapid detection card equipment observed	2	1	50	(5 - 95)
P. falciparum + P. vivax rapid detection card equipment observed	2	2	100	(-)

As shown in Table 5.13, 17.6% of primary care facilities, 60% of secondary care facilities, and 100% of department/district ETV units routinely store RDTs.

Table 5.13: Rapid diagnostic test routine storage (questionnaire)

	N	n	%	95% CI
Primary care units: Does this facility routinely store any malaria rapid diagnostic tests (RDTs)?				
No, picked up from another facility	34	2	5.9	(1 - 22)
Yes, stores malaria rapid diagnostic tests (RDTs)	34	6	17.6	(8 - 35)
None of the above	34	26	76.5	(59 - 88)
Secondary care units: Does this facility routinely store any malaria rapid diagnostic tests (RDTs)?				
No, picked up from another facility	5	0	0	(-)
Yes, stores malaria rapid diagnostic tests (RDTs)	5	3	60	(19 - 91)
None of the above	5	2	40	(9 - 81)
Department/ district ETV units: Does this facility routinely store any malaria rapid diagnostic tests (RDTs)?				
No, picked up from another facility	3	0	0	(-)
Yes, stores malaria rapid diagnostic tests (RDTs)	3	3	100	(-)
None of the above	3	0	0	(-)

5.3 Malaria microscopy

The gold standard for malaria diagnosis is by microscopy. A TBF sample is prepared on a laboratory slide, stained, then examined under a microscope for presence of malaria parasites. The preparation of the slide is simple and is carried out by nurses, microscopists, or lab technicians depending on facility practices. Slides are also prepared in the field by vector control technicians and microscopists. Trained microscopists can identify the parasite density as well as the parasite species in a blood sample prepared correctly. After initiating antimalarial treatment, the parasite density of an infected patient will begin to decrease and eventually drop to zero.

The Colombia baseline sample was selected based on Ministry of Health documentation and all primary units selected were reported to have malaria microscopy capabilities. Table 5.14 presents which units self-reported malaria microscopy capacity alongside the expected results based on the Ministry of Health documentation. Five facilities had revisits pending due to incorrect data entry regarding on-site microscopy capacity when data collection was suspended. In some cases, facility type and microscopy capability was incorrectly recorded in the Ministry of Health documentation, which is why we expected to have two private facilities with microscopy capability in the sample of completed facilities, but actually collected three. These units (one each: microscopy post, primary care unit, private laboratory, hospital, and departmental laboratory) are reported as not having diagnostic capabilities in Table 5.14.

Table 5.14: Microscopy expected and reported

Type of unit	Expected microscopy - planned	Expected microscopy - survey completed	Capacity for microscopy (reported)
Microscopy post	16	8	8*
Private laboratory	4	2	3*
Primary level	27	19	8*
Hospital	7	5	3*
Department/ district ETV	3	2	0
Department/ district reference laboratory	3	2	1*
Total	**60/60**	**38/43**	**23/43**

*One microscopy post, one primary care unit, one private laboratory, one hospital, and one departmental laboratory reported without microscopy capabilities were pending revisit to collect missing microscopy information when data collection was suspended.

5.3.1 Microscopic diagnosis practices

In Colombia, all facilities providing primary care to patients are expected to have the capacity to prepare TBF slides. In the health facility interview and observation, 66.7% of primary care facilities were found to take TBF samples, as shown in Table 5.15). The health facility survey (interview and observation) determined microscopic diagnostic capacity at 52.8% of primary care facilities and 60% of secondary care facilities.

Table 5.15: Microscopy and thick blood film sampling according to interview + observation

	N	n	%	95% CI
Primary care units				
Unit takes thick blood film samples	36	24	66.7	(49 - 80)
Unit has microscopy capacity	36	19	52.8	(36 - 69)
Secondary care units				
Unit takes thick blood film samples	5	4	80	(29 - 97)
Unit has microscopy capacity	5	3	60	(19 - 91)
Department/ district ETV units				
Unit takes thick blood film samples	3	3	100	(-)
Unit has microscopy capacity	3	0	0	(-)

According to the interview alone and as seen in Table 5.16, 66.7% of all facilities (regardless of type) have personnel that take TBF samples in-facility, and 33.3% have personnel that take TBF samples in the community. Since data collection was paused in Colombia, not all modules were complete in every facility, therefore, the denominators in Table 5.15 and Table 5.16 may differ.

Table 5.16: Thick blood film sampling according to interview

	N	n	%	95% CI
Health personnel in this facility take thick blood film samples in-facility	42	28	66.7	(51 - 80)
Health personnel take thick blood film samples in the community	39	13	33.3	(20 - 50)

As shown in Table 5.17 and regardless of facility type, 85.7% of facilities conduct initial diagnosis of malaria according to the interview. Facilities that do not conduct initial diagnosis either do not have microscopic diagnostic capacity, or they exclusively examine already-diagnosed slides for quality control (such as some department/ district laboratories). Of those 24 facilities that report conducting initial diagnosis, 8.3% also examine samples taken by community health workers, and 12.5% sometimes send slides elsewhere for initial diagnosis (for example, when the sole laboratorist is on leave). Among the 4 facilities that do not conduct initial diagnosis, 50% send samples to another facility for initial diagnosis.

Among all 5 facilities that send samples to another facility (sometimes or always), 80% report sending them to another health care facility, while 20% report sending them directly to the department/ district laboratory for initial diagnosis (Table 5.18).

Table 5.17: Microscopy capacity in facility according to interview

	N	n	%	95% CI
Thick blood film samples examined for initial diagnosis of malaria in-facility	28	24	85.7	(67 - 95)
Thick blood film samples taken by community health workers (health promotors/microscopists) examined for malaria in-facility	24	2	8.3	(2 - 29)
Samples sometimes sent elsewhere for initial diagnosis of malaria, among facilities with capacity	24	3	12.5	(4 - 33)
Samples sent elsewhere for initial diagnosis of malaria, among facilities without capacity	4	2	50	(12 - 88)

Table 5.18: Samples sent elsewhere: location

	N	n	%	95% CI
Location of initial diagnosis				
Another health facility	5	4	80	(29 - 97)
Department/ district laboratory	5	1	20	(3 - 71)

Facilities that reported conducting initial diagnosis (regardless of facility type) were asked about the personnel responsible for examining slides, and respondents could indicate more than one type. In 33.3% of facilities there is at least one malaria microscopist, 58.3% of facilities have at least one microbiologist who conducts malaria diagnosis, and 8.3% have other lab personnel that read malaria slides (Table 5.19).

Table 5.19: Personnel responsible for malaria microscopy testing

	N	n	%	95% CI
Personnel responsible for TBF examination				
Microbiologist (laboratory)	24	14	58.3	(38 - 76)
Malaria microscopist	24	8	33.3	(17 - 55)
Other lab technician/ bioanalyst	24	2	8.3	(2 - 29)
Other	24	3	12.5	(4 - 33)

The health facility survey also asked about any affiliated personnel (employed by another institution rather than by the facility directly) who conduct malaria diagnosis. Only 4.5% of facilities had affiliated personnel involved in diagnosis (Table 5.20). Both of the facilities that have affiliated diagnostic personnel only have one employee in that position.

Table 5.20: Diagnostic personnel not employed but working in facility

	N	n	%	95% CI
Affiliated microscopists work at but are not employed by facility	44	2	4.5	(1 - 17)

5.3.2 Indicator 7.01: Supplies and equipment for malaria testing and treatment

In order to be able to detect and treat malaria, facilities must have certain basic supplies and equipment on hand. The indicator negotiated for RMEI considers whether these required basic inputs were observed at the facilities in the sample. The requirements vary by facility type, as detailed in Table 5.21.

Table 5.21: Indicator P7.01: Required components by facility type

Component	Microscopy post (9)	Private laboratory (5)	Primary level (22)	Hospital (5)	ETV / Reference Lab (5)
Medications (basic)	All	All	All	All	If reported microscopy capacity or on-site diagnosis
Medications (severe malaria)	All	All	All	All	
Sampling equipment	All	All	All	All	If reported microscopy capacity or on-site diagnosis
Forms for sending samples	All	All	All	All	If reported microscopy capacity or on-site diagnosis
Equipment for on-site diagnosis (RDT)	If reported on-site diagnosis				
Microscopy equipment	If reported microscopy capacity				
Staining and sample reading equipment	If reported microscopy capacity				
Staining reagents	If reported microscopy capacity				

As shown in Table 5.21, the indicator is dependent on units reporting microscopy and RDT capacity. The sample was selected based on Ministry of Health documentation and all primary units selected were reported to have malaria diagnostic capabilities. Due to the Covid-19 pandemic and suspension of data collection, not all facilities were visited and pending revisits to completed units with missing or incorrect data were never completed. Table 5.22 presents data collected and what is used for the indicator.

Table 5.22: Indicator P7.01: Health facilities included in indicator

Type of unit	Visited	Observation and laboratory modules completed	On-site diagnosis reported (RDTs)	Microscopy reported	Included in 7.01 denominator
Microscopy post	9	8[1]	5	8	9[1]
Private laboratory	5	5	1	3	5
Primary level	22	22	3	8	22
Hospital	5	4[2]	1	3	5[2]
Department/ district ETV	3	2[3]	1	0	1[3]
Department/ district reference laboratory	2	2[3]	0	1	1[3]
Total	**46**	**43**	**11**	**23**	**43**

[1]In one microscopy post, the observation module was not completed and the components on medications, equipment to take samples, and on-site diagnosis were not evaluated.
[2]In one hospital, the microscopy module was not completed and the components of microscopy, forms for sending samples, equipment for staining, and reagents were not evaluated.
[3]One ETV unit and one reference laboratory are excluded from the indicator because they reported no diagnostic capacity.

The indicator results are shown in Table 5.23. Only 4.7% of all the facilities in the sample had all of the inputs required for the corresponding facility type.

Table 5.23: Indicator P7.01: Equipment and medications

	N	n	%	95% CI
Antimalarial medications	42	4	9.5	(3 - 23)
Medications for basic treatment: Chloroquine	42	21	50	(35 - 65)
Medications for basic treatment: Primaquine (5 or 15 mg tablets)	42	20	47.6	(33 - 63)
Medications for basic treatment: Artemisinin derivatives (artemether + lumefantrine)	42	18	42.9	(28 - 59)
Medication for treatment of severe malaria: Quinine / Artesunate	40	5	12.5	(5 - 27)
No stockout of malaria medications in past 3 months	42	4	9.5	(3 - 23)
Sampling and biosafety equipment	42	25	59.5	(44 - 74)
Disposable gloves	42	30	71.4	(55 - 83)
Lancets	42	29	69	(53 - 81)
Microscope slides (frosted or non-frosted)	42	27	64.3	(48 - 78)
Sample submission forms	42	23	54.8	(39 - 69)
Rapid diagnostic tests (RDTs) for onsite testing	10	6	60	(29 - 85)
Microscopy equipment	23	15	65.2	(43 - 82)
Binocular microscope (with 100x retractable lens)	23	17	73.9	(52 - 88)
Cell counter (manual or automatic)	23	18	78.3	(56 - 91)
Equipment for staining and testing	23	17	73.9	(52 - 88)
Immersion oil	23	19	82.6	(61 - 94)
Staining tray/ container	23	21	91.3	(70 - 98)
Laboratory stopwatch	23	21	91.3	(70 - 98)
Container for mixing dye/ stain	23	21	91.3	(70 - 98)
Pipettes/ droppers/ syringes	23	19	82.6	(61 - 94)
Reagents for staining	23	8	34.8	(18 - 57)
GIEMSA solution (or alternative: Methylene blue + Solution A + Solution B + Methanol)	23	19	82.6	(61 - 94)
GIEMSA solution	23	6	26.1	(12 - 48)
Methylene blue + Solution A + Solution B + Methanol	23	17	73.9	(52 - 88)
Buffer solution or buffered water	23	11	47.8	(28 - 68)
No stockout of reagents in past 3 months	23	8	34.8	(18 - 57)
Units with all required equipment and medications	43	2	4.7	(1 - 18)

5.3.3 Stock of microscopy inputs and equipment

The observation module of the health facility survey checked stock of sample-taking and microscopy supplies and equipment. Each item in the observation list had to be observed by the surveyor, checked for functionality, in the case of equipment, and recorded to the electronic module. Table 5.24 and Table 5.25 show the proportion of facilities where each item for sample-taking and microscopy, respectively, was observed on the day of the survey. Some supplies for sample-taking (Alcohol swabs, Cotton-wool swabs, Acetone or Acetone alcohol (antiseptic), Needles, Vacutainer-type needles, Capillary tubes) were sought for observation only in facilities with microscopy or laboratory.

Three microscopy posts that were expected to take blood samples and perform malaria microscopy reported that they did not do those activities because their microscope has been broken for one year or longer. They send patients that need microscopy diagnosis to a nearby health facility for testing. These

three microscopy posts were included in the 7.01 payment indicator for sample-taking supplies and microscopy equipment and supplies.

Table 5.24: Sample-taking supplies observed

	N	n	%	95% CI
Disposable gloves	44	31	70.5	(55 - 82)
Alcohol swabs	44	10	22.7	(12 - 38)
Cotton-wool swabs	44	29	65.9	(50 - 79)
Acetone or Acetone alcohol (antiseptic)	44	15	34.1	(21 - 50)
Lancets	44	30	68.2	(53 - 81)
Syringes (for taking blood)	44	22	50	(35 - 65)
Needles	44	18	40.9	(27 - 56)
Vacutainer-type needles	44	19	43.2	(29 - 59)
Capillary tubes	44	19	43.2	(29 - 59)
Sharps box	44	31	70.5	(55 - 82)
Microscope slides (not frosted)	44	20	45.5	(31 - 61)
Frosted microscope slides	44	21	47.7	(33 - 63)

Table 5.25: Microscopy equipment and supplies observed, among all facilities reporting microscopy capacity

	N	n	%	95% CI
Lens-cleaning tissues	23	12	52.2	(32 - 72)
Spare bulbs (for microscopes)	23	5	21.7	(9 - 44)
Spare fuses (for microscopes)	23	5	21.7	(9 - 44)
Immersion oil	23	19	82.6	(61 - 94)
Oil immersion lens-cleaning solution	23	5	21.7	(9 - 44)
Staining rack	23	19	82.6	(61 - 94)
Drying rack (or sheet)	23	16	69.6	(48 - 85)
Measuring cylinder/disposable graduated cylinder	23	14	60.9	(39 - 79)
Glass or plastic bottles with a lid, that do not allow the passage of light	23	12	52.2	(32 - 72)
Filter paper (or other input to act as filter paper)	23	13	56.5	(36 - 75)
Slide holders or wooden dowels	23	13	56.5	(36 - 75)
Containers for mixing dye or stain	23	19	82.6	(61 - 94)
Concave staining surface	23	19	82.6	(61 - 94)
Staining tray/sheet/container	23	17	73.9	(52 - 88)
Glass petri dish	23	7	30.4	(15 - 52)
Plastic petri dish	23	7	30.4	(15 - 52)
Syringes	23	12	52.2	(32 - 72)
Disposable droppers	23	15	65.2	(43 - 82)
Test tubes with screw caps	23	7	30.4	(15 - 52)
Test tubes without caps (glass or plastic)*	16	8	50	(27 - 73)
Safety glasses (including the over-spectacle type)	23	10	43.5	(25 - 64)
Gowns	23	20	87	(65 - 96)
Markers	23	18	78.3	(56 - 91)
Detergents	23	13	56.5	(36 - 75)
Timer in laboratory	23	15	65.2	(43 - 82)

*Only observed when test tubes with screw caps were not observed.

Each microscope present at facilities in the sample was observed separately for characteristics. The number of microscopes at each facility is detailed in Figure 5.1. The observed characteristics, by microscope, are shown in Table 5.26.

Figure 5.1: Functional microscopes per facility

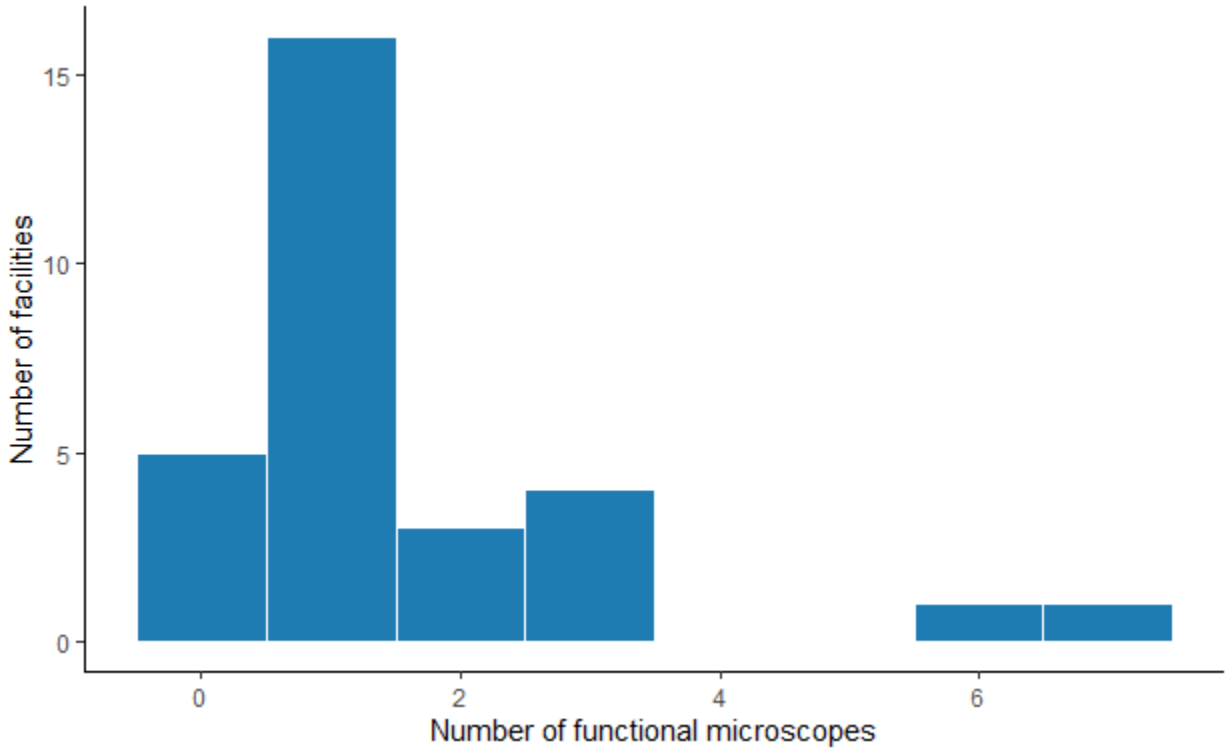


Table 5.26: Microscope characteristics among all observed microscopes

	N	n	%	95% CI
Is this a binocular microscope?	47	47	100	(-)
Is this a light microscope?	47	41	87.2	(74 - 94)
Is this a fluorescence microscope?	47	4	8.5	(3 - 21)
Is this a dark field microscope?	47	11	23.4	(13 - 38)
Is this a solar power microscope?	47	16	34	(22 - 49)
Lens observed: 4x	47	38	80.9	(67 - 90)
Lens observed: 10x	47	45	95.7	(84 - 99)
Lens observed: 20x	47	3	6.4	(2 - 18)
Lens observed: 40x	47	46	97.9	(86 - 100)
Lens observed: 100x	47	44	93.6	(82 - 98)
Lens observed: 1000x	47	0	0	(-)
Does the binocular microscope have an oil immersion lens?	47	44	93.6	(82 - 98)

Chapter 6: Malaria Case Detection and Diagnosis

Crucial to any malaria elimination program is quick detection of new malaria cases. Quickly administering treatment to the patient and enacting reactive activities in the community to search for additional cases and to monitor and control vector populations can interrupt the chain of transmission. In Colombia, active case detection is carried out by vector control personnel both through planned activities and in response to malaria cases. Passive case detection relies on health facilities to suspect and test for malaria in patients who present with fever or other malaria symptoms, and is a key component of malaria program strategy in the elimination phase. In Colombia, clinical and community health personnel (health promotors/microscopists) are trained to suspect and test for malaria in patients with high fever. Other signs that suggest malaria are history of recent fever, chills, and sweating, particularly in an alternating pattern.

6.1 Active case detection and outreach

As a part of the health facility interview, respondents were asked about vector control personnel and community health workers (health promotors/microscopists) affiliated with the facility. Many primary care facilities had at least one vector control technician or community health worker affiliated, all of whom were involved in malaria service provision. Vector control personnel and volunteer collaborators were also usually affiliated to ETV units and reference laboratories (Table 6.1).

Table 6.1: Affiliated malaria personnel

	N	n	%	95% CI
Primary care units				
Vector control personnel	34	2	5.9	(1 - 22)
Community health workers (health promotors/microscopists)	34	13	38.2	(23 - 56)
Community health workers (health promotors/microscopists) involved in malaria activities (such as vector control, diagnosis, case detection, or treatment)	13	13	100	(-)
Other personnel involved in malaria diagnosis or treatment	34	0	0	(-)
Secondary care units				
Vector control personnel	5	0	0	(-)
Community health workers (health promotors/microscopists)	5	2	40	(9 - 81)
Community health workers (health promotors/microscopists) involved in malaria activities (such as vector control, diagnosis, case detection, or treatment)	2	2	100	(-)
Other personnel involved in malaria diagnosis or treatment	5	1	20	(3 - 71)
Department/ district ETV units & Reference labs				
Vector control personnel	5	5	100	(-)
Community health workers (health promotors/microscopists)	5	2	40	(9 - 81)
Community health workers (health promotors/microscopists) involved in malaria activities (such as vector control, diagnosis, case detection, or treatment)	2	2	100	(-)
Other personnel involved in malaria diagnosis or treatment	5	0	0	(-)

As shown in Table 6.2, 32.4% of primary care facilities and 100% of department/district ETV units reported that facility personnel participate in active searches for malaria. All department/district ETV units also reported storing mosquito nets for distribution and employing personnel involved with indoor residual spraying. Educational campaigns about malaria were conducted by all department/district ETV units. Reference laboratories do not do community outreach, so these questions were not included during the interview at these units.

Table 6.2: Active case detection and community activities

	N	n	%	95% CI
Primary care units				
Conducts active search for malaria cases	34	11	32.4	(18 - 50)
Stores insecticide-treated mosquito nets for distribution in the community	34	0	0	(-)
Performs indoor residual spraying	34	0	0	(-)
Conducts educational campaigns about malaria in the community	34	17	50	(33 - 67)
Other malaria outreach activities	34	5	14.7	(6 - 32)
Secondary care units				
Conducts active search for malaria cases	5	1	20	(3 - 71)
Stores insecticide-treated mosquito nets for distribution in the community	5	0	0	(-)
Performs indoor residual spraying	5	0	0	(-)
Conducts educational campaigns about malaria in the community	5	1	20	(3 - 71)
Other malaria outreach activities	5	1	20	(3 - 71)
Department/ district ETV units				
Conducts active search for malaria cases	3	3	100	(-)
Stores insecticide-treated mosquito nets for distribution in the community	3	3	100	(-)
Performs indoor residual spraying	3	3	100	(-)
Conducts educational campaigns about malaria in the community	3	3	100	(-)
Other malaria outreach activities	3	3	100	(-)

Facilities that reported participation in active search for malaria cases were asked about how active case detection activities are planned in the community. As shown in Table 6.3, many facilities (regardless of facility type) reported they do active case detection after there is a case of malaria in the catchment area (46.7% of facilities).

The breakdown of health facilities that complete active case detection after there is a case of malaria in the catchment area and health facilities that schedule active case detection on a periodic basis are shown by department in Figure 6.1 and Figure 6.2.

Table 6.3: Determinants of active case detection

	N	n	%	95% CI
When do you search for suspected malaria cases in your catchment area?				
After there is a case of malaria in the catchment area	15	7	46.7	(23 - 72)
On a scheduled periodic basis	15	4	26.7	(10 - 54)
Daily	15	2	13.3	(3 - 42)
When directed from health authorities	15	1	6.7	(1 - 37)
Other	15	3	20	(6 - 48)

Figure 6.1: Active case detection completed after there is a case of malaria in the catchment area of the health facility, by department/ district

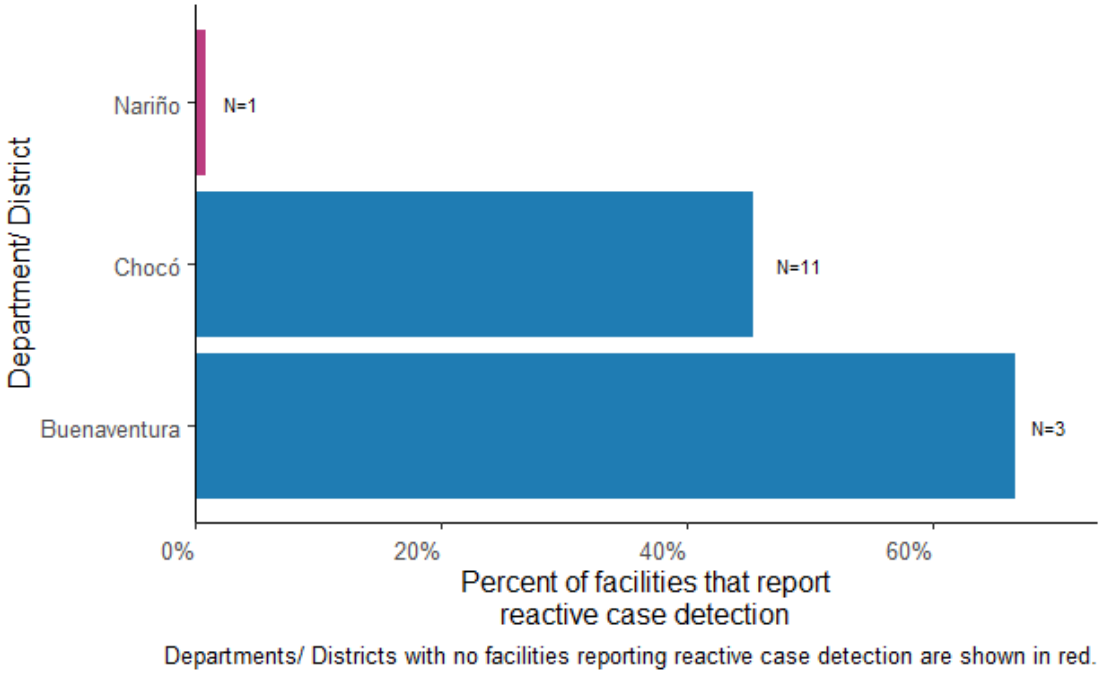
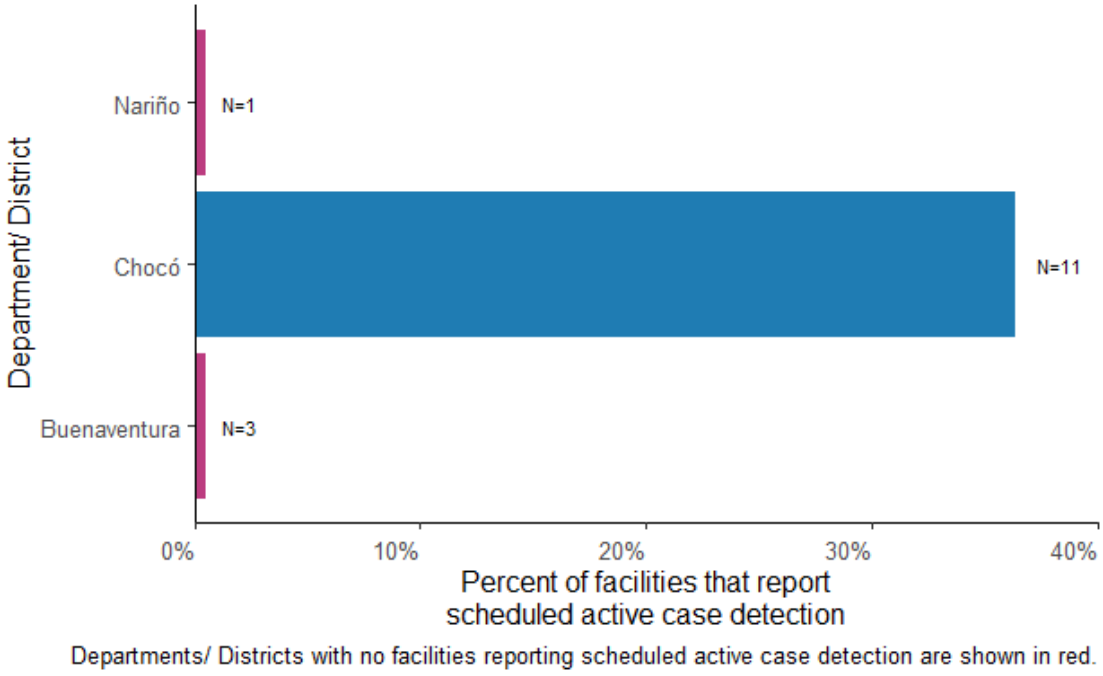


Figure 6.2: Active case detection scheduled on a periodic basis, by department/ district



Respondents were also asked a series of questions about malaria detection activities in the community and referrals from community health workers (health promoters/ microscopists). Among facilities that administer malaria treatment, 12.1% of primary care units and 40% of secondary care units received referrals from community health workers to treat malaria. Diagnosis activities were common, with 17.6%

of primary care facilities receiving referrals for malaria testing, 29% of primary care units taking TBF samples in the community, and 22.6% of primary care units taking RDTs in the community (Table 6.4).

Table 6.4: Community malaria activities - questionnaire

	N	n	%	95% CI
Primary care units				
Do you receive referred patients from community health workers (health promotors/microscopists) for malaria testing?	34	6	17.6	(8 - 35)
Do you receive referred patients from community health workers (health promotors/microscopists) for malaria treatment?	33	4	12.1	(4 - 29)
Do health personnel take thick blood film samples in the community?	31	9	29	(15 - 48)
Do health personnel in this facility perform rapid diagnostic testing for malaria in the community?	31	7	22.6	(11 - 41)
Do community health workers (health promotors/microscopists) receive malaria rapid tests from this facility for use in the community?	34	2	5.9	(1 - 22)
Secondary care units				
Do you receive referred patients from community health workers (health promotors/microscopists) for malaria testing?	5	2	40	(9 - 81)
Do you receive referred patients from community health workers (health promotors/microscopists) for malaria treatment?	5	2	40	(9 - 81)
Do health personnel take thick blood film samples in the community?	5	1	20	(3 - 71)
Do health personnel in this facility perform rapid diagnostic testing for malaria in the community?	5	2	40	(9 - 81)
Do community health workers (health promotors/microscopists) receive malaria rapid tests from this facility for use in the community?	5	2	40	(9 - 81)
Department/ district ETV units				
Do you receive referred patients from community health workers (health promotors/microscopists) for malaria testing?	3	0	0	(-)
Do health personnel take thick blood film samples in the community?	3	3	100	(-)
Do health personnel in this facility perform rapid diagnostic testing for malaria in the community?	3	3	100	(-)
Do community health workers (health promotors/microscopists) receive malaria rapid tests from this facility for use in the community?	3	2	66.7	(14 - 96)

6.2 Passive case detection (health facility questionnaire)

Personnel in health facilities are trained to suspect and test for malaria in patients who present with fever or other symptoms to the facility, known as passive case detection. Patients presenting with clinical signs that meet the definition of a suspected malaria case will have a sample taken, usually of capillary blood,

to prepare a TBF slide and sometimes to perform a rapid diagnostic test as well. If the *Plasmodium* parasite is detected via rapid test or microscopy, treatment with the first-line regimen corresponding to the parasite species begins and the case is notified through the SIVIGILA system. If the health facility the patient visits does not have microscopic diagnostic capacity, the TBF slide is sent to a nearby health facility for testing. The slide is tested by the lab, and in the case that malaria is confirmed, health personnel are notified so that they can locate the patient and begin to administer treatment.

During the health facility interview, respondents in facilities that reported conducting malaria tests were asked who decides whether a patient will receive a diagnostic test for malaria, and could indicate more than one personnel type. Table 6.5 shows that doctors order the test in 40% of primary care facilities and 100% of secondary care facilities, and nurses order the test or take the sample at triage in 20% of secondary care facilities. The “Other” option for primary care units shows that patients request the malaria tests themselves and community health workers (health promoters/ microscopists) can send requests for patients to have malaria tests completed.

Table 6.5: Malaria testing by facility personnel among facilities conducting testing

	N	n	%	95% CI
Primary care units: Who decides whether a patient presenting at this facility will receive a malaria test?				
Nurse at triage or pre-clinic	25	0	0	(-)
Doctor during consult	25	10	40	(22 - 60)
Lab staff or microscopy staff	25	7	28	(14 - 49)
Other	25	13	52	(32 - 71)
Secondary care units: Who decides whether a patient presenting at this facility will receive a malaria test?				
Nurse at triage or pre-clinic	5	1	20	(3 - 71)
Doctor during consult	5	5	100	(-)
Lab staff or microscopy staff	5	0	0	(-)
Other	5	0	0	(-)

Next, respondents were asked to mention what criteria are used to determine whether a patient gets a malaria test, at triage (Table 6.6) and at consult (Table 6.7). The respondent answered with the criteria they use at the facility and the interviewer marked the corresponding options in the survey without reading them aloud. In both triage and consult, high fever was an important criterion that determined testing (100% and 93.3% respectively) and chills was also frequently mentioned (in 100% of facilities at triage). Few respondents mentioned travel history as a determining factor for malaria testing.

Table 6.6: Malaria testing criteria at triage

	N	n	%	95% CI
What criteria must a patient meet in order to get a blood sample taken for malaria test during triage or pre-clinic?				
High fever	1	1	100	(-)
Chills	1	1	100	(-)
General malaise	1	1	100	(-)

Table 6.7: Malaria testing criteria at consultation

	N	n	%	95% CI
What criteria must a patient meet in order for the doctor to order a malaria test during the consultation?				
High fever	15	14	93.3	(63 - 99)
General malaise	15	10	66.7	(40 - 86)
Chills	15	9	60	(34 - 81)
History of recent travel to areas with endemic malaria	15	5	33.3	(14 - 60)
Sweating	15	2	13.3	(3 - 42)
History of recent fever	15	1	6.7	(1 - 37)

	N	n	%	95% CI
Weakness (asthenia or adynamia)	15	1	6.7	(1 - 37)
Other	15	3	20	(6 - 48)

6.3 Fever cases with blood test (LQAS survey)

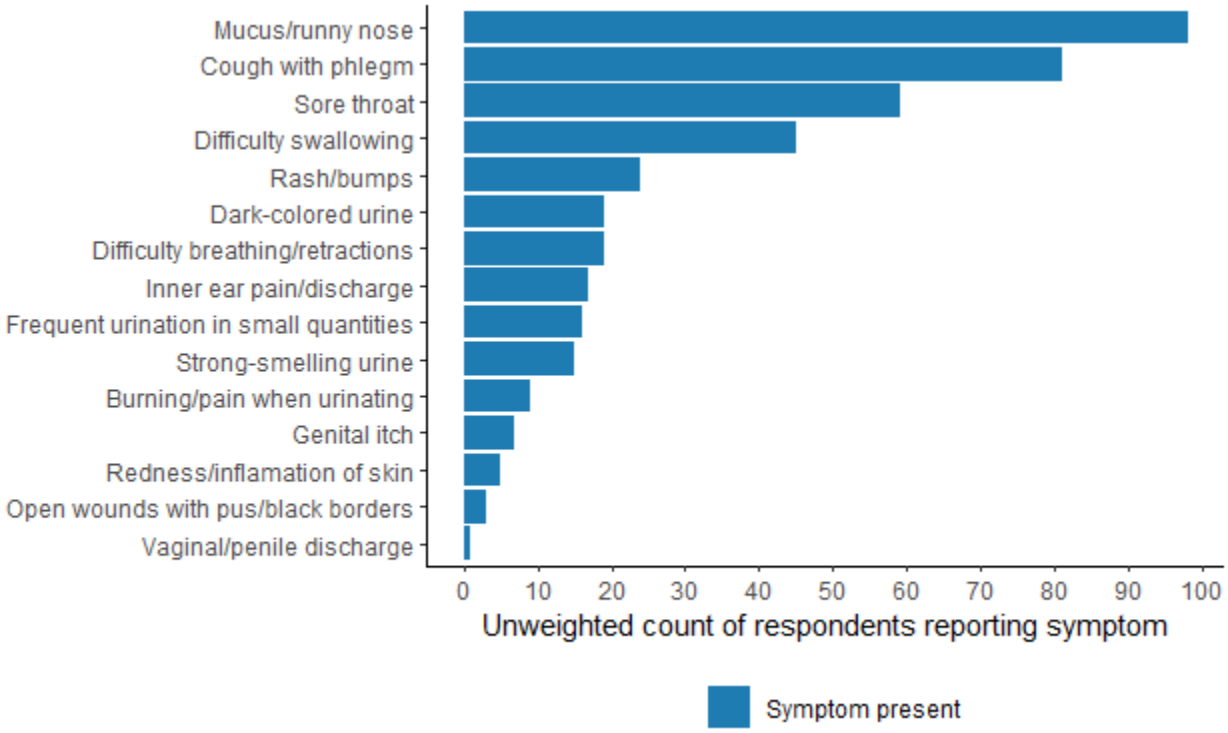
In the community survey (LQAS), interviews with households included questions about history of fever during the two weeks prior to the survey for all usual members of the household. The estimates from the LQAS survey reported in this section are not weighted due to the very small size of the sub-sample of eligible fevers.

If the primary interview respondent reported that a household member had a recent fever, the interviewer asked to speak to the person who had the fever, or in the case that a child or adolescent had a fever, with the child's primary caregiver. If the person with the fever was not available and the primary respondent knew the details of their recent fever, that person was permitted to respond on behalf of the fever patient. The respondent answered questions about other symptoms suffered during the febrile illness and whether and where they sought medical attention. As seen in Table 6.8, 13.7% of the individuals whose households were selected for the LQAS survey experienced a fever during the two weeks prior to the date of the survey. However, not all patients with fever need to be tested for malaria according to suspected case definitions: patients with respiratory symptoms, urinary symptoms, or skin symptoms suggesting an infection unrelated to malaria will receive a clinical diagnosis and treatment without needing to test to rule out malaria. Of the 299 respondents who reported experiencing fever, the majority experienced other symptoms that suggested a condition other than malaria. Only 146 people, or 48.8% of the individuals reporting fever, were free of other symptoms excluding them from having to receive a malaria test. The simultaneous symptoms reported by respondents who experienced a recent fever are detailed in Figure 6.3.

Table 6.8: Eligible fever cases reported in LQAS household survey

	N	n	%	95% CI
LQAS respondents	2255	2255	100	(-)
Fever cases in the last two weeks	2185	299	13.7	(11 - 17)
Fever without exclusion symptoms	299	146	48.8	(42 - 56)

Figure 6.3: Exclusion symptoms experienced by respondents reporting fever



6.3.1 Indicator 2.02: Fever cases with blood test (household)

Because it may be difficult for community members to know or remember which specific blood tests were ordered or carried out by a medical professional they visited, individuals who reported that a blood sample was taken during their illness are considered to have had a malaria test for the purpose of the indicator.

All respondents reporting fever without exclusion symptoms were asked whether, during the illness, a blood sample was taken from their finger, heel, earlobe, or vein. As shown in Table 6.9, 47.2% of respondents with an eligible fever (with no exclusion symptoms) had a blood sample taken.

Table 6.9: Indicator 2.02: Fevers with blood sample

	N	n	%	95% CI
Fever cases in past two weeks	2185	299	13.7	(11 - 17)
Fevers with no exclusion symptoms	299	146	48.8	(42 - 56)
Omitted due to 'do not know' responses	146	2	1.4	(0 - 5)
Fevers with any blood sample	144	68	47.2	(31 - 64)
Capillary blood test	144	63	43.8	(27 - 62)
Venal blood test	144	12	8.3	(4 - 18)

Table 6.10: Indicator 2.02: result by department/ district

	N	n	%	95% CI
Fevers with any blood sample				
Buenaventura	8	0	0	(-)
Chocó	91	56	61.5	(43 - 78)
Nariño	45	12	26.7	(10 - 53)

	N	n	%	95% CI
Total	144	68	47.2	(31 - 64)

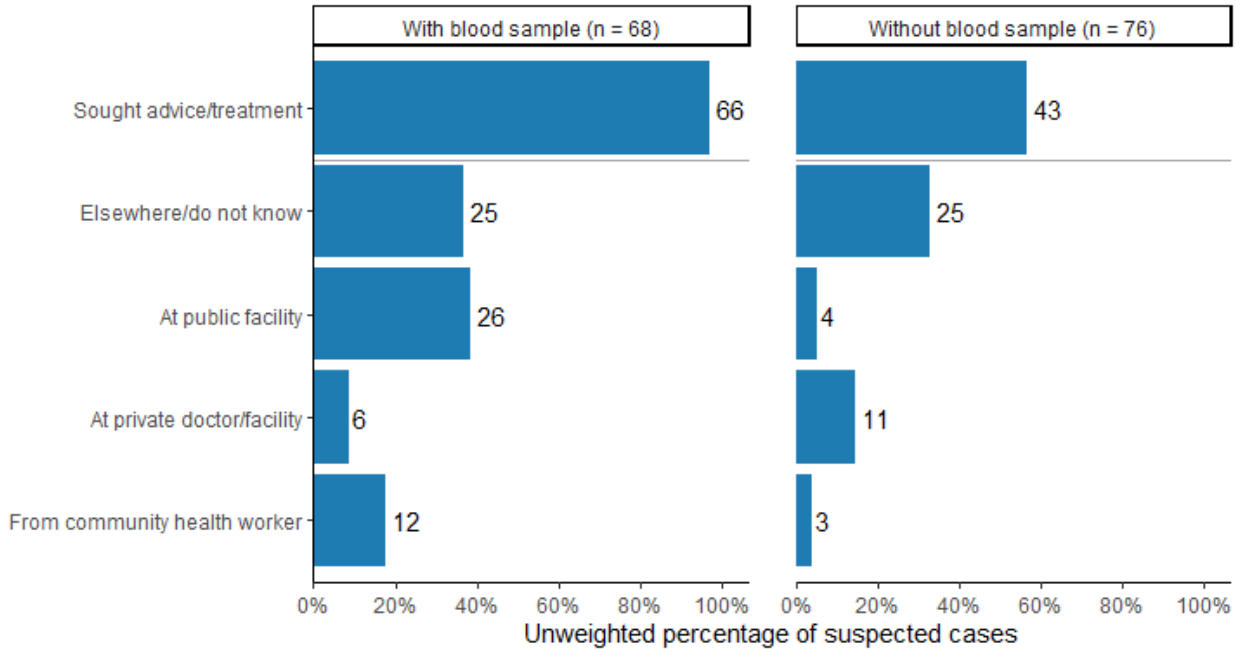
Respondents who reported a blood sample draw were asked whether their blood was tested for malaria, and if so, the result of the test. As seen in Table 6.11, 86.8% of respondents with a blood sample reported a malaria test, and 57.6% of those who had the malaria test reported a positive test result.

Table 6.11: Result of blood tests, LQAS fevers

	N	n	%	95% CI
Blood tested for malaria	68	59	86.8	(63 - 96)
Result of malaria test				
Positive malaria	59	34	57.6	(38 - 75)
Negative malaria	59	25	42.4	(25 - 62)

Figure 6.4 shows care-seeking behavior among respondents with fever. Respondents with fever who reported receiving a blood test are shown in the left panel, and respondents with fever who did not receive a blood test in the right panel. Most of those who received a blood test sought treatment at a public health facility.

Figure 6.4: Treatment sought by respondents with fever cases



The calculation for Indicator 2.02 is presented in Table 6.12 both excluding cases with symptoms suggesting an illness other than malaria (47.2%) and including all fever cases reported from the past two weeks (40.1%).

Table 6.12: Indicator 2.02: Fevers with blood sample, with and without exclusion symptoms

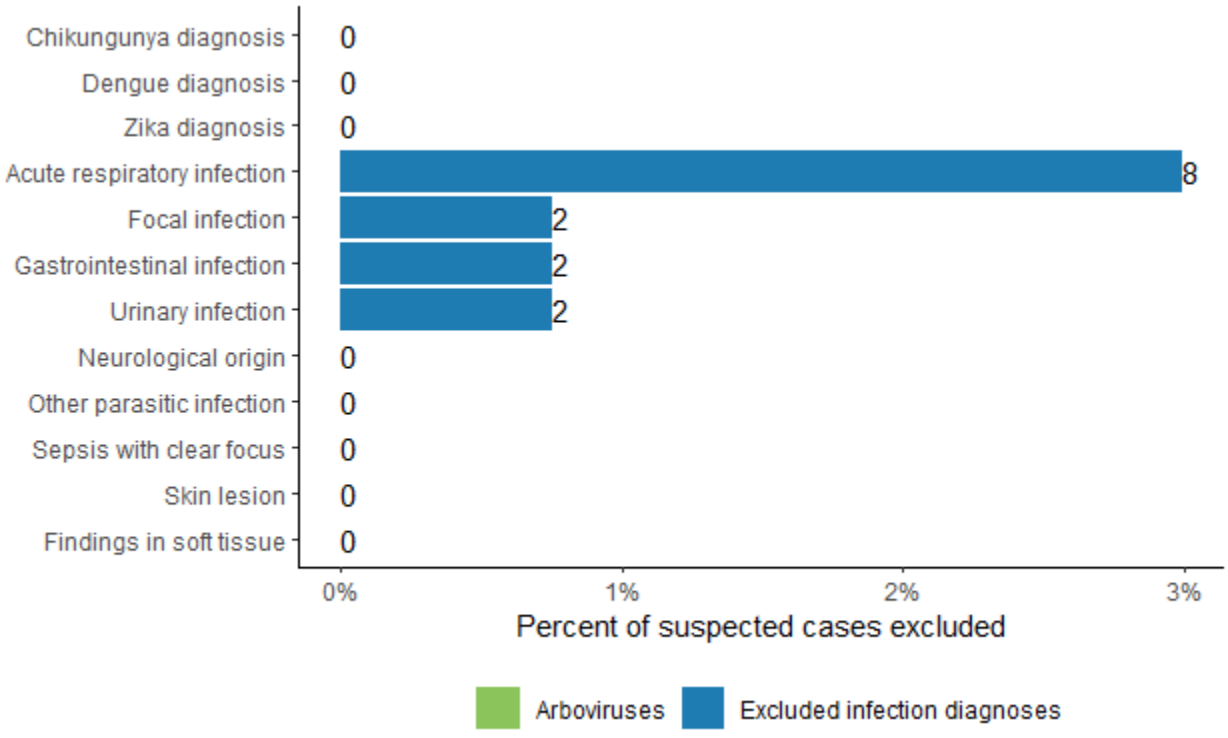
	N	n	%	95% CI
Fevers (with no exclusion symptoms) with any blood sample	144	68	47.2	(31 - 64)
All fevers with any blood sample	297	119	40.1	(29 - 53)

6.4 Suspected malaria cases with parasitological test (medical record review)

For a clinical comparison to the indicator measured in the LQAS survey, the health facility survey included a review of medical records of patients with fever or other malaria symptoms (suspected cases of malaria). In each facility that provided care to patients, field personnel selected eligible patient visits based on attention registries or diagnosis databases according to the process described in Chapter 2 and Appendix C. The eligible time window for review was the calendar year 2018. Suspected cases with an eligible diagnosis or principal complaint (details in Appendix B, Indicator 2.01) were selected at random, and all relevant records of the patient's visit were sought out for completion of a chart review module. For each case, field staff reviewed electronic databases, attention registries, laboratory records, and patient medical records as available and entered information related to the diagnosis, symptoms, and lab tests to the electronic survey module. No information that could identify the patients was collected.

Some of the sampled records were eligible to be selected based on information on the attention registry, such as a primary or initial diagnosis from the inclusion list, but upon review of the full chart, were found to be ineligible due to a diagnosis of another identified infection with clear cause or a diagnosis of arbovirus with a positive viral test result documented. The frequency of diagnoses of exclusion among cases ruled ineligible after sample selection is shown in Figure 6.5. Each of these ineligible records was replaced with an alternate record selected to a back-up sample in order to ensure completion of the total quota for medical record reviews in each facility. In some primary care facilities, field personnel found an inadequate number of eligible attentions from the year 2018 to meet the quota, and all eligible cases from 2018 were reviewed. In other facilities, medical record review could not be completed at all, as previously discussed in Chapter 2.

Figure 6.5: Exclusion diagnoses for review of suspected malaria cases

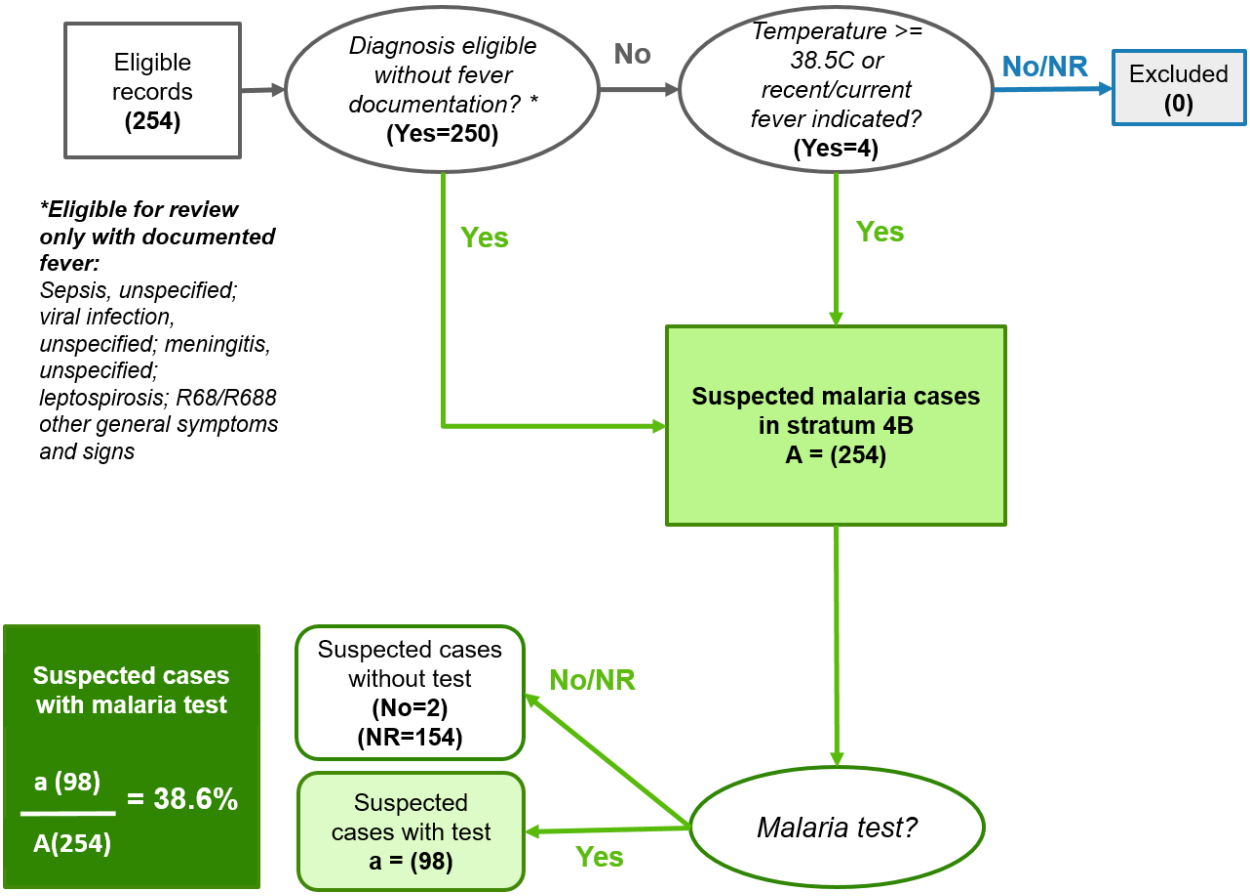


6.4.1 Indicator 2.01: Suspected malaria cases with parasitological test (medical record review)

IHME conducted a second eligibility review of the data collected from medical records in order to identify the cases eligible for inclusion in indicator 2.01 (suspected cases with malaria test) according to a

decision algorithm shown in Figure 6.6. Certain inclusion diagnoses only meet the suspected case definition (that is, malaria should be ruled out before making a clinical diagnosis of another condition) if the patient presented with fever or had a history of recent fever. However, in Colombia, 100% of the suspected cases reviewed were eligible for consideration in indicator 2.01.

Figure 6.6: Eligibility of suspected cases reviewed for Indicator 2.01

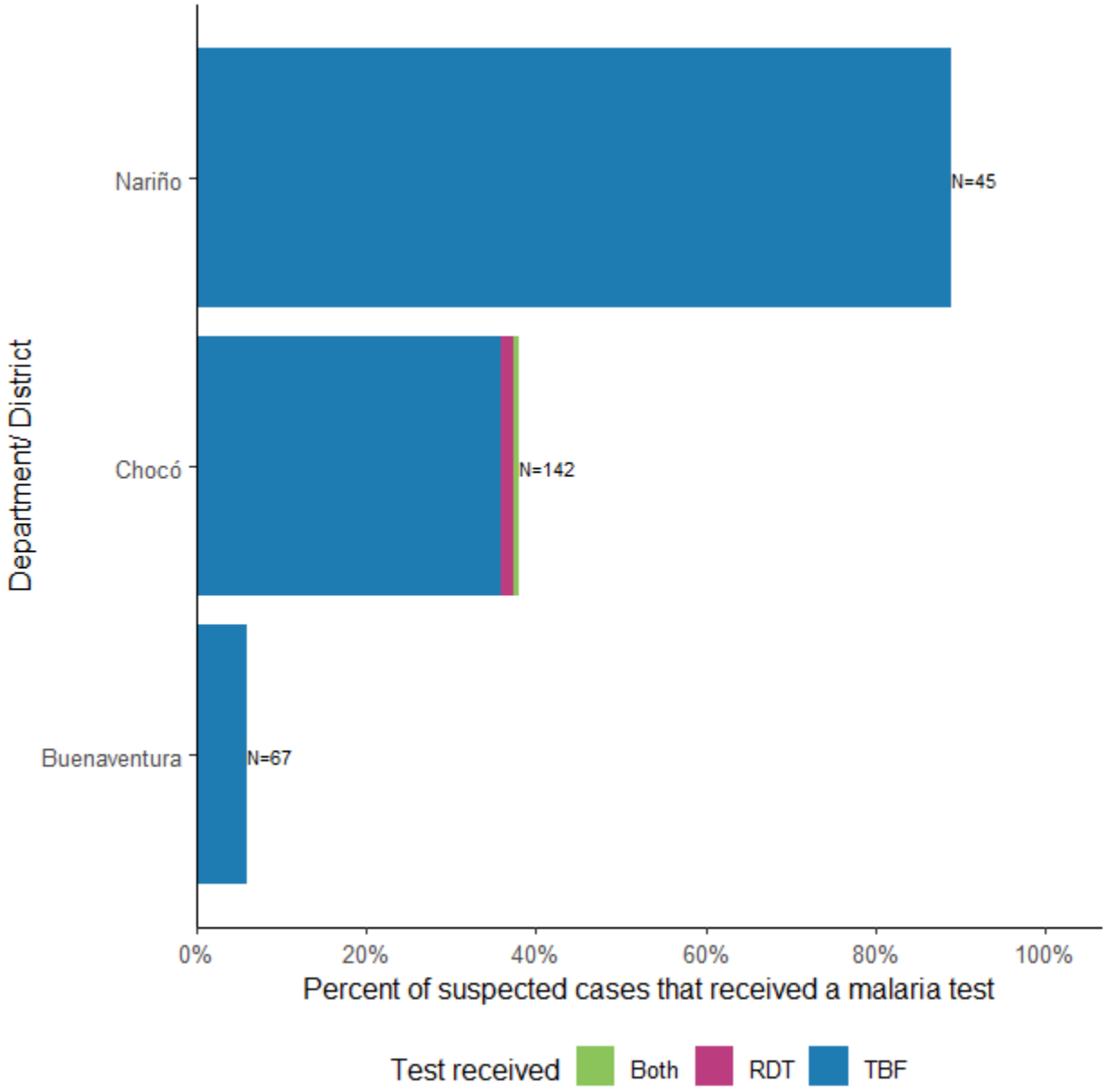


For the purposes of the indicator, cases with evidence that a malaria test was ordered or that a sample was taken, as well as cases with a malaria test result registered, were considered to have had a parasitological test. The test could be a rapid diagnostic test or thick blood film, and some patients had evidence of both tests in the record. As shown in Table 6.13, 38.6% of patients with suspected malaria had evidence that a malaria test was received. Of these 98 patients with evidence of a test, 3.1% received an RDT and 98% a TBF. For comparison, Figure 6.7 shows the results by department/ district. The baseline measurement was not designed to produce representative estimates at the department/ district level, so results by department/ district should be interpreted with discretion.

Table 6.13: Indicator 2.01: Suspected cases with malaria test

	N	n	%	95% CI
Suspected case with malaria test	254	98	38.6	(33 - 45)
Rapid diagnostic test	98	3	3.1	(1 - 9)
Thick blood film	98	96	98	(92 - 99)

Figure 6.7: Comparison: result by department/ district



6.5 Malaria diagnosis (medical record review)

Early diagnosis of malaria is essential to interrupt transmission in a timely manner and to ensure the patient receives treatment before illness becomes more severe or complicated. The health facility survey included a record review of confirmed malaria cases. At primary care facilities, hospitals, and ETV units selected to the sample, field personnel attempted to review all paper records of confirmed malaria cases from the year 2018 stored at those units as described in Chapter 2. All case records that were stored on-site were sought out and considered for the review. Table 6.15 shows the type of unit where records for confirmed malaria cases were found within each department. It was expected that all UPGD facilities (public and private) and ETV units would have confirmed malaria cases to review, but only one private facility in each department had paper reports available. Confirmed case reports were not available at the

two completed local ETV units because confirmed cases found by ETV employees in the community were sent directly to the municipal health authority and not stored in the ETV unit itself. Other units that were recorded as UPGD units did not have malaria diagnostic capabilities or did not store the paper confirmed case forms on site, but sent to their municipal health authority.

Figure 6.8 shows that the majority of confirmed malaria case reviews used the SIVIGILA #465 case notification form. An example of this form is shown in Figure 6.9 for reference of the content included from this data source.

Table 6.15: Confirmed malaria cases reviewed by facility type and department/ district

Type of unit	Buenaventura	Chocó	Nariño
Primary care facility (private)	0	77*	0
Private laboratory	0	0	1
Hospital (private)	25	0	0

*All observed records were individual case notification reports, except for one confirmed case in Chocó, which was captured using the patient's medical record.

Figure 6.8: Sources of confirmed case medical record review

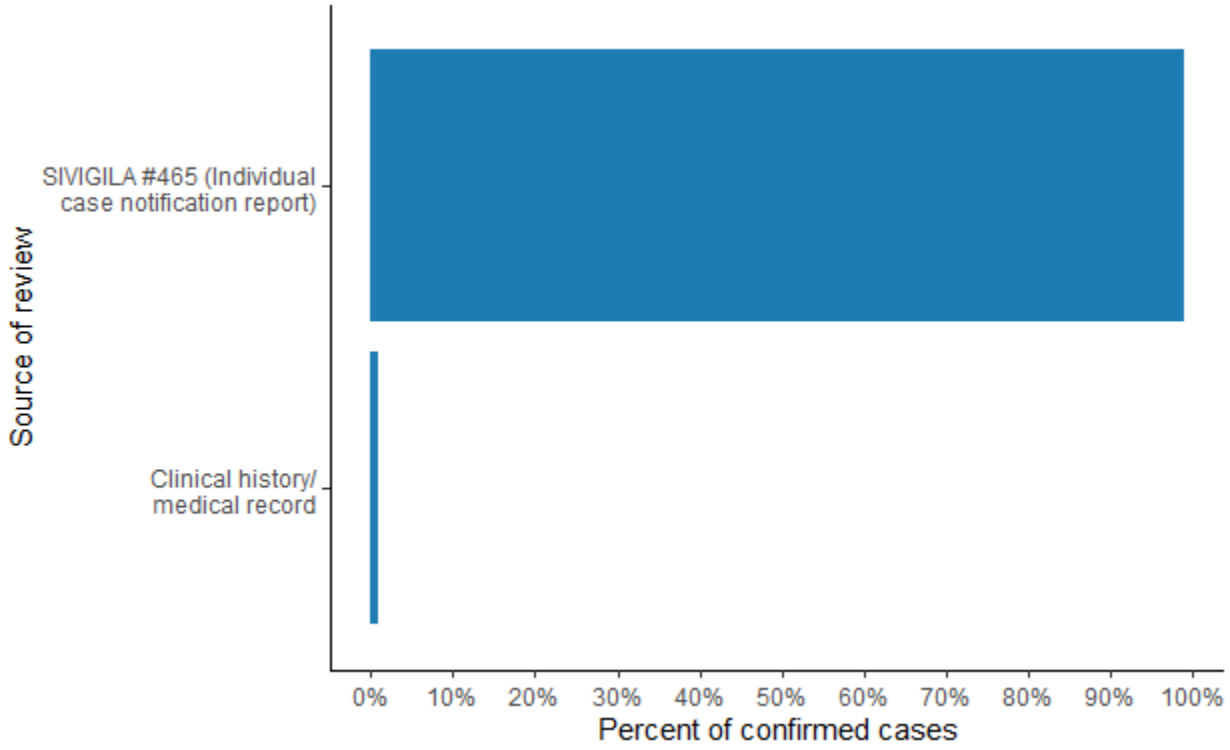
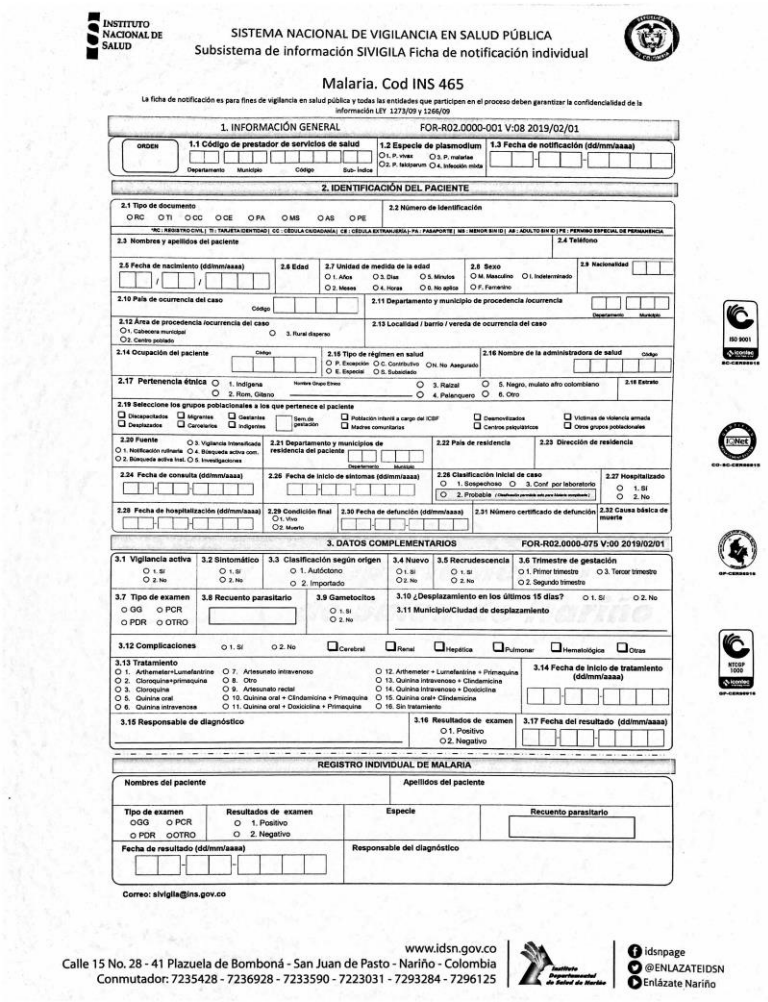


Figure 6.9: SIVIGILA #465 blank case notification form



INSTITUTO NACIONAL DE SALUD

SISTEMA NACIONAL DE VIGILANCIA EN SALUD PÚBLICA
Subsistema de información SIVIGILA Ficha de notificación individual

Malaria. Cod INS 465

La ficha de notificación es para fines de vigilancia en salud pública y todas las entidades que participen en el proceso deben garantizar la confidencialidad de la información LEY 1273/09 y 1266/09

1. INFORMACIÓN GENERAL — FOR-R02.0000-001 V:08 2019/02/01

ORDEN

1.1 Código de prestador de servicios de salud — Departamento | Municipio | Código | Sub- Índice

1.2 Especie de plasmodium
O 1. P. vivax O 3. P. malariae
O 2. P. falciparum O 4. Infección mixta

1.3 Fecha de notificación (dd/mm/aaaa)

2. IDENTIFICACIÓN DEL PACIENTE

2.1 Tipo de documento
O RC O TI O CC O CE O PA O MS O AS O PE

2.2 Número de identificación

*RC : REGISTRO CIVIL | TI : TARJETA IDENTIDAD | CC : CÉDULA CIUDADANÍA | CE : CÉDULA EXTRANJERÍA | PA : PASAPORTE | MS : MENOR SIN ID | AS : ADULTO SIN ID | PE : PERMISO ESPECIAL DE PERMANENCIA

2.3 Nombres y apellidos del paciente

2.4 Teléfono

2.5 Fecha de nacimiento (dd/mm/aaaa)

2.6 Edad

2.7 Unidad de medida de la edad
O 1. Años O 3. Días O 5. Minutos
O 2. Meses O 4. Horas O 6. No aplica

2.8 Sexo
O M. Masculino O I. Indeterminado
O F. Femenino

2.9 Nacionalidad

2.10 País de ocurrencia del caso — Código

2.11 Departamento y municipio de procedencia /ocurrencia — Departamento | Municipio

2.12 Área de procedencia /ocurrencia del caso
O 1. Cabecera municipal
O 2. Centro poblado
O 3. Rural disperso

2.13 Localidad / barrio / vereda de ocurrencia del caso

2.14 Ocupación del paciente — Código

2.15 Tipo de régimen en salud
O P. Excepción O C. Contributivo O N. No Asegurado
O E. Especial O S. Subsidiado

2.16 Nombre de la administradora de salud — Código

2.17 Pertenencia étnica
O 1. Indígena — Nombre Grupo Etnico
O 2. Rom, Gitano
O 3. Raizal
O 4. Palenquero
O 5. Negro, mulato afro colombiano
O 6. Otro

2.18 Estrato

2.19 Seleccione los grupos poblacionales a los que pertenece el paciente
Discapacitados | Migrantes | Gestantes | Sem.de gestación | Población infantil a cargo del ICBF | Desmovilizados | Víctimas de violencia armada
Desplazados | Carcelarios | Indígenas | Madres comunitarias | Centros psiquiátricos | Otros grupos poblacionales

2.20 Fuente
O 1. Notificación rutinaria O 3. Vigilancia intensificada O 4. Búsqueda activa com. O 5. Investigaciones
O 2. Búsqueda activa Inst.

2.21 Departamento y municipios de residencia del paciente — Departamento | Municipio

2.22 País de residencia

2.23 Dirección de residencia

2.24 Fecha de consulta (dd/mm/aaaa)

2.25 Fecha de inicio de síntomas (dd/mm/aaaa)

2.26 Clasificación inicial de caso
O 1. Sospechoso O 3. Conf por laboratorio
O 2. Probable

2.27 Hospitalizado
O 1. SI
O 2. No

2.28 Fecha de hospitalización (dd/mm/aaaa)

2.29 Condición final
O 1. Vivo
O 2. Muerto

2.30 Fecha de defunción (dd/mm/aaaa)

2.31 Número certificado de defunción

2.32 Causa básica de muerte

3. DATOS COMPLEMENTARIOS — FOR-R02.0000-075 V:00 2019/02/01

3.1 Vigilancia activa
O 1. SI
O 2. No

3.2 Sintomático
O 1. SI
O 2. No

3.3 Clasificación según origen
O 1. Autóctono
O 2. Importado

3.4 Nuevo
O 1. SI
O 2. No

3.5 Recrudescencia
O 1. SI
O 2. No

3.6 Trimestre de gestación
O 1. Primer trimestre O 3. Tercer trimestre
O 2. Segundo trimestre

3.7 Tipo de examen
O GG O PCR
O PDR O OTRO

3.8 Recuento parasitario

3.9 Gametocitos
O 1. SI
O 2. No

3.10 ¿Desplazamiento en los últimos 15 días? O 1. SI O 2. No

3.11 Municipio/Ciudad de desplazamiento

3.12 Complicaciones O 1. SI O 2. No — Cerebral | Renal | Hepática | Pulmonar | Hematológica | Otras

3.13 Tratamiento
O 1. Artemeter+Lumefantrine
O 2. Cloroquina+primaquina
O 3. Cloroquina
O 5. Quinina oral
O 6. Quinina intravenosa
O 7. Artesunato intravenoso
O 8. Otro
O 9. Artesunato rectal
O 10. Quinina oral + Clindamicina + Primaquina
O 11. Quinina oral + Doxiciclina + Primaquina
O 12. Arthemeter + Lumefantrine + Primaquina
O 13. Quinina intravenoso + Clindamicina
O 14. Quinina Intravenoso + Doxiciclina
O 15. Quinina oral+ Clindamicina
O 16. Sin tratamiento

3.14 Fecha de inicio de tratamiento (dd/mm/aaaa)

3.15 Responsable de diagnóstico

3.16 Resultados de examen
O 1. Positivo
O 2. Negativo

3.17 Fecha del resultado (dd/mm/aaaa)

REGISTRO INDIVIDUAL DE MALARIA

Nombres del paciente

Apellidos del paciente

Tipo de examen
OGG O PCR
O PDR OOTRO

Resultados de examen
O 1. Positivo
O 2. Negativo

Especie

Recuento parasitario

Fecha de resultado (dd/mm/aaaa)

Responsable del diagnóstico

Correo: sivigila@ins.gov.co

www.idsn.gov.co
Calle 15 No. 28 - 41 Plazuela de Bomboná - San Juan de Pasto - Nariño - Colombia
Conmutador: 7235428 - 7236928 - 7233590 - 7223031 - 7293284 - 7296125

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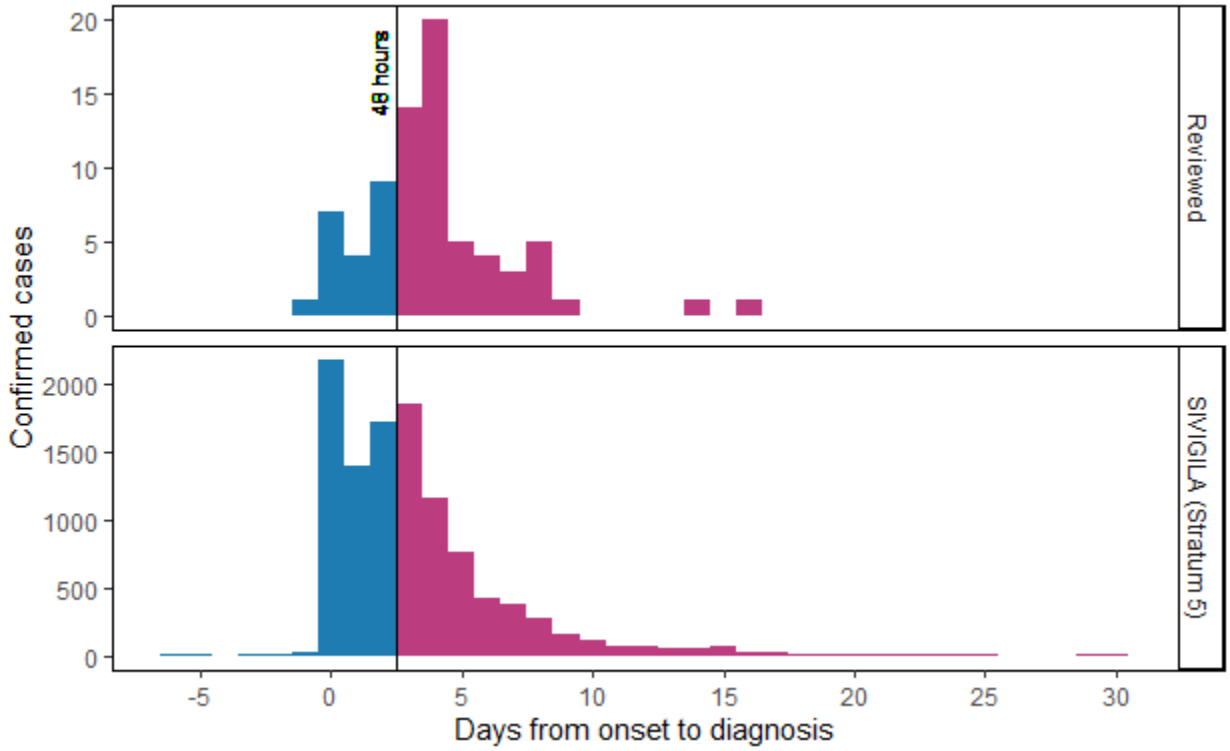
@ENLAZATEIDSN
Enlázate Nariño

The SIGIVILA #465 reports reviewed during baseline data collection were the original paper reports. These paper reports were completed while the patient was receiving care and later the data were entered into the national surveillance database, SIVIGILA. All confirmed cases of malaria within Colombia follow this process. IHME was provided the de-identified SIVIGILA database for 2018 confirmed cases of malaria within the RMEI study area by the Colombia Ministry of Health. When possible, this SIVIGILA database data are shown in comparison to the data collected by field staff during RMEI baseline data collection. To make the SIVIGILA data more comparable to the collected RMEI baseline data, only SIVIGILA cases from 2018 in stratum 5 were used in analyses.

As a part of each record review module, field staff recorded the date of symptom onset, date of fever onset, and date of diagnosis from the SIVIGILA #465 form. Figure 6.10 shows the number of days from fever onset (or onset of other malaria symptoms, if date of fever onset was not recorded) to the date of diagnosis in the RMEI collected data and in the 2018 SIVIGILA database. If diagnosis was recorded more than seven days before or more than 30 days after fever onset, the case is excluded from the indicator because of the suspicion of recording error (on the notification form or in the survey module). This suspected error affected 3 cases from the RMEI collected data and 173 cases from the SIVIGILA data which are excluded from the figure. In 1 case, diagnosis was recorded before symptom onset which is a plausible scenario for cases tested through active case detection or for other reasons where testing was recommended before symptoms presented. The SIVIGILA data shows a larger proportion of cases with a smaller window between symptom onset and diagnosis than what was reviewed on paper.

Figure 6.10: Time from symptom onset to diagnosis, reviewed and SIVIGILA



The personnel who performed the diagnosis of the reviewed confirmed malaria cases are reported in Table 6.16 (diagnosis by RDT) and Table 6.17 (diagnosis by TBF). Many reports did not have the personnel recorded (36.8% for records with TBF diagnosis). The personnel most commonly recorded as collecting a RDT were microscopists (100%). The personnel most commonly recorded as preparing TBFs were lab technicians/ microbiologists/ bacteriologists (36.8%) and microscopists (29.5%).

Table 6.16: Personnel who performed diagnosis of confirmed cases, RDT

	N	n	%	95% CI
Who took the RDT?				
Microscopist	2	2	100	(-)

Table 6.17: Personnel who performed diagnosis of confirmed cases, TBF

	N	n	%	95% CI
Who took the TBF?				
Not registered	95	35	36.8	(28 - 47)
Lab tech/ microbiologist/ bacteriologist	95	31	32.6	(24 - 43)
Microscopist	95	28	29.5	(21 - 40)
Other	95	1	1.1	(0 - 7)

6.5.1 Indicator 4.02: Time to diagnosis for confirmed cases (medical record review)

Diagnosis within two days (48 hours) of symptom onset was negotiated as an indicator for RMEI. As shown in Table 6.18, 75% of confirmed case records in Colombia had both fever/symptom onset and diagnosis dates registered. Only 21% were diagnosed within 48 hours of fever/symptom onset, and 8% were diagnosed more than a week after fever/symptom onset.

Table 6.18: Indicator 4.02: Fever/symptom onset to diagnosis within 48 hours

	N	n	%	95% CI
Total confirmed malaria cases	103	103	100	(-)
Excluded due to suspected inscription/data entry error (<-7 day or >30 day window)	103	3	2.9	(1 - 9)
Denominator: Confirmed cases with valid dates	100	100	100	(-)
Fever/symptom onset date registered	100	98	98	(92 - 100)
Diagnosis date registered	100	76	76	(67 - 83)
Both dates registered	100	75	75	(65 - 83)
Diagnosis before onset (presumptive)	100	1	1	(0 - 7)
Cases diagnosed within 48 hours of onset	100	21	21	(14 - 30)
3 days	100	14	14	(8 - 22)
4-5 days	100	25	25	(17 - 35)
6-7 days	100	7	7	(3 - 14)
Over 7 days	100	8	8	(4 - 15)
Indicator result: Cases diagnosed within 48 hours of onset	100	21	21	(14 - 30)

Figure 6.11 shows the same indicator results in a graphic format, with both RMEI collected data and SIVIGILA data. The data provided from the SIVIGILA database had significantly fewer dates missing, a smaller proportion of cases excluded due to suspected date error, and a notably higher proportion of cases were diagnosed within 48 hours of onset of symptoms. This result is contrary to our expectation that cases from the few facilities where we were able to review confirmed cases should have been managed better than average, because they were urban facilities serving patients with easier access to care.

Figure 6.11: Indicator 4.02: Cases categorized, reviewed and SIVIGILA

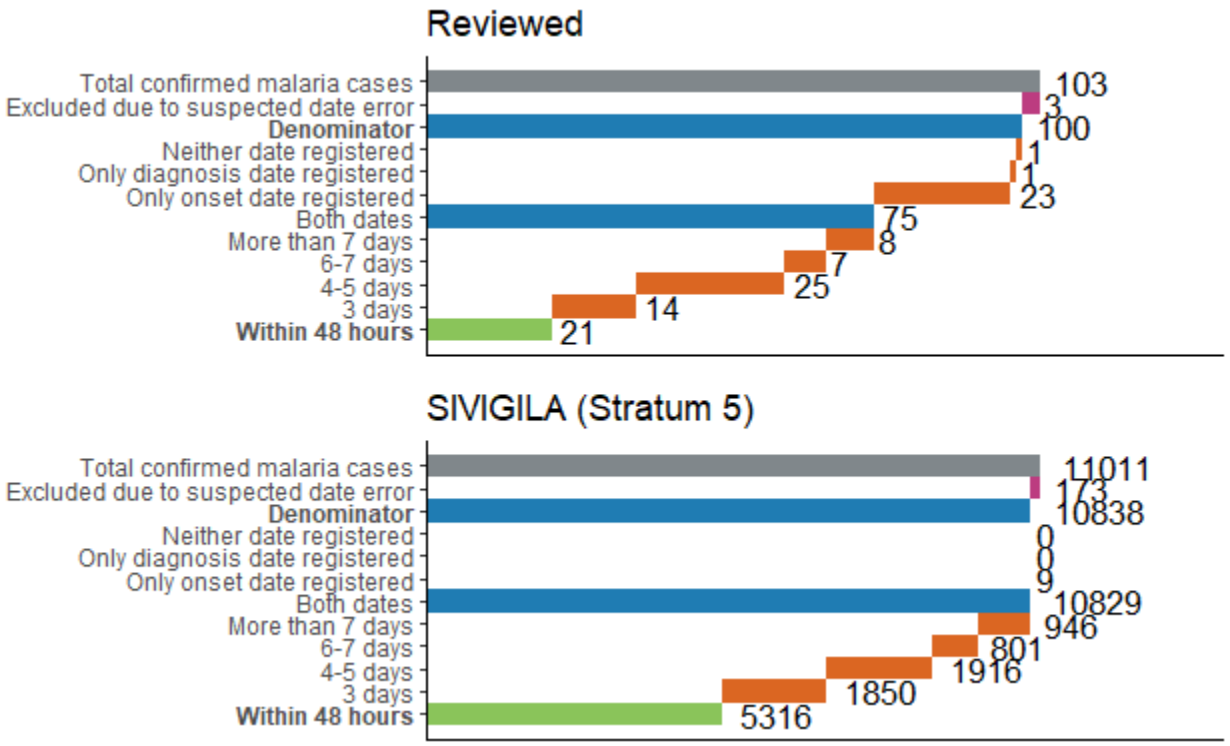


Table 6.19 shows the indicator by diagnosis type. Cases diagnosed by TBF (28%) were more likely to be diagnosed within 48 hours of symptom onset.

Table 6.19: Comparison: result by diagnosis test

	N	n	%	95% CI
Diagnosis within 48 hours of symptom onset				
RDT	1	0	0	(-)
TBF	75	21	28	(19 - 39)
No test date registered	24	0	0	(-)
Total	100	21	21	(14 - 30)

6.5.2 Case detection and classification

Early diagnosis of malaria is dependent on the person with fever and whether they seek care with medical personnel. If the person has minimal or no knowledge of malaria or cannot easily access a health facility, they may not seek care in a timely manner. In Colombia, health facility workers and ETV personnel may actively search for malaria cases in the community, rather than wait for patients with symptoms to come into health facilities. This can be a routine activity (active search) or in response to a confirmed case of malaria (reactive search).

During the confirmed case medical record review, field personnel reviewed 103 cases, of which 94 were detected passively, one was detected during active search, one was detected during routine surveillance activities, and seven did not have the source of the case registered (Table 6.20). We expected to find confirmed cases from active case detection at the local ETV offices, but the paper forms were no longer stored there. Thus, our sample consists primarily of confirmed cases found at primary and secondary care units where passive case detection is more common. The SIVIGILA data showed 39.7% of cases detected through active search.

A malaria case can be classified based on where the patient likely contracted the disease. Cases that are classified as autochthonous, or locally transmitted, were likely contracted within the patient's community and other community members are at higher risk for infection.

According to the case notification forms, 56.3% of malaria cases were autochthonous to Colombia (Table 6.21). The SIVIGILA data reported a higher percentage of autochthonous cases (92.1%), which was likely due to data being updated in the SIVIGILA database after investigations were completed by ETV personnel.

Table 6.20: Source of confirmed case detection

	N	n	%	95% CI
Reviewed: Case detection source				
Passive search	103	94	91.3	(84 - 95)
Surveillance	103	1	1	(0 - 7)
Active search	103	1	1	(0 - 7)
Not registered	103	7	6.8	(3 - 14)
National Malaria Database: Case detection source				
Passive search	11268	6799	60.3	(59 - 61)
Active search	11268	4469	39.7	(39 - 41)

Table 6.21: Classification of confirmed malaria cases

Classification	#	%
Reviewed		
Autochthonous/indigenous/local	58	56.3%
Imported	39	37.9%
Not registered	6	5.8%
Total cases	103	
National Malaria Database		
Autochthonous/indigenous/local	10374	92.1%
Imported	894	7.9%
Total cases	11268	

6.5.3 Indicator E2.04: Time to notification for confirmed cases (medical record review)

Notification within 24 hours of diagnosis was negotiated as an indicator for RMEI. All confirmed cases of malaria were expected to have a notification report, but as shown in Figure 6.12 not all collected cases had a reviewed notification form and not all notification forms had a date recorded for when notification occurred. Cases without notification date registered were not considered to have been notified within 24 hours. As shown in Table 6.22, 64.1% of confirmed case records in Colombia had both diagnosis and notification dates registered. Only 41.6% were notified within 24 hours of diagnosis.

Figure 6.12: Confirmed cases: source of notification information

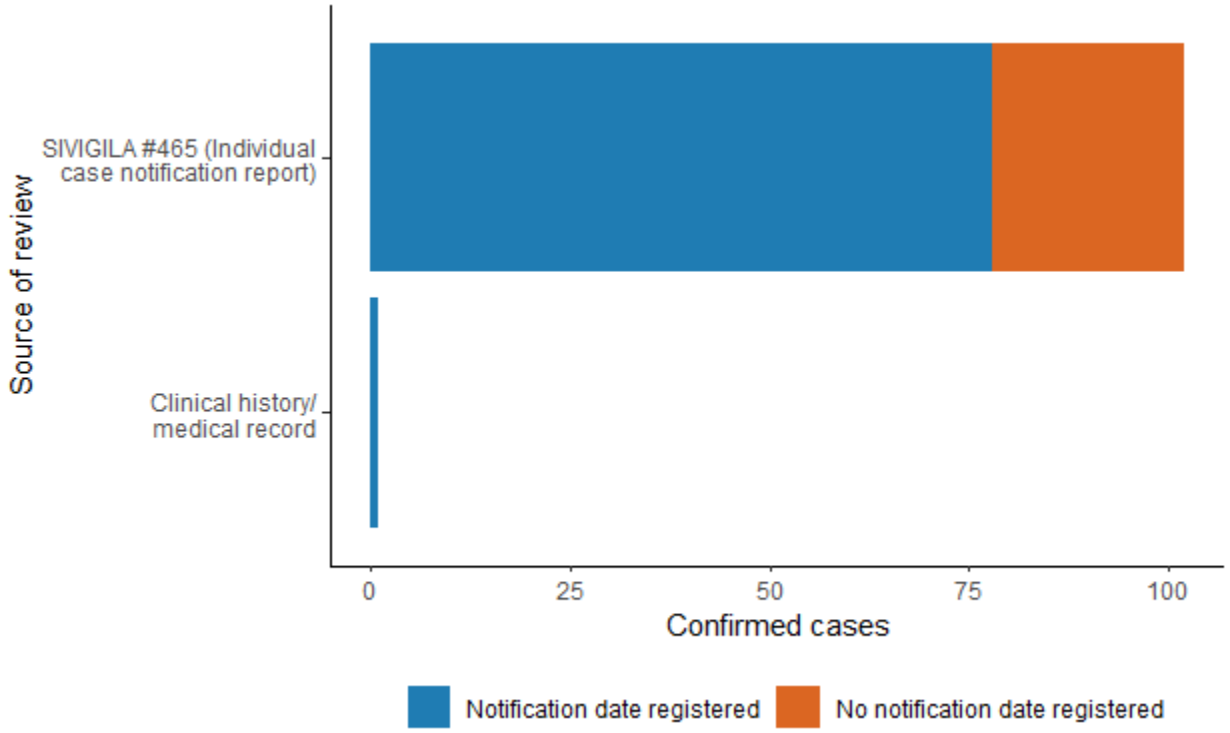


Table 6.22: Indicator E2.04: Notification within 24 hours of diagnosis

	N	n	%	95% CI
Diagnosis date registered	103	79	76.7	(67 - 84)
Notification date registered	103	79	76.7	(67 - 84)
Both dates registered	103	66	64.1	(54 - 73)
Excluded due to suspected inscription/data entry error (<-7 day or >30 day window)	103	2	1.9	(0 - 8)
Notification within 24 hours of diagnosis	101	42	41.6	(32 - 52)

Chapter 7: Malaria treatment

In Colombia, routine malaria treatment is managed by the health facility where diagnosis occurred. Supervision of ingestion of all doses is not the norm in Colombia due to the large amount of cases seen in the country. Normally the first dose is supervised when a positive diagnosis is made, but the patient is given the rest of the malaria medication to take at home unsupervised. Occasionally the patient may be expected to visit a nearby health facility in order to receive medication if there is concern the patient does not understand the instructions about dosage and timing or there is concern the patient may not complete the full course of treatment. The patient may be admitted to the hospital for treatment if they have severe or complicated malaria. The survey results in the following sections align to some extent with these expectations, though they suggest substantial variation in administration and supervision practices by facilities (or at least in knowledge of standard practices by personnel in health facilities that may diagnose malaria cases infrequently).

7.1 Treatment administration practices

The health facility interview includes questions about malaria service provision (in all health facilities and department/ district ETV units). Respondents listened to the list of activities shown in Table 7.1 and were asked to indicate whether personnel at the facility provide each service (yes or no). Many facilities reported that they prescribe treatment via their own pharmacies (35.3% of primary care facilities), supervise treatment at the facility (32.4% of primary care facilities), and visit or call to ensure medication has been taken (23.5% of primary care facilities). “Other” responses received for this question include primary health units determining whether supervision is needed based on how the patient takes the first dose, secondary care units supervising all doses when the patient is from outside the community, and ETV units giving malaria medications to community health workers who visit the patient at home to give all medication and supervise the first dose.

Table 7.1: Services provided by facilities for malaria treatment

	N	n	%	95% CI
Primary care units: Services provided for malaria treatment				
Prescribe treatment to pharmacy at this facility	34	12	35.3	(21 - 53)
Provide prescription to external pharmacy	34	1	2.9	(0 - 19)
Give medication to take at home (unsupervised)	34	8	23.5	(12 - 41)
Supervise ingestion (in the facility)	34	11	32.4	(18 - 50)
Supervise ingestion (in the community)	34	5	14.7	(6 - 32)
Call or visit the home to ask if treatment was taken (without supervising ingestion)	34	8	23.5	(12 - 41)
None of the above	34	14	41.2	(26 - 59)
Other	34	3	8.8	(3 - 25)
Secondary care units: Services provided for malaria treatment				
Prescribe treatment to pharmacy at this facility	5	5	100	(-)
Give medication to take at home (unsupervised)	5	4	80	(29 - 97)
Supervise ingestion (in the facility)	5	4	80	(29 - 97)
Supervise ingestion (in the community)	5	1	20	(3 - 71)
Call or visit the home to ask if treatment was taken (without supervising ingestion)	5	1	20	(3 - 71)
Department/ district ETV units: Services provided for malaria treatment				
Prescribe treatment to pharmacy at this facility	3	1	33.3	(4 - 86)

	N	n	%	95% CI
Give medication to take at home (unsupervised)	3	1	33.3	(4 - 86)
Supervise ingestion (in the facility)	3	1	33.3	(4 - 86)
Supervise ingestion (in the community)	3	1	33.3	(4 - 86)
Call or visit the home to ask if treatment was taken (without supervising ingestion)	3	1	33.3	(4 - 86)
None of the above	3	1	33.3	(4 - 86)
Other	3	1	33.3	(4 - 86)

If the respondent reported that personnel supervise ingestion in-facility, the interviewer asked how many doses are supervised at the facility. At 25% of facilities that supervise treatment regardless of type, all doses are supervised at the facility, and at 68.7% of these facilities only the first dose is supervised in-facility (Table 7.2). Respondents at facilities that supervise some but not all doses in-facility were asked who is responsible for administering the remaining doses (medication was prescribed to the patient to take at home in 100% of cases).

Table 7.2: Doses supervised in-facility

	N	n	%	95% CI
Doses supervised in-facility				
Only the first dose	16	11	68.7	(42 - 87)
Only some doses	16	1	6.3	(1 - 35)
All doses	16	4	25	(9 - 52)

Table 7.3: Personnel responsible for subsequent administrations

	N	n	%	95% CI
Administration of subsequent doses				
Patient was prescribed medication to take at home	12	12	100	(-)
Treatment is supervised at the patient's home by health facility personnel	12	0	0	(-)
Treatment is administered by vector control personnel at the patient's home	12	0	0	(-)
Treatment is administered by health promoter/community health workers at the patient's home	12	0	0	(-)
Other	12	0	0	(-)

All facilities that provide malaria care were asked if personnel ever administer malaria treatment before a positive test result, and all replied that they do not. Respondents reported that community personnel do not administer presumptive treatment, either (Table 7.4).

Table 7.4: Presumptive treatment

	N	n	%	95% CI
Do clinical staff in this facility ever give antimalarial treatment for suspected malaria without waiting for a positive malaria test result? (Among facilities that provide treatment services on-site)	27	0	0	(-)
Do community health workers (health promoters/ microscopists) or vector control personnel associated with this facility ever treat suspected malaria without waiting for a positive malaria test result? (Among all facilities excluding national lab)	16	0	0	(-)

7.2 Storage and stock of antimalarial medications

The health facility survey included an observation of antimalarial medications in stock on the day of the survey and of stock records for the three months prior (in all health facilities and department/ district ETV units). First, the respondent (typically the pharmacist or pharmacy technician) was asked if the facility routinely stocks any antimalarial medications. As shown in Table 7.5, 51.4% of primary care facilities, 100% of secondary care facilities, and 100% of department/ district ETV units reported stock of antimalarials. One ETV unit did not complete the observation module before data collection was suspended, so antimalarial information was not collected and that unit is not included in the table.

Table 7.5: Facility types reporting stock of antimalarials

	N	n	%	95% CI
Facilities reporting antimalarial stock in past 3 months				
Primary care units	35	18	51.4	(35 - 68)
Secondary care units	5	5	100	(-)
Department/ district ETV units	2	2	100	(-)

Next, the respondent was asked to respond whether or not the facility stocks each of a list of antimalarial medications including those shown in Table 7.6. Among the facilities that reported stocking any antimalarials, the most common pharmaceuticals were chloroquine (94.4% of primary care facilities, 80% of secondary care facilities, and 100% of administrative units with any antimalarials), primaquine (88.9% of primary care facilities, 100% of secondary care facilities, and 100% of administrative units with any antimalarials) and artemisinin (artemether + lumefantrine) tablets (72.2% of primary care facilities, 100% of secondary care facilities, and 100% of administrative units with any antimalarials). Any drugs that were reported to be stocked were then sought for observation by survey personnel. The drug presentation was registered and the surveyor checked the expiration date to see if at least one dose of the medication was valid on the day of the survey. As seen in Table 7.7, no doses or only expired doses of chloroquine were observed in 4.3% of primary care facilities that stock chloroquine, no doses or only expired doses of primaquine were observed in 4.3% of primary care facilities that stock primaquine, and no doses or only expired doses of artemisinin (artemether + lumefantrine) tablets were observed in 5% of primary care facilities that stock artemisinin (artemether + lumefantrine) tablets, suggesting maintaining supply or replacing expired stock of first-line malarial medications is not a major challenge in Colombia.

Table 7.6: Reported stock of antimalarials

	N	n	%	95% CI
Primary care units				
Has this facility stocked any antimalarials for at least one day over the past three months?	35	18	51.4	(35 - 68)
Chloroquine	18	17	94.4	(68 - 99)
Primaquine	18	16	88.9	(63 - 97)
Artemisinin (Artemether + Lumefantrine tablets (ex. Coartem))	18	13	72.2	(47 - 88)
Artesunate	18	2	11.1	(3 - 37)
Amodiaquine	18	1	5.6	(1 - 32)
Fansidar/SP Fansidar/SP [Sulfadoxine (500mg) + Pyrimethamine (25mg)]	18	1	5.6	(1 - 32)
Sulfadoxine	18	1	5.6	(1 - 32)
Pyrimethamine	18	2	11.1	(3 - 37)
Quinine	18	2	11.1	(3 - 37)
Artemether injection	18	2	11.1	(3 - 37)
Secondary care units				
Has this facility stocked any antimalarials for at least one day over the past three months?	5	5	100	(-)

	N	n	%	95% CI
Chloroquine	5	4	80	(29 - 97)
Primaquine	5	5	100	(-)
Artemisinin (Artemether + Lumefantrine tablets (ex. Coartem))	5	5	100	(-)
Artesunate	5	3	60	(19 - 91)
Sulfadoxine	5	1	20	(3 - 71)
Pyrimethamine	5	1	20	(3 - 71)
Quinine	5	2	40	(9 - 81)
Artemether injection	5	2	40	(9 - 81)
Quinine Dihydrochloride	5	1	20	(3 - 71)
Department/ district ETV units & Reference labs				
Has this facility stocked any antimalarials for at least one day over the past three months?	2	2	100	(-)
Chloroquine	2	2	100	(-)
Primaquine	2	2	100	(-)
Artemisinin (Artemether + Lumefantrine tablets (ex. Coartem))	2	2	100	(-)
Artesunate	2	2	100	(-)
Quinine	2	1	50	(5 - 95)
Mefloquine	2	1	50	(5 - 95)

Table 7.7: Antimalarials observed in facility, among those reporting stock

	N	n	%	95% CI
Chloroquine tablets observed				
At least one observed and valid	23	22	95.7	(73 - 99)
Not observed	23	1	4.3	(1 - 27)
Primaquine tablets observed				
At least one observed and valid	23	22	95.7	(73 - 99)
Not observed	23	1	4.3	(1 - 27)
Artemisinin (Artemether + Lumefantrine tablets (ex. Coartem)) tablets observed				
At least one observed and valid	20	19	95	(70 - 99)
Not observed	20	1	5	(1 - 30)
Artesunate tablets observed				
At least one observed and valid	7	3	42.9	(14 - 78)
Not observed	7	2	28.6	(7 - 69)
At least one observed, but none valid	7	2	28.6	(7 - 69)
Artesunate suppositories observed				
Not observed	7	4	57.1	(22 - 86)
At least one observed, but none valid	7	2	28.6	(7 - 69)
At least one observed and valid	7	1	14.3	(2 - 60)
Injectable artesunate observed				
At least one observed and valid	7	5	71.4	(31 - 93)
Not observed	7	1	14.3	(2 - 60)
At least one observed, but none valid	7	1	14.3	(2 - 60)

Because most health facilities do not store medications to treat severe malaria, the interview asked how a patient with severe or drug-resistant malaria receives treatment (Table 7.8). While first-line medications for chloroquine-resistant *P. falciparum* are routinely stored in Colombia primary care facilities, most

facilities (regardless of type) informed that the patient is referred to a location that stores medication (80% of facilities) when they need a type of medication not available in the surveyed facility.

Table 7.8: Antimalarial delivery for severe or chloroquine-resistant cases

	N	n	%	95% CI
If a case of severe or drug-resistant malaria is detected in this facility, how does the patient get special antimalarial medication that is not stored here?				
Patient is referred to a location that stores medication	25	20	80	(59 - 92)
Treatment is delivered to this health facility by vector control or malaria program staff	25	0	0	(-)
Treatment is delivered to the patient's home by vector control or malaria program staff	25	0	0	(-)
Other	25	3	12	(4 - 33)

The interview also asked about how antimalarial supplies are managed. As seen in Table 7.9, 27.8% of primary care facilities generally order their own antimalarials. Among those primary care facilities that do not determine their own antimalarial supplies, most frequently the supply is determined by the regional vector control or malaria program (Table 7.10). Entries for “other” for who determines malaria medication needs for primary care facilities includes the department reference lab and the hospital to which the unit is affiliated.

Table 7.9: Determination of malaria medication needs

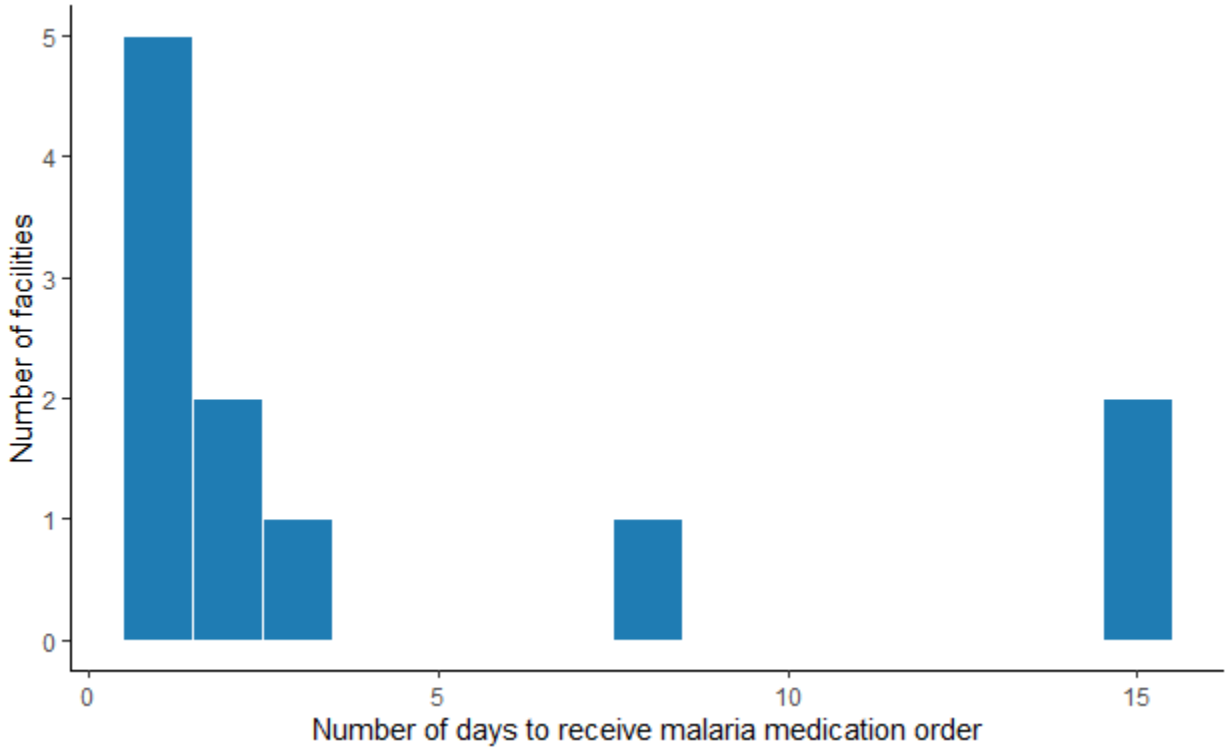
	N	n	%	95% CI
Primary care units: How is the quantity of malaria medication needed by this facility determined?				
The health facility determines the quantity of antimalarials required and orders it	18	5	27.8	(12 - 53)
The amount of each antimalarial sent to this facility is determined elsewhere	18	13	72.2	(47 - 88)
Secondary care units: How is the quantity of malaria medication needed by this facility determined?				
The health facility determines the quantity of antimalarials required and orders it	5	4	80	(29 - 97)
The amount of each antimalarial sent to this facility is determined elsewhere	5	1	20	(3 - 71)
Department/ district ETV units: How is the quantity of malaria medication needed by this facility determined?				
The health facility determines the quantity of antimalarials required and orders it	3	2	66.7	(14 - 96)
The amount of each antimalarial sent to this facility is determined elsewhere	3	1	33.3	(4 - 86)

Table 7.10: Determination of malaria medication needs: authority

	N	n	%	95% CI
Primary care units: Who determines the quantity of malaria medication that are given to this facility?				
Regional vector control or malaria program	13	4	30.8	(12 - 60)
Other	13	9	69.2	(40 - 88)
Secondary care units: Who determines the quantity of malaria medication that are given to this facility?				
Regional vector control or malaria program	1	1	100	(-)
Department/ district ETV units: Who determines the quantity of malaria medication that are given to this facility?				
National malaria program	1	1	100	(-)

Figure 7.1 shows the usual number of days between ordering and receiving antimalarials as reported at facilities that order their own antimalarial medications.

Figure 7.1: Days to receive ordered malaria medication



The interview also asked about recent shortages of antimalarial medication and how they are handled. All facilities that stock antimalarials reported that they always or almost always receive the expected quantities of antimalarial medications (Table 7.11). As seen in Table 7.12, if there is a shortage, many facilities reported that they borrow from another health facility (50% of primary care facilities that stock antimalarials). Respondents could indicate more than one answer to this question.

Table 7.11: Medication order reliability

	N	n	%	95% CI
Primary care units: During the past 6 months, have you always, almost always, or almost never received the amount of each medicine that you ordered (or that you are supposed to routinely receive)?				
Always	18	15	83.3	(58 - 95)
Almost always	18	3	16.7	(5 - 42)
Secondary care units: During the past 6 months, have you always, almost always, or almost never received the amount of each medicine that you ordered (or that you are supposed to routinely receive)?				
Always	5	3	60	(19 - 91)
Almost always	5	2	40	(9 - 81)
Department/ district ETV units: During the past 6 months, have you always, almost always, or almost never received the amount of each medicine that you ordered (or that you are supposed to routinely receive)?				
Almost always	3	2	66.7	(14 - 96)
Always	3	1	33.3	(4 - 86)

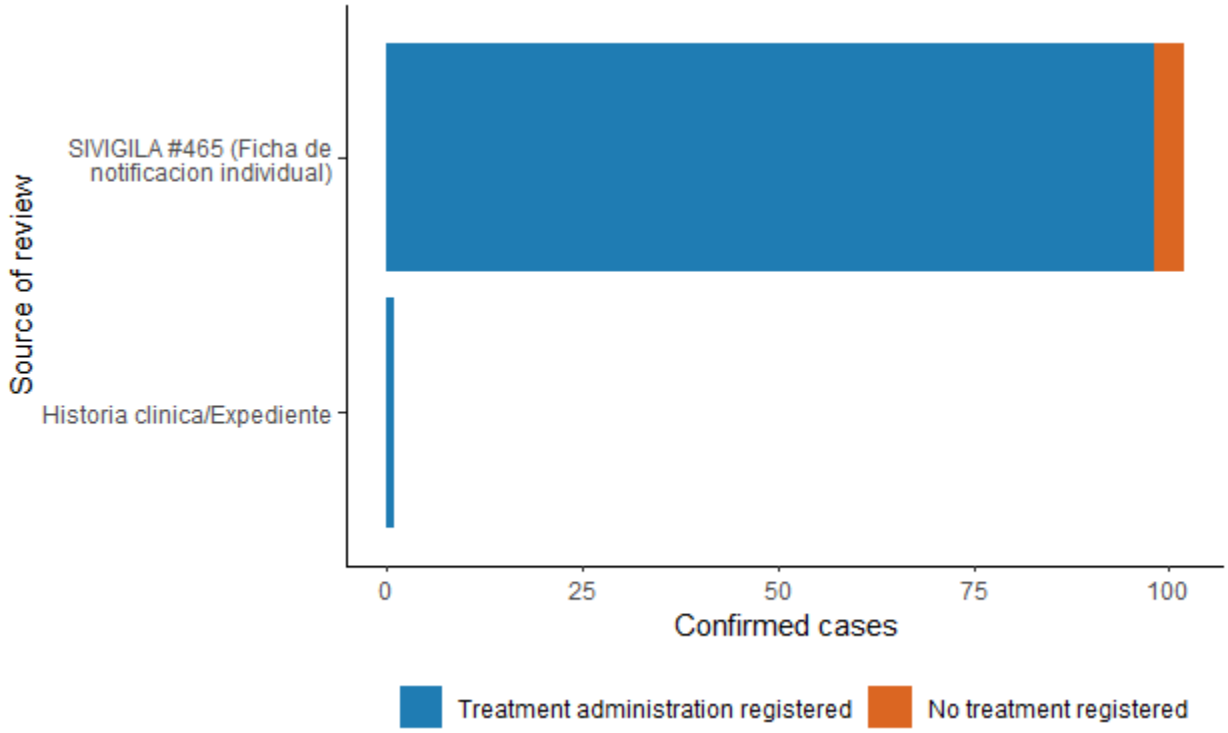
Table 7.12: Malaria medication shortages

	N	n	%	95% CI
Primary care units: If there is a shortage of a specific malaria medication between routine orders, what is the most commonly used procedure in this facility?				
Special order	18	5	27.8	(12 - 53)
Borrow from another health facility	18	9	50	(28 - 72)
Never without medications	18	6	33.3	(15 - 58)
Secondary care units: If there is a shortage of a specific malaria medication between routine orders, what is the most commonly used procedure in this facility?				
Special order	5	3	60	(19 - 91)
Borrow from another health facility	5	1	20	(3 - 71)
Never without medications	5	1	20	(3 - 71)
Department/ district ETV units: If there is a shortage of a specific malaria medication between routine orders, what is the most commonly used procedure in this facility?				
Special order	3	2	66.7	(14 - 96)
Borrow from another health facility	3	1	33.3	(4 - 86)

7.3 Confirmed cases: Time to treatment initiation

According to the targets of malaria elimination programs, the first dose of antimalarial treatment should be administered to the patient no later than 24 hours after diagnosis in order to interrupt community transmission as rapidly as possible. The review of confirmed malaria cases captured the dates of diagnosis and of treatment initiation, as well as the medications administered. Figure 7.2 shows that SIVIGILA #465 case notification forms were observed in most confirmed case reviews, and the majority of the forms had some treatment information registered. The form has space to register diagnosis date and treatment initiation date. Where dates are registered for both a rapid diagnostic test and a microscopic diagnosis, the earlier date is considered.

Figure 7.2: Confirmed cases: source of treatment information



Antimalarial treatment is prescribed according to the test result. In Colombia during 2018, first-line regimens are different for *Plasmodium vivax* malaria, *Plasmodium falciparum* malaria, and mixed cases of malaria due to the presence of chloroquine-resistant *P. falciparum* in the country. The first-line regimen for *P. vivax* malaria consists of chloroquine and primaquine, the regimen for *P. falciparum* cases requires artemisinin-based medication, and the regimen for mixed infection requires primaquine and artemisinin-based medication. After 2018, the first-line regimen for *P. falciparum* malaria changed to require artemisinin-based medication and primaquine, which will be the treatment scheme required for future rounds of RMEI-Colombia.

As seen in Table 7.13, 85% of the reviewed *P. vivax* cases had the correct regimen registered, 96% of the reviewed *P. falciparum* cases had the correct regimen registered, and 66.7% of the reviewed mixed cases had the correct regimen registered. Five of the cases reviewed did not have parasite species registered on any of the forms reviewed, and thus the corresponding regimen could not be identified. These cases are not considered to have had the correct treatment regimen administered, because of the failure to register the species. The lower panel of the table shows a comparison with SIVIGILA data for cases from 2018 originating in the municipalities of the study area classified in malaria stratum 5. A higher proportion of confirmed malaria cases had the adequate treatment for malaria in the SIVIGILA database than among the cases reviewed by field personnel during the RMEI baseline measurement.

Table 7.13: Confirmed cases: Appropriate treatment by parasite species

	N	n	%	95% CI
Reviewed				
Total cases with adequate treatment for species	103	91	88.3	(81 - 93)
P. vivax with adequate treatment for species	20	17	85	(62 - 95)
P. falciparum with adequate treatment for species	75	72	96	(88 - 99)
P. falciparum with adequate treatment for species + primaquine	75	0	0	(-)
Mixed cases with adequate treatment	3	2	66.7	(15 - 96)
Species not registered	103	5	4.9	(2 - 11)
SIVIGILA (Stratum 5)				
Total cases with adequate treatment for species	11011	10373	94.2	(94 - 95)
P. vivax with adequate treatment for species	2959	2455	83	(82 - 84)
P. falciparum with adequate treatment for species	7533	7472	99.2	(99 - 99)
P. falciparum with adequate treatment for species + primaquine	7648	489	6.4	(6 - 7)
Mixed cases with adequate treatment	343	307	89.5	(86 - 92)
Species not registered	11011	0	0	(-)

Table 7.14 shows the timing of administration of the first dose of antimalarial treatment. In 73.8% of the cases reviewed, both diagnosis and treatment date were registered, compared to 99.4% in the SIVIGILA data. This suggests that any additional case data compiled by personnel responsible for data entry to address empty spaces left on paper forms when the SIVIGILA notification is entered electronically, is not consistently recorded on the original paper form.

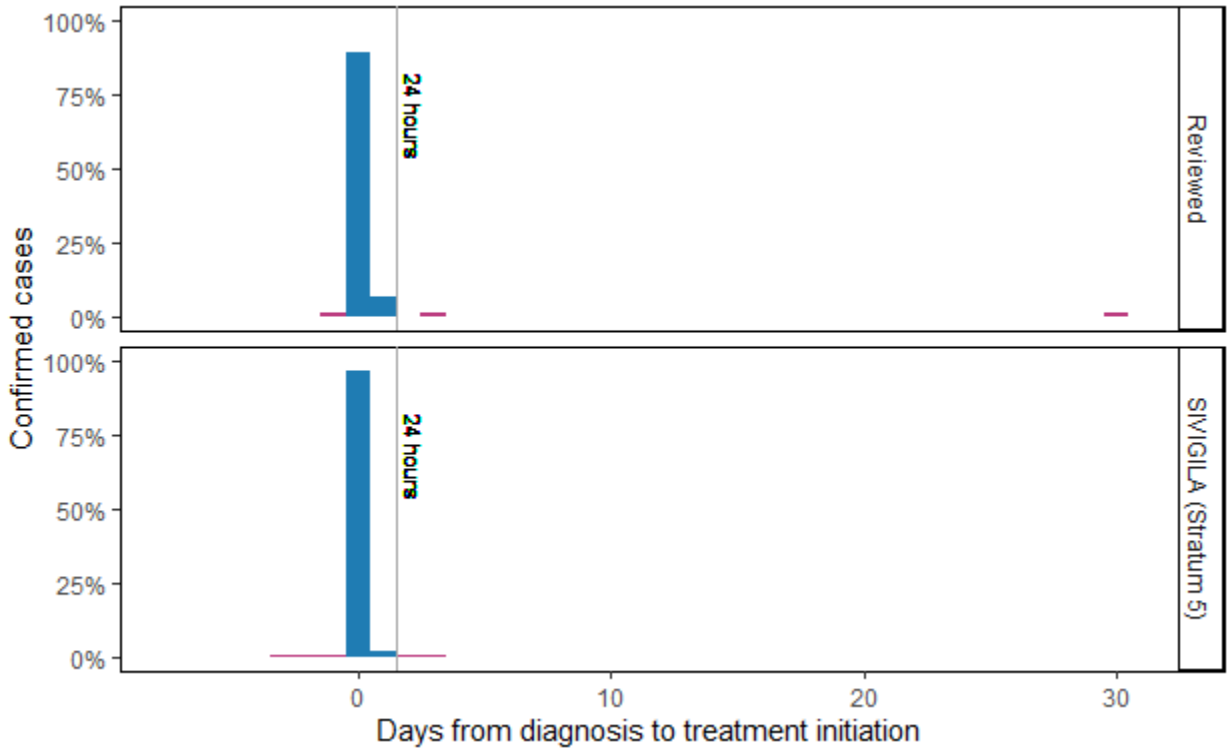
Table 7.14: Confirmed cases: Treatment timeliness

	N	n	%	95% CI
Reviewed				
Diagnosis date registered	103	79	76.7	(68 - 84)
Treatment start date registered	103	97	94.2	(88 - 97)
Both dates registered	103	76	73.8	(64 - 81)
Excluded due to suspected inscription/data entry error (<-7 day or >30 day window)	103	1	1	(0 - 7)
Any treatment within 24 hours of diagnosis	102	72	70.6	(61 - 79)
SIVIGILA (Stratum 5)				
Diagnosis date registered	11011	11002	99.9	(100 - 100)
Treatment start date registered	11011	10956	99.5	(99 - 100)
Both dates registered	11011	10947	99.4	(99 - 100)
Excluded due to suspected inscription/data entry error (<-7 day or >30 day window)	11011	149	1.4	(1 - 2)
Any treatment within 24 hours of diagnosis	10862	10642	98	(98 - 98)

Evidence of any antimalarial treatment within one day of diagnosis was found in 70.6% of cases reviewed. Figure 7.3 shows the number of days from the date of diagnosis to the date of treatment initiation. Cases with treatment initiation on the same day of diagnosis or one day after are shown in blue. Cases with treatment initiation before diagnosis (by RDT or microscopy) are not considered timely, because presumptive treatment is contrary to the norm in Colombia. If treatment initiation was recorded

more than seven days before or more than 30 days after diagnosis, the case is excluded from the indicator because of the suspicion of recording error (on the notification form or in the survey module). This suspected error affected 76 cases in the reviewed data, which are excluded from the figure.

Figure 7.3: Confirmed cases: Diagnosis to treatment initiation time frame



An indicator negotiated for RMEI measures the proportion of cases with the first dose of antimalarial treatment administered within one day of diagnosis, as shown in Table 7.15. Among the cases reviewed, 88.3% had the antimalarial treatment corresponding to the parasite species registered correctly on the forms. In 70.6% of the cases, the first dose of any treatment was registered as administered within one day (24 hours) of diagnosis, and in 62.7% of the cases, the first dose of the appropriate treatment was registered as administered within one day of diagnosis. A higher proportion of the cases in the SIVIGILA database has diagnosis and treatment dates registered, and appropriate treatment and timing. For comparison, Table 7.16 shows the result by department and Table 7.17 shows the result by the diagnosis type for reviewed cases.

Table 7.15: Indicator 4.01: Timely treatment initiation

	N	n	%	95% CI
Reviewed				
Total malaria cases	103	103	100	(-)
Correct treatment administered for species	103	91	88.3	(81 - 93)
Diagnosis and treatment dates registered	103	76	73.8	(64 - 81)
Excluded due to suspected inscription/data entry error (<-7 day or >30 day window)	103	1	1	(0 - 7)
First dose treatment within 24 hours of diagnosis	102	72	70.6	(61 - 79)
Correct treatment administered within 24 hours of diagnosis	102	64	62.7	(53 - 72)
SIVIGILA (Stratum 5)				

	N	n	%	95% CI
Total malaria cases	11011	11011	100	(-)
Correct treatment administered for species	11011	10373	94.2	(94 - 95)
Diagnosis and treatment dates registered	11011	10947	99.4	(99 - 100)
Excluded due to suspected inscription/data entry error (<-7 day or >30 day window)	11011	149	1.4	(1 - 2)
First dose treatment within 24 hours of diagnosis	10862	10642	98	(98 - 98)
Correct treatment administered within 24 hours of diagnosis	10862	10054	92.6	(92 - 93)

Table 7.18: Comparison: result by department/ district

	N	n	%	95% CI
Timely treatment initiation				
Buenaventura	25	13	52	(33 - 71)
Chocó	76	51	67.1	(56 - 77)
Nariño	1	0	0	(-)
Total	102	64	62.7	(53 - 72)

Table 7.19: Comparison: result by diagnosis type

	N	n	%	95% CI
Timely treatment initiation				
RDT	1	1	100	(-)
TBF	77	63	81.8	(71 - 89)
No test date registered	24	0	0	(-)
Total	102	64	62.7	(53 - 72)

7.4 Confirmed cases: Adequate and complete treatment

In order to ensure radical cure with chloroquine, primaquine, or artemisinin-based treatment, patients must take medication daily for a period of 3-14 days, even though symptoms may start to subside within a few days of treatment initiation. In Colombia, the national norm requires treatment according to parasite species, following these regimens:

- For *P. vivax* cases: 3 days of chloroquine and 7 or 14 days of primaquine
- For *P. falciparum* cases: 3 days of artemisinin-based treatment (artemether + lumefantrine)
- For mixed infections cases: 3 days of artemisinin-based treatment (artemether + lumefantrine) and 7 or 14 days of primaquine
- For severe malaria cases: If IV treatment with artesunate started, when completed: 3 days of artemisinin-based treatment (artemether + lumefantrine) and one day of primaquine

7.4.1 Completion of malaria treatment

The Colombia malaria case notification form includes space to register the treatment type and the date treatment was started. There is no space to enter the dosage prescribed, the number of doses administered for any medication selected, or whether the treatment was supervised by health facility personnel or community health workers.

Table 7.20 shows treatment completion by parasite species as registered on the notification forms observed during baseline data collection. Ten of the cases reviewed did not have the parasite species registered, so the corresponding treatment scheme could not be identified and thus treatment is considered incomplete. Documentation of the number of days treatment was taken by the patient was not

found in any of the reviewed cases, thus none of the reviewed cases had recorded evidence of adequate and complete treatment.

Table 7.20: Confirmed cases: Complete treatment by malaria species

	N	n	%	95% CI
Total cases with adequate treatment complete	103	0	0	(-)
P. vivax cases with adequate treatment complete	18	0	0	(-)
P. falciparum with adequate treatment complete	72	0	0	(-)
Mixed cases with adequate treatment complete	3	0	0	(-)
Species not registered	103	10	9.7	(5 - 17)

Adequate and complete antimalarial treatment with supervision was negotiated as an indicator for RMEI. Cases with evidence of at least one dose of antimalarial treatment supervised are considered to have treatment supervision. In Colombia, treatment supervision is not the country standard practice, so there is no space on the notification form to record this information. Some forms observed had additional notes where it was recorded that the first dose was supervised on-site. Table 7.21 shows the indicator results. None of the cases reviewed had evidence of complete and adequate treatment, and only 13.6% had evidence of any supervision. This evidence could be a note on the case investigation form that one or more doses were supervised, or a separate form included in the patient's record. Overall, none of the cases reviewed had evidence that treatment was adequate, complete, and supervised.

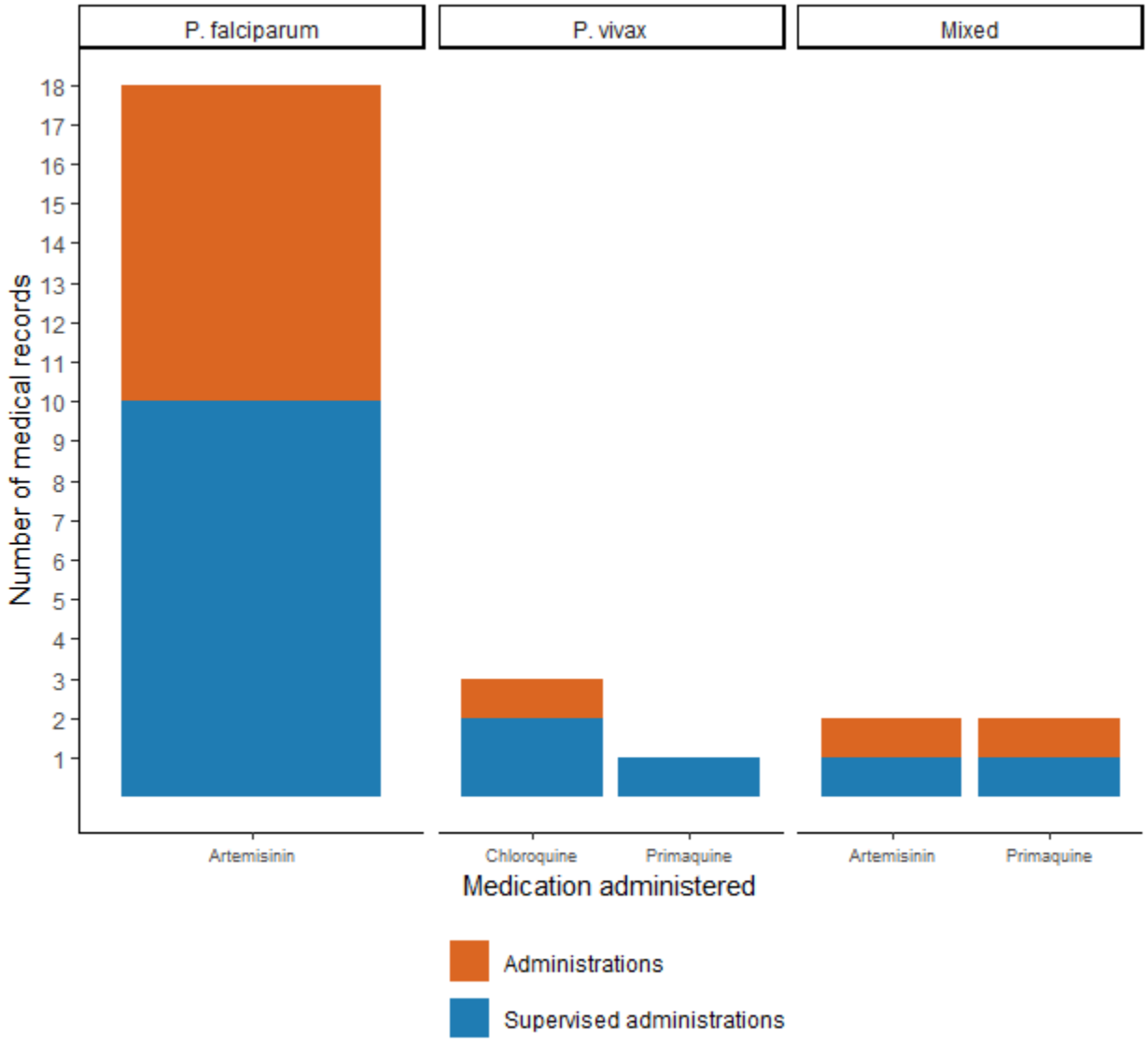
Table 7.21: Indicator 4.03: Complete treatment with supervision

	N	n	%	95% CI
Denominator: Total malaria cases	103	103	100	(-)
Adequate treatment and number of doses administered	103	0	0	(-)
Evidence of at least one supervised dose	103	14	13.6	(8 - 22)
Indicator Result: Complete treatment with supervision	103	0	0	(-)

7.4.2 Supervision of malaria treatment

Figure 7.4 shows the number of doses with evidence of administration and supervision by species. Since there is no space on the notification form to record number of doses the patient will take during the antimalarial course, dosage is only recorded if there is a note of administration of the first dose on-site. However, only the exact number of administrations specified in each treatment scheme is considered adequate and complete treatment, so there may be potential to improve results for adequate treatment simply by standardizing registration by case investigators to reflect the number of daily doses of treatment given.

Figure 7.4: Confirmed cases: Evidence of one supervised dose



7.5 Patient follow-up testing

Best practices for malaria case management also include follow-up testing to monitor the parasite density in blood samples taken periodically after treatment is begun, to confirm the absence of malaria infection.

7.5.1 Health facility interview: Follow up testing practices

According to the health facility interview and as shown in Table 7.23, 65% of respondents said that malaria patients receive at least one follow-up test. Table 7.24 shows that the thick blood film sample is most frequent for follow-up testing.

Table 7.23: Follow-up testing after malaria treatment: facility interview

	N	n	%	95% CI
After a patient begins treatment for malaria, do they ever receive a follow-up test for malaria?	40	26	65	(49 - 78)

Table 7.24: Follow-up testing methods

	N	n	%	95% CI
Is an RDT or thick blood film more commonly used for follow-up tests?				
Only thick blood film used more commonly	12	12	100	(-)

The interview also asked how many follow-up tests are routinely administered according to facility practices (Figure 7.5), and when the first and last samples are taken from the patient for follow-up testing (Figure 7.6). Primary and secondary care health facilities report conducting follow-up testing beginning one or two weeks after diagnosis. Some primary care facilities only conduct, or are only aware of, the first follow-up test within two weeks of diagnosis.

Figure 7.5: Follow-up tests administered according to facility practices

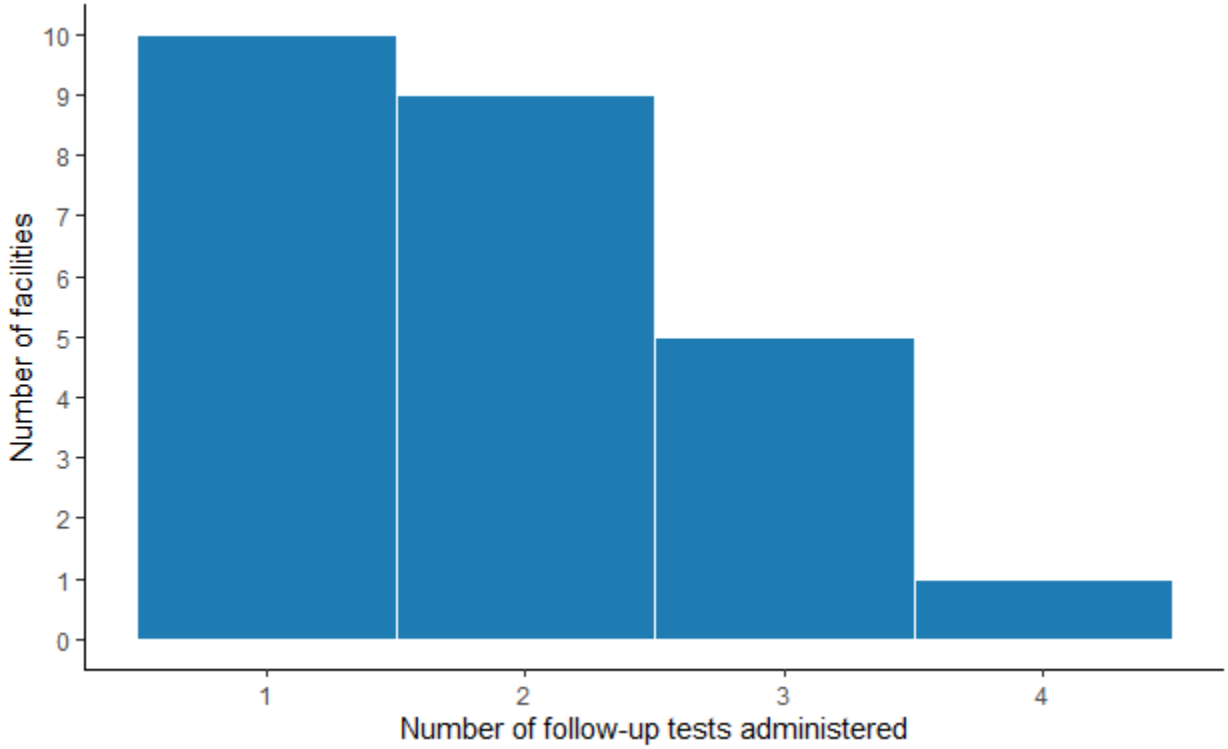
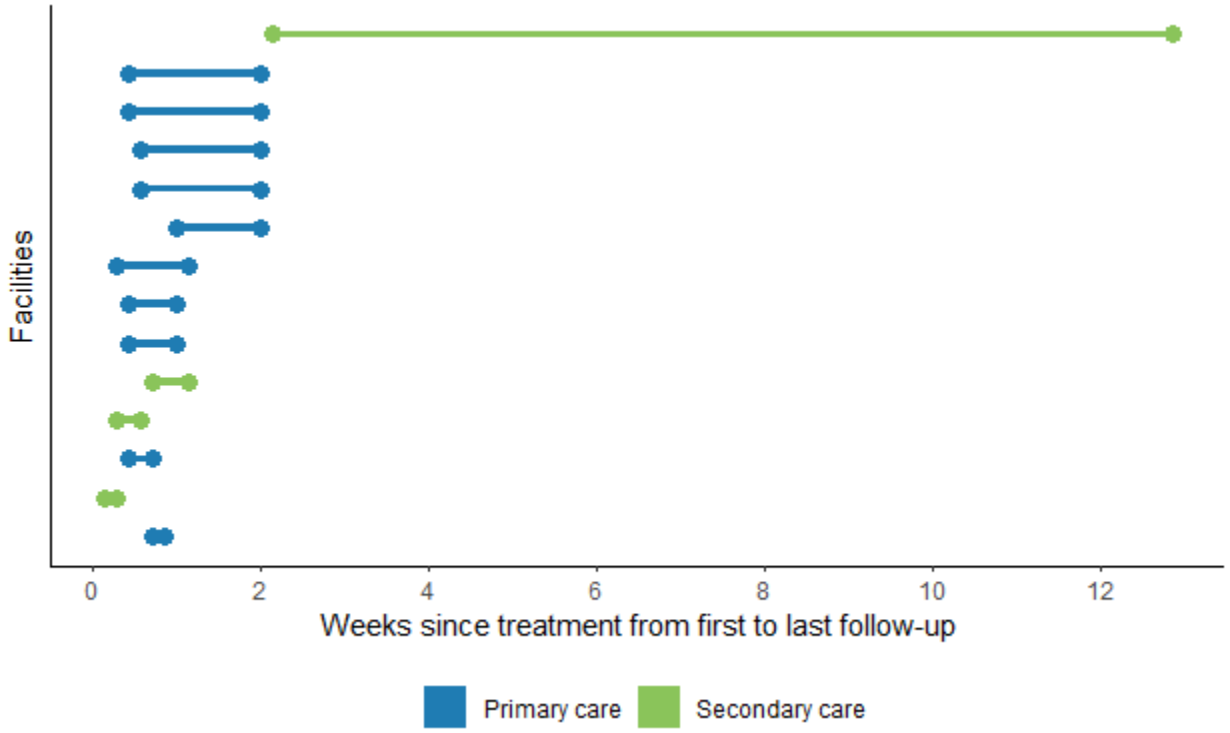


Figure 7.6: Timing from first to last follow-up test



7.5.2 Confirmed cases: Follow-up testing practices

In Colombia follow-up tests may be tracked in the patient's medical record or according to other local practices, but the case notification form (SIVIGILA #465) does not have space to track follow-up malaria testing. This notification form is completed when the malaria diagnosis is made and the follow-up tests can occur weeks later. Thus, no evidence of follow-up tests was observed for any of the confirmed cases reviewed (Table 7.25).

Table 7.25: Follow-up testing after malaria treatment: medical record review

	N	n	%	95% CI
Received at least one follow-up test for malaria?	103	0	0	(-)

Chapter 8: Surveillance, Notification, and Reporting

This chapter provides an overview of the malaria surveillance system in Colombia based on the fact-finding visit and health facility surveys, and summarizes results related to case reporting and laboratory reporting and quality control indicators.

8.1 Background

The fact-finding trip in July 2019 allowed for an understanding of Colombian information systems and notification and reporting flows at the local, department/ district, and central levels. The trip focused on identifying how individual cases are identified and notified (including positive and negative test results for suspected cases) and understanding the weekly and monthly reporting requirements to which facilities are subject. This regular, aggregate reporting allows the department/ district and central levels to stay aware of malaria transmission activity, and the data can be used as an input for planning and directing resources where they are most needed. A brief summary of the primary information systems in Colombia is detailed below.

8.1.1 Insurance information system

Colombians are served by a broad range of public and private health care providers and insurance schemes. For quantification of procedures and services for insurance purposes, the system *Registro Individual de Prestación de Servicios de Salud* (RIPS) is used nationwide. RIPS quantifies all patient procedures and services using International Classification of Diseases (ICD) codes. It provides the minimum and basic data required to monitor the Health Benefits System in the General System of Social Security in Health (SGSSS), in relation to a mandatory package of services. The objective of RIPS is to facilitate the commercial relations between the managing entities (payers) and the independent institutions and professionals (providers) by presenting the detail of the invoice for the sale of services, with a standard structure to facilitate communication and data transfer, regardless of the computer solutions that each provider uses.

The aggregate RIPS database, including information from all patients in Colombia, gets consolidated in the Integrated Social Protection Information System (*Sistema Integrado de Informacion de la Proteccion Social*, or SISPRO) where it is managed by the Colombian Ministry of Health and Social Protection (MSPS).

Small healthcare units that do not have a computer or internet are able to fill out paper RIPS forms which are then sent on to larger units (UPGDs) where they are transcribed into the electronic RIPS system. Thus, there is electronic documentation of all procedures and services provided for every person in the country through the RIPS database. However, the RIPS system does not currently record the facility name of where the patient was diagnosed and treated, it only shows the name of the facility where the data was entered into the system. Thus, based on the fact-finding visit, we expected to encounter difficulties to identify patient medical records using the RIPS system, given the lack of information available regarding the location of patient treatment and diagnosis.

8.1.2 Electronic medical record (EMR) systems

The majority of health facilities in Colombia operate using electronic medical record (EMR) systems, though some smaller or more remote locations only maintain paper-based records. There are many different EMR systems in existence in Colombia. From our observation, each insurance company tends to have its own custom EMR system and these different systems are not interoperable. In some facilities, EMR systems are connected to or include a module to connect to the RIPS system. In other facilities, they use two separate systems – one for patient medical history in the EMR and another for the RIPS information.

In almost every location we visited, we noted instances where malaria testing, diagnosis, and treatment information is not entered into the EMR and is only entered into RIPS. For example, it is not uncommon

for patients to go directly to a microscopy post or lab and request a malaria test. In these cases, if the test result is positive, the lab/ microscopist may provide treatment directly to the patient without that individual ever having to see a doctor or other healthcare provider. In these instances, the record of the test, diagnosis, and treatment provided is recorded through RIPS and the surveillance system but not in the EMR.

8.1.3 Laboratory information systems

Laboratory information, including the reporting of the total number of positive and negative malaria test results and the documented process for indirect and direct laboratory quality control is managed exclusively through paper forms and spreadsheets rather than through web information systems. General information gathered regarding the laboratory information system for malaria is summarized below.

Reporting of total samples taken and number of positive and negative test results:

- Each laboratory unit sends the number of positive and negative samples examined to the departmental headquarters through a paper form. This form can be physically transported, faxed, or emailed. Department labs send aggregated totals for positive and negative tests conducted to the national reference laboratory for malaria.
  - The report submission date is not recorded on lab reporting forms summarizing the number of positive and negative cases (only the date of the reporting period, i.e., when the samples were tested).
  - At the department labs, it is possible to see reports of the number of samples taken by facility. However, this information cannot be found at the national level where all data received are aggregated by department.
- Information about the number of negative samples taken is never entered into the SIVIGILA system. These data can only be captured at the departmental and national labs.

8.1.4 Public health surveillance system

All positive malaria cases are reported to the national public health surveillance system (*Sistema Nacional de Vigilancia en Salud Pública*, or SIVIGILA), a Colombia-specific system for tracking of information of 106 diseases. General information gathered regarding the SIVIGILA system is summarized below:

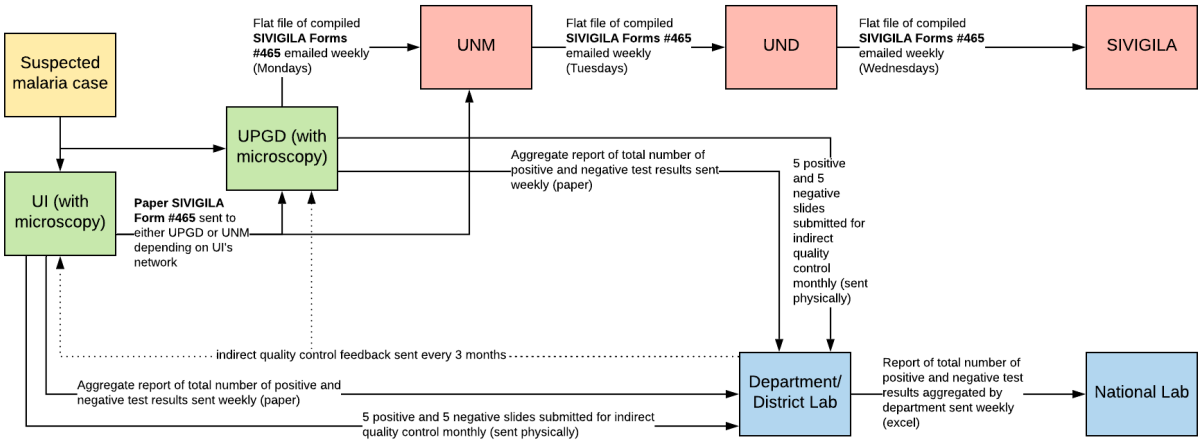
- Since initiation, all UPGDs (primary notification units) were required to report to SIVIGILA in order to be certified to provide services.
  - Since 2006, by law, UPGDs must report certain diseases (including malaria).
  - For all other diseases (except malaria), confirmation of case is required by a physician. However, for malaria, confirmation can be made by a community health worker or microscopist.
- The SIVIGILA form for malaria (#465) is only required for positive cases, and only positive cases enter into the system as each entry is nominal. Given the quantity of malaria cases and tests in Colombia, it is not yet realistic to be able to enter in nominal data for every negative malaria test.
- SIVIGILA collects basic demographic information and travel history of the patient, and information about the malaria case. Codes are included to document where the case was notified from, the residence of the patient, and where the malaria infection is expected to have occurred. The time of reporting is documented.
- At national level, all of the data are managed by the National Institute of Health (INS) and epidemiologists verify the data quality and check for duplicates.

8.2 Notification of malaria test results

Figure 8.1 shows the information flows beginning with a patient with malaria symptoms. The left side of the diagram shows sample-taking and examination practices, already discussed in Chapters 5 and 6.

Once a slide has been examined, the patient must be informed of the test result. Additionally, the laboratory is obligated to inform the municipal health authorities of malaria test results. Negative results are informed in aggregate, once weekly or once monthly. Positive results are often notified immediately to relevant personnel in the associated UPGD or UNM (*Unidades Notificadoras Municipales*, municipality notification units; includes local ETV units, hospitals, and UPGD units that report to department/ district notification units), and at the point where the sample was taken. Any positive results will also be included in aggregate monthly or weekly laboratory reporting. Reporting practices were inconsistent in the RMEI study area in Colombia during 2018.

Figure 8.1: Colombia surveillance system flow diagram



DEFINITIONS:

SIVIGILA = Sistema Nacional de Vigilancia en Salud Pública (National public health surveillance system).

SIVIGILA Form #465= Malaria case notification form.

UI = Health care facility classified as an Informing Unit – does not enter data directly into SIVIGILA electronic system.

UPGD = Health care facility classified as a Primary Data Generating Units - enters data directly into SIVIGILA electronic system.

UNM = Municipality notification units.

UND = Department or District notification units.

8.2.1 Notification to patient among facilities that send slides elsewhere for diagnosis

The health facility interview included questions about notification of malaria test results. As described in Chapter 5, health facilities that do not have microscopic diagnostic capacity in-facility (or have it in-facility only at certain days or hours) send thick blood film slides to another health facility or laboratory for initial diagnosis. Table 8.1 and Table 8.2 show the method by which a patient is notified of a negative test result among the four facilities that send slides elsewhere for examination and reported they receive negative test results for the slides they send. Respondents could indicate more than one answer to these questions. In all cases, respondents reported that health personnel from the facility where the sample was taken are responsible for notifying the patient of the negative test result. The notification is often by phone call (in 75% of facilities).

Table 8.1: Notification to patient of negative test results (among facilities that send slides elsewhere for examination): personnel

	N	n	%	95% CI
Who notifies the patient of a negative test result?				
Health personnel from this facility	4	4	100	(-)

Table 8.2: Notification to patient of negative test results (among facilities that send slides elsewhere for examination): method

	N	n	%	95% CI
How is the patient notified of a negative test result? (among those notified by facility personnel)				
Phone call	4	3	75	(22 - 97)
In person	4	2	50	(12 - 88)
Physical document delivery	4	1	25	(3 - 78)

In the case of a positive test result, four facilities that send slides elsewhere for examination reported they receive positive test results for the slides they send. Among these facilities, all are sometimes or always responsible to notify the patient of the positive test result by their own personnel (Table 8.3), and the most common modality for notification of a positive test result is in person or by phone call (Table 8.4).

Table 8.3: Notification to patient of positive test results (among facilities that send slides elsewhere for examination): personnel

	N	n	%	95% CI
Who notifies the patient of a positive test result?				
Health personnel from this facility	4	4	100	(-)

Table 8.4: Notification to patient of positive test results (among facilities that send slides elsewhere for examination): method

	N	n	%	95% CI
How is the patient notified of a positive test result? (among those notified by facility personnel)				
In person	4	3	75	(22 - 97)
Phone call	4	3	75	(22 - 97)
Physical document delivery	4	1	25	(3 - 78)

8.2.2 Notification to patient among facilities that examine slides for malaria

Other health facilities reported their own microscopic diagnosis capacity in-house. In these 24 facilities, health personnel from the facility where the sample was taken are responsible for notifying at least some patients of a negative test result in 91.7% of facilities (Table 8.5). In the case that a positive test result is detected in the facility, 91.7% are sometimes or always responsible to notify the patient of the positive test result by their own personnel.

Table 8.5: Notification to patient of negative test results (among facilities that examine slides): personnel

	N	n	%	95% CI
Who notifies the patient of a negative test result?				
Health personnel from this facility	24	22	91.7	(71 - 98)
Community health worker (health promoter/ microscopist)	24	3	12.5	(4 - 33)

Table 8.6: Notification to patient of positive test results (among facilities that examine slides): personnel

	N	n	%	95% CI
Who notifies the patient of a positive test result?				
Health personnel from this facility	24	22	91.7	(71 - 98)
Community health worker (health promoter/ microscopist)	24	1	4.2	(1 - 26)
Other	24	2	8.3	(2 - 29)

8.2.3 Notification to health authorities among facilities that examine slides for malaria or perform rapid diagnostic tests

When a case of malaria is confirmed in Colombia, notification must be sent to health authorities. Among all facilities that either examine TBF slides or perform RDTs, 40% notify the municipal health authority and 16.7% notify the epidemiological surveillance unit (Table 8.7). The majority of the text entries for “Other” show notification to the hospital to which the health unit is affiliated.

Table 8.7: Notification to health authorities of positive test results

	N	n	%	95% CI
Who is notified when a confirmed case of malaria is detected?				
Municipal health authority	30	12	40	(24 - 59)
Epidemiological surveillance unit	30	5	16.7	(7 - 35)
Department health authority	30	4	13.3	(5 - 31)
District health authority	30	2	6.7	(2 - 24)
Department laboratory	30	1	3.3	(0 - 21)
Local vector control unit	30	1	3.3	(0 - 21)
Other	30	9	30	(16 - 49)

8.3 Malaria surveillance data and reporting

All health facilities in the sample were asked if they have access to an electronic health information system as shown in Table 8.8. Twenty-nine percent of primary care facilities, 80% of secondary care facilities, and 40% of administrative units reported access. Facilities with access to any electronic information system were asked if they have access to a system for entering information about malaria, and 50% of secondary care facilities and 100% of administrative units reported access to a system used for malaria information.

Table 8.8: Access to electronic information systems

	N	n	%	95% CI
Primary care units				
Access to an electronic health information system for capturing and/or consulting health statistics	34	10	29.4	(16 - 47)
Access to an electronic health information system for entering malaria-specific information	10	5	50	(22 - 78)
Secondary care units				
Access to an electronic health information system for capturing and/or consulting health statistics	5	4	80	(29 - 97)
Access to an electronic health information system for entering malaria-specific information	4	2	50	(12 - 88)

	N	n	%	95% CI
Department/ district ETV units & Reference labs				
Access to an electronic health information system for capturing and/or consulting health statistics	5	2	40	(9 - 81)
Access to an electronic health information system for entering malaria-specific information	2	2	100	(-)

8.3.1 Indicator 2.03: Malaria case reporting

RMEI indicator 2.03 has two parts: case reporting and laboratory reporting. According to the negotiated definition for case reporting, health units in Colombia that conduct malaria diagnosis (by RDT or microscopy) must send weekly reports to the reporting unit (*Unidad Primaria Generadora de Datos* (UPGD) or *Unidad Notificadora Municipal* (UNM)) that include the aggregate number of malaria cases detected during the week, or a notification that zero malaria cases were detected. The report is to be sent by the following Monday before 3 PM and have the date sent from the facility recorded on the report. The report can be specific to malaria or combined with other notifiable diseases, so long as the exact number of malaria cases can be determined from the report.

The fact-finding visit revealed that Colombia does not use aggregate reports for notification of confirmed malaria cases. When a confirmed case of malaria is diagnosed, the individual notification form (SIVIGILA #465) is completed and entered into the SIVIGILA database. Aggregate counts can be observed using the SIVIGILA database. The destination of the individual notification reports for entry into the SIVIGILA database is shown in Table 8.9, and respondents could indicate more than one destination.

Table 8.9: Destination of case notification reports observed

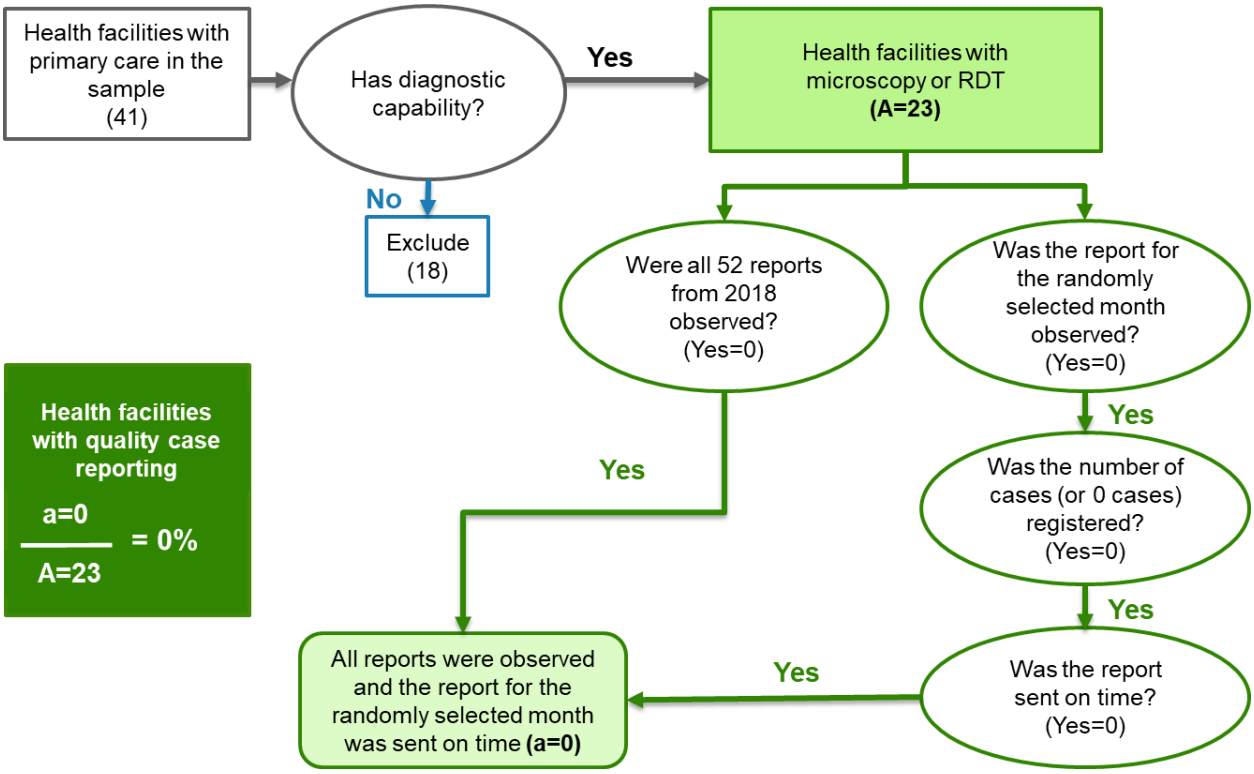
	N	n	%	95% CI
Where are case reports sent?				
Department laboratory	10	4	40	(15 - 71)
Affiliated hospital	10	2	20	(5 - 56)
Department health authority	10	2	20	(5 - 56)
National health authority	10	1	10	(1 - 49)
Other	10	1	10	(1 - 49)

Field personnel conducted an audit of all malaria case reports from 2018 stored at primary and secondary level facilities in the sample. They began by discerning whether the facility prepared monthly or weekly reports during 2018. They then sought to observe all 12 monthly reports or all 52 weekly reports for the year 2018. If a week was missing, they looked for written evidence of why the report was not submitted (for example, if the only microscopist was on holiday). Next, the electronic survey module presented a randomly selected month (or set of four epidemiological weeks). Surveyors sought to find the reports corresponding to this month, and then proceeded to enter detailed information from the report to the survey module, such as the number of malaria cases reported (or whether zero cases were reported) and the date sent or received as listed on the report (or as listed in a logbook of official correspondence sent and received, in facilities that use such a book).Health facility eligibility and completion of indicator according to a decision algorithm is shown in Figure 8.2.

Table 8.10 shows the results of the case reporting component of the indicator, which requires the following:

- that the reports be in a weekly format
- that all 52 reports be observed for the year 2018
- that all four weekly reports be observed for the selected month with send date
- that all four send dates are verified to be before 3 PM on the following Monday

Figure 8.2: Eligibility of health facilities for Indicator 2.03 (case reporting)



23 facilities that provide attention to patients and report malaria diagnostic capability are eligible for consideration in the indicator. The results are shown in Table 8.10 and none of the units met all the requirements of the indicator. This result was expected given the norm of submitting individual cases through SIVIGILA rather than preparing aggregate reports for positive cases.

Table 8.10: Indicator 2.03: Case reporting

	N	n	%	95% CI
Relevant units	41	41	100	(-)
Units with diagnostic capacity	41	23	56.1	(40 - 71)
Units indicating reporting of malaria cases	23	23	100	(-)
At least one weekly report from 2018 observed	23	0	0	(-)
All 52 weekly reports from 2018 observed	23	0	0	(-)
Four weekly reports for randomly selected month observed	23	0	0	(-)
Number of cases (or zero) recorded for all reports of randomly selected month	23	0	0	(-)
Dates for reports of randomly selected month observed	23	0	0	(-)
Dates for reports of randomly selected month are valid	23	0	0	(-)
Result: Malaria case reporting to standard*	23	0	0	(-)

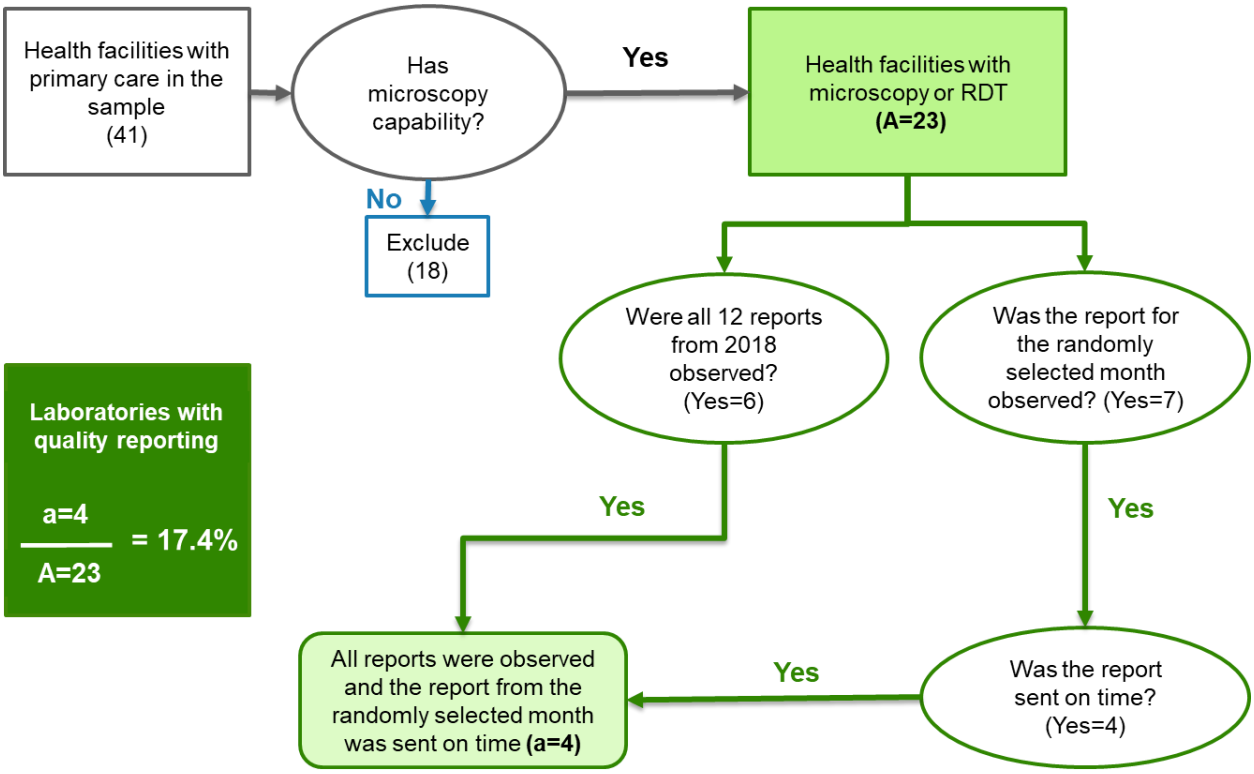
*Three attention units had monthly reports available, for which all 12 were observed

8.3.2 Indicator 2.03: Laboratory production reporting

The other component of Indicator 2.03 is the observation of monthly laboratory production reports that show the number of TBF slides examined and the number of RDTs performed. All facilities that conduct malaria diagnosis (by RDT or microscopy) must send these reports to the department/ district or national reference laboratory within a month following the end of each quarter. The observation of the laboratory reports during the survey was conducted in the same way as the case reports. Health facility eligibility and completion of indicator according to a decision algorithm is shown in Figure 8.3. The indicator required:

- that the reports be in a monthly format
- that all 12 reports be observed for the year 2018
- that the report be observed for the randomly selected month with send date

Figure 8.3: Eligibility of health facilities for Indicator 2.03 (laboratory reporting)



23 facilities that provide attention to patients are eligible for consideration in the indicator. The results are shown in Table 8.11 and four units met all the requirements of the indicator. The breakdown of the case reporting component of the indicator for reviewed cases is shown in Table 8.12.

Table 8.11: Indicator 2.03: Lab reporting

	N	n	%	95% CI
Relevant units	41	41	100	(-)
Units with diagnostic capacity	41	23	56.1	(40 - 71)
At least one monthly report from 2018 observed	23	8	34.8	(18 - 57)
All 12 monthly reports from 2018 observed	23	6	26.1	(12 - 48)
Report for randomly selected month observed	23	7	30.4	(15 - 52)
Date for report of randomly selected month observed	23	4	17.4	(6 - 39)
Result: Malaria case reporting to standard	23	4	17.4	(6 - 39)

Table 8.12: Comparison: result by department/ district

	N	n	%	95% CI
Laboratory reporting to standard				
Buenaventura	7	1	14.3	(2 - 60)
Chocó	15	2	13.3	(3 - 42)
Nariño	1	1	100	(-)
Total	23	4	17.4	(6 - 39)

The destination where laboratory production reports are sent is shown in Table 8.13. Text entries for “other” include ETV units and central level authorities.

Table 8.13: Destination of lab production reports observed

	N	n	%	95% CI
Where are laboratory production reports sent?				
Department	32	10	31.3	(17 - 50)
Hospital	32	9	28.1	(15 - 47)
Municipality/ District	32	7	21.9	(10 - 40)
Other	32	8	25	(13 - 43)

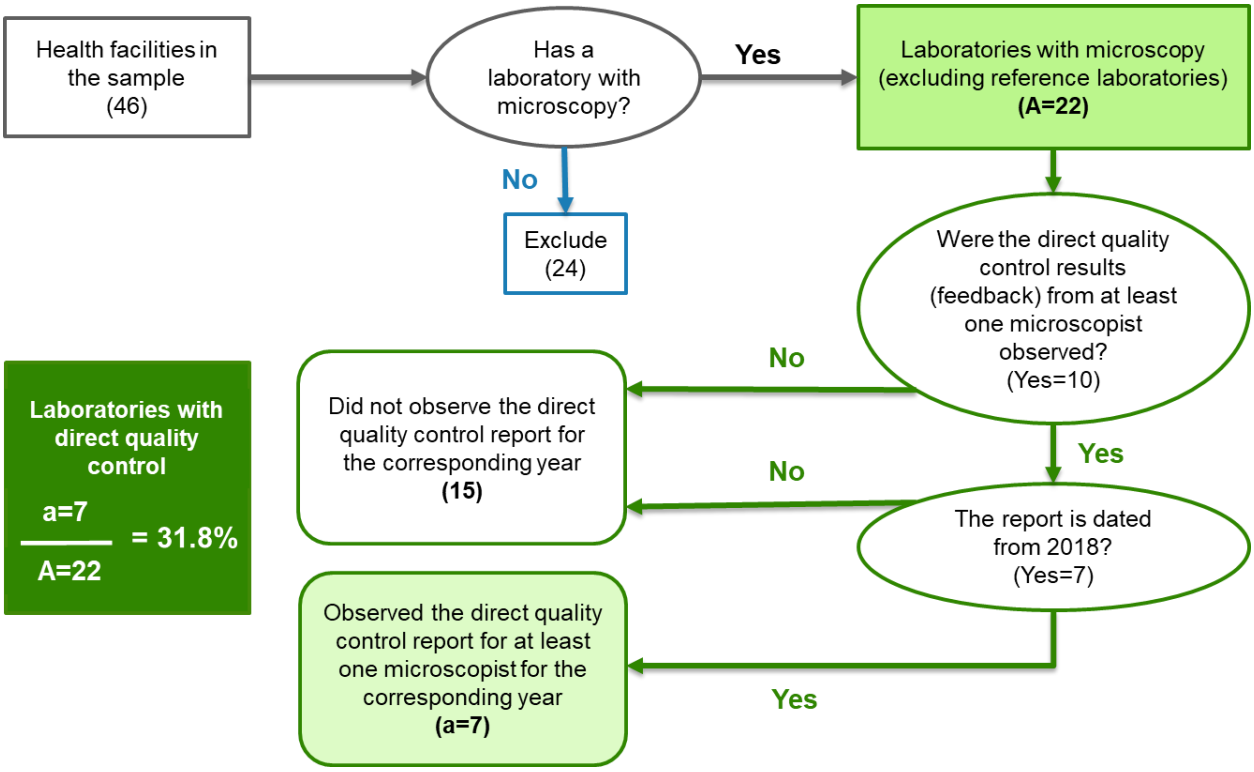
8.4 Indicator 3.02: Laboratory quality control

One of the RMEI indicators requires participation of the departmental/ district reference laboratories for malaria in an external quality control certification with the Pan American Health Organization, which was observed at the department reference laboratory in Chocó for the year 2018.

Additionally, all laboratories and microscopy posts that diagnose malaria through microscopy must participate in direct and indirect quality control exercises with their corresponding department/ district reference laboratory. Thus, 22 laboratories at the primary, secondary, and department/ district levels are eligible for separate components of the indicator.

The first exercise, direct quality control, is a yearly slide panel exam administered by the reference laboratory in which the evaluated microscopist must examine several slides (for which the results are known by the reference laboratory) and submit the test result of each with parasite density and species. The reference laboratory then checks the results submitted and provides feedback to the evaluated microscopist. Health facility eligibility was determined according to a decision algorithm shown in Figure 8.4. According to Table 8.14, complete evidence of participation in direct quality control was observed at 31.8% of local laboratories. The evidence required was a report of the results of the 2018 exam received back from the reference laboratory with feedback.

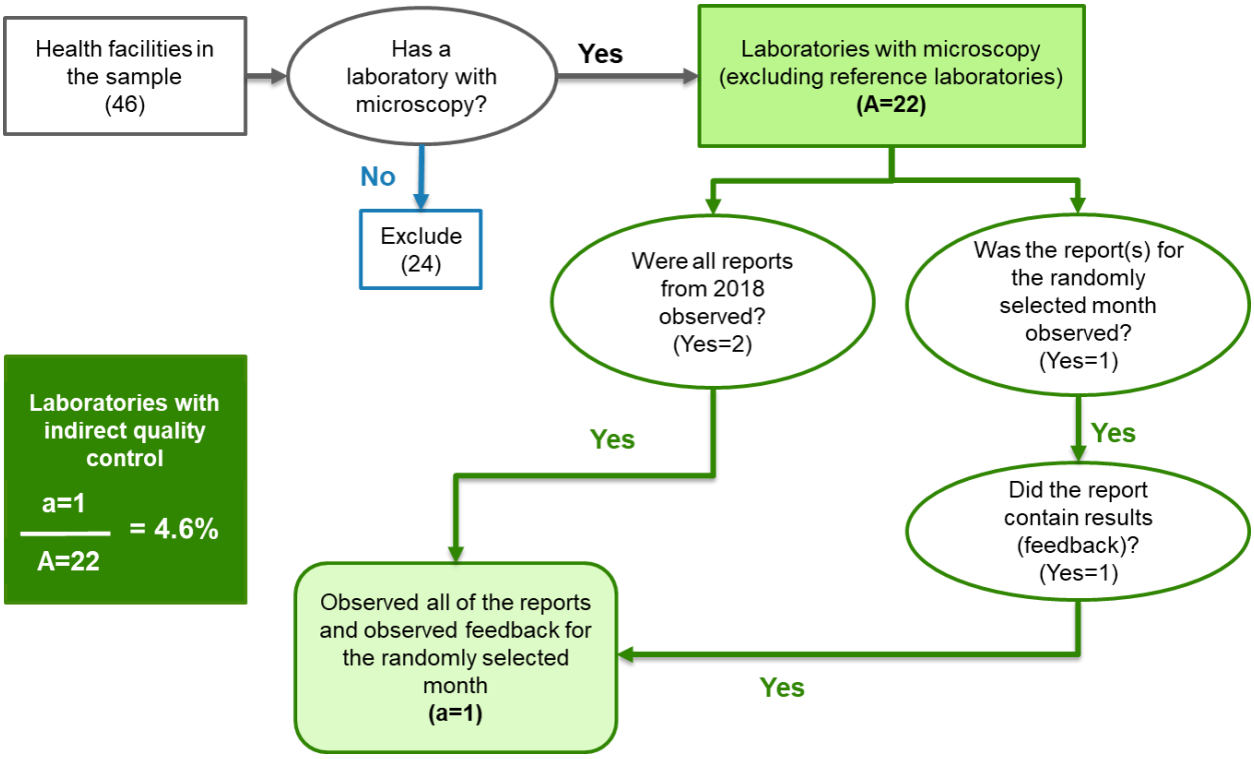
Figure 8.4: Eligibility of health facilities for Indicator 3.02 (direct)



The second exercise, indirect quality control, is a cross-check of a set number of the slides initially diagnosed by each local laboratory by a senior microscopist. In Colombia, local laboratories must send five slides with a negative test result for malaria and five slides with a positive test result (or 10 total, if there are fewer than five positive test results) to the department/ district reference lab for cross-checking each week, month, or quarter. The selection method for the five negative and five positive slides may vary regionally or locally. Feedback from the reference lab is provided once every quarter. Department/ district laboratories do not complete routine indirect quality control with the national laboratory. Health facility eligibility was determined according to a decision algorithm shown in Figure 8.5. While 72.7% of local laboratories reported participating in quality control, none of them met the standards of the indicator based on the reporting observation. The evidence required was:

- that all 52 reports (or written evidence that no slides were examined in a given week without a report) be observed for the year 2018 for reports in a weekly format OR
- that all 12 reports be observed for the year 2018 for reports in a monthly format OR
- that all 4 reports be observed for the year 2018 for reports in a quarterly format AND
- that the report be observed for a randomly selected month in 2018 (or the corresponding four epidemiological weeks or the corresponding quarter), with results or feedback from the reference laboratory.

Figure 8.5: Eligibility of health facilities for Indicator 3.02 (indirect)



The detailed results of the indicator are shown in Table 8.14 and Table 8.15. A breakdown of the direct and indirect components of the indicator for reviewd cases by department are shown in Table 8.16.

Table 8.14: Indicator 3.02: Indirect and direct quality control

	N	n	%	95% CI
Facilities with microscopy (excluding national lab)	46	22	47.8	(33 - 63)
Facilities passing direct quality control (DQC) component	22	7	31.8	(16 - 54)
Facilities that report participating in DQC	22	14	63.6	(42 - 81)
Feedback for at least one assessment in 2018 was observed	22	10	45.5	(26 - 67)
Feedback report with results was dated 2018	22	7	31.8	(16 - 54)
Facilities passing indirect quality control (IDQC) component	22	1	4.5	(1 - 28)
Facilities that report participating in IDQC	22	16	72.7	(50 - 88)
Randomly selected month report was observed	22	1	4.5	(1 - 28)
Cross-checked results and feedback were observed on randomly selected report	22	1	4.5	(1 - 28)
All reports observed for 2018	22	2	9.1	(2 - 31)
Facilities passing both direct and indirect quality control	22	1	4.5	(1 - 28)

Table 8.15: Indicator 3.02: Indirect quality control in detail

	N	n	%	95% CI
Facilities who have microscopy (excluding department/ district reference labs)	46	22	47.8	(33 - 63)
At least one report was observed for 2018	22	4	18.2	(7 - 41)
Reports are quarterly	22	2	9.1	(2 - 31)
1 report observed	22	1	4.5	(1 - 28)
4 reports observed	22	1	4.5	(1 - 28)
Reports are monthly	22	2	9.1	(2 - 31)
1-3 reports observed	22	1	4.5	(1 - 28)
12 reports observed	22	1	4.5	(1 - 28)
All reports observed for 2018	22	2	9.1	(2 - 31)

Table 8.16: Comparison: result by department/ district

	N	n	%	95% CI
Buenaventura				
Facilities passing direct quality control (DQC) component	7	1	14.3	(2 - 60)
Facilities passing indirect quality control (IDQC) component	7	0	0	(-)
Facilities passing both direct and indirect quality control	7	0	0	(-)
Chocó				
Facilities passing direct quality control (DQC) component	14	6	42.9	(20 - 69)
Facilities passing indirect quality control (IDQC) component	14	1	7.1	(1 - 39)
Facilities passing both direct and indirect quality control	14	1	7.1	(1 - 39)
Nariño				
Facilities passing direct quality control (DQC) component	1	0	0	(-)
Facilities passing indirect quality control (IDQC) component	1	0	0	(-)
Facilities passing both direct and indirect quality control	1	0	0	(-)

8.5 Indicator 3.01: Results of indirect quality control with the reference laboratory

The RMEI indicators also require detailed review of the indirect quality control reports and the response from the reference laboratory with results of the slide cross-check.

Indirect quality control is a cross-check of a set number of the slides initially diagnosed by each local laboratory by a senior microscopist. In Colombia, local laboratories must send five slides with a negative test result for malaria and five slides with a positive test result (or 10 total, if there are fewer than five positive test results) to the department/ district reference lab for cross-checking each week, month, or quarter. Department/ district laboratories do not perform routine indirect quality control with the national laboratory, so they were not included in the denominator for this indicator. Only 5.3% of the eligible health facilities with diagnostic capabilities met the standards of the indicator based on the reporting observation. The evidence required was:

- that the report be observed for a randomly selected week/month/quarter in 2018 (or the corresponding four epidemiological weeks or the corresponding three months), with results or feedback from the reference laboratory

- that the results or feedback from the reference laboratory indicated five positive and five negative slides were cross-checked (or 10 total if fewer than five positive test results).

The detailed results of the indicator are shown in Table 8.17.

Table 8.17: Indicator 3.01: Quality control results

	N	n	%	95% CI
Facilities with microscopy	46	22	47.8	(33 - 63)
Facilities excluded due to missing data*	22	3	13.6	(4 - 36)
Original report observed for selected time period	19	1	5.3	(1 - 31)
Results or feedback observed for report in selected time period	19	1	5.3	(1 - 31)
Results show 5 negative and 5 positive slides sent for cross-check	1	0	0	(-)
Results show at least 10 slides sent for cross-check	1	1	100	(-)
Facility received indirect quality control results or feedback from the reference lab for selected time period	19	1	5.3	(1 - 31)

*Revisits were pending to these units when data collection was suspended due to Covid-19

Chapter 9: Challenges, Conclusions, and Recommendations

9.1 Challenges and limitations

9.1.1 Suspension of data collection

Colombia Ministry of Health interventions implemented to prevent the spread of Covid-19 halted active data collection on March 20, 2020. At this point in data collection, only 30 health facilities were completed, out of the planned sample of 60. An additional 16 health facilities, including two reference laboratories, were not fully completed and were pending revisits. These units do not have complete data that fully represents the services provided on-site and in the community.

Data collection continued between the first travel restriction implemented by the Colombia Ministry of Health on March 16 and the mandatory quarantine on March 20. During this time, the field team was unable to travel to rural health units that served ethnic and indigenous communities so they completed easily-accessible urban units that were not being affected by the travel restriction. Rural and indigenous communities have less access to medical resources and due to the first travel restriction, the data collected has a higher proportion of health facilities and communities in urban and non-indigenous areas than the original sample.

When the data collection team was planning travel to the health facilities in the sample, they planned to visit the rural, hard to reach locations at the end of data collection. Due to this plan and the early termination of data collection, the three health facilities and two communities in stratum 4, which are located in a remote area near the Panama border, were not visited. These units were important to capture how malaria services varied between areas of high (malaria stratum 5) and low (malaria stratum 4) autochthonous malaria transmission, however, only health facilities in stratum 5 were completed, so the data only represents health facilities in regions of high autochthonous malaria transmission.

9.1.2 Challenges for health facility data collection

A strike of employees of all public health units in Quibdó, Chocó occurred during data collection. The field team working in the region completed interviews at private health units in the sample, which were not affected by the strike. Data collection at several of the public units was deferred while awaiting the end of the strike, but data collection was suspended before the strike was resolved. Due to this, the composition of completed health facilities in Quibdó, Chocó shows a higher proportion of private facilities completed in the municipality. Private facilities typically provide specific services, which are not as wide ranging as public facilities, and do not have as well as a defined notification system about suspected and confirmed cases of malaria.

In Colombia, field personnel were generally able to gain authorization to interview in selected health facilities and to observe relevant service areas. However, it was challenging to access laboratories and to observe laboratory forms in the few cases where the laboratorist was on leave or otherwise not available during the week of the visit. Interviewers were planning to conduct revisits when key personnel were not available at the initial visit, but were not able to complete the revisits due to early suspension of data collection due to Covid-19. Even if the facility director was able to unlock the laboratory and allow interviewers to observe equipment, other facility personnel were often not equipped to find laboratory supplies, records of stock, and reporting files.

9.1.3 Challenges for suspected case review

A key challenge for the review of suspected malaria cases was identification of a sufficient number of eligible cases, particularly in smaller UI health facilities. In cases when small UI health facilities did not keep lists of fever cases nor International Classification of Diseases (ICD) code databases for electronic extraction, but had daily logbooks to sample from, often the total number of eligible attentions in the year 2018 did not meet the quota for record revision. Occasionally, health facility personnel had difficulty locating selected records for review (for example, when medical record number was left blank on the

attention registry). Because many facilities in the sample did not have any electronic system or physical logbook that could be used as a sampling frame, the field team had to select the sample of suspected cases at random from all medical records in the health facility for many of the units. When this occurred, 45 medical records were selected and eligible cases were reviewed, but if the quota was not met, no new medical records were selected for evaluation. In each of these cases, none or only one of the medical records selected was eligible for review for the suspected malaria cases quota.

Another challenge was the availability of patient data for review, even if registries were available to select the sample. Some facilities do not open paper or electronic records for attentions of patients presenting with fever. Private laboratories included in the sample generally do not maintain patient records at all, but rather refer the patient for medical care after laboratory testing is conducted on-site. And in health facilities that are part of a care network with various sites, patient records are sometimes stored or accessible only at the main facility and not at the local branches where patients seek care. In other cases, records were accessible only by certain statistics personnel who were not available to assist survey personnel during the visit, or facilities had experienced personnel changes since 2018 and new personnel were not familiar with how to find and use registries from previous years.

IHME was informed by local Ministry of Health personnel that during a software transition in 2018 for the public health facilities, all electronic medical record data for routine attentions in 2018 in Buenaventura was mistakenly deleted. Before the loss of data was noticed, most physical records were destroyed as well. Due to this data loss, few health facilities in Buenaventura had any medical records available for the suspected case review. Due to this discovery at the beginning of data collection, the quota of suspected cases was increased in Nariño and Chocó in an attempt to make up for data not able to be captured in Buenaventura. However, those departments were affected by the limitations mentioned above, and the number of cases collected in all three departments was well below the quota expected based on the number of facility visits complete when data collection was suspended.

9.1.4 Challenges for confirmed case review

In Colombia, malaria case notification forms (SIVIGILA #465) were generally found for reviewed confirmed cases of malaria and could be reviewed at the UPGD or UNM units where they were entered into the SIVIGILA database. Health facilities that did not have access to the SIVIGILA database, UI facilities and some UPGD facilities, did not store malaria case notification forms as they were sent to associated reporting units for data entry into the SIVIGILA database. The information found on these forms was sufficient to measure most indicators, with two exceptions. This form does not have space to enter the dosage of medication received or how many days of treatment the patient received, so it was not possible to measure complete and continuous treatment. Additionally, sometimes the species of the parasite was not registered on the forms, making it impossible to determine what treatment scheme should have been followed, and evidence of treatment supervision was not often found. From the fact-finding visit, we anticipated these obstacles to measurement.

During the data collection, field staff were informed that the practice in Buenaventura during 2018 was to destroy SIVIGILA #465 forms after entering the data to the system. Due to this discovery at the beginning of data collection, the quota of confirmed cases was increased in Nariño and Chocó in an attempt to make up for data not able to be captured in Buenaventura. However, those departments were affected by the limitations mentioned above, and the number of cases collected in all three departments was well below the quota expected based on the number of facility visits complete when data collection was suspended. Additionally, it is important to note that confirmed cases were only found in urban facilities, though this issue was not due to Covid-19. During data collection, the team expected to find confirmed cases at rural facilities in stratum 5, but when the field team visited, they did not have any paper records available. At the time data collection was suspended in Colombia, the team should have collected around 600 confirmed cases, but only around 100 were retrieved.

9.1.5 Challenges for case and lab reporting review

In Colombia, there is no standard method of aggregate reporting of confirmed cases of malaria. Confirmed malaria cases are reported individually using paper SIVIGILA #465 forms which are entered into the SIVIGILA database. Within the SIVIGILA database, the weekly or monthly statistics can be reviewed by the reference laboratories, but there is no aggregate report that can be reviewed at the local level for this information. Even if a local level facility has access to SIVIGILA, they do not have access to the aggregate reporting information.

Although RMEI has instated standard guidelines for reporting confirmed cases weekly and indirect quality control monthly, many health facilities did not follow those timelines. Confirmed case reporting was most commonly completed monthly and multiple health facilities completed indirect quality control on a once quarterly basis. Participation in laboratory quality control programs seems to have been limited in 2018, and some facilities participating in the indirect review were found to send slides for review wrapped in scrap paper without the standard report form that serves as a record of laboratory activity.

9.1.6 Challenges for household data collection

Household data collection in Colombia encountered few logistical challenges. In terms of the measurement of vector control intervention coverage, interviewers found that mosquito nets they observed were generally not labeled with a brand name (unless they were still in their original packaging and unused). Evidence of the completion and date of indoor residual spraying (such as a “house card” signed by vector control personnel) was rarely observed. Recall bias has the potential to affect results for both vector control and case detection indicators, as respondents may have trouble remembering the details of a recent fever, or the time frame when IRS was applied to their home. For most of the fevers reported during the last two weeks, the respondent also reported exclusion symptoms, therefore the sub-sample size for the case detection indicator is quite small.

9.2 Key findings and recommendations

Formats of paper documents should be reviewed in order to ensure essential information is captured, but more importantly, the pipeline from recording on paper in the field to the final electronic database should be reviewed and improved to ensure the highest data quality, and to ensure the inclusion of information on case management captured after malaria diagnosis (treatment administration and supervision and follow-up parasitological tests). The process should dictate adherence to standard procedures, with information about the patient and case captured and recorded at the moment of medical attention or in follow-up contacts soon after diagnosis; health providers and case investigators should be trained not to leave required information blank on original forms that data entry personnel later have to seek to fill when notifying cases to SIVIGILA. As discussed in Chapter 7, the baseline measurement uncovered substantial differences (in both data missingness, and timeliness of diagnosis and treatment) between records kept on paper and those accessed through the SIVIGILA system. The emphasis must be on ensuring complete and precise data at the lowest levels of information, and in enabling effective data storage, processing, quality control, and analysis for decision-making at the department/ district and central levels.

Because malaria and other infectious disease programs have been managed for decades as parallel, vertically integrated systems, some disconnects between service provision in health facilities and through the vector control program persist. In Colombia, health care is provided through a variety of public and private networks and insurance schemes, which also poses a challenge to coordination for service provision and reporting. Different groups manage different activities for case detection, case management, and vector control, and there is not always a clear coordination plan. Vector control teams in the field must inform to the malaria program, while patients visit health facilities that are part of separate reporting chains. To reach malaria elimination, stakeholders will have to work to bridge gaps and reduce fragmentation in service provision.

Some practices and procedures are not standardized across the RMEI-Colombia study area, in particular notification flows and detection and record-keeping protocols for patients with fever presenting at a health

facility (suspected malaria cases). At the local level, there is a notable variation in practices among health facilities, such as private facilities, and sometimes a lack of understanding of central-level operations and goals. It is crucial to reach a shared understanding of how each part of the system connects with the others in order to reach success in malaria elimination and other projects in the Latin American region.

Appendix A: Indicator Matrices

A.1 Performance indicator matrix

#	Indicator	N	%	CI
2.02	Fever cases with blood sample	144	47.2	(31 - 64)
2.03	Case reporting with quality	23	0	(-)
	Lab production reporting	23	17.4	(6 - 39)
3.01	Slide results cross-checked at a reference laboratory	19	5.3	(1 - 31)
4.02	Diagnosis within 48 hours	100	21	(14 - 30)
4.01	Treatment within 24 hours	102	62.7	(53 - 72)
6.01	Vector control coverage	844	40.3	(18 - 68)
7.01	Equipment and instruments for diagnosis and treatment	43	4.7	(1 - 18)

A.2 Monitoring indicator matrix

#	Indicator	N	%	CI
M2.01	Suspected cases with malaria test (MRR)	254	38.6	(33 - 45)
E2.04	Notified within 24 hours of detection	101	41.6	(32 - 52)
M3.02	Quality control (external)	1	100	(-)
	Quality control (direct)	22	31.8	(16 - 54)
	Quality control (indirect)	22	4.5	(1 - 28)
E3.03	Equipment and instruments for sampling, diagnosis and RDTs	42	16.7	(8 - 32)
E4.05	Health facilities without stockouts of first-line treatments	42	40.5	(26 - 56)
E6.03	Population protected by IRS	2084	14.4	(13 - 16)
E6.05	Population protected by ITNs	2103	28.8	(27 - 31)

#	Indicator	N	Median	CI
E4.03	Median time between onset of symptoms and start of treatment (days): passive surveillance	93	4	(-)
	Median time between onset of symptoms and start of treatment (days): surveillance type not registered	7	4	(-)
	Median time between onset of symptoms and start of treatment (days): active surveillance	1	0	(-)
	Median time between onset of symptoms and start of treatment (days): increased surveillance	1	8	(-)

Appendix B: Indicator Definitions

This section defines the indicators verified in IHME surveys, and excludes others that are measured by expert review.

M2.01: Suspected malaria cases with parasitological test

Source: Medical record review of suspected cases of malaria

Denominator: Cases with suspicion of malaria (registered fever or eligible diagnoses)

Sampling by ICD code - diagnoses eligible for review

- A41.9 Sepsis, unspecified organism
- A68 Relapsing fevers
- A68.9 Relapsing fever, unspecified
- A98.5 Hemorrhagic fever with renal syndrome
- B34.9 Viral infection, unspecified
- B50 *Plasmodium falciparum* malaria
- B50.0 *Plasmodium falciparum* malaria with cerebral complications
- B50.8 Other severe and complicated *Plasmodium falciparum* malaria
- B50.9 *Plasmodium falciparum* malaria, unspecified
- B51 *Plasmodium vivax* malaria
- B51.0 *Plasmodium vivax* malaria with rupture of spleen
- B51.8 *Plasmodium vivax* malaria with other complications
- B51.9 *Plasmodium vivax* malaria without complication
- B52 *Plasmodium malariae* malaria
- B52.0 *Plasmodium malariae* malaria with nephropathy
- B52.8 *Plasmodium malariae* malaria with other complications
- B52.9 *Plasmodium malariae* malaria without complication
- B53 Other specified malaria
- B53.0 *Plasmodium ovale* malaria
- B53.1 Malaria due to simian plasmodia
- B53.8 Other malaria, not elsewhere classified
- B54.X Unspecified malaria
- G03.9 Meningitis, unspecified
- R16 Hepatomegaly and splenomegaly, not elsewhere classified
- R16.1 Splenomegaly, not elsewhere classified
- R16.2 Hepatomegaly with splenomegaly, not elsewhere classified
- R17.X Unspecified jaundice
- R50 Fever of other and unknown origin
- R50.0 Fever with chills
- R50.1 Persistent fever
- R50.8 Other specified fever
- R50.9 Fever, unspecified
- R51.X Headache
- R68 Other general symptoms and signs
- R68.8 Other general symptoms and signs
- A27 Leptospirosis

- A27.0 Leptospirosis icterohemorrhagica
- A278 Other forms of leptospirosis
- A279 Leptospirosis, unspecified
- A90.X Dengue fever [classical dengue]
- A91.X Dengue hemorrhagic fever
- A92 Other mosquito-borne viral fevers
- A92.0 Chikungunya virus disease
- A92.8 Other specified mosquito-borne viral fevers
- A92.9 Mosquito-borne viral fever, unspecified

Sampling by presumptive or final diagnosis - diagnoses eligible for review

- Fever (acute, relapsing, persistent, unspecified, etc.)
- Malaria (*P. falciparum*, *P. vivax* or unspecified)
- Leptospirosis
- Dengue (classical, hemorrhagic or unspecified)
- Chikungunya
- Mosquito-borne fever
- Viral infection, unspecified
- Meningitis
- Hepatomegaly
- Splenomegaly

Sampling by principal complaint - motives eligible for review

- Fever
- Malaria
- Dengue
- Chikungunya

Numerator: Cases with evidence a malaria test was ordered

Exclusions:

1. Diagnoses ineligible without a documented fever:

Sampling by ICD code

- A41.9 Sepsis, unspecified organism
- B34.9 Viral infection, unspecified
- G03.9 Meningitis, unspecified
- R68 Other general symptoms and signs
- R68.8 Other general symptoms and signs
- A27 Leptospirosis
- A27.0 Leptospirosis icterohemorrhagica
- A27.8 Other forms of leptospirosis
- A27.9 Leptospirosis, unspecified

Sampling by presumptive or final diagnosis

- Leptospirosis
- Viral infection, unspecified

- Meningitis

2. Diagnoses ineligible for record review (febrile illnesses with defined etiology):

- Arbovirus with positive viral test
  - Dengue
  - Chikungunya
  - Zika
  - Acute respiratory infection
- Gastrointestinal infection
- Fever of neurological origin
- Skin lesion
- Urinary infection
- Findings in soft tissues
- Focal infection
- Other parasitological infection

P2.02: Fever cases with blood sample

Source: Household survey

Denominator: People in stratum 4 or 5 communities who reported fever during the two weeks prior to the survey

Numerator: People who reported a blood sample was taken from their finger, heel, earlobe, or vein during their febrile illness

Exclusions: People who reported the presence of respiratory, urinary, or skin symptoms during their febrile illness (Sore throat, difficulty swallowing, ear pain and secretions, cough with discharge or phlegm, Mucus or nasal secretions, intercostal retractions or retractions of the thorax muscles, pain or discomfort urinating, strong smelling urine, dark colored urine, genital itch, frequent urination and in small quantities, vaginal or penile secretions, pimples or rash, redness or inflammation of the skin or presence of pus in the skin, open wounds with presence of pus or black borders)

P2.03a: Malaria case reports with quality standards

Source: Health facility observation

Denominator: Health facilities with self-reported diagnostic capacity (microscopy or RDTs)

Numerator: Health facilities with weekly epidemiological surveillance reports observed

- Reports list the aggregate number of malaria cases or report of zero cases
- Reports observed for all 52 weeks of the year 2018
- Reports in randomly selected month list sending date
- All observed dates before 3PM of the following Monday

Exclusions: Department/ district ETV offices, department/ district reference laboratory

P2.03b: Malaria laboratory production reports with quality standards

Source: Health facility observation

Denominator: Health facilities with self-reported diagnostic capacity (microscopy or RDTs)

Numerator: Health facilities with monthly (or weekly) laboratory production reports observed

- Reports list the malaria samples taken (thick blood film or RDT)
- Reports observed for all 12 months or 52 weeks of the year 2018
- Reports in randomly selected month list sending date

Exclusions: Department/ district ETV offices, department/ district reference laboratory

P3.01: Slides sent to reference laboratory for indirect quality control (cross-check verification) - positive and negative slides

Source: Health facility observation

Denominator: Health facilities with self-reported microscopic diagnostic capacity

Numerator: Health facilities with observation of slide cross-check report and results from the reference laboratory with 5 positive and 5 negative slides (or 10 total if fewer than 5 positive malaria slides) sent for cross-check verification, dated 2018.

Exclusions: N/A

M3.02a: Department/ district laboratory participates in external quality control

Source: Health facility observation

Denominator: Department/ district malaria reference laboratory

Numerator: Laboratory with observation of Diagnostic Performance Results Report from the Pan American Health Organization dated 2018 or 2019**

Exclusions: N/A

M3.02b: Laboratories that participate in direct quality control

Source: Health facility observation

Denominator: Health facilities with self-reported microscopic diagnostic capacity

Numerator: Health facilities with observation of Evaluation Results Report (for slide panel exam) from the reference laboratory for at least one microscopist responsible for malaria diagnosis, dated 2018

Exclusions: N/A

P3.02c: Laboratories that participate in indirect quality control

Source: Health facility observation

Denominator: Health facilities with self-reported microscopic diagnostic capacity

Numerator: Health facilities with monthly (or weekly) slide cross-check reports observed

- Reports observed for all 12 months or 52 weeks of the year 2018
- Reports in randomly selected month have results and feedback from the reference laboratory

Exclusions: N/A

P4.01: Malaria cases with treatment within 24 hours of diagnosis

Source: Medical record review of SIVIGILA notification forms for confirmed cases of malaria

Denominator: Number of confirmed malaria cases reviewed

Numerator: Number of confirmed malaria cases that received first-line antimalarial treatment according to national policy the day of diagnosis or the day after diagnosis, as recorded on case notification forms

- *P. vivax*: chloroquine + primaquine
- *P. falciparum*: artemisinin-based treatment (artemether + lumefantrine)
- Mixed malaria: artemisinin-based treatment (artemether + lumefantrine) + primaquine
- Severe malaria cases: artesunate or quinine or artemether (or others according to the norm)

Exclusions: Cases with an extreme time interval (suspected of registration errors): treatment begun more than 7 days before or more than 30 days after diagnosis date

P4.02: Malaria cases with diagnosis within 48 hours of start of symptoms

Source: Medical record review of SIVIGILA notification forms for confirmed cases of malaria

Denominator: Number of confirmed malaria cases reviewed

Numerator: Number of confirmed malaria cases that were diagnosed within two days or less after fever or other symptoms began, as recorded on case notification forms

Exclusions: Cases with an extreme time interval (suspected of registration errors): diagnosis more than 7 days before or more than 30 days after symptoms began

M4.03: Malaria cases with complete and supervised treatment

Source: Medical record review of SIVIGILA notification forms for confirmed cases of malaria

Denominator: Number of confirmed malaria cases reviewed

Numerator: Number of confirmed malaria cases that received complete antimalarial treatment according to national policy with at least one dose supervised, as recorded on case notification forms

- For *P. vivax* cases: 3 days of chloroquine and 7 or 14 days of primaquine
- For *P. falciparum* cases: 3 days of artemisinin-based treatment (artemether + lumefantrine)
- For mixed infections cases: 3 days of artemisinin-based treatment (artemether + lumefantrine) and 7 or 14 days of primaquine
- For severe malaria cases: If IV treatment with artesunate started, when completed: 3 days of artemisinin-based treatment (artemether + lumefantrine) and one day of primaquine

Exclusions: If the patient died, treatment will be required until the day prior to death. Cases with death on the day of diagnosis or the following day excluded.

P6.01: Risk group protected with vector control interventions

Source: Household survey

Denominator: People who slept at home the night before the survey in target communities (determined from sampling documentation provided by the Ministry of Health)

Numerator: People protected by either of two vector control interventions (IRS or LLIN)

- Respondent informed that interior walls of dwelling were sprayed in the 12 months prior to the survey
- Respondent informed that the individual slept under an insecticide-treated net the night prior to the survey

Exclusions: People in households with “don’t know” response to indoor residual spraying, who did not sleep under a net the night prior

P7.01: Equipment and supplies for malaria diagnosis and treatment

Source: Health facility observation

Denominator: Points of care and laboratories

Numerator: Points of care and laboratories with supplies for the diagnosis and treatment of malaria observed the day of the survey and without stockout in the three months prior to the survey

First-line antimalarial medications: Chloroquine tablets + Primaquine tablets (15 mg or 5 mg) + Derivatives or artemisinin (artemether + lumefantrine) without stockout in the three months prior to the survey

- All microscopy posts, private laboratories, primary care facilities, and hospitals. Department/ district ETV units and reference laboratories that report microscopy capacity or on-site diagnosis.

Antimalarial medications for severe malaria: Quinine or Artesunate [tablets, IV, or rectal] without stockout in the three months prior to the survey

- All microscopy posts, private laboratories, primary care facilities, and hospitals

Supplies for taking samples and elements for basic biosafety: Disposable gloves + lancets + microscope slides

- All microscopy posts, private laboratories, primary care facilities, and hospitals. Department/ district ETV units and reference laboratories that report microscopy capacity or on-site diagnosis.

Forms for sending slide samples

- All microscopy posts, private laboratories, primary care facilities, and hospitals. Department/ district ETV units and reference laboratories that report microscopy capacity or on-site diagnosis.

Supplies for on-site diagnosis: Rapid diagnostic tests (RDTs)

- All health facilities that report on-site diagnosis, including department/ district labs and ETV units

Equipment for microscopy: Microscope (with 100x retractable lens) + cell counter (manual or automatic)

- All health facilities that reported microscopic diagnostic capacity, including department/ district labs and ETV units

Supplies for staining and testing: Immersion oil + concave slide or coloring tray/container + laboratory stopwatch (or other method of keeping time) + plastic or glass tubes (or alternative according to country) + syringe/pipette/dropper

- All health facilities that reported microscopic diagnostic capacity, including department/ district labs and ETV units

Reagents for staining: Giemsa or [Methylene blue + Solution A + Solution B + Methanol] + Buffer solution or [buffer tablets + distilled water]

- All health facilities that reported microscopic diagnostic capacity, including department/ district labs and ETV units

Exclusions: *Supplies for taking samples and elements for basic biosafety:* Disposable gloves + lancets + microscope slides

- Four eligible establishments where this information was not captured (revisit was pending when data collection was suspended due to Covid-19) are excluded from this component of the indicator.

Forms for sending slide samples

- Four eligible establishments where this information was not captured (revisit was pending when data collection was suspended due to Covid-19) are excluded from this component of the indicator.

Appendix C: Sample design and methods

C.1 Sample size

The size of the sample of health facilities for Colombia was defined as a part of the funding proposal to cover 60 points of measurement. In the case of the RMEI indicators, the “effective sample size”, or number of observations with data available for a specific indicator, varies from a fraction of the facility sample (e.g., participation in microscopy quality control assessment can only be measured in facilities with microscopy capabilities) to a much larger number (e.g., several hundred records of fever cases reviewed to verify if a malaria test was taken). The sample of 60 points was allocated purposively among different types of facilities based on the findings of the joint IDB-IHME factfinding visit in order to satisfy minimum anticipated effective sample sizes. The LQAS measurement was defined as a part of the funding proposal to cover 32 communities with 25 households surveyed in each, or a total of 800 households surveyed.

In terms of the ability to calculate indicator estimates precisely, as the size of the sample increases, the marginal return (in terms of estimation power) of each additional observation diminishes. The probability of failing to detect a true impact decreases as sample size increases, but the chance of a “false positive” finding rises. Thus, the statistics of sample size calculations focuses on balancing the risk of these two types of error by identifying the minimum sample size necessary to detect a difference considered to be meaningful, or to calculate an estimate with believable precision. Another important consideration in fixing the sample size for a public health intervention is financial, in order to maximize the resources available to benefit the target population by keeping measurement costs modest. The per-facility cost of data collection is also subject to an economy of scale, but the decrease in cost for the marginal facility is modest after 30 facilities, based on IHME’s data collection experience in the region.

The precision of the indicator estimate is driven by two factors: the size of the sample, and the population variance of the indicator. For a binary indicator, an estimate near 0 or near 1 will have low population variance. An estimate between .25 and .75 will have higher population variance. Because the sample was selected before RMEI indicators had been tracked or reported in Colombia, the population variance was difficult to estimate a priori, necessitating review of a range of scenarios where population variance and sample size are allowed to vary, as shown in Figure C.1.

Figure C.1: Sample size and corresponding margin of error by population variance

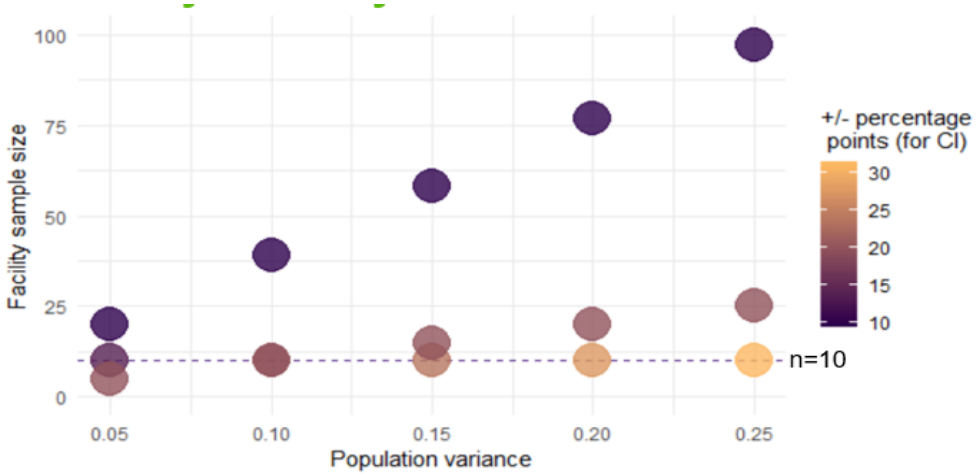


Figure 1. Facility sample sizes and corresponding margins of error across different levels of population variance. Potentially acceptable margins of error range from +/-10 ppts (ideal) to +/-30 ppts (considered high) on either side of the point estimate.

C.2 Sample selection procedures

C.2.1 Selecting health facilities

We prepared the sampling frame of facilities eligible for random selection by identifying all primary care facilities (*"puesto de microscopia," "laboratorio privado," "puesto de salud,"* and *"centro de salud"*) in the 12 municipalities of the study area. All eligible facilities had malaria diagnostic capabilities (microscopy or RDT) based on referral networks and facility lists provided by the Colombia Ministry of Health. All primary care facilities provided were in strata 4 or 5. Public and private health facilities were eligible for selection in the sample, but military and police heath facilities were excluded. Eligible facilities were listed according to whether vector control activities (IRS or ITN distribution) were carried out within the catchment area, as noted in intervention activity lists that the Ministry of Health provided to IHME. Primary care facilities were sorted by a random variable and a sample was drawn in one stratum: with microscopy or RDT in malaria stratum 4 or 5.

Facilities with vector control activities carried out in the catchment area during 2018 had first priority for selection. If all facilities with vector control activity had been selected and spaces still remained in the sample, facilities were selected at random among all eligible facilities until the full sample size was reached. The remaining facilities were selected and added, in random order, to an alternate sample to be used in the case a selected facility could not be surveyed and required substitution.

Next, we built a list of the eligible administrative units responsible for notification and reporting, reference laboratories, and referral hospitals according to the referral network, including each municipality with primary care units already selected to the sample. This sampling frame consisting of, respectively, department/ district ETV units (*"sede departmental/distrital de Enfermedades Transmitidas por Vectores (ETV)"*), department/ district reference labs, and hospitals, which were selected with certainty. Each ETV unit and reference laboratory was assigned to the maximum stratum found in its service area, which was stratum 5 in all three cases.

C.2.2 Selecting suspected cases of malaria

Based on the list of eligible attentions extracted from the digital system or the attention records, interviewers selected the sample manually by first counting the total number of attentions and total eligible attentions during a one-month period during 2018. Next, they entered the totals to the Quotas Module to receive a randomly generated start date during 2018 and a calculated skip interval to use to select records. Using the registry or extracted list, they began at the provided start date, and then skipped through the list searching for eligible cases from 2018 according to the provided skip interval. They made a list of selected records to search out and review, but identifiable patient information was never entered to the survey modules.

C.2.3 Selecting confirmed cases of malaria

The budgeted quota of confirmed cases of malaria was allocated among selected facilities based on the relative proportion of confirmed malaria cases in each municipality in 2018. If the number of confirmed cases for 2018 available for review in the facility was smaller than the quota, all records from 2018 were reviewed. If the number of confirmed cases available for review was greater than the quota, which happened in only one instance early in data collection, interviewers used a list of confirmed malaria cases extracted from the digital system or attention records to select the sample manually using the same systematic method described in the previous section.

Prior to the start of data collection, it was anticipated that there might be issues collecting confirmed case information from UI (*"Unidad Informadora"*) facilities. These units do not store records or report to the SIVIGILA (*"Sistema Nacional de Vigilancia en Salud Pública"*) system, so they send their confirmed case notification forms to an associated facility for electronic data entry. After documents are entered electronically, they are no longer stored at the UI facility, which makes it unlikely that any UI unit would have medical records or confirmed case reports available for review in facility. To make sure the quota of

confirmed cases was met, facilities that was registered as UI in the Ministry of Health documentation were not selected to have confirmed case review completed and the quota of confirmed cases was increased at UPGD registered facilities.

Twenty-six units that were expected to have confirmed case information did not have confirmed case reports on-site or they were not available to review. Eighteen facilities that were marked as UPGD in the Ministry of Health documentation did not store confirmed case reports on site and did not have access to electronic databases to review. Four facilities did not perform malaria microscopy or use RDTs on-site, so patients with suspected malaria were sent to another facility for malaria testing, treatment, and investigation. The remaining 4 units had confirmed case reports on-site but the reports for 2018 was inaccessible, destroyed, or incomplete.

C.2.4 Selecting communities

IHME used information about vector control interventions and referral networks received from the Ministry of Health to select one community in the catchment area of each of 32 primary care facilities for the household survey. Primary care facilities with ITN or IRS interventions since the start of 2018 reported in the catchment area were selected with certainty. Due to vector control intervention data being unavailable in certain municipalities, primary care facilities selected in Riosucio, Chocó, and public or rural primary care facilities selected in Buenaventura were also selected with certainty for the community sample. The remaining facilities were selected at random among the public or rural primary care facilities remaining in the health facility sample. Within the selected catchment area, a community that had received ITN or IRS interventions since the start of 2018 was selected at random among all communities with vector control interventions. If no communities received vector control interventions or intervention status was unknown, a community was selected at random among all communities in the catchment area. A second and third community from the catchment area were selected as backups in the event that the first community could not be surveyed due to security concerns, logistical challenges, or community refusal of the study.

C.2.5 Selecting households

In order to achieve the desired sample size of 800 households, we sought to complete interviews with residents of 25 randomly selected households in each of the 32 communities selected from the catchment areas of the ambulatory facilities in the health facility sample.

Field staff selected the sample of households using systematic manual sampling techniques with the dwelling as the unit of random selection. In the sample, IHME provided a random integer between 1 and 9 and a randomly selected cardinal direction to use as a starting point, and a skip interval calculated by dividing the total number of households in the community in order to achieve a sample of 25 households completed. If the calculated interval was greater than 9, an interval of 9 was given such that only a single sector of larger communities was surveyed to facilitate field operations. The field team started at the recognized center of the community (such as a plaza, church, or market) and began sample selection in the random direction provided by the sampling module, counting dwellings first to the random start point and subsequently according to the skip interval, along the right hand side of the street. Each selected household was approached to explain the study and request participation. Upon reaching a dead end or reaching the border of the community, field workers made a turn to the right (or turned around) and continued the systematic selection along the right hand side. If a selected dwelling contained more than one household, each of those households was eligible for the survey and counted toward the quota of 25 households per community. If a selected household could not be interviewed due to absence or refusal, it was replaced with the household in the dwelling next door on the right side.

Informed consent was sought from each respondent to the household questionnaire. Occasionally, a survey was refused in course, resulting in a partially complete household result. Because multiple interviewers worked the sample simultaneously, in a handful of instances more than 25 surveys were completed. In the baseline, counts of complete households by community range from 15 to 29 households. Counts of absent households range from 0 to 8 households. Counts of refused households range from 0 to 2 households.

C.3 Interruption to data collection

Shortly after data collection started in February 2020, the 2019-nCov acute respiratory disease (Covid-19) reached Colombia. In order to prevent the spread of the disease, the Colombia Ministry of Health implemented strict national interventions. On March 16, 2020 travel was restricted to ethnic and indigenous communities. On March 20, 2020 the country released a notice of country-wide quarantine starting on March 24. Data collection was immediately suspended to allow the field team to travel home safely. After quarantine was extended multiple times, baseline data collection officially concluded on April 16, 2020.

Data collection continued between the first travel restriction implemented on March 16 and the mandatory quarantine on March 20. During this time, the field team was unable to travel to rural health units that served ethnic and indigenous communities, so they completed easily-accessible urban units that were not being affected by the travel restriction. This, along with the scheduled plan of completing the least accessible locations later in data collection, affected the composition of the completed units.

Three municipalities in the sample were in stratum 4, but were not completed due to the early conclusion of data collection. These municipalities were all remote and near the Panama border, so they were reserved until the end of data collection. Without these communities, the sample represents stratum 5 alone.

Only 46 health facilities and 24 communities were visited before suspension of data collection due to Covid-19. Three ETV units and two reference laboratories were visited, but data collection was not completed there and follow-up visits were pending when field activities had to be suspended.

C.4 Sampling weights for the household survey

Household data is weighted by the inverse of the probability of selection according to the Large Country - Lot Quality Assurance Sampling method of Hedt, Olives, Pagano & Valadez (2008) with modifications to adjust to the facility-matched sample design. Estimates in this report take into account sampling weight, clustering, stratification, and the finite population correction.

Where

m = The number of households sampled in community *i* in the catchment area of facility *h*

M = The total number of households in the catchment area of facility *h*

n = The number of communities (each matched to a primary care facility *h*) sampled in the study region

N = The total number of primary care facilities in the study region

$$Weight = \frac{1}{P(ith\ community\ selected) * P(jth\ household\ selected \mid ith\ community\ selected)}$$

$$= \frac{1}{\frac{n}{N}\left(\frac{m}{M}\right)} = \frac{NM}{nm}$$

This report of the Regional Malaria Elimination Initiative (RMEI) Colombia baseline survey was produced in agreement with the Inter-American Development Bank (IDB). All analyses and writing were conducted by the Institute for Health Metrics and Evaluation (IHME) at the University of Washington.

About IHME

The Institute for Health Metrics and Evaluation (IHME) is an independent population health research center at UW Medicine, part of the University of Washington, that provides rigorous and comparable measurement of the world's most important health problems and evaluates the strategies used to address them. IHME makes this information freely available so that policymakers have the evidence they need to make informed decisions about how to allocate resources to best improve population health.

IHME aspires to make available to the world high-quality information on population health, its determinants, and the performance of health systems. We seek to achieve this directly, by catalyzing the work of others, and by training researchers as well as policymakers.

Our mission is to improve the health of the world's populations by providing the best information on population health.

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