mesoamerica MALARIA

saludmesoamerica.org

Regional Malaria Elimination Initiative Guatemala

Baseline Measurement (2020)

October 2020

Table of Contents

Acronyms

BMGF - Bill & Melinda Gates Foundation
CAPI - Computer-assisted personal interview
CHAI - Clinton Health Access Initiative
Col-vol - *Colaborador voluntario* (volunteer collaborator)
COCODES - *Consejo comunitario de desarrollo* (community development council)
COMISCA - Council of Ministers of Central America and the Dominican Republic
CSF - Carlos Slim Foundation
DAS - *Dirección de Área de Salud* (health area headquarters)
DTI-R - Detection, Diagnosis, Treatment, Investigation, and Response
ETV - *Enfermedades Transmitidas por Vectores* (vector-borne diseases program)
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
RMEI - Regional Malaria Elimination Initiative
TBF - Thick blood film

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 Guatemala, with input from the Ministry of Health and Social Assistance. 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 Guatemala. Hospitals and administrative headquarters 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 Guatemala baseline measurement is summarized in Table E1. The information sought as a part of the measurement varied by facility type.

Table E1: Guatemala data collection summary

Point of data collection	Number completed	Measurement completed
Ambulatory health facilities with/without malaria microscopy	30	Health facility questionnaire and observation
		Medical record review of suspected cases of malaria
		Treatment stock
		Laboratory supplies/reports
		Household measurement in catchment area
Health district / Health Center with/without malaria microscopy	20	Health facility questionnaire and observation
		Medical record review of suspected cases of malaria
		Treatment stock
		Laboratory supplies/reports
Hospitals	6	Household measurement in catchment area
		Medical record review of suspected cases of malaria
		Treatment stock
		Laboratory supplies/reports
Suspected malaria cases reviewed	*1196*	

Point of data collection	Number completed	Measurement completed
Health Area Headquarters (DAS)	5	Record review of confirmed cases of malaria
		Stock of treatment and diagnostic supplies
		Laboratory supplies and reporting
		Laboratory certification and quality control
Confirmed malaria cases reviewed	*709*	
National malaria reference laboratory	1	Laboratory supplies and reporting
		Laboratory certification and quality control
Communities	31	Coverage of vector control interventions
		Fever cases with malaria test
		Treatment of confirmed malaria cases
Households interviewed	*789*	

Summary of results

Malaria prevention

In order to protect the populations most at risk of malaria infection, the public health system in Guatemala 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	29	79.3%	14.3%
Both	1	79.1%	70.4%
None	1	70.9%	50.4%

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	0	0	(-)
Sampling and biosafety equipment	47	31	66	(51 - 78)
Sample submission forms	7	5	71.4	(32 - 93)
Microscopy equipment	34	24	70.6	(53 - 84)
Equipment for staining and testing	34	25	73.5	(56 - 86)
Reagents for staining	34	11	32.4	(19 - 50)
Units with all required equipment and medications	**56**	**4**	**7.1**	**(3 - 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.

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)	89	11	12.4	(6 - 25)
Suspected case with malaria test (medical record review)	1196	62	5.2	(4 - 7)

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 the health area headquarters (*"Dirección de Área de Salud"*, DAS). The review captured up to 200 cases from 2018 at each DAS included in the sample. 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 is 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	875	120	13.7	(12 - 16)
3 days	875	82	9.4	(8 - 11)
4-5 days	875	129	14.7	(13 - 17)
6-7 days	875	106	12.1	(10 - 14)
Over 7 days	875	158	18.1	(16 - 21)
Indicator result: Cases diagnosed within 48 hours of onset*	875	120	13.7	(12 - 16)

*34 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 investigation 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 appropriate treatment 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	909	586	64.5	(61 - 68)
First dose treatment within 24 hours of diagnosis*	884	517	58.5	(55 - 62)
Correct treatment administered within 24 hours of diagnosis*	884	451	51	(48 - 54)

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

The indicator for complete, supervised treatment of malaria identifies the cases with evidence that all doses of the appropriate treatment scheme were administered to the patient, and that at least one dose was supervised by any health care provider (Table E7). Cases with *Plasmodium* species, type of medication administered, or number of treatment administrations not registered are not considered to have complete treatment.

Table E7: Complete and supervised treatment, Confirmed case review

	N	n	%	95% CI
Adequate treatment and number of doses administered	909	39	4.3	(3 - 6)
Evidence of at least one supervised dose	909	0	0	(-)
Indicator Result: Complete treatment with supervision	909	0	0	(-)

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 was sought in the national reference laboratory (from 2018 or 2019).

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	38	1	2.6	(0 - 17)
Laboratory production reporting to standard	28	3	10.7	(3 - 29)
External quality control: 2018 National Lab Evaluation form observed	1	1	100	(-)
Facilities passing direct quality control (DQC) component	33	2	6.1	(1 - 22)
Facilities passing indirect quality control (IDQC) component	33	2	6.1	(1 - 22)

Key findings

The results of the Guatemala 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 the capacity to improve information availability, but in order to be effective, adoption of 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 Guatemala 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, 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 Guatemala, 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 Guatemala, active, residual, and inactive foci were defined, and each municipality was assigned to a stratum 1 through 4, as seen in Table 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 on the Initiative as their level of importation risk and number of autochthonous cases evolves. The malaria program in Guatemala 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 country-wide, and improving surveillance capacity by reviewing existing practices, expanding use of digital information systems, and standardizing reporting for case detection.

Figure 1.1: Guatemala malaria stratification: national

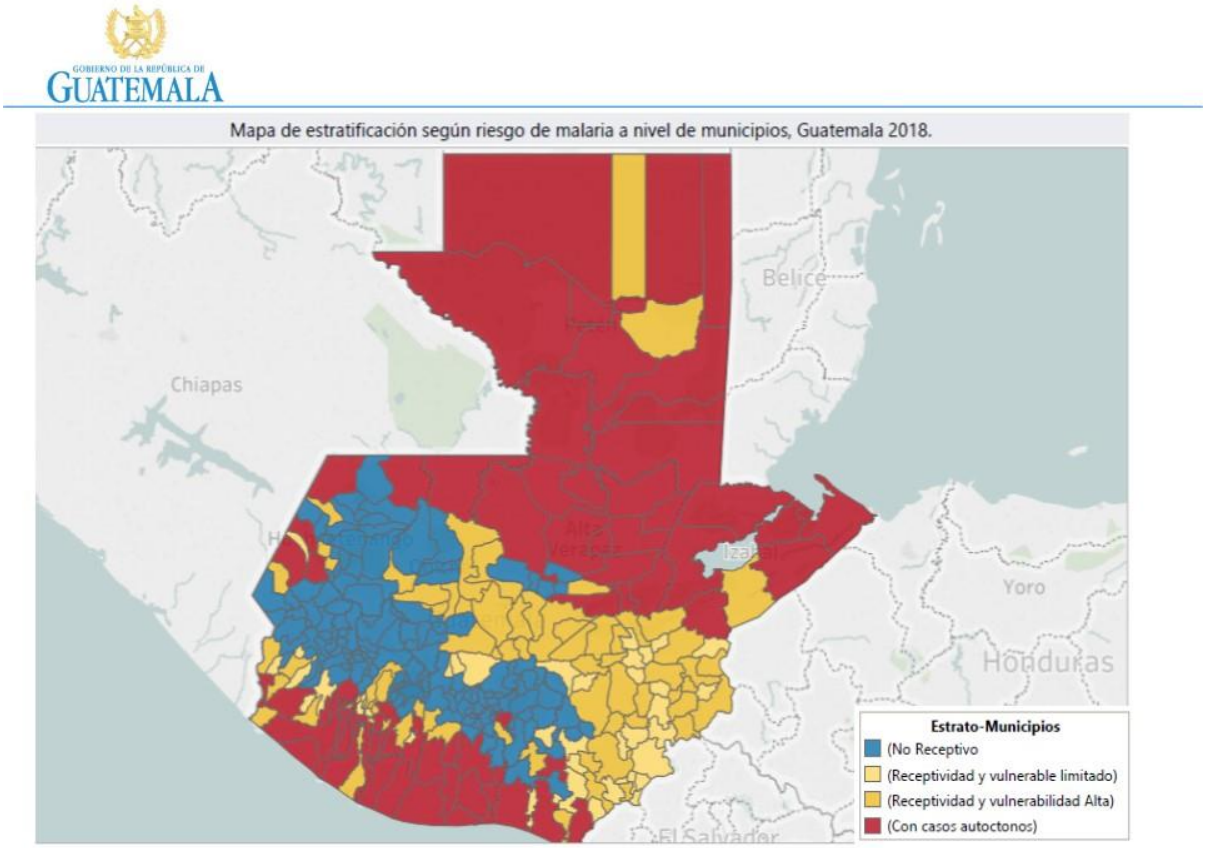


Table 1.1: Guatemala malaria stratification: Definition and distribution of strata

Stratum	Number of municipalities	Definition
1	156	Non-receptive
2	40	Receptive, no autochthonous cases, no risk of importation
3	69	Receptive, risk of importation, no autochthonous cases
4	70	Receptive, presence of autochthonous cases in last 3 years

In Guatemala, malaria burden has dropped progressively since 2015, though transmission persists in several departments, in particular near the coasts and in the lowland north of the country. In 2018, the reference year for the baseline measurement, Guatemala had 3018 confirmed cases of malaria according to national public health surveillance data provided by the Ministry of Health and Social Assistance, though only 1235 cases were recorded during 2019. Guatemala has historically depended on a vertically integrated malaria program that operates in close coordination with programs for other vector-transmitted diseases, and receives grant support from the Global Fund. Guatemala has an established network of community health volunteers called *"colaboradores voluntarios"* ("col-vol", volunteer collaborator) who collaborate in case detection in communities with active malaria transmission and with limited access to health services. In the malaria elimination phase, Guatemala will transition malaria detection and case management to be more closely horizontally integrated within the public primary care system, increasingly relying on passive detection of cases at health facilities and eventually shifting responsibility to primary care providers to administer treatment and follow-up care.

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 a part of RMEI 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 Guatemala 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 and case investigation forms for confirmed malaria cases at selected health area headquarters.

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 Guatemala 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 health areas of Guatemala in October 2019. During the exploratory visit, the team visited a range of health facilities and col-vol 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 Guatemala, the sample includes primary care facilities, hospitals, municipal health district administrations with health center (*"centro de salud", CAP, CAIMI,* or *CENAPA*) and vector control program, DAS with regional reference laboratories, and the national reference laboratory. Households within the catchment area of primary care facilities selected to the sample were interviewed for the community survey. Table 1.2 shows the information collected at each point.

Table 1.2: Points of data collection for baseline measurement

Type of health unit	Measurement completed
Ambulatory health facilities with/without malaria microscopy	Health facility questionnaire and observation
	Medical record review of suspected cases of malaria
	Treatment stock
	Lab supplies/reports, if microscopy
	Household measurement in catchment area
Health district / Health Center with/without malaria microscopy	Health facility questionnaire and observation
	Medical record review of suspected cases of malaria
	Treatment stock
	Lab supplies/reports, if microscopy
	Household measurement in catchment area
Hospitals	Health facility questionnaire and observation
	Medical record review of suspected cases of malaria
	Treatment stock
	Lab supplies/reports
Health Area Headquarters (DAS)	Health facility questionnaire and observation
	Lab supplies/reports
	Treatment stock
	Record review of confirmed cases of malaria
National lab	Lab supplies and reporting
	Lab certification and quality control
Households	Coverage of vector control interventions
	Fever cases with malaria test
	Treatment of confirmed malaria cases

Another point of care critical to systems of malaria detection and treatment in Guatemala is the *"colaborador voluntario"* (col-vol). These volunteer community health workers provide fever screening and malaria testing via rapid diagnostic test or thick blood film (TBF or "gota gruesa") preparation, out of their own homes or around their communities. Col-vol posts were considered for inclusion in the measurement sample, because col-vols prepare TBF slides, keep registers of patients tested, and sometimes store and administer treatment for confirmed malaria cases. However, because col-vols do not manage their own supply stocks, keep records of patient care, nor have primary responsibility for case investigation and follow-up, the col-vol post is not eligible for inclusion in the RMEI indicators. All the necessary records to

be reviewed for a patient with malaria detected by a col-vol, or with treatment supervised by a col-vol, will be filed at a health facility rather than at the col-vol's home and these records are captured within the existing sampling frame. Further, col-vol posts are costly to reach because they are intended to serve communities without an easily accessible health facility, and col-vols may not keep regular hours since they are volunteers and not health system employees. Confirmed cases of malaria detected by a col-vol were included in the review of medical records, as paperwork for cases detected at any service point is always filed at the DAS where review took place, in Guatemala.

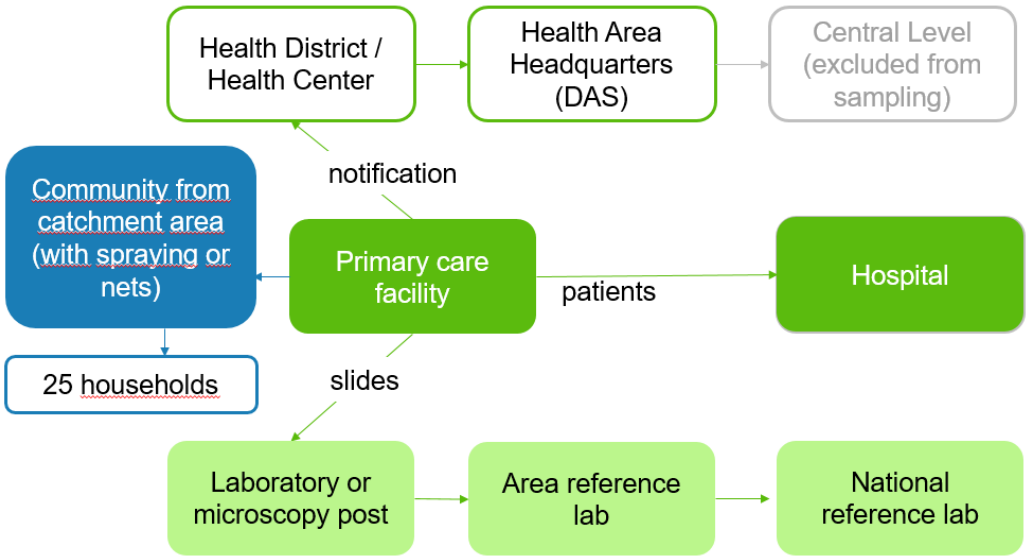
Chapter 2: Survey Methodology

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 toward presenting representative estimates for the focus areas identified for interventions through the Initiative. Since the Initiative aims to eliminate malaria, 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 Guatemala, the sample is made up of facilities and communities in malaria strata 3 and 4 (see strata definitions in Table 1.1). We focused on zones with autochthonous malaria cases in order to maximize our sample size from these zones.

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 (*"puestos de salud," "centros de convergencia,"* and *"unidades mínimas 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 and administrative units (the health district office or *sede de distrito* with municipal health center, and health area headquarters or *"dirección de área de salud" (DAS)*) responsible for notification and reporting, as depicted in Figure 2.1. The communities we selected for the household survey are within the catchment areas of the selected primary care facilities.

Figure 2.1: RMEI-Guatemala baseline health system structure



2.1.1 Health facility sample selection

In Guatemala, malaria stratification was completed at the municipality level. Primary care facilities in municipalities classified as malaria stratum 3 or malaria stratum 4 with vector control measures (ITN distribution or IRS) implemented in the catchment area were eligible to enter the sampling frame. Because patients with fever may seek care at any health facility, but only a fraction of these facilities has microscopy capacity, the sample of primary care facilities was drawn separately for facilities with and without microscopy. This ensured a sufficient denominator to measure indicators for laboratory inputs, equipment, and reporting. The sample was thus selected in three sampling strata: with microscopy

capacity in malaria strata 3 and 4 combined, without microscopy capacity in malaria stratum 3, and without microscopy capacity in malaria stratum 4.

The sampling frame was built based on referral networks and facility lists provided by the Guatemala Ministry of Health and Social Assistance. Each health facility eligible to be selected for the sample was assigned to a malaria stratum 1 through 4 based on its municipality. We assigned each administrative unit (*"dirección de área de salud" (DAS)*) to the maximum stratum found in its service area (areas with any municipalities in stratum 4 are therefore assigned to stratum 4).

The initial sampling frame for the health facility survey is the list of facilities that provide primary care services for malaria. In order to ensure necessary information is captured for all indicators, for each selected facility we included the ancillary units from the reporting chain (district offices with health center, area headquarters and reference labs, and referral hospitals) associated with a selected primary care facility for measurement, up to a fixed sample size defined to balance budget considerations with statistical power for analysis. For example, once a local-level ambulatory facility was selected at random, several related units were identified for inclusion (or for random selection, if more than one qualifies). These include the hospital to which it refers severe malaria cases, the health district it reports to and where vector control personnel are based, the reference laboratory responsible for its microscopy quality control, and the area headquarters where confirmed malaria cases from the facility are investigated and filed. 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. Additionally, the selection strategy allows for a random sample of facilities to be included in the measurement for supplies and equipment, testing of suspected cases, and reporting sent from the local level, but remains cost-effective by concentrating visits to health area offices to review confirmed cases of malaria and household measurement in the zones with the most autochthonous transmission.

2.1.2 Substitutions within the sample

We selected two backup facilities per municipality in case sampled facilities could not be interviewed due to security or logistic concerns. When replacement was required, we replaced 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 were not available in the same municipality, we replaced with a randomly selected facility from the same malaria stratum. In the Guatemala baseline, one primary care facility was replaced during data collection. The originally selected facility, a *"centro de convergencia"* was replaced by the *"puesto de salud"* serving the same community, because it was found that the *"centro de convergencia"* only provides vaccinations on occasion while all other primary care services including fever care are administered at the *"puesto de salud"*.

At the end of the data collection in March 2020, the survey was refused at two health facilities with one associated community because despite collaboration from local facility staff, personnel at the corresponding DAS refused to receive the survey team and provide permission for the survey to take place at the two selected facilities over the course of several visits on separate days. These facilities and community were not replaced since the end of the data collection period had been reached.

Household data collection was refused by the community development council (*consejo comunitario de desarrollo,* COCODES) in one selected community. The selected community was the only one in the corresponding facility's catchment area that had vector control measures, so the survey was conducted in another community served by the same health facility but without vector control measures.

2.1.3 Community and household sample selection

One community was selected for the Lot Quality Assurance Sampling (LQAS) household survey from the catchment area of each of the 32 primary care facilities selected to the 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. IHME selected the community sample based on referral networks and vector control information provided by the central-level Ministry of Health and Social Assistance. The sample included a random starting point, starting direction, and calculated skip interval that survey personnel used for field random selection of households in the selected community.

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 visit results among selected and replacement households are shown in Table 2.1.

Table 2.1: Result in households selected for survey, unweighted proportions

	N	n	%	95% CI
Status of selected households				
Complete	1029	789	76.7	(74 - 79)
Members absent	1029	170	16.5	(14 - 19)
Refused	1029	41	4	(3 - 5)
Unoccupied dwelling	1029	26	2.5	(2 - 4)
Postponed	1029	1	0.1	(0 - 1)
Other	1029	2	0.2	(0 - 1)

2.1.4 Confirmed case review sample selection

For confirmed cases of malaria, the sample was designed to include review of a random sample of up to 200 confirmed cases from 2018 in the selected health area headquarters serving stratum 4. Field staff collected information from all documents available at the area headquarters, including case notification and investigation forms, lab records, and treatment follow-up forms. Table 2.2 shows the number of cases expected at each area headquarters in the sample (based on counts of cases by municipality in the microstratification data provided to IHME), and the number of case reviews completed during data collection. In Escuintla, case records from 2018 were no longer filed at the area headquarters, thus no confirmed case reviews could be completed in that department.

Table 2.2: Confirmed case collection

Área de Salud	Confirmed cases according to stratification documentation	Confirmed cases captured during collection
Alta Verapaz	753	200
Escuintla	1513	0
Petén Norte	114	109
Suchitepéquez	223	200
Izabal	256	200
Total	2859	709

2.1.5 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 or diagnosis databases. 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 2.3 shows the total number of suspected cases reviewed (1228), the number of cases selected based on diagnosis or principal complaint but found to be ineligible based on final diagnosis (33), and the cases selected and requested at facilities for which no paperwork could be located for review (8). In many facilities in Guatemala, all eligible cases from the entire year 2018 were selected for review, because there were relatively few attentions with eligible diagnoses recorded.

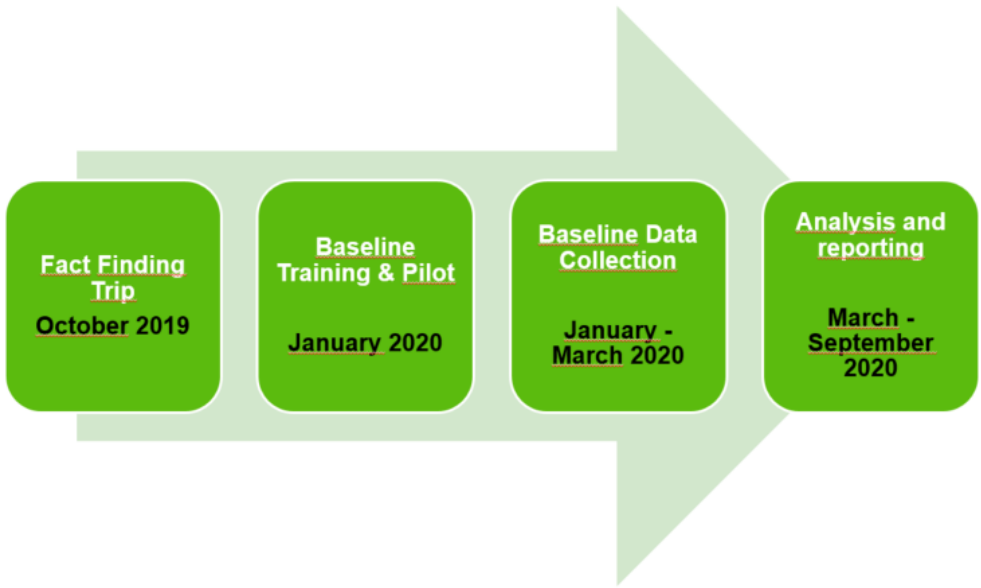
Table 2.3: Suspected case collection

	#
Total suspected cases selected for review	1269
Suspected cases selected but could not be located for review	8
All suspected cases screened for eligibility	1261
Ineligible suspected cases discarded	33
Eligible suspected cases collected	1228

2.2 Survey implementation

In Guatemala, baseline data was collected between January and March 2020. The timeline of baseline measurement activities is shown in Figure 2.2.

Figure 2.2: RMEI-Guatemala 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 English, Achi', Akateko, Awakateko, Chicomuceltec, Chiorti', Chuj, Garifuna, Itza', Ixil, Jakalteko, Kaqchikel, K'iche', Mam, Maya,

Mopan, Poquomam, Poqomchi', Q'anjob'al, Q'eqchi', Sakapulteko, Sipakapense, Tacanec, Tektiteko, Tz'utujil, Uspanteko, and Xinca as required.

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 approved 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, notification, or case investigation 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 Guatemala between January 6 and January 11, 2020. The local agency contracted for data collection in Guatemala, UNIMER, hired 12 nurses and three 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 three-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 Guatemala Ministry of Health and Social Assistance provided oversight during pilot exercises. IHME and UNIMER 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. During supervision of the data collection launch from January 13-17, 2020, an IHME staff member observed active household and health facility data collection and provided feedback to data collectors. UNIMER continued providing retraining throughout data collection to maintain homogeneity and quality standards of the data collection teams over time.

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 Guatemala. 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 Guatemala Ministry of Health and Social Assistance.

2.2.5 Ethical considerations

The study received authorization from by the Guatemala Ministry of Health and Social Assistance and the DAS in each department to conduct data collection in health facilities, and by local authorities (COCODES) 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 UNIMER, 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-Guatemala Baseline LQAS Survey in households. 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.

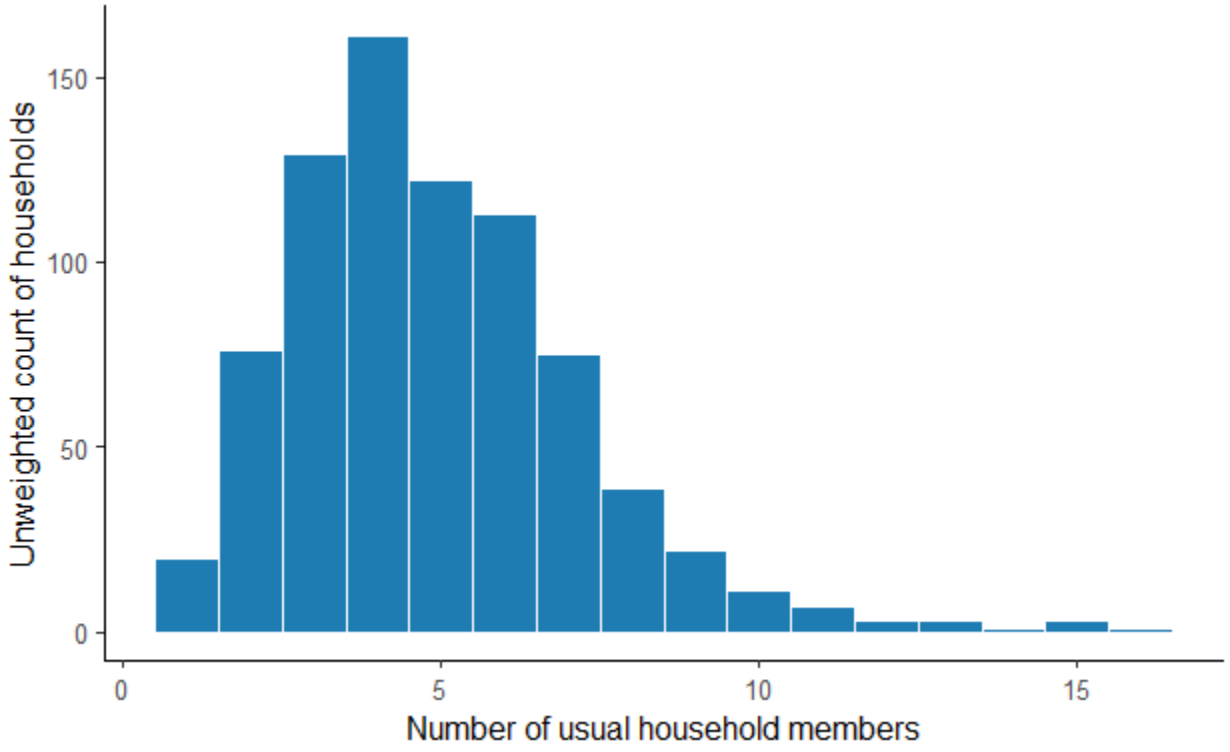
3.1 Characteristics of participating households

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

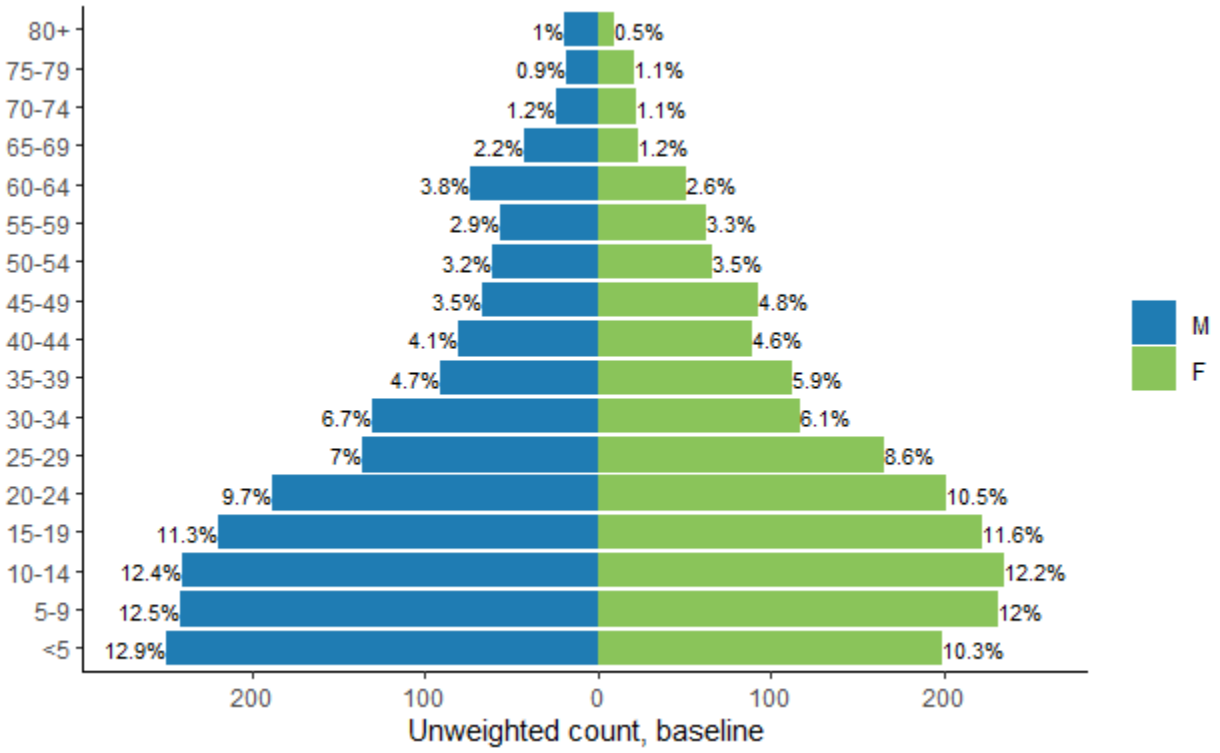
A total of 786 households in the Guatemala baseline survey completed the interview. The unweighted distribution of the number of members by household is shown in Figure 3.1. The survey sample for Guatemala has a median household size of 5 and an unweighted average household size of 4.9.

Figure 3.1: Household size, unweighted percent distribution



The unweighted distribution of the de facto household population in the surveyed households in Guatemala by five-year age groups and by sex is shown in Figure 3.2. Guatemala 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, 36% of the population in the baseline is under age 15 years, more than half (59%) of the population is in the economically productive age range (15-64), and the remaining 5% 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 Guatemala, 33.5% of household members had no formal schooling, and 43.5% completed only primary education. Sixty-four percent speak Spanish and 59.3% speak Q'eqchi'. Thirty-nine percent identify as ethnically Q'eqchi'.

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	2465	757	33.5	(30 - 37)
Primary	2465	1112	43.5	(40 - 47)
Secondary	2465	328	13.4	(11 - 16)
University	2465	29	1.3	(1 - 3)
Masters	2465	1	0.1	(0 - 1)
Diversified Secondary (diversificado)	2465	210	7.1	(5 - 10)
Don't know	2465	28	1.2	(1 - 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	2465	1720	63.8	(50 - 75)
Q'eqchi'	2465	1310	59.3	(40 - 76)
Achi', Rabinal	2465	118	3.1	(1 - 9)
K'iche'	2465	54	2.4	(1 - 10)

	N	n	%	95% CI
Poqomchi’	2465	97	2.2	(0 - 11)
Kaqchikel	2465	18	0.6	(0 - 2)
Mam	2465	8	0.2	(0 - 1)
Poquomam	2465	6	0.2	(0 - 1)
Achi’, Cubulco	2465	5	0.1	(0 - 0)
Tz’utujil	2465	5	0.1	(0 - 1)
Other	2465	18	0.8	(0 - 2)
Don't know	2465	2	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				
None	2404	1293	52.6	(40 - 65)
Q’eqchi’	2404	840	39	(27 - 52)
Achi’, Rabinal	2404	101	2.9	(1 - 7)
K’iche’	2404	53	2.4	(1 - 10)
Poqomchi’	2404	41	1	(0 - 4)
Kaqchikel	2404	9	0.2	(0 - 1)
Mam	2404	6	0.2	(0 - 1)
Poquomam	2404	6	0.2	(0 - 1)
Tz’utujil	2404	4	0.1	(0 - 1)
Other	2404	24	0.9	(0 - 2)
Don't know	2404	34	0.9	(0 - 2)

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 Guatemala, as seen in Table 3.4, Table 3.5, and Table 3.6, most homes are built with walls of plywood, sheet metal (zinc/alucin) roofs, and earth/sand floors.

Table 3.4: Exterior wall material as observed

	N	n	%	95% CI
Main material of exterior walls of dwelling				
Plywood	786	348	48	(36 - 60)
Cement block	786	256	28.5	(19 - 41)
Cane/palm/trunks	786	31	5.5	(3 - 11)
Polished wood	786	33	5.3	(3 - 10)
"Bahareque"/wattle-and-daub (mud plaster and cane)	786	22	2.8	(1 - 9)
Uncovered adobe	786	29	2.7	(1 - 8)
Palm/bamboo	786	16	1.6	(1 - 4)
Brick/covered adobe	786	14	1.6	(1 - 3)
Cardboard/waste material	786	3	0.6	(0 - 3)
Quarry stone	786	1	0.1	(0 - 1)
Stone with lime/cement	786	1	0	(-)
Prefabricated material	786	1	0	(-)
Other	786	31	3.2	(2 - 6)

Table 3.5: Roofing material as observed

	N	n	%	95% CI
Main material of roof of dwelling				
Sheet metal (zinc/Alucin)	786	673	83.6	(70 - 92)
Thatch/palm leaf/cane	786	46	8	(3 - 20)
Clay tile	786	37	3.3	(1 - 8)
Concrete	786	6	1	(0 - 4)
Wood planks	786	5	0.8	(0 - 3)
Cement fiber/asbestos sheet	786	6	0.8	(0 - 2)
No roof	786	1	0.2	(0 - 2)
Cardboard/waste material	786	1	0.2	(0 - 2)
Cement tile	786	2	0.2	(0 - 1)
Other	786	9	1.8	(0 - 10)

Table 3.6: Flooring material as observed

	N	n	%	95% CI
Main material of floor of dwelling				
Earth/sand	786	420	58.9	(46 - 71)
Cement sheet/board	786	296	33.3	(26 - 42)
Ceramic tiles	786	37	4.5	(2 - 11)
Cement brick or tile	786	26	2.7	(1 - 5)
Parquet or polished wood	786	1	0.2	(0 - 2)
Wood planks	786	1	0.1	(0 - 1)
"Embarrada"	786	1	0.1	(0 - 1)
Other	786	4	0.1	(0 - 1)

Many houses (80.3%) have open roof eaves. Most have no glass in windows (53.9%), screens in windows (62.5%), nor screens in doors (99.1%).

Table 3.7: Open or closed roof eave as observed

	N	n	%	95% CI
Open gap between wall and roof eave	785	620	80.3	(73 - 86)

Table 3.8: Glass in windows as observed

	N	n	%	95% CI
Do windows have glass panes?				
None	786	448	53.9	(45 - 62)
There are no windows in the house	786	250	35.3	(26 - 46)
Yes, in all windows	786	68	8.2	(4 - 15)
Yes, but only in some windows	786	20	2.6	(1 - 5)

Table 3.9: Screens in windows as observed

	N	n	%	95% CI
Do windows have screens?				
None	786	518	62.5	(53 - 71)
There are no windows in the house	786	245	35.1	(26 - 46)
Yes, in all windows	786	17	1.7	(1 - 3)
Yes, but only in some windows	786	6	0.7	(0 - 2)

Table 3.10: Screens in doors as observed

	N	n	%	95% CI
Do doors have screens?				
None	786	778	99.1	(98 - 100)
Yes, but only in some doors	786	7	0.8	(0 - 2)
Yes, in all doors	786	1	0.1	(0 - 1)

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 69% of homes had clean surroundings without standing water on the day of the survey, 4.1% 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	786	538	69	(62 - 75)
Trash, tires, or other refuse present, but no standing water	786	192	23.1	(18 - 29)
Yes, puddles	786	41	5.3	(3 - 8)
Yes, pond or other natural water body	786	29	4.1	(2 - 7)
Yes, water collected in trash, tires, or other small containers	786	17	1.8	(1 - 3)
Other	786	7	0.7	(0 - 2)

Table 3.12 shows the principal water source of the household as reported by the respondent; 36.1% of households have water piped to their house. The most common type of sanitation facility is a pit latrine (67.9% of households), as seen in Table 3.13.

Table 3.12: Principal water source

	N	n	%	95% CI
Main source of drinking water				
Piped into dwelling	786	324	36.1	(21 - 54)
Protected dug well	786	113	14.4	(8 - 25)
Rainwater	786	83	11	(4 - 27)
Tube well or borehole	786	59	7.3	(4 - 13)
Surface water (river/dam/lake/pond/stream/canal/irrigation channel)	786	43	6.1	(2 - 15)
Unprotected dug well	786	36	5.5	(3 - 11)
Public tap/standpipe	786	21	2.8	(1 - 7)
Piped to yard/plot	786	19	2.6	(1 - 8)
Large jug of purified water	786	14	1.9	(0 - 7)
Unprotected spring	786	9	0.6	(0 - 2)
Protected spring	786	4	0.4	(0 - 1)
Cart with small tank	786	1	0.2	(0 - 2)
Bottled water	786	1	0.2	(0 - 2)
Other	786	59	10.9	(5 - 23)

Table 3.13: Type of sanitation facility used

	N	n	%	95% CI
Type of toilet used				
Pit latrine	786	503	67.9	(56 - 77)
Flush toilet	786	113	13.6	(7 - 24)
Dry latrine	786	68	7.3	(5 - 11)
Pour flush toilet	786	62	6.3	(4 - 10)
No facility/bush/field	786	24	3	(1 - 7)
Hanging latrine	786	7	0.9	(0 - 3)
Other	786	6	0.5	(0 - 1)
Don't know	786	2	0.3	(0 - 1)
Decline to respond	786	1	0.2	(0 - 2)

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 a separate building (Table 3.15).

Table 3.14: Cooking fuel source

	N	n	%	95% CI
Principal cooking fuel				
Wood	786	748	95.1	(90 - 98)
Gas tank	786	134	15.2	(8 - 28)
Electricity	786	8	1	(0 - 2)
Charcoal	786	6	0.8	(0 - 2)
No food cooked in household	786	1	0.2	(0 - 2)
Straw/shrubs/grass	786	1	0.1	(0 - 1)
Agricultural crop	786	0	0	(-)
Other	786	0	0	(-)

Table 3.15: Cooking location

	N	n	%	95% CI
Where cooking is done*				
In a separate building	785	405	50.5	(43 - 58)
In the house	785	352	46.8	(39 - 54)
Outdoors	785	26	2.6	(1 - 5)
Other	785	1	0.1	(0 - 1)
Don't know	785	1	0.1	(0 - 1)

*One household responded 'No food cooked in household.'

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 (79.4%) have electricity. Of the 409 households that own livestock, most own poultry (88% 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	786	626	79.4	(71 - 86)
Radio	785	296	38.7	(35 - 42)
Sound system	785	148	17.1	(13 - 23)
Television	785	370	43.6	(33 - 55)
Home telephone	785	15	1.6	(1 - 3)
Mobile phone	785	625	79.6	(73 - 85)
Refrigerator	785	238	26.7	(18 - 38)
Washing machine	785	31	3.7	(2 - 9)
Computer	785	35	4	(2 - 9)
Electric fan	785	94	11.2	(6 - 20)
Air conditioner	785	4	0.6	(0 - 3)
Watch	785	203	27.7	(22 - 35)
Guitar	785	27	3.6	(2 - 6)
Bike	785	243	30.2	(23 - 38)
Motorcycle or scooter	785	202	23.7	(17 - 33)
Animal-drawn cart	785	2	0.2	(0 - 1)
Car	785	70	8.1	(5 - 14)
Truck	785	9	1.3	(1 - 2)
Motor boat	785	3	0.3	(0 - 2)
Bank account	774	82	9.5	(6 - 15)

Table 3.17: Livestock ownership

	N	n	%	95% CI
Cattle	409	19	4.5	(3 - 7)
Horses, donkeys or mules	409	19	4.1	(2 - 8)
Goats or sheep	410	5	1	(0 - 2)
Chickens or other poultry	407	365	88	(83 - 92)
Pigs	411	147	35.8	(27 - 46)

Table 3.18: Ownership of agricultural land

	N	n	%	95% CI
Does any member of the household own, rent, or share agricultural land?				
No	786	557	71.5	(64 - 78)
Yes, rent	786	122	15.2	(12 - 20)
Yes, own	786	92	11.5	(8 - 17)
Yes, share	786	11	1.4	(1 - 3)
Don't know	786	4	0.5	(0 - 1)

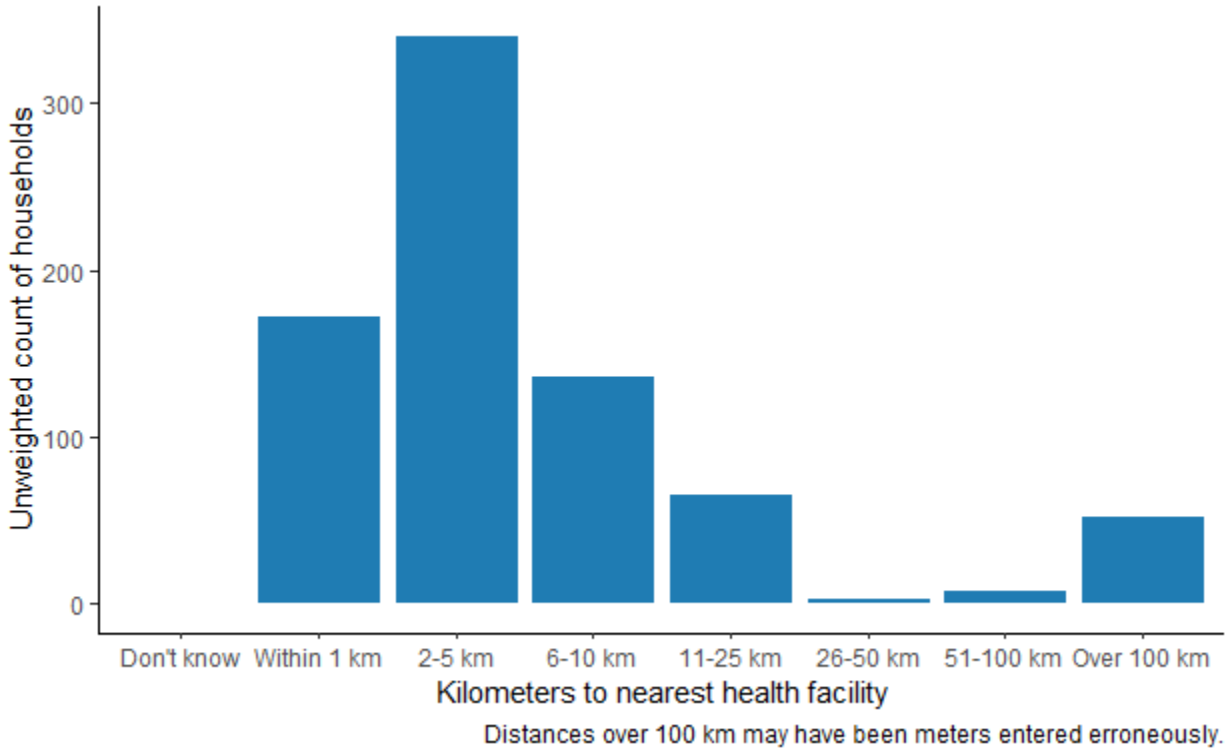
As a part of the interview, respondents estimated their monthly household income (including money earned by all members of the household and received from other sources such as public benefits or remittances). Though some households are hesitant to report their income, the estimates as reported are shown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

Table 3.19: Monthly household income, all sources

	N	n	%	95% CI
Monthly household income, Guatemala Quetzal				
Less than 250 quetzales	786	59	7.5	(5 - 10)
250 - 499 quetzales	786	145	18.1	(13 - 24)
500 - 999 quetzales	786	151	17.1	(13 - 22)
1000 - 1999 quetzales	786	107	12.1	(8 - 17)
2000 - 2999 quetzales	786	70	7.7	(5 - 12)
3000 - 4999 quetzales	786	38	4	(2 - 7)
5000 - 6999 quetzales	786	11	1	(0 - 3)
7000 - 9999 quetzales	786	2	0.2	(0 - 1)
More than 10000 quetzales	786	1	0.1	(0 - 0)
Don't know	786	166	26.1	(18 - 36)
Decline to respond	786	36	6.1	(3 - 11)

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. The survey sample for Guatemala has 36.5 kilometers and an unweighted average travel time of 24.3 minutes by usual mode of travel to the nearest health facility.

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



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 3.20 shows, most respondents had heard of malaria before (64%). Respondents were asked the cause of malaria (Table 3.21) and the mode of transmission of malaria (Table 3.22) and interviewers could register more than one response. Most respondents are aware of the role of mosquitoes in malaria transmission.

Table 3.20: Malaria awareness

	N	n	%	95% CI
Heard of illness called malaria	766	494	64	(54 - 73)

Table 3.21: Knowledge of cause of malaria

	N	n	%	95% CI
In your opinion, what causes malaria?				
Mosquito bites	494	337	68.5	(62 - 75)
Dirty surroundings	494	28	6.3	(4 - 9)
Stagnant water	494	20	4.9	(3 - 8)
Working in the forest or the fields	494	8	2	(1 - 4)
Contaminated air	494	6	1.8	(1 - 4)
Anopheles mosquito bite	494	7	1.6	(0 - 6)
Cold or changing weather	494	5	1.5	(1 - 4)
Eating dirty food/drinking dirty water	494	4	1.1	(0 - 3)
Weedy surroundings	494	3	0.7	(0 - 2)
Other	494	9	1.5	(1 - 3)
Don't know	494	128	24.6	(19 - 32)

Table 3.22: Knowledge of malaria transmission

	N	n	%	95% CI
How is malaria transmitted?				
By mosquitoes	494	345	71.6	(65 - 77)
Poor personal hygiene	494	19	3.6	(2 - 6)
Stagnant water	494	17	3.6	(2 - 7)
Eating dirty food/drinking dirty water	494	7	1.8	(1 - 4)
Passes from one person to another	494	5	1.2	(0 - 3)
Contaminated air	494	2	0.5	(0 - 2)
Other	494	4	0.9	(0 - 2)
Don't know	494	133	25.5	(20 - 31)

Respondents were also asked the main sign or symptom of malaria and more than one response could be registered (Table 3.23). 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 3.24 shows the combinations of symptoms that are most common during a malaria illness, which were not commonly reported together by respondents.

Table 3.23: Knowledge of malaria symptoms

	N	n	%	95% CI
Main sign or symptom of malaria known				
Fever	494	329	66.3	(59 - 73)
Headache	494	203	41.4	(36 - 47)
Chills	494	162	35.6	(28 - 44)
Body ache or joint pain	494	150	30.6	(21 - 42)
Nausea and vomiting	494	57	11.6	(8 - 17)
Body weakness	494	24	5.2	(3 - 9)
Diarrhea	494	19	3.6	(2 - 6)
Dizziness	494	9	1.5	(1 - 3)
Loss of appetite	494	6	1	(1 - 2)
Sweating	494	6	0.7	(0 - 2)
Pale eyes or skin	494	2	0.4	(0 - 2)
Cough	494	1	0.2	(0 - 2)
Other	494	14	2.3	(1 - 5)
Don't know	494	129	26	(19 - 34)

Table 3.24: Multiple common symptoms of malaria known

	N	n	%	95% CI
Fever and chills	494	152	30.8	(27 - 35)
Fever and sweating	494	5	1	(0 - 2)
Fever, chills, and sweating	494	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. Most did not report to know anyone who had malaria in the last year (Table 3.25).

Table 3.25: 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	494	274	55.3	(45 - 65)
One person	494	27	4.7	(3 - 9)
2-4 people	494	38	7.3	(4 - 12)
5-10 people	494	25	5	(3 - 9)
11-100 people	494	7	1.3	(0 - 4)
Don't know	494	123	26.4	(20 - 33)

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, 42.7% had heard messages about malaria during the last year. Of those who had heard messages, the specific information heard is detailed in Table 3.26. 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 3.27.

Table 3.26: Malaria messages heard in last year

	N	n	%	95% CI
Messages seen or heard in last year				
Eliminate breeding sites/clean up trash	205	79	36.2	(30 - 43)
If have fever go to health facility	205	67	32	(25 - 40)
Sleep under an insecticide-treated mosquito net	205	59	27.3	(21 - 35)
Sleep under a net every night to protect yourself against malaria	205	41	18.9	(12 - 28)
Nets are used to protect from mosquitoes	205	39	15.7	(11 - 22)
Nets are being distributed free of charge	205	14	9	(5 - 15)
Always test before treating malaria	205	12	6.4	(3 - 13)
Wash nets only when they are dirty	205	12	4.3	(2 - 7)
Malaria kills	205	8	2.6	(1 - 7)
Treatment for severe malaria is available free of charge	205	5	1.9	(1 - 5)
Dry nets in the shade, not in direct sunlight	205	2	1.4	(0 - 5)
Don't wash nets more than 4 times per year	205	3	1.2	(0 - 4)
Anopheles mosquitoes transmit malaria by biting people at night	205	1	0.9	(0 - 7)
Be sure to tuck the borders of the net under the mattress	205	1	0.9	(0 - 7)
Treat malaria with ACTs	205	1	0.4	(0 - 3)
Other	205	15	8.7	(6 - 13)
Don't know	205	16	8.6	(5 - 14)

Table 3.27: Source of malaria messages

Source of messages, among those who heard them	N	n	%	95% CI
On the radio	205	95	47.8	(38 - 58)
On TV	205	59	27.8	(19 - 39)
On a poster or billboard	205	44	20.2	(12 - 32)
From a community health worker	205	112	55.8	(47 - 64)
From personnel at a health facility	205	109	54.5	(41 - 67)
At a community event	205	90	42.8	(30 - 57)
At school	205	48	23.6	(16 - 33)
On the internet or social media	205	14	6.2	(4 - 11)
Somewhere else	204	2	1.3	(0 - 4)

3.2.3 Knowledge of community resources

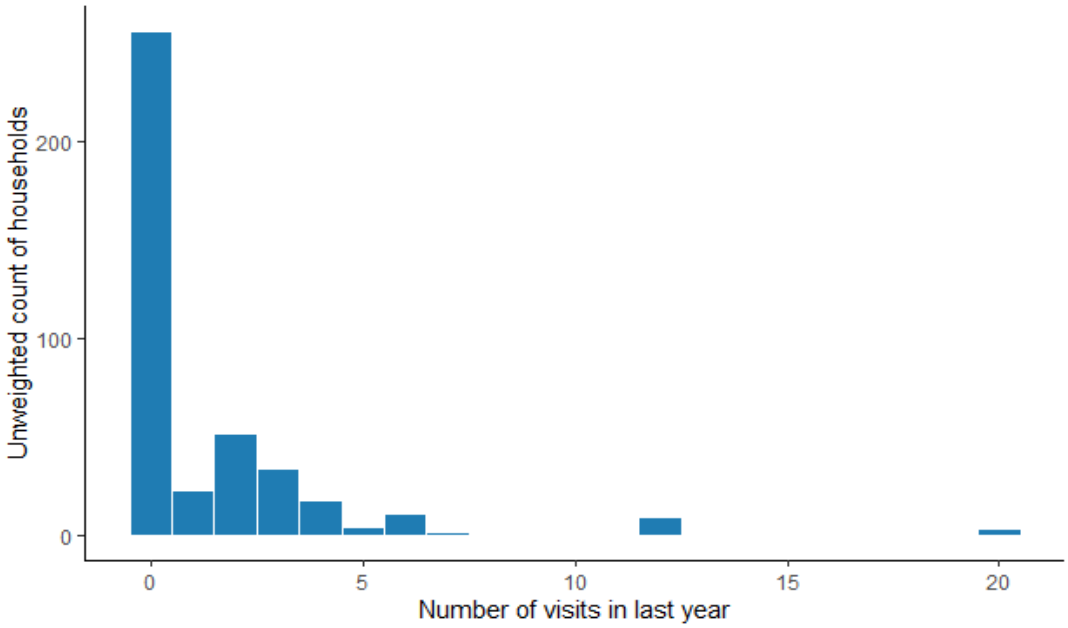
A key component of malaria detection in many regions in Guatemala is the volunteer collaborator program. Volunteer collaborators (*colaboradores voluntarios*), or “col-vols”, are community members who are trained to carry out malaria detection activities such as screening, taking blood samples for thick blood film or rapid tests, 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 Guatemala baseline survey, 66.8% of households know of a col-vol in their community. Of those who knew of a col-vol, 42.2% reported receiving a home visit by that volunteer during the year before the date of the survey (Table 3.28). The number of visits received from the col-vol is shown in Figure 3.4.

Table 3.28: Knowledge of col-vols

	N	n	%	95% CI
Know of col-vol in own community	715	439	66.8	(55 - 77)
Visited by col-vol in last year	430*	175	42.2	(33 - 52)

*One household declined to respond and 8 households responded 'Don't know.

Figure 3.4: Number of visits from col-vols in last year



Malaria testing and treatment is provided free of charge through the Ministry of Health and Social Assistance in Guatemala, and 80.9% of respondents are aware of this benefit (Table 3.29). 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 primary care facilities (Table 3.30, Table 3.31).

Table 3.29: Knowledge of free-of-cost malaria healthcare

	N	n	%	95% CI
Aware malaria diagnosis and treatment are provided free by the government	460	363	80.9	(74 - 87)

Table 3.30: 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	494	261	53.5	(41 - 65)
Col-Vol	494	88	18.4	(11 - 29)
Public Sector: Fieldworker/Community Health Worker	494	59	13.3	(8 - 21)
Public Sector: Government hospital	494	66	12.4	(8 - 19)
Other public sector	494	11	1.8	(1 - 4)
Private medical sector: Private doctor	494	7	1.4	(1 - 3)

	N	n	%	95% CI
Other private sector	494	3	0.5	(0 - 2)
Public Sector: mobile clinic	494	2	0.2	(0 - 2)
Private medical sector: Private hospital/clinic	494	2	0.2	(0 - 1)
Private medical sector: Pharmacy	494	1	0.1	(0 - 1)
Private medical sector: mobile clinic	494	0	0	(-)
Traditional healer	494	0	0	(-)
Other	494	6	1.4	(1 - 3)
Don't know	494	47	9.4	(6 - 15)

Table 3.31: 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	435	246	56.6	(44 - 68)
Col-Vol	435	79	18.3	(11 - 29)
Public Sector: Government hospital	435	76	15.8	(9 - 25)
Public Sector: Fieldworker/Community Health Worker	435	59	15.6	(9 - 25)
Other public sector	435	7	1.4	(1 - 4)
Private medical sector: Pharmacy	435	3	0.7	(0 - 2)
Private medical sector: Private doctor	435	3	0.6	(0 - 2)
Private medical sector: Private hospital/clinic	435	1	0.1	(0 - 1)
Public Sector: mobile clinic	435	0	0	(-)
Private medical sector: mobile clinic	435	0	0	(-)
Other private sector	435	0	0	(-)
Traditional healer	435	0	0	(-)
Other	435	8	1.6	(1 - 3)
Don't know	435	11	2	(1 - 4)

Table 3.32: Knowledge of col-vols by area

	N	n	%	95% CI
Alta Verapaz (16 communities)				
Know of col-vol in own community	376	283	80.2	(68 - 89)
Visited by col-vol in last year	275	99	37.2	(26 - 51)
Col-vols conduct testing for malaria	224	62	28.6	(18 - 42)
Col-vols provide treatment for malaria	192	58	30.3	(20 - 43)
Baja Verapaz (2 communities)				
Know of col-vol in own community	44	12	30.2	(21 - 41)
Visited by col-vol in last year	12	8	69.5	(60 - 78)
Col-vols conduct testing for malaria	30	1	4	(2 - 7)
Col-vols provide treatment for malaria	29	0	0	(-)
Escuintla (1 community)				
Know of col-vol in own community	26	22	84.6	(85 - 85)
Visited by col-vol in last year	22	14	63.6	(64 - 64)
Col-vols conduct testing for malaria	21	2	9.5	(10 - 10)
Col-vols provide treatment for malaria	20	2	10	(10 - 10)
Ixcán (1 community)				
Know of col-vol in own community	24	21	87.5	(87 - 88)

	N	n	%	95% CI
Visited by col-vol in last year	21	12	57.1	(57 - 57)
Col-vols conduct testing for malaria	13	2	15.4	(15 - 15)
Col-vols provide treatment for malaria	11	1	9.1	(9 - 9)
Petén Norte (2 communities)				
Know of col-vol in own community	41	21	47	(33 - 61)
Visited by col-vol in last year	21	6	50.8	(20 - 81)
Col-vols conduct testing for malaria	27	4	10.2	(6 - 17)
Col-vols provide treatment for malaria	23	4	11.3	(6 - 20)
Petén Sur Occidental (3 communities)				
Know of col-vol in own community	61	37	60.3	(34 - 82)
Visited by col-vol in last year	37	16	43.7	(25 - 64)
Col-vols conduct testing for malaria	46	7	15.1	(3 - 49)
Col-vols provide treatment for malaria	42	6	14.2	(3 - 45)
Petén Sur Oriental (1 community)				
Know of col-vol in own community	23	6	28.5	(18 - 42)
Visited by col-vol in last year	6	3	50	(50 - 50)
Col-vols conduct testing for malaria	25	0	0	(-)
Col-vols provide treatment for malaria	24	0	0	(-)
Suchitepéquez (4 communities)				
Know of col-vol in own community	96	33	35.2	(22 - 51)
Visited by col-vol in last year	32	15	45.7	(38 - 54)
Col-vols conduct testing for malaria	87	10	11.3	(5 - 24)
Col-vols provide treatment for malaria	73	8	11.7	(6 - 21)
Zacapa (1 community)				
Know of col-vol in own community	24	4	16.7	(17 - 17)
Visited by col-vol in last year	4	2	50	(50 - 50)
Col-vols conduct testing for malaria	21	0	0	(-)
Col-vols provide treatment for malaria	21	0	0	(-)

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. Few households reported members who migrated for work (Table 3.33). Among individuals in surveyed households, 6% reported travel outside the community in the last two weeks (Table 3.34). According to respondents, most household members did not participate in any of the risk activities listed in Table 3.35 in the two months prior to the survey.

Table 3.33: Temporal migration within surveyed households

	N	n	%	95% CI
At least one member migrates seasonally	786	79	9.9	(6 - 15)
At least one member migrates weekly	784	83	10.3	(7 - 14)

Table 3.34: Recent travel by individuals in surveyed households

	N	n	%	95% CI
Individual traveled outside community in last 2 weeks	3857	264	6	(4 - 9)

Table 3.35: Exposure to risky activities by individuals in surveyed households

	N	n	%	95% CI
Individuals participating in malaria risk activities				
None of these	3861	2437	61.8	(58 - 66)
Cultivating crops or working in the fields	3861	1119	30.3	(27 - 34)
Gathering firewood in the forest	3861	607	16.3	(13 - 20)
Sleeping outdoors overnight	3861	95	3.6	(1 - 11)
Working in trade	3861	119	2.6	(2 - 5)
Working in timber/lumber industries in the forest	3861	52	1.5	(1 - 3)
Producing charcoal	3861	10	0.3	(0 - 1)
Working in fishing	3861	15	0.3	(0 - 1)
Working in a mine	3861	7	0.2	(0 - 1)
Collecting shellfish	3861	9	0.2	(0 - 1)
Don't know	3861	6	0.1	(0 - 0)
Decline to respond	3861	3	0.1	(0 - 0)

Respondents were also asked what can be done to protect against malaria (Table 3.36), and what practices they follow in their own households (Table 3.37). The respondent replied in free form, and the interviewer classified the answers according to the options in the survey. The responses again 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 0.5% of households said they do not use any malaria prevention measures at home.

Table 3.36: Protective measures known by household

	N	n	%	95% CI
Methods known to protect against malaria				
Eliminate mosquito breeding areas (tires, bottles, or others)	361	162	43.9	(35 - 53)
Sleep under a mosquito net	361	138	39.4	(32 - 47)
Keep house surroundings clean	361	65	17.1	(11 - 26)
Sleep under an insecticide-treated mosquito net	361	49	13.2	(8 - 21)
Cut the grass around the house	361	24	6.2	(4 - 10)
Clean water storage tanks with bleach	361	26	6.1	(4 - 10)
Add bleach temephos (Abate) to the water tank	361	20	5.3	(3 - 8)
Fumigate or spray house with insecticides	361	15	3.9	(2 - 7)
Use insect repellent	361	13	3.9	(2 - 7)
Avoid mosquito bites	361	10	2.6	(1 - 6)
Fill in puddles (stagnant water)	361	12	2.5	(1 - 6)
Take preventive medication	361	5	2.2	(1 - 6)
Put mosquito screens on the windows	361	6	1.4	(1 - 4)
Use mosquito coils	361	3	0.9	(0 - 4)
Can't be prevented	361	2	0.5	(0 - 3)
Other	361	17	4.1	(2 - 7)
Don't know	361	39	12.1	(7 - 20)

Table 3.37: Protective measures used by household

	N	n	%	95% CI
Primary methods used in household to protect against malaria				
Eliminate mosquito breeding areas (tires, bottles, or others)	361	181	50.1	(42 - 59)
Sleep under a mosquito net	361	138	37.5	(28 - 48)
Keep house surroundings clean	361	74	20.6	(15 - 27)
Sleep under an insecticide-treated mosquito net	361	71	20.4	(11 - 35)
Clean water storage tanks with bleach	361	52	13	(10 - 18)
Cut the grass around the house	361	43	11.5	(8 - 16)
Add bleach or temephos (Abate) to the water tank	361	21	5.9	(4 - 10)
Fumigate or spray house with insecticides	361	20	5.8	(2 - 14)
Use insect repellent	361	13	3.4	(2 - 5)
Fill in puddles (stagnant water)	361	14	3.3	(2 - 5)
Avoid mosquito bites	361	10	3.1	(2 - 5)
Organize community cleaning work days	361	7	2.2	(1 - 5)
Take preventive medication	361	8	2	(1 - 4)
Put mosquito screens on the windows	361	5	0.9	(0 - 2)
Use mosquito coils	361	4	0.7	(0 - 2)
Does nothing to protect from malaria	361	2	0.5	(0 - 2)
Other	361	24	6.8	(4 - 11)
Don't know	361	17	5.6	(3 - 10)

Chapter 4: Vector control activities

This chapter provides a descriptive summary of vector control measures used in the households selected for the RMEI-Guatemala Baseline LQAS Survey. 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 Guatemala households

Vector control plans in Guatemala 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 Guatemala, the community sample was designed to capture data from 32 communities with vector control measures implemented during 2018 and 2019. Health facilities were listed for selection to the sample based on whether interventions were carried out in the communities in their service area according to data received from the central-level Ministry of Health and Social Assistance. According to these data, 426 communities across 14 areas should have received spraying, and 11 communities (in La Gomera and Santa Lucía Cotzumalguapa districts of Escuintla) should have received net distribution. However, because the intervention data are organized by locality and not by 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.

In one selected community with vector control interventions planned, the COCODES refused to authorize surveys in the locality. This community was substituted with another locality from the catchment area of the same health facility, but the substitute community did not have vector control interventions planned (though it did have widespread treated net use). Another community was neither surveyed nor substituted after the DAS in the area failed to authorize data collection at the corresponding health facility. Therefore, 30 communities with vector control interventions planned and one community without interventions planned were surveyed.

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.

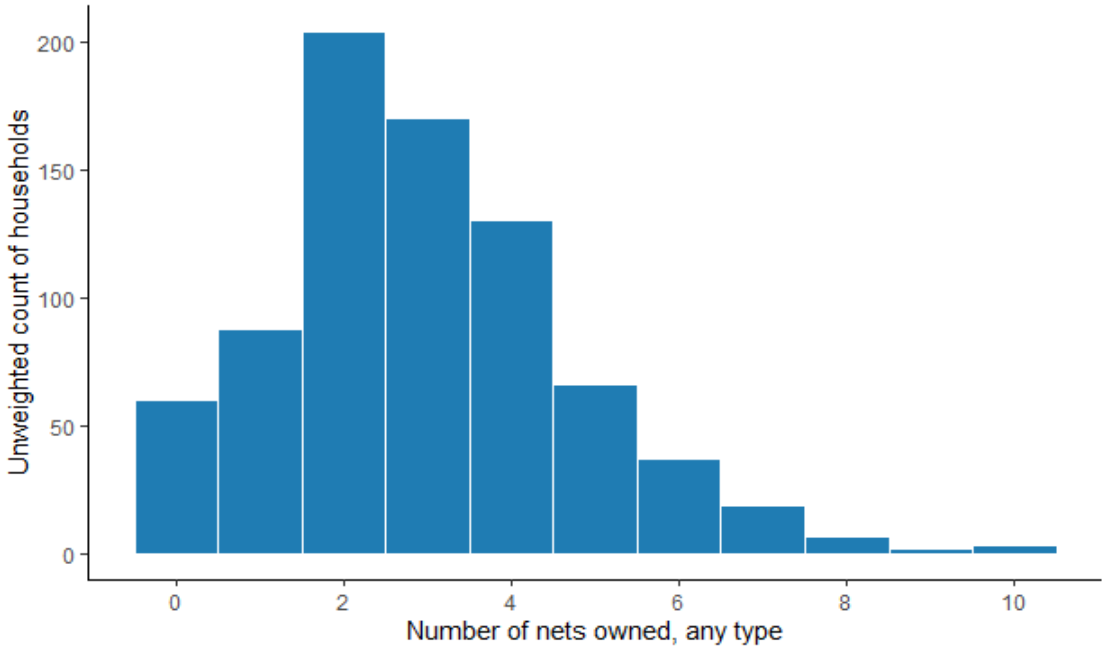
4.2.1 Ownership of nets by surveyed households

As Table 4.1 shows, 92.9% of households own at least one treated or untreated mosquito net. The number of nets owned (regardless of type) is shown in Figure 4.1.

Table 4.1: Ownership of mosquito nets by households

	N	n	%	95% CI
Households with at least one mosquito net	786	728	92.9	(89 - 95)

Figure 4.1: Number of nets owned by households, unweighted count



Respondents were asked where they obtained each mosquito net. As shown in Table 4.2, most nets treated with insecticide were obtained from health personnel, in a facility or in the community. Treated nets listed with an “other” source were often reported to be obtained from the COCODES, which likely collaborated with net distribution by public health personnel. Most untreated nets were obtained in a store (46%, in Table 4.3). Untreated nets listed with an “other” source were reported to be purchased from peddlers, markets, or an unspecified seller.

Table 4.2: Source of insecticide-treated nets

	N	n	%	95% CI
Source of net				
Vector control or malaria program	2140	1769	82.7	(81 - 84)
Government health facility	2140	251	11.7	(10 - 13)
Community health worker or Col-Vol	2140	52	2.4	(2 - 3)
Shop/market	2140	6	0.3	(0 - 1)
Private health facility	2140	2	0.1	(0 - 0)
School	2140	1	0	(-)
Other	2140	15	0.7	(0 - 1)
Don't know	2140	44	2.1	(2 - 3)

Table 4.3: Source of untreated nets

	N	n	%	95% CI
Source of net				
Shop/market	198	91	46	(39 - 53)
School	198	28	14.1	(10 - 20)
Other	198	55	27.8	(22 - 34)
Don't know	198	22	11.1	(7 - 16)
Decline to respond	198	2	1	(0 - 4)

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 4.4, and the condition of nets that respondents declined to show to field personnel is shown in Table 4.5.

Table 4.4: Condition of observed nets

	N	n	%	95% CI
Condition of mosquito net as observed				
No holes	1901	1219	64.1	(62 - 66)
Only thumb-sized holes	1901	488	25.7	(24 - 28)
At least one fist or head-sized hole	1901	150	7.9	(7 - 9)
Net never used	1901	42	2.2	(2 - 3)
Don't know	1901	2	0.1	(0 - 0)

Table 4.5: Reported condition of nets not observed

	N	n	%	95% CI
Condition of mosquito net as reported				
No holes	437	242	55.4	(51 - 60)
Only thumb-sized holes	437	101	23.1	(19 - 27)
At least one fist or head-sized hole	437	27	6.2	(4 - 9)
Net never used	437	19	4.3	(3 - 7)
Don't know	437	48	11	(8 - 14)

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 4.6 shows how the respondent reported drying each net after washing.

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

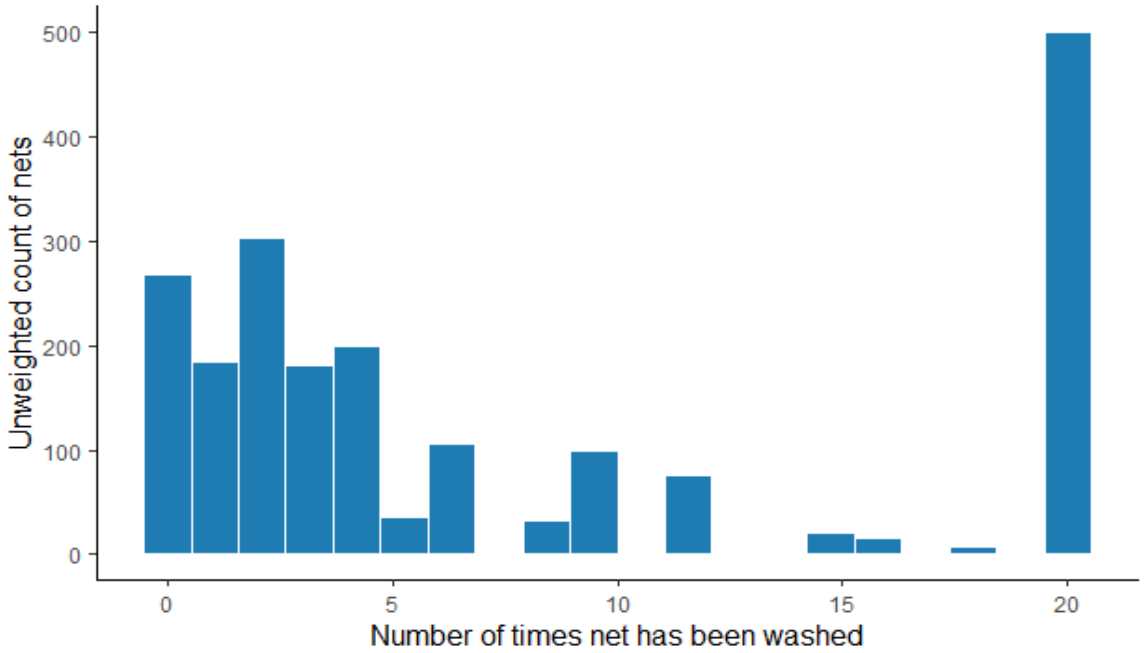


Table 4.6: Care of insecticide-treated nets - drying

	N	n	%	95% CI
Method of drying net				
In the shade	1767	1083	61.3	(59 - 64)
In the sun	1767	535	30.3	(28 - 32)
Indoors	1767	149	8.4	(7 - 10)

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 4.7 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, 80.7% 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, 84% were reported to have slept under a net treated with insecticide.

Table 4.7: Use of net for sleeping previous night

	N	n	%	95% CI
Total				
Slept under treated net	3789	2992	80.7	(74 - 86)
Slept under untreated net	3789	270	6.1	(4 - 9)
Under 5				
Slept under treated net	441	361	84	(79 - 88)
Slept under untreated net	441	37	7	(4 - 12)
Pregnant				
Slept under treated net	34	25	78.9	(59 - 91)
Slept under untreated net	34	2	3.2	(1 - 13)
Reported usually sleeping under net during pregnancy	31	24	80.3	(60 - 92)

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 4.8. 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 without explaining why.

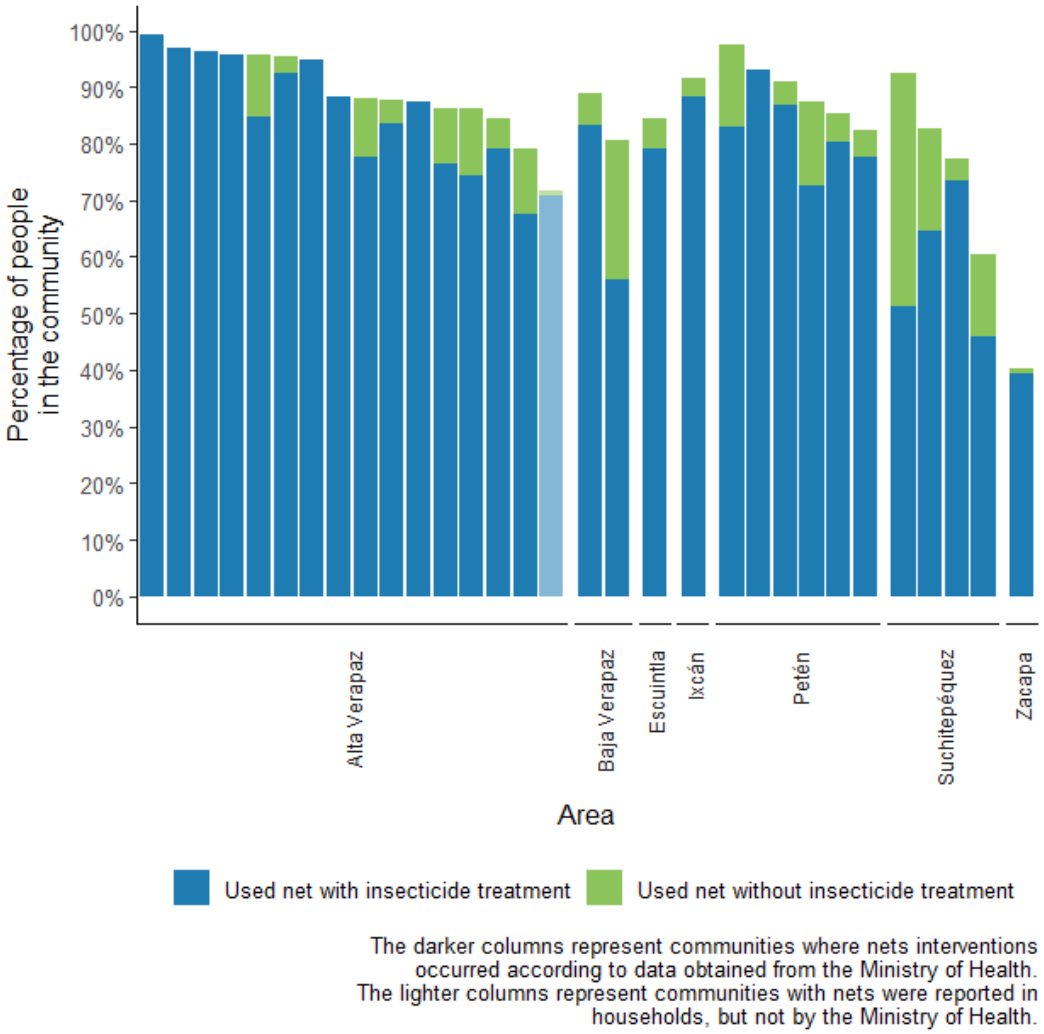
Table 4.8: Reasons for not using net

	N	n	%	95% CI
Reasons for not sleeping under mosquito net				
Extra net/more nets available than sleeping areas	199	42	23	(15 - 33)
Don't have enough nets	199	40	18.2	(11 - 29)
Saving net for later	199	33	16.8	(8 - 31)
Too hot	199	20	8.8	(6 - 14)
Usual user(s) did not sleep here last night	199	10	6.8	(3 - 15)
Net too old/torn	199	5	2.5	(1 - 7)
No malaria now	199	6	2.3	(1 - 6)
Feel closed in/afraid	199	3	2	(1 - 6)
Sleep in a hammock and available mosquito nets do not work	199	3	1.7	(0 - 6)
Net too expensive	199	4	1	(0 - 4)

	N	n	%	95% CI
It is bad for the skin, it causes irritation	199	2	0.9	(0 - 4)
Not necessary, using fan instead	199	2	0.9	(0 - 4)
No mosquitoes	199	2	0.5	(0 - 2)
Net too dirty	199	1	0.5	(0 - 4)
Net not available last night/net being washed	199	1	0.5	(0 - 4)
Don't know where or how to get another net	199	1	0.1	(0 - 1)
Other	199	14	6.4	(3 - 12)
Don't know	199	20	10.9	(6 - 20)
Decline to respond	199	5	3.1	(1 - 8)

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 and generally had high coverage. Untreated net use is notable in some communities. The baseline measurement was not designed to produce representative estimates at the department level, so results by department should be interpreted with discretion.

Figure 4.3: Net use by department and community



4.3 Indoor Residual Spraying

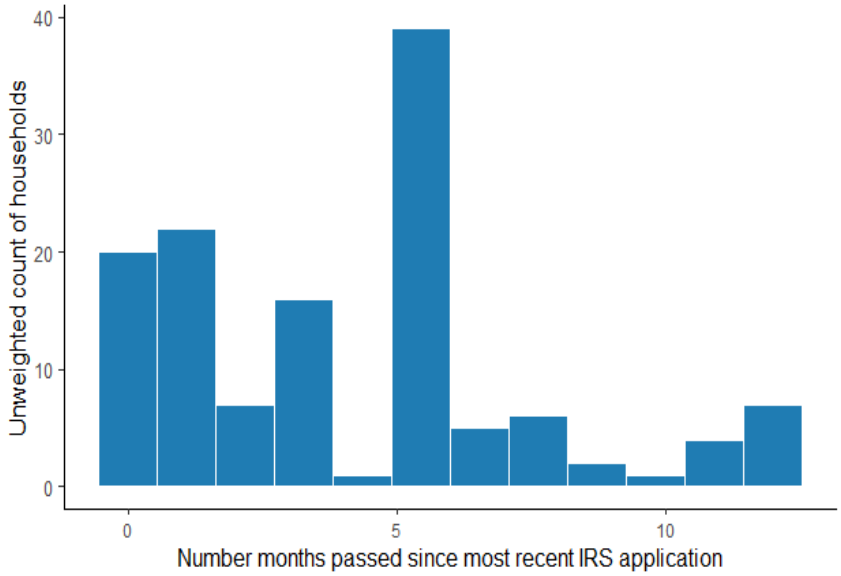
The other key vector control intervention of the Initiative is to offer to spray the interior walls of the dwelling against mosquitoes (usually with deltamethrin or a comparable insecticide). Insecticide application is usually carried out by staff or contractors of the vector control program every 4 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 4.9, 18.5% of households were offered IRS, and spraying was carried out in 94.1% 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 23% of households that received IRS. The response “don’t know” was given to the question about observing evidence of IRS completion in nine households.

Table 4.9: Households offered and accepting spraying

	N	n	%	95% CI
Offered indoor residual spraying	782	154	18.5	(10 - 31)
Accepted indoor residual spraying	151	140	94.1	(87 - 97)
Evidence observed (card, sticker, mark)	131	38	23	(8 - 49)

Respondents were asked how long ago the most recent spraying occurred. The results in Figure 4.4 suggest that spraying is carried out at least every six months in most cases.

Figure 4.4: Number of months since most recent spraying occurred



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 4.10. The respondents who replied “other” said that someone came to their home to offer spraying, but never returned to apply the insecticide.

Table 4.10: Reasons for not accepting spraying

	N	n	%	95% CI
Reason house was not sprayed				
No one was at home	11	3	25	(7 - 61)
Other	11	5	53.7	(27 - 79)

	N	n	%	95% CI
Don't know	11	3	21.2	(7 - 49)

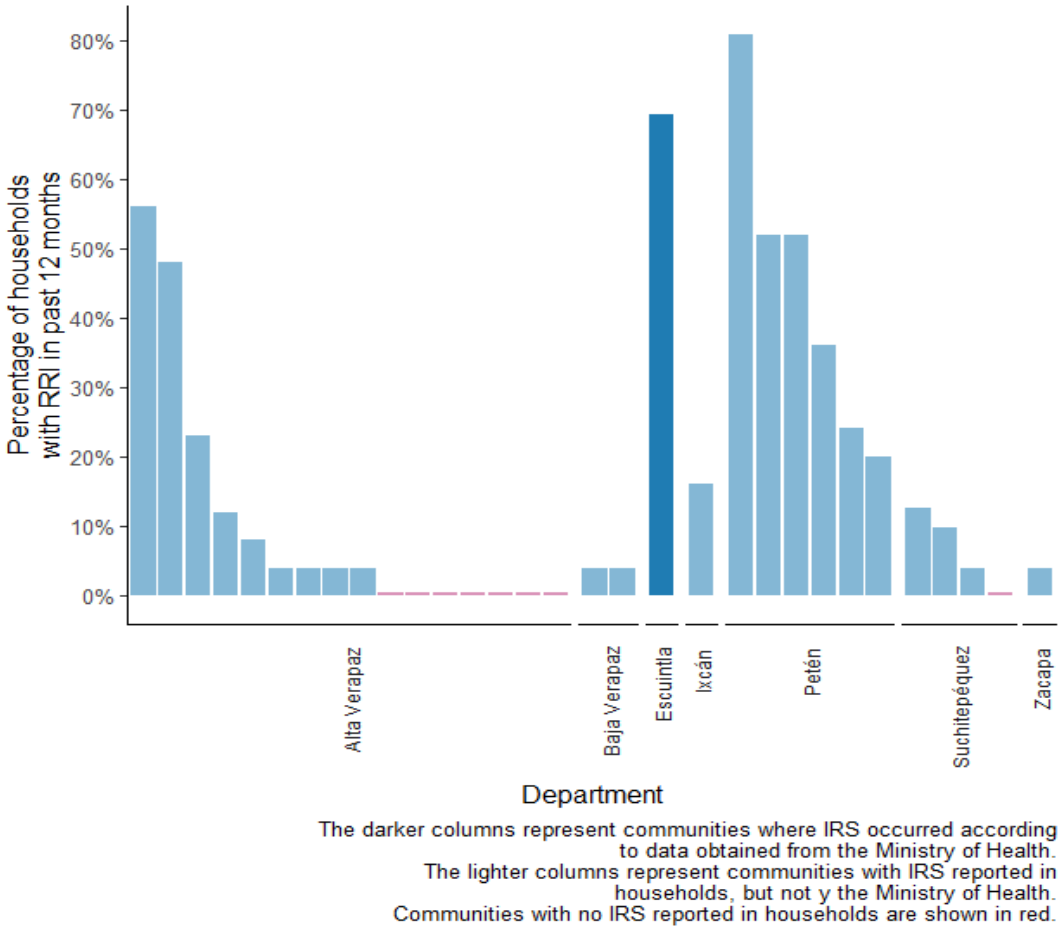
Households receiving IRS were asked whether they washed, painted, or plastered any walls since the most recent application (which diminishes the effectiveness of the insecticide), as shown in Table 4.11.

Table 4.11: Post-spraying practices

	N	n	%	95% CI
Walls painted since last IRS	140	13	11.4	(4 - 31)
Walls washed since last IRS	140	8	6.8	(2 - 19)
Walls plastered since last IRS	138	8	5.8	(2 - 15)

Figure 4.5 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 vector control staff at the corresponding health facility are highlighted in darker colors. The measured coverage of IRS is quite high in some communities not expected to receive it. A few factors could contribute to this mismatch. First, IRS could have been carried out despite not being reflected in plans from the central level of the Ministry of Health and Social Assistance, for example in response to a confirmed malaria case or dynamic vector activity. Second, 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 4.5: Indoor residual spraying by department 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 some target communities, as seen in Table 4.12). Table 4.13 shows the indicator results, with 83.8% of individual usual household members in target communities covered by one of the two interventions. The breakdown of the indicator by malaria stratum is shown in Table 4.14.

Table 4.12: Vector control received by reported intervention

Vector control reported	Communities	Used treated net	House sprayed
Nets	29	79.3%	14.3%
Both	1	79.1%	70.4%
None	1	70.9%	50.4%

Table 4.13: Vector control indicator

	N	n	%	95% CI
Usual household members in vector control communities who slept in house last night	3753	3662	97.6	(97 - 98)
Slept under insecticide treated net	3662	2902	80.9	(74 - 86)
House sprayed with mosquito treatment past 12 months	3631	583	15.3	(8 - 26)
Omitted from household spraying calculations due to 'do not know' responses	3662	31	0.7	(0 - 2)
'DK' responses included in indicator because they slept under treated net	31	17	54.9	(33 - 75)
Received either vector control to standard	3648	2988	83.8	(78 - 88)

Table 4.14: Vector control indicator: result by malaria stratum

	N	n	%	95% CI
Received either vector control to standard				
Malaria stratum 4	3020	2531	85.3	(79 - 90)
Malaria stratum 3	628	457	70.1	(64 - 75)
Total	3648	2988	83.8	(78 - 88)

Chapter 5: Malaria Diagnostic Capacity

This chapter provides a descriptive summary of the health facilities surveyed for the RMEI-Guatemala 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 58 facilities of various types as shown in Table 5.1. Thirty of the surveyed facilities provide primary level care, 16 are health centers, and 6 are hospitals. The remaining facilities in the sample are DAS that manage local malaria reporting and vector control programming and the national malaria reference lab.

Table 5.1: Health facility survey sample by facility type

	Facility Type	#
Primary care	Centro de convergencia (CC)	12
	Puesto de salud (PS)	18
Health Centers	Centro de Atención Integral Materno Infantil (CAIMI)	1
	Centro de Atención Médica Permanente (CAP)	7
	Centro de salud (CS)	8
Hospitals	Hospital	6
DAS/ National Lab	Dirección de Area de Salud (DAS)	5
	Laboratorio de referencia nacional	1
Total		58

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 an administrative facility) is the primary respondent. 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).

Most attention facilities in the sample provided services from Monday through Friday. A smaller number were open on the weekends (Table 5.2). Fifty percent of health centers and 100% of hospitals had services open 24 hours (Table 5.3).

Table 5.2: Workweek of facility

	N	n	%	95% CI
Primary care units: Days of the week service is provided				
Monday	30	30	100	(-)
Tuesday	30	29	96.7	(79 - 100)
Wednesday	30	28	93.3	(76 - 98)
Thursday	30	28	93.3	(76 - 98)
Friday	30	28	93.3	(76 - 98)
Saturday	30	1	3.3	(0 - 21)
Sunday	30	1	3.3	(0 - 21)
Health centers: Days of the week service is provided				
Tuesday	16	16	100	(-)
Thursday	16	16	100	(-)
Monday	16	15	93.7	(65 - 99)
Wednesday	16	15	93.7	(65 - 99)

	N	n	%	95% CI
Friday	16	15	93.7	(65 - 99)
Saturday	16	9	56.2	(32 - 78)
Sunday	16	9	56.2	(32 - 78)
Hospitals: Days of the week service is provided				
Monday	6	6	100	(-)
Tuesday	6	6	100	(-)
Wednesday	6	6	100	(-)
Thursday	6	6	100	(-)
Friday	6	6	100	(-)
Saturday	6	6	100	(-)
Sunday	6	6	100	(-)

Table 5.3: Hours of operation

	N	n	%	95% CI
Primary care units: Hours of operation				
Open less than 24 hours	30	30	100	(-)
Open 24 hours	30	0	0	(-)
Health centers: Hours of operation				
Open less than 24 hours	16	8	50	(27 - 73)
Open 24 hours	16	8	50	(27 - 73)
Hospitals: Hours of operation				
Open 24 hours	6	6	100	(-)
Open less than 24 hours	6	0	0	(-)

Survey respondents indicated the type and number of personnel employed at the health facility. Table 5.4 shows the proportion of facilities that employ at least one of each personnel type. Physicians are employed at 13.3% of primary level facilities and 93.7% of health centers. In terms of laboratory diagnosis, microbiologists are employed at 20% and lab technicians at 16.7% of primary care units. Primary level units and health centers do not employ epidemiology personnel while 68.7 percent of health centers do employ other statistics personnel, important functions for malaria notification and reporting.

Table 5.4: Facility personnel

	N	n	%	95% CI
Primary care units				
General physician	30	4	13.3	(5 - 31)
Pediatrician	30	0	0	(-)
Nutritionist /dietician	30	0	0	(-)
Pharmacist	30	0	0	(-)
Auxiliary nurse	30	29	96.7	(79 - 100)
Practical nurse	30	0	0	(-)
Registered nurse	30	3	10	(3 - 28)
Professional midwife	30	11	36.7	(21 - 55)
Social worker	30	4	13.3	(5 - 31)
Microbiologist (laboratory)	30	6	20	(9 - 39)
Lab technician	30	5	16.7	(7 - 35)
Dispenser at pharmacy	30	1	3.3	(0 - 21)
Epidemiology personnel	30	0	0	(-)

	N	n	%	95% CI
Other personnel specific for statistics and reporting	30	0	0	(-)
Health centers				
General physician	16	15	93.7	(65 - 99)
Pediatrician	16	2	12.5	(3 - 40)
Nutritionist /dietician	16	4	25	(9 - 52)
Pharmacist	16	1	6.3	(1 - 35)
Auxiliary nurse	16	16	100	(-)
Practical nurse	16	3	18.8	(6 - 46)
Registered nurse	16	11	68.7	(43 - 87)
Professional midwife	16	3	18.8	(6 - 46)
Social worker	16	4	25	(9 - 52)
Microbiologist (laboratory)	16	1	6.3	(1 - 35)
Lab technician	16	13	81.2	(54 - 94)
Dispenser at pharmacy	16	12	75	(48 - 91)
Epidemiology personnel	16	0	0	(-)
Other personnel specific for statistics and reporting	16	11	68.7	(43 - 87)
Hospitals				
General physician	6	6	100	(-)
Pediatrician	6	6	100	(-)
Nutritionist /dietician	6	5	83.3	(35 - 98)
Pharmacist	6	5	83.3	(35 - 98)
Auxiliary nurse	6	6	100	(-)
Practical nurse	6	3	50	(16 - 84)
Registered nurse	6	4	66.7	(26 - 92)
Professional midwife	6	1	16.7	(2 - 65)
Social worker	6	6	100	(-)
Microbiologist (laboratory)	6	3	50	(16 - 84)
Lab technician	6	6	100	(-)
Dispenser at pharmacy	6	6	100	(-)
Epidemiology personnel	6	5	83.3	(35 - 98)
Other personnel specific for statistics and reporting	6	5	83.3	(35 - 98)
DAS				
Epidemiology personnel	5	3	60	(19 - 90)
Other personnel specific for statistics and reporting	5	5	100	(-)

5.2 Rapid diagnostic tests

Rapid diagnostic tests (RDT) are used in Guatemala 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 Guatemala 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. The slide may be examined at the facility where the patient sought care, or may be sent to a facility with a lab or microscopy post for examination.

5.2.1 Rapid diagnostic test practices

In Guatemala, 26.7% of primary care facilities store RDTs, and 50% provide testing with RDTs (Table 5.5). In 50% of primary care facilities, personnel test with RDTs inside the facility, and personnel conduct testing in the community in 36.7% of facilities (Table 5.6). Testing in the community is most often conducted daily (26.1% of facilities that conduct testing in the community), as shown in Table 5.7.

Table 5.5: Rapid diagnostic testing according to interview and observation

	N	n	%	95% CI
Primary care units				
Unit stores RDTs	30	8	26.7	(14 - 46)
Unit conducts RDT testing	30	15	50	(32 - 68)
Health centers				
Unit stores RDTs	16	3	18.8	(6 - 46)
Unit conducts RDT testing	16	7	43.8	(22 - 68)
Hospitals				
Unit stores RDTs	6	0	0	(-)
Unit conducts RDT testing	6	3	50	(16 - 84)
DAS				
Unit stores RDTs	5	2	40	(10 - 81)
Unit conducts RDT testing	5	5	100	(-)

Table 5.6: Rapid diagnostic testing practices (interview)

	N	n	%	95% CI
Primary care units				
Do health personnel perform rapid diagnostic testing for malaria in this facility?	30	15	50	(32 - 68)
Do health personnel in this facility perform rapid diagnostic testing for malaria in the community?	30	11	36.7	(21 - 55)
Health centers				
Do health personnel perform rapid diagnostic testing for malaria in this facility?	16	7	43.8	(22 - 68)
Do health personnel in this facility perform rapid diagnostic testing for malaria in the community?	16	7	43.8	(22 - 68)
Hospitals				
Do health personnel perform rapid diagnostic testing for malaria in this facility?	6	3	50	(16 - 84)
Do health personnel in this facility perform rapid diagnostic testing for malaria in the community?	6	0	0	(-)
DAS				
Do health personnel perform rapid diagnostic testing for malaria in this facility?	5	4	80	(29 - 97)
Do health personnel in this facility perform rapid diagnostic testing for malaria in the community?	5	5	100	(-)

Table 5.7: Community rapid diagnostic testing frequency

	N	n	%	95% CI
Frequency of rapid diagnostic testing in the community				
Daily	23	6	26.1	(12 - 48)
Only in reaction to a positive malaria case	23	5	21.7	(9 - 44)
At least once per week	23	3	13	(4 - 34)
At least once per month	23	1	4.3	(1 - 26)
At least once per quarter	23	1	4.3	(1 - 26)
Other	23	6	26.1	(12 - 48)
Don't know	23	1	4.3	(1 - 26)

Respondents at facilities that reported using both RDTs and microscopic diagnosis methods were asked which of the two methods are more commonly used. While 56.7% of facilities reported using both RDT and microscopy routinely for the same patient, 33.3% reported taking only a TBF sample routinely (Table 5.8).

Table 5.8: 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?				
Both RDT and thick blood film: Samples are routinely taken for both tests at the same time	30	17	56.7	(38 - 73)
Only thick blood film used more commonly	30	10	33.3	(19 - 52)
Either RDT or thick blood film: RDTs and thick blood films are used equal amount, but each patient only receives one test or the other	30	2	6.7	(2 - 24)
Only RDT used more commonly	30	1	3.3	(0 - 21)

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, 93.3% of primary care facilities, 85.7% of health centers, and 100% of hospitals that used RDTs reported that they require confirmation by TBF examination in order to start treatment (Table 5.9).

Table 5.9: 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	15	14	93.3	(63 - 99)
Health centers	7	6	85.7	(40 - 98)
Hospitals	3	3	100	(-)

5.2.2 Rapid diagnostic testing as measured in medical record review

The health facility survey included a 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 case notification and investigation paperwork stored at the DAS (for confirmed cases) and based on patient charts, attention registries, and lab records at selected health facilities (for suspected cases). As seen in Table 5.10, 55% of confirmed cases reviewed had evidence of an RDT, and 0.7% of suspected cases reviewed had evidence of receiving an RDT.

Table 5.10: Rapid diagnostic testing observed in medical record review

	N	n	%	95% CI
RDT observed in record				
Confirmed cases	709	390	55	(51 - 59)
Suspected cases	1228	9	0.7	(0 - 1)

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 26.7% of primary care facilities. No rapid tests were observed the day of the survey in 73.3% of primary care facilities (Table 5.11).

Table 5.11: Rapid diagnostic test supply observed

	N	n	%	95% CI
Primary care units				
P. falciparum rapid detection card equipment observed	30	6	20	(9 - 39)
P. falciparum + P. vivax rapid detection card equipment observed	30	8	26.7	(14 - 46)
None of these rapid detection cards observed	30	22	73.3	(54 - 86)
Health centers				
P. falciparum rapid detection card equipment observed	16	1	6.3	(1 - 35)
P. falciparum + P. vivax rapid detection card equipment observed	16	3	18.8	(6 - 46)
None of these rapid detection cards observed	16	13	81.2	(54 - 94)
Hospitals				
None of these rapid detection cards observed	6	6	100	(-)
DAS				
P. falciparum rapid detection card equipment observed	5	1	20	(3 - 71)
P. falciparum + P. vivax rapid detection card equipment observed	5	2	40	(10 - 81)
None of these rapid detection cards observed	5	3	60	(19 - 90)

Figure 5.1: Rapid diagnostic test supply

As shown in Table 5.12, 36.7% of primary care facilities, 37.5% of health centers, 16.7% of hospitals, and 80% of DAS routinely store RDTs.

Table 5.12: 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, delivered when services are being provided	30	2	6.7	(2 - 24)
No, picked up from another facility	30	4	13.3	(5 - 31)
Yes, stores malaria rapid diagnostic tests (RDTs)	30	11	36.7	(21 - 55)
None of the above	30	11	36.7	(21 - 55)
Don't know	30	2	6.7	(2 - 24)

Health centers: Does this facility routinely store any malaria rapid diagnostic tests (RDTs)?				
No, delivered when services are being provided	16	0	0	(-)
No, picked up from another facility	16	1	6.3	(1 - 35)
Yes, stores malaria rapid diagnostic tests (RDTs)	16	6	37.5	(17 - 63)
None of the above	16	9	56.2	(32 - 78)
Hospitals: Does this facility routinely store any malaria rapid diagnostic tests (RDTs)?				
No, delivered when services are being provided	6	0	0	(-)
No, picked up from another facility	6	0	0	(-)
Yes, stores malaria rapid diagnostic tests (RDTs)	6	1	16.7	(2 - 65)
None of the above	6	5	83.3	(35 - 98)
DAS: Does this facility routinely store any malaria rapid diagnostic tests (RDTs)?				
No, delivered when services are being provided	5	0	0	(-)
No, picked up from another facility	5	0	0	(-)
Yes, stores malaria rapid diagnostic tests (RDTs)	5	4	80	(29 - 97)
None of the above	5	1	20	(3 - 71)

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 or lab technicians depending on facility practices. Slides are also prepared in the field by vector control technicians and volunteer collaborators (col-vols). 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.

5.3.1 Microscopic diagnosis practices

In Guatemala, all facilities in the sample are expected to have the capacity to prepare TBF slides. In the health facility interview and observation, 70% of primary care facilities, 87.5% of health centers and all of the hospitals and DAS were found to take TBF samples, as in Table 5.13. The health facility survey (interview and observation) determined microscopic diagnostic capacity at 36.7% of primary care facilities, 81.2% of health centers, 100% of hospitals, and 60% of DAS.

Table 5.13: Microscopy and thick blood film sampling according to interview + observation

	N	n	%	95% CI
Primary care units				
Unit takes thick blood film samples	30	21	70	(51 - 84)
Unit has microscopy capacity	30	11	36.7	(21 - 55)
Health centers				
Unit takes thick blood film samples	16	14	87.5	(60 - 97)
Unit has microscopy capacity	16	13	81.2	(54 - 94)
Hospitals				
Unit takes thick blood film samples	6	6	100	(-)
Unit has microscopy capacity	6	6	100	(-)

DAS				
Unit takes thick blood film samples	5	5	100	(-)
Unit has microscopy capacity	5	3	60	(19 - 90)

According to the interview alone and as seen in Table 5.14, 80.7% of all facilities (regardless of type) have personnel that take TBF samples in-facility, and 49.1% have personnel that take TBF samples in the community.

Table 5.14: Thick blood film sampling according to interview

	N	n	%	95% CI
Health personnel in this facility take thick blood film samples in-facility	57	46	80.7	(68 - 89)
Health personnel take thick blood film samples in the community	57	28	49.1	(36 - 62)

As shown in Table 5.15 and regardless of facility type, 67.4% 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 regional laboratories and at the national laboratory). Of those 31 facilities that report conducting initial diagnosis, 74.2% also examine samples taken by community health workers or volunteer collaborators, and 30% sometimes send slides elsewhere for initial diagnosis (for example, when the sole laboratorist is on leave). Among the 15 facilities that do not conduct initial diagnosis, 80% send samples to another facility for initial diagnosis.

Among all 21 facilities that send samples to another facility (sometimes or always), 47.6% report sending them to another health care facility, while 38.1% report sending them directly to the regional laboratory for initial diagnosis (Table 5.16). The three facilities that sent slides to an “other” location reported sending them to a vector control or malaria program laboratory.

Table 5.15: Microscopy capacity in facility according to interview

	N	n	%	95% CI
Thick blood film samples examined for initial diagnosis of malaria in-facility	46	31	67.4	(52 - 80)
Thick blood film samples taken by community health workers (health promotors/volunteer collaborators) examined for malaria in-facility	31	23	74.2	(56 - 87)
Samples sometimes sent elsewhere for initial diagnosis of malaria, among facilities with capacity	30	9	30	(16 - 49)
Samples sent elsewhere for initial diagnosis of malaria, among facilities without capacity	15	12	80	(52 - 94)

Table 5.16: Samples sent elsewhere: location

	N	n	%	95% CI
Location of initial diagnosis				
Another health facility	21	10	47.6	(27 - 69)
Regional laboratory	21	8	38.1	(20 - 60)
Other	21	3	14.3	(5 - 37)

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 48.4% of facilities there is at least one malaria microscopist, 9.7% of facilities have at least one microbiologist who conducts malaria diagnosis, and 54.8% have other lab personnel that read malaria slides (Table 5.17). Figure 5.2 shows the number of employed personnel of all personnel types who conduct malaria diagnosis at each facility in the sample.

Table 5.17: Personnel responsible for malaria microscopy testing

	N	n	%	95% CI
Personnel responsible for TBF examination				
Other lab technician	31	17	54.8	(37 - 72)
Malaria microscopist	31	15	48.4	(31 - 66)
Microbiologist (laboratory)	31	3	9.7	(3 - 27)

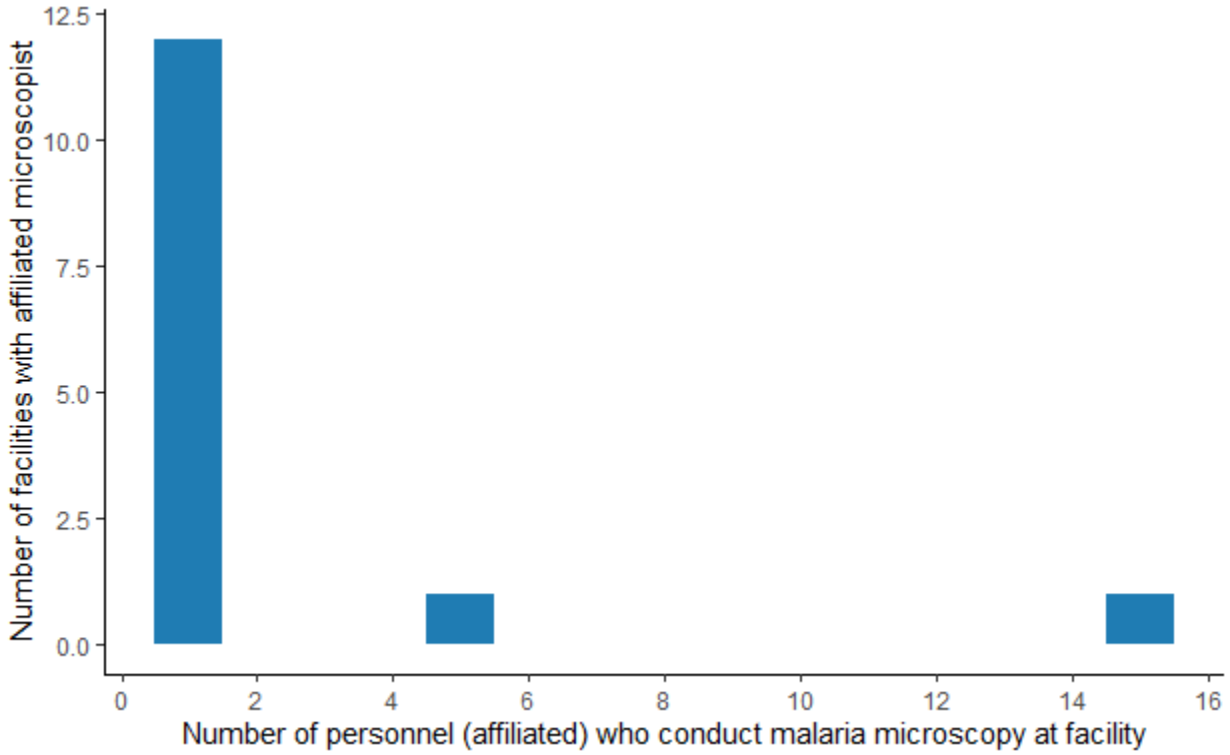
Figure 5.2: Diagnostic personnel employed by facilities

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 8.6% of facilities had affiliated personnel involved in diagnosis (Table 5.18). Figure 5.3 shows the number of affiliated diagnostic personnel at each of the five facilities reporting affiliates.

Table 5.18: Diagnostic personnel not employed but working in facility

	N	n	%	95% CI
Affiliated microscopists work at but are not employed by facility	58	5	8.6	(4 - 20)

Figure 5.3: Diagnostic personnel affiliated to facilities



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 5.19.

Table 5.19: Indicator P7.01: Required components by facility type

Component	Primary level (46)	Secondary level (6)	Administrative Units / National Lab (6)
Medications (basic)	Stratum 4	Stratum 4	
Medications (severe malaria)			
Medications (CQ resistant)			
Sampling equipment	All	All	
Forms for sending samples	All	All	
Equipment for on-site diagnosis (RDT)			
Microscopy equipment	If reported microscopy capacity		
Staining and sample reading equipment	If reported microscopy capacity		
Staining reagents	If reported microscopy capacity		

The indicator results are shown in Table 5.20. Only 7.1% of all the facilities in the sample had all of the inputs required for the corresponding facility type. Table 5.21 shows, for comparison, the results in malaria stratum 4 versus malaria stratum 3.

Table 5.20: Indicator P7.01: Equipment and medications

	N	n	%	95% CI
Antimalarial medications	42	0	0	(-)
Medications for basic treatment: Chloroquine	42	6	14.3	(6 - 29)
Medications for basic treatment: Primaquine (5 or 15 mg tablets)	42	3	7.1	(2 - 21)
No stockout of chloroquine or primaquine in past 3 months	42	0	0	(-)
Sampling and biosafety equipment	47	31	66	(51 - 78)
Disposable gloves	47	41	87.2	(74 - 94)
Lancets	47	35	74.5	(60 - 85)
Microscope slides (frosted or non-frosted)	47	37	78.7	(64 - 88)
Sample submission forms	7	5	71.4	(32 - 93)
Microscopy equipment	34	24	70.6	(53 - 84)
Binocular microscope (with 100x retractable lens)	34	32	94.1	(79 - 99)
Cell counter (manual or automatic)	34	24	70.6	(53 - 84)
Equipment for staining and testing	34	25	73.5	(56 - 86)
Immersion oil	34	33	97.1	(81 - 100)
Staining tray/ container	34	33	97.1	(81 - 100)
Laboratory stopwatch	34	31	91.2	(75 - 97)
Container for mixing dye/ stain	34	29	85.3	(69 - 94)
Pipettes/ droppers/ syringes	34	29	85.3	(69 - 94)
Reagents for staining	34	11	32.4	(19 - 50)
GIEMSA solution (or alternative: Methylene blue + Solution A + Solution B + Methanol)	34	30	88.2	(72 - 96)
Buffer solution or buffered water	34	12	35.3	(21 - 53)
No stockout of reagents in past 3 months	34	11	32.4	(19 - 50)
Units with all required equipment and medications	56	4	7.1	(3 - 18)

Table 5.21: Comparison: result by facility stratification

	N	n	%	95% CI
P7.01 Equipment Indicator				
Stratum 3	10	3	30	(10 - 63)
Stratum 4	46	1	2.2	(0 - 15)
Total	56	4	7.1	(3 - 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 5.22 and Table 5.23 show the proportion of facilities where each item for sample-taking and microscopy, respectively, was observed on the day of the survey.

Table 5.22: Sample-taking supplies observed

	N	n	%	95% CI
Disposable gloves	47	41	87.2	(74 - 94)
Alcohol swabs	47	11	23.4	(13 - 38)
Cotton-wool swabs	47	24	51.1	(37 - 65)
Acetone or Acetone alcohol (antiseptic)	47	20	42.6	(29 - 57)
Lancets	47	35	74.5	(60 - 85)
Syringes (for taking blood)	47	29	61.7	(47 - 75)
Needles	47	24	51.1	(37 - 65)
Vacutainer-type needles	47	7	14.9	(7 - 29)
Capillary tubes	47	17	36.2	(23 - 51)
Sharps box	47	44	93.6	(81 - 98)
Microscope slides (not frosted)	47	27	57.4	(43 - 71)
Frosted microscope slides	47	19	40.4	(27 - 55)

Table 5.23: Microscopy equipment and supplies observed, among all facilities reporting microscopy capacity

	N	n	%	95% CI
Lens-cleaning tissues	34	20	58.8	(41 - 74)
Spare bulbs (for microscopes)	34	6	17.6	(8 - 35)
Spare fuses (for microscopes)	34	2	5.9	(1 - 21)
Immersion oil	34	33	97.1	(81 - 100)
Oil immersion lens-cleaning solution	34	1	2.9	(0 - 19)
Staining rack	34	25	73.5	(56 - 86)
Drying rack (or sheet)	34	30	88.2	(72 - 96)
Measuring cylinder/disposable graduated cylinder	34	8	23.5	(12 - 41)
Glass or plastic bottles with a lid, that do not allow the passage of light	34	9	26.5	(14 - 44)
Filter paper (or other input to act as filter paper)	34	6	17.6	(8 - 35)
Slide holders or wooden dowels	34	8	23.5	(12 - 41)
Containers for mixing dye or stain	34	22	64.7	(47 - 79)
Concave staining surface	34	2	5.9	(1 - 21)
Staining tray/sheet/container	34	19	55.9	(39 - 72)
Glass petri dish	34	3	8.8	(3 - 25)
Plastic petri dish	34	5	14.7	(6 - 31)
Syringes	34	9	26.5	(14 - 44)
Disposable droppers	34	19	55.9	(39 - 72)
Test tubes with screw caps	34	11	32.4	(19 - 50)
Test tubes without caps (glass or plastic)*	23	7	30.4	(15 - 52)
Safety glasses (including the over-spectacle type)	34	5	14.7	(6 - 31)
Gowns	34	24	70.6	(53 - 84)
Markers	34	25	73.5	(56 - 86)
Detergents	34	23	67.6	(50 - 81)
Timer in laboratory	34	7	20.6	(10 - 38)

*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 5.4. The observed characteristics, by microscope, are shown in Table 5.24.

Figure 5.4: Functional microscopes per facility

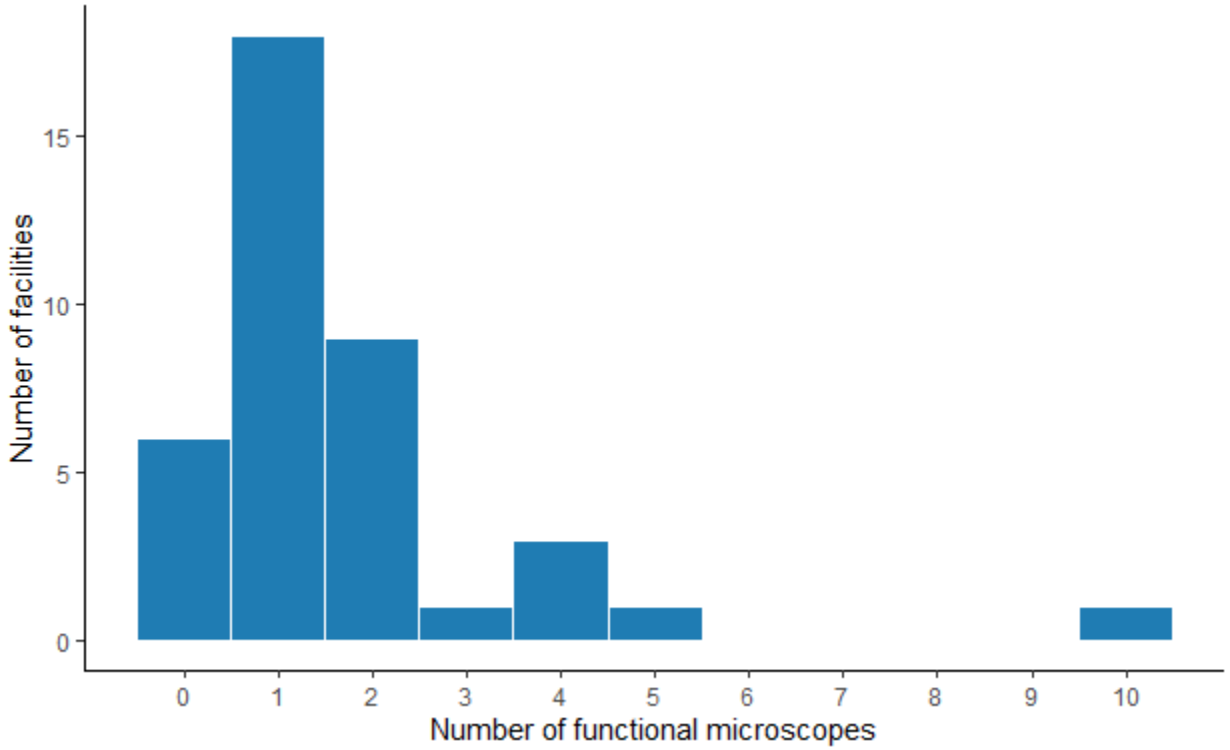


Table 5.24: Microscope characteristics among all observed microscopes

	N	n	%	95% CI
Is this a binocular microscope?	67	67	100	(-)
Is this a light microscope?	67	67	100	(-)
Is this a fluorescence microscope?	67	6	9	(4 - 19)
Is this a dark field microscope?	67	10	14.9	(8 - 26)
Is this a solar power microscope?	67	1	1.5	(0 - 10)
Lens observed: 4x	67	63	94	(85 - 98)
Lens observed: 10x	67	60	89.6	(79 - 95)
Lens observed: 20x	67	5	7.5	(3 - 17)
Lens observed: 40x	67	60	89.6	(79 - 95)
Lens observed: 100x	67	66	98.5	(90 - 100)
Lens observed: 1000x	67	1	1.5	(0 - 10)
Does the binocular microscope have an oil immersion lens?	67	67	100	(-)

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 Guatemala, active case detection is carried out by vector control personnel both through planned activities and in response to malaria cases confirmed in areas without ongoing transmission. 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 Guatemala, clinical and community health personnel are trained to suspect and test for malaria in patients with high fever in zones with local transmission or among patients who have traveled to those zones. Other signs that suggest malaria are history of recent fever, chills, and sweating, particularly in an alternating pattern. In addition, zones with ongoing or recent transmission may have volunteer collaborators (*colaboradores voluntarios*, or “col-vols”) based in localities with difficult access to health facilities. Community members experiencing fever or other malaria symptoms can seek out the col-vol, who will take a blood sample if he or she suspects the patient may have malaria.

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 affiliated with the facility. Vector control activities are managed by DAS, where 80% had vector control personnel affiliated. Community health workers were affiliated with all facility types (Table 6.1).

Table 6.1: Affiliated malaria personnel

	N	n	%	95% CI
Primary care units				
Community health workers/volunteer collaborators	30	19	63.3	(45 - 79)
Community health workers/volunteer collaborators involved in malaria activities (such as vector control, diagnosis, case detection, or treatment)	19	11	57.9	(35 - 78)
Other personnel involved in malaria diagnosis or treatment	30	1	3.3	(0 - 21)
Health centers				
Community health workers/volunteer collaborators	16	8	50	(27 - 73)
Community health workers/volunteer collaborators involved in malaria activities (such as vector control, diagnosis, case detection, or treatment)	8	7	87.5	(45 - 98)
Other personnel involved in malaria diagnosis or treatment	16	2	12.5	(3 - 40)
Hospitals				
Community health workers/volunteer collaborators	6	2	33.3	(8 - 74)
Community health workers/volunteer collaborators involved in malaria activities (such as vector control, diagnosis, case detection, or treatment)	2	0	0	(-)
Other personnel involved in malaria diagnosis or treatment	6	0	0	(-)

DAS				
Vector control personnel	5	4	80	(29 - 97)
Community health workers/volunteer collaborators	5	3	60	(19 - 90)
Community health workers/volunteer collaborators involved in malaria activities (such as vector control, diagnosis, case detection, or treatment)	3	3	100	(-)
Other personnel involved in malaria diagnosis or treatment	5	0	0	(-)

As shown in Table 6.2, 46.7% of primary care facilities and 56.2% of health centers reported that facility personnel participate in active searches for malaria. Some DAS also reported storing mosquito nets for distribution (80%) and employing personnel involved with indoor residual spraying (20%). Educational campaigns about malaria were conducted by 100% of DAS.

Table 6.2: Active case detection and community activities

	N	n	%	95% CI
Primary care units				
Conducts active search for malaria cases	30	14	46.7	(29 - 65)
Stores insecticide-treated mosquito nets for distribution in the community	30	2	6.7	(2 - 24)
Performs indoor residual spraying	30	3	10	(3 - 28)
Conducts educational campaigns about malaria in the community	30	21	70	(51 - 84)
Other malaria outreach activities	30	19	63.3	(45 - 79)
Health centers				
Conducts active search for malaria cases	16	9	56.2	(32 - 78)
Stores insecticide-treated mosquito nets for distribution in the community	16	3	18.8	(6 - 46)
Performs indoor residual spraying	16	3	18.8	(6 - 46)
Conducts educational campaigns about malaria in the community	16	11	68.7	(43 - 87)
Other malaria outreach activities	16	10	62.5	(37 - 83)
Hospitals				
Conducts active search for malaria cases	6	0	0	(-)
Stores insecticide-treated mosquito nets for distribution in the community	6	0	0	(-)
Performs indoor residual spraying	6	1	16.7	(2 - 65)
Conducts educational campaigns about malaria in the community	6	0	0	(-)
Other malaria outreach activities	6	1	16.7	(2 - 65)
DAS				
Conducts active search for malaria cases	5	5	100	(-)
Stores insecticide-treated mosquito nets for distribution in the community	5	4	80	(29 - 97)
Performs indoor residual spraying	5	1	20	(3 - 71)
Conducts educational campaigns about malaria in the community	5	5	100	(-)
Other malaria outreach activities	5	4	80	(29 - 97)

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 on a scheduled periodic basis (25% of facilities) or daily (21.4% of facilities). The one facility that reported doing active search according to direction from health authorities said the direction came from the central level (Table 6.4).

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?				
On a scheduled periodic basis	28	7	25	(12 - 45)
After there is a case of malaria in the catchment area	28	7	25	(12 - 45)
Daily	28	6	21.4	(10 - 41)
When events (market, celebrations, vacations) are happening in the community	28	5	17.9	(7 - 37)
Based on seasonality	28	2	7.1	(2 - 25)
When directed from health authorities	28	1	3.6	(0 - 22)
Other	28	10	35.7	(20 - 55)

Table 6.4: Active case detection direction from health authorities

	N	n	%	95% CI
Agency/level that orders the active search				
National malaria programs/ central level	1	1	100	(-)

Figure 6.1: Active case detection completed after there is a case of malaria in the catchment area of the health facility, by facility type and stratification

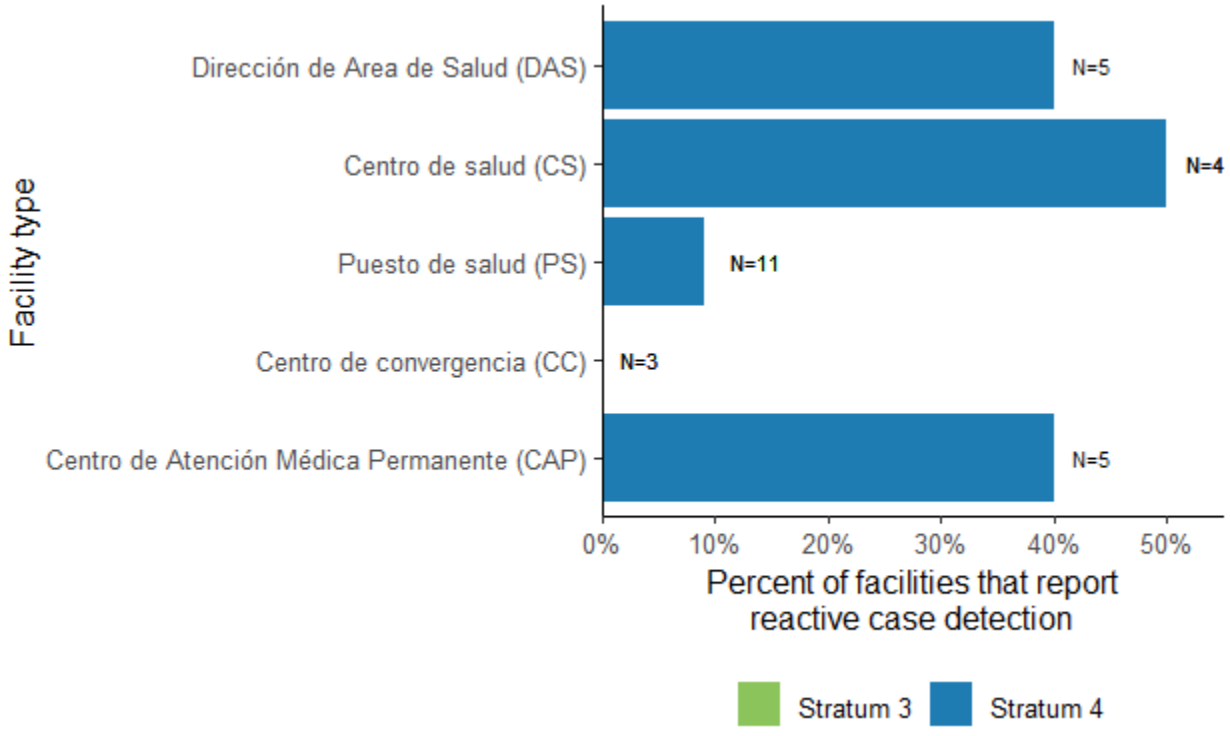
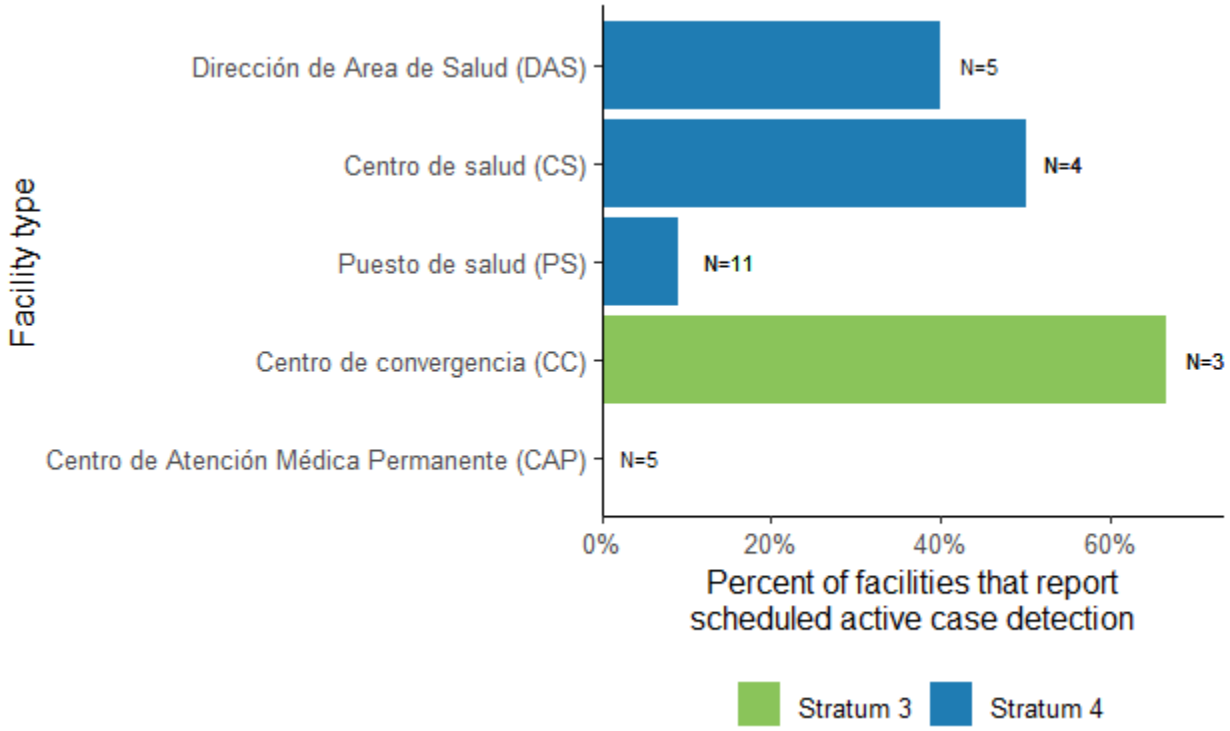


Figure 6.2: Active case detection scheduled on a periodic basis, by facility type and stratification



The facilities that reported storing mosquito nets were asked how the nets are distributed, and could list more than one method. The results are summarized in Table 6.5.

Table 6.5: Community net distribution

	N	n	%	95% CI
Mode of treated net distribution				
Vector control personnel distributes the nets in the community	9	8	88.9	(48 - 99)
Personnel from this health facility distributes the nets in the community	9	1	11.1	(1 - 52)
Community health workers puck up the nets to distribute	9	1	11.1	(1 - 52)
Other	9	1	11.1	(1 - 52)
Don't know	9	1	11.1	(1 - 52)

Respondents were also asked a series of questions about malaria detection activities in the community and referrals from community health workers. Among facilities that administer malaria treatment, 23.3% of primary care units and 56.2% of health centers received referrals from col-vols or other community health workers to treat malaria. Diagnosis activities were common, with 43.3% of primary care facilities receiving referrals for malaria testing, 50% of primary care units taking TBF samples in the community, and 36.7% of primary care units taking RDTs in the community.

Table 6.6: Community malaria activities - questionnaire

	N	n	%	95% CI
Primary care units				
Do you receive referred patients from community health workers or volunteer collaborators for malaria testing?	30	13	43.3	(27 - 62)
Do you receive referred patients from community health workers or volunteer collaborators for malaria treatment?	30	7	23.3	(11 - 42)
Do health personnel take thick blood film samples in the community?	30	15	50	(32 - 68)
Do health personnel in this facility perform rapid diagnostic testing for malaria in the community?	30	11	36.7	(21 - 55)
Do community health workers or volunteer collaborators receive malaria rapid tests from this facility for use in the community?	30	8	26.7	(14 - 46)
Health centers				
Do you receive referred patients from community health workers or volunteer collaborators for malaria testing?	16	12	75	(48 - 91)
Do you receive referred patients from community health workers or volunteer collaborators for malaria treatment?	16	9	56.2	(32 - 78)
Do health personnel take thick blood film samples in the community?	16	8	50	(27 - 73)
Do health personnel in this facility perform rapid diagnostic testing for malaria in the community?	16	7	43.8	(22 - 68)
Do community health workers or volunteer collaborators receive malaria rapid tests from this facility for use in the community?	16	5	31.3	(13 - 57)
Hospitals				
Do you receive referred patients from community health workers or volunteer collaborators for malaria testing?	6	0	0	(-)
Do health personnel take thick blood film samples in the community?	6	0	0	(-)
Do health personnel in this facility perform rapid diagnostic testing for malaria in the community?	6	0	0	(-)
Do community health workers or volunteer collaborators receive malaria rapid tests from this facility for use in the community?	6	0	0	(-)
DAS				
Do you receive referred patients from community health workers or volunteer collaborators for malaria testing?	5	0	0	(-)
Do you receive referred patients from community health workers or volunteer collaborators for malaria treatment?	0	0		-
Do health personnel take thick blood film samples in the community?	5	5	100	(-)
Do health personnel in this facility perform rapid diagnostic testing for malaria in the community?	5	5	100	(-)

	N	n	%	95% CI
Do community health workers or volunteer collaborators receive malaria rapid tests from this facility for use in the community?	5	4	80	(29 - 97)

6.2 Passive case detection practices (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 to local vector control personnel and to the DAS. If the health facility the patient visits does not have microscopic diagnostic capacity, or if the patient visits a col-vol for testing, the TBF slide is sent, along with a suspected case notification form filled by the provider who took the sample, to a nearby lab for testing, transported by vector control technicians who either visit on a regular basis (usually at least weekly) for pickup or who are notified by phone that a slide is ready for testing. The slide is tested by the lab, and in the case that malaria is confirmed, vector control 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 6.7 shows that doctors order the test in 19% of primary care facilities and 100% of health centers, and nurses order the test or take the sample at triage in 90.5% of primary care facilities and 57.1% of health centers. The text response entered for “other” in a hospital was that the emergency room physician determines which patients are tested.

Table 6.7: 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	21	19	90.5	(68 - 98)
Doctor during consult	21	4	19	(7 - 42)
Lab staff or microscopy staff	21	3	14.3	(5 - 37)
Other	21	0	0	(-)
Health centers: Who decides whether a patient presenting at this facility will receive a malaria test?				
Nurse at triage or pre-clinic	14	8	57.1	(31 - 80)
Doctor during consult	14	14	100	(-)
Lab staff or microscopy staff	14	1	7.1	(1 - 38)
Other	14	0	0	(-)
Hospitals: Who decides whether a patient presenting at this facility will receive a malaria test?				
Nurse at triage or pre-clinic	6	0	0	(-)
Doctor during consult	6	6	100	(-)
Lab staff or microscopy staff	6	0	0	(-)
Other	6	1	16.7	(2 - 65)

Next, respondents were asked to mention what criteria are used to determine whether a patient gets a malaria test, at triage (Table 6.8) and at consult (Table 6.9). 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 (92.3% and 91.7% respectively) and chills was also frequently mentioned (in 42.3% of facilities at triage). Few respondents mentioned travel history as a determining factor for malaria testing.

Table 6.8: 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	26	24	92.3	(73 - 98)
Chills	26	11	42.3	(25 - 62)
Fever for more than 3 days	26	9	34.6	(19 - 55)
General malaise	26	8	30.8	(16 - 51)
Sweating	26	6	23.1	(10 - 43)
History of recent travel to areas with endemic malaria	26	5	19.2	(8 - 39)
History of recent fever	26	2	7.7	(2 - 27)
Profuse sweating	26	2	7.7	(2 - 27)
Fever without nonspecific digestive symptoms (vomiting, abdominal pain, loss of appetite)	26	2	7.7	(2 - 27)
Prior history of malaria	26	2	7.7	(2 - 27)
Fever without rash	26	2	7.7	(2 - 27)
Fever without respiratory symptoms	26	2	7.7	(2 - 27)
Weakness (asthenia or adynamia)	26	1	3.8	(1 - 24)
Other	26	9	34.6	(19 - 55)

Table 6.9: 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	24	22	91.7	(71 - 98)
Chills	24	7	29.2	(14 - 50)
General malaise	24	6	25	(11 - 46)
History of recent fever	24	4	16.7	(6 - 38)
Sweating	24	4	16.7	(6 - 38)
History of recent travel to areas with endemic malaria	24	4	16.7	(6 - 38)
Prior history of malaria	24	4	16.7	(6 - 38)
Profuse sweating	24	3	12.5	(4 - 33)
Fever without nonspecific digestive symptoms (vomiting, abdominal pain, loss of appetite)	24	3	12.5	(4 - 33)
Fever without rash	24	3	12.5	(4 - 33)
Fever without respiratory symptoms	24	3	12.5	(4 - 33)
Weakness (asthenia or adynamia)	24	2	8.3	(2 - 29)
Other	24	3	12.5	(4 - 33)

6.3 Fever cases with blood test (LQAS)

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.

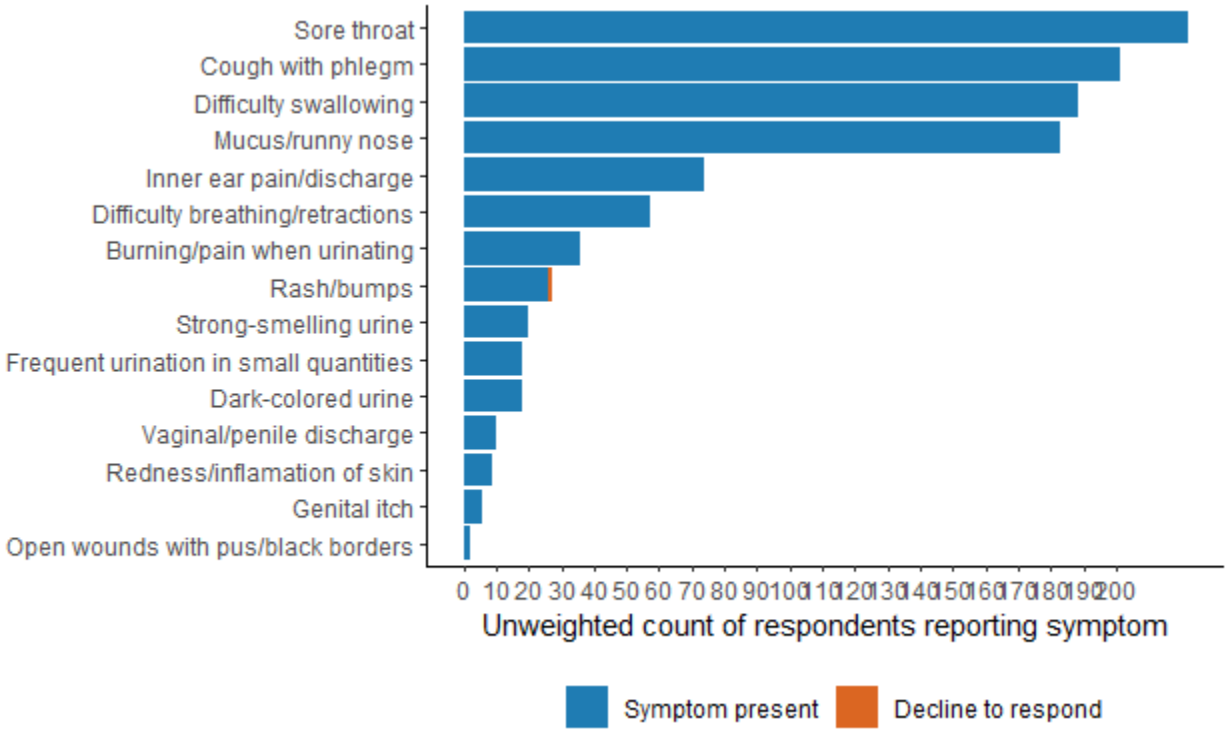
If the primary interview respondent reported that a household member had a recent fever, the interviewer asked to speak to the person who had the fever, or in the case that a child or adolescent had a fever, with the child's primary caregiver. If the person with the fever was not available and the primary 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 6.10, 9.7% 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 374 respondents who reported experiencing fever, the majority experienced other symptoms that suggested a condition other than malaria. Only 90 people, or 24.1% 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 6.10: Eligible fever cases reported in LQAS household survey

	N	n	%	95% CI
LQAS respondents	3880	3880	100	(-)
Fever cases in the last two weeks	3852	374	9.7	(8 - 11)
Fever without exclusion symptoms	374	90	24.1	(18 - 32)

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 6.11, 12.4% of respondents with an eligible fever (with no exclusion symptoms) had a blood sample taken.

Table 6.11: Indicator 2.02: Fevers with blood sample

	N	n	%	95% CI
Fever cases in past two weeks	3852	374	9.7	(8 - 11)
Fevers with no exclusion symptoms	374	90	24.1	(18 - 32)
Omitted due to 'do not know' responses	90	1	1.1	(0 - 8)
Fevers with any blood sample	89	11	12.4	(6 - 25)
Capillary blood test	89	11	12.4	(6 - 25)
Venal blood test	89	0	0	(-)

Table 6.12: Indicator 2.02: Result by malaria stratum

	N	n	%	95% CI
Fevers with any blood sample				
Stratum 3	17	2	11.8	(5 - 26)
Stratum 4	72	9	12.5	(5 - 28)
Total	89	11	12.4	(6 - 25)

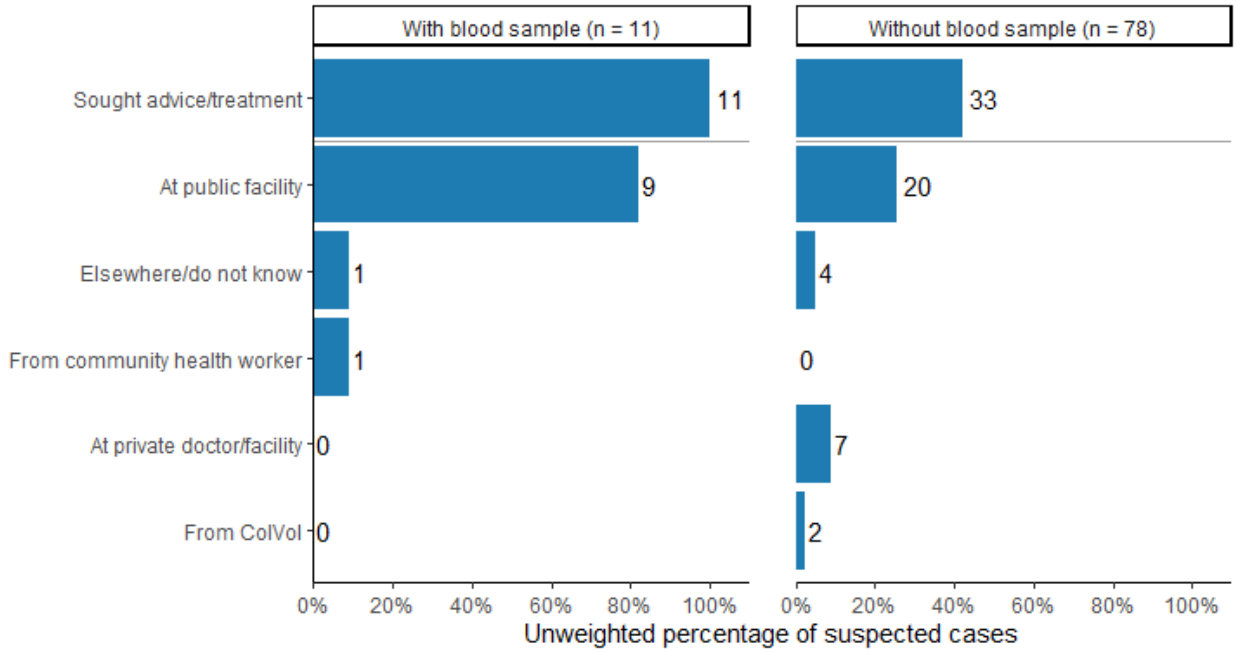
Respondents who reported a blood sample draw were asked whether their blood was tested for malaria, and if so, the result of the test. As seen in Table 6.13, 81.8% of respondents with a blood sample reported a malaria test, and 66.7% of those who had the malaria test reported a negative result.

Table 6.13: Result of blood tests, LQAS fevers

	N	n	%	95% CI
Blood tested for malaria	11	9	81.8	(50 - 95)
Result of malaria test				
Negative malaria	9	6	66.7	(22 - 94)
Don't know	9	3	33.3	(6 - 78)

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 6.14 both excluding cases with symptoms suggesting an illness other than malaria (12.4%) and including all fever cases reported from the past two weeks (26.4%).

Table 6.14: 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	89	11	12.4	(6 - 25)
All fevers with any blood sample	371	98	26.4	(18 - 38)

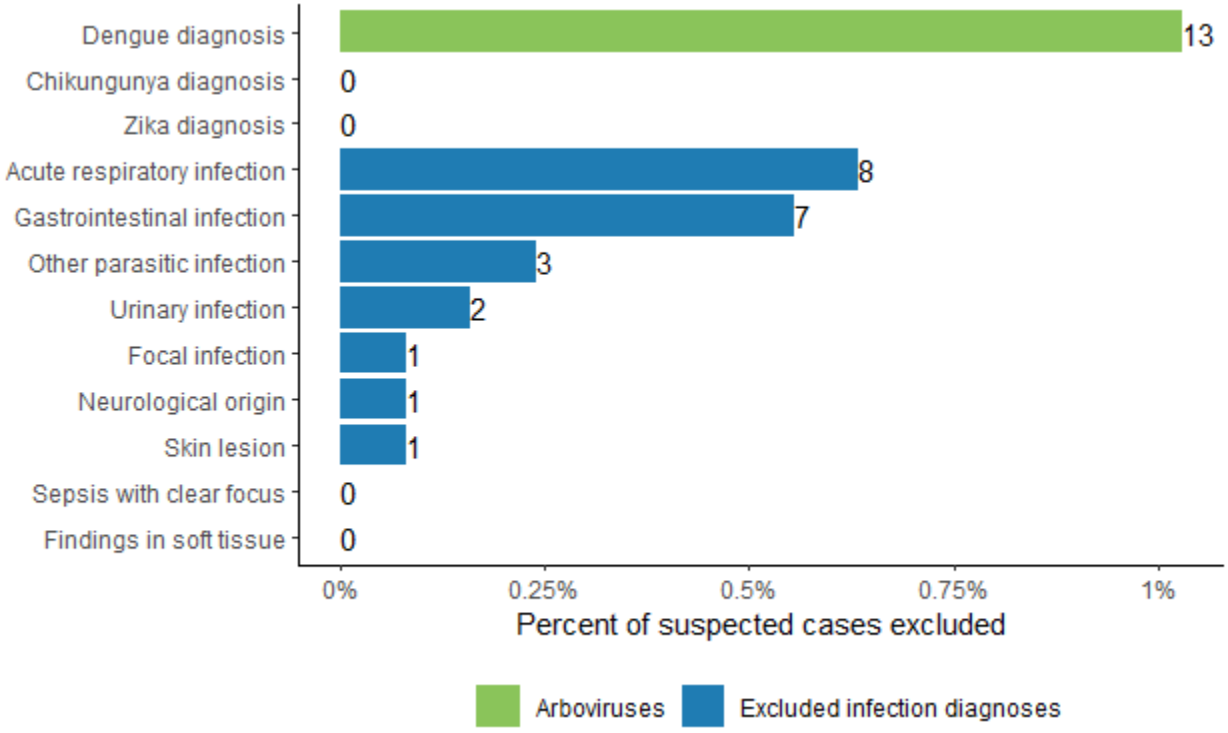
6.4 Suspected malaria cases with parasitological test (medical record review)

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 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.

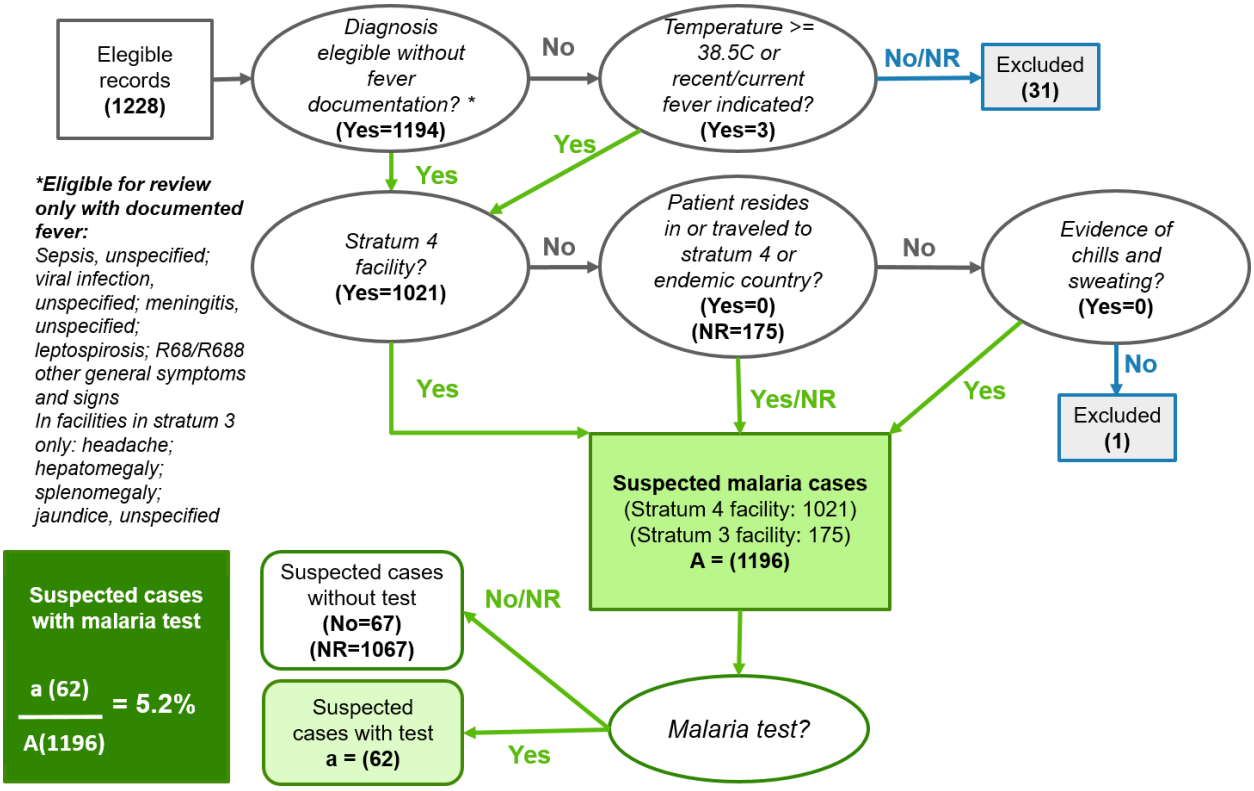
Figure 6.5: Exclusion diagnoses for review of suspected malaria cases



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. Facilities in malaria stratum 4 are subject to a different suspected malaria case definition than facilities in malaria stratum 3, where patients presenting with fever do not require a test to rule out malaria unless they traveled to an endemic area or show other malaria symptoms like chills and sweating. Additionally, 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. Thus, additional ineligible records were identified and excluded from the indicator during the eligibility review.

Figure 6.6: Eligibility of suspected cases reviewed for Indicator 2.01



In total in Guatemala, 1196 of the 1228 suspected cases reviewed were eligible for consideration in 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 6.15, 5.2% of patients with suspected malaria had evidence that a malaria test was received. Of these 62 patients with evidence of a test, 14.5% received an RDT and 88.7% a TBF. For comparison, Table 6.16 shows the results by malaria stratum and Figure 6.7 shows the results by department. The baseline measurement was not designed to produce representative estimates at the department level, so results by department should be interpreted with discretion.

Table 6.15: Indicator 2.01: Suspected cases with malaria test

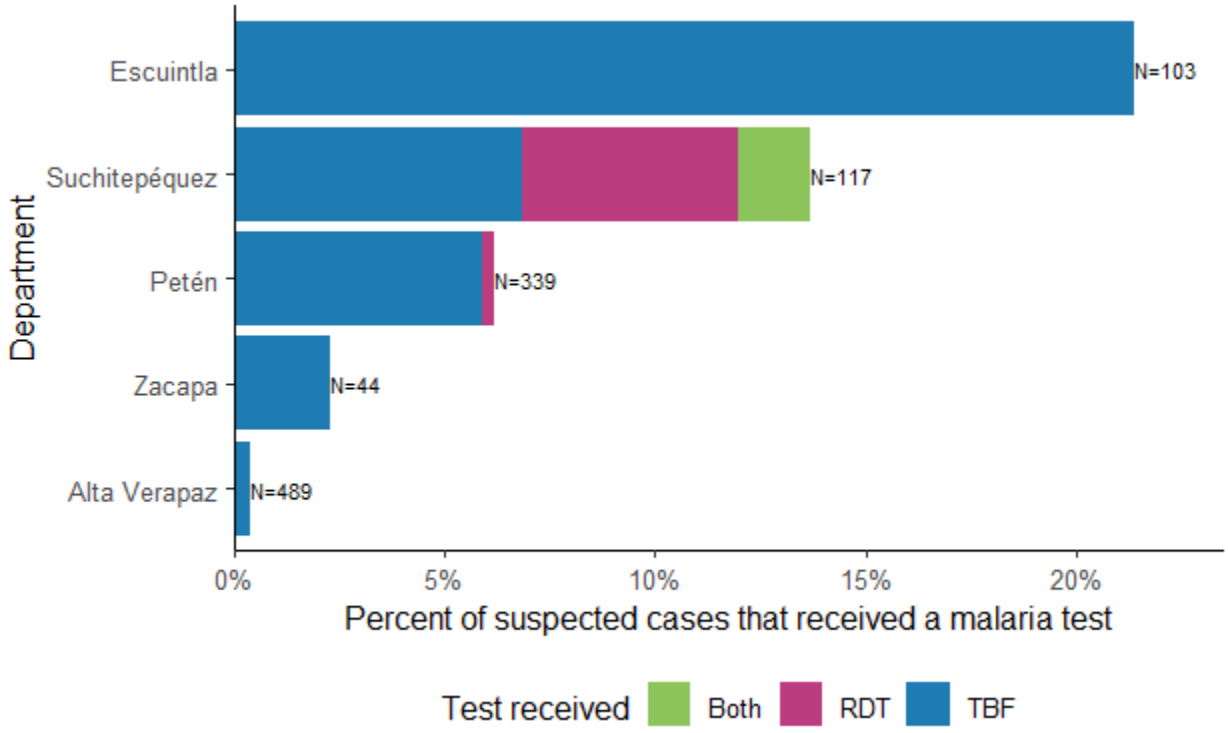
	N	n	%	95% CI
Suspected case with malaria test*	1196	62	5.2	(4 - 7)
Rapid diagnostic test	62	9	14.5	(8 - 26)
Thick blood film	62	55	88.7	(78 - 95)

*Two suspected cases received both the rapid diagnostic test and the thick blood film test

Table 6.16: Comparison: result by facility stratification

	N	n	%	95% CI
Suspected cases with malaria test				
Stratum 3	175	1	0.6	(0 - 4)
Stratum 4	1021	61	6	(5 - 8)
Total	1196	62	5.2	(4 - 7)

Figure 6.7: Comparison: result by department



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 DAS selected to the sample, field personnel reviewed all paper records of confirmed malaria cases from the year 2018 stored at those units as described in Chapter 2. Case records sampled (see Chapter 2 and Appendix C for selection methods) were reviewed from all available sources, including case notification forms, case investigation forms, and any patient charts, laboratory records, or treatment forms filed at the DAS. Figure 6.8 shows that the majority of confirmed malaria case reviews used the epidemiological investigation form and the L-1 lab report. An example of the investigation form is shown in Figure 6.9 for reference.

Figure 6.8: Sources of confirmed case medical record review

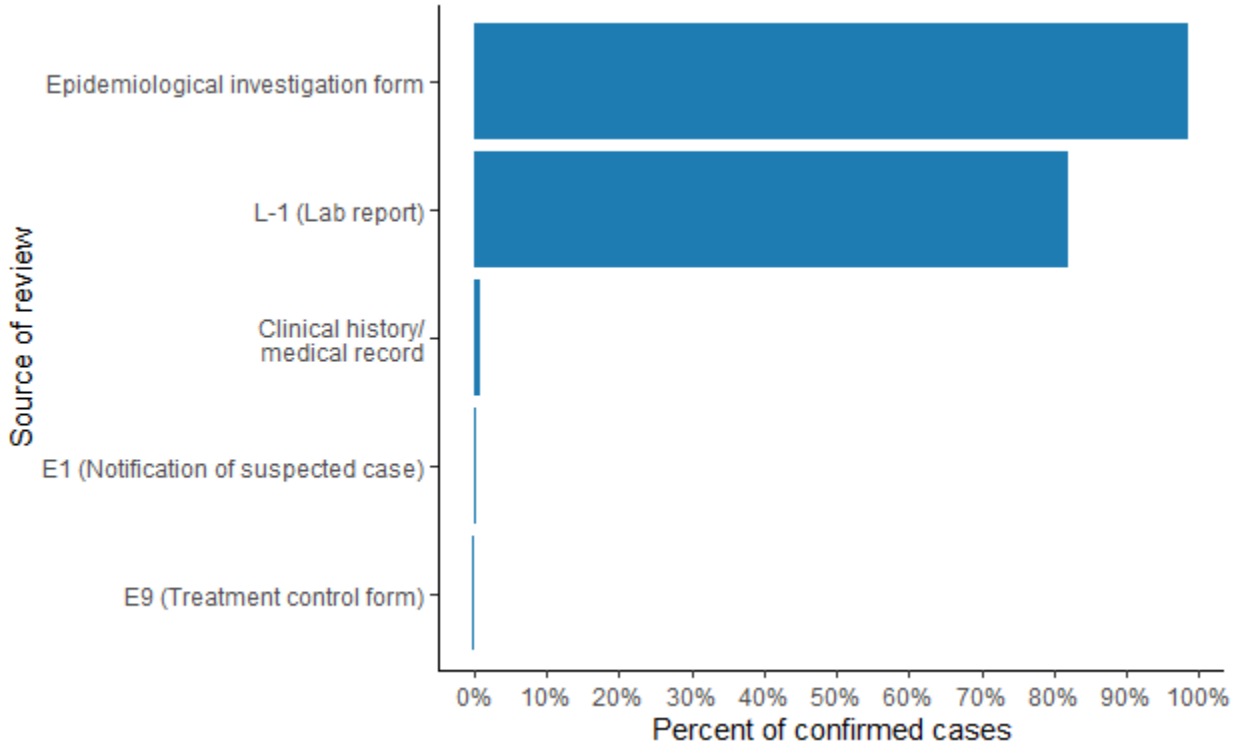
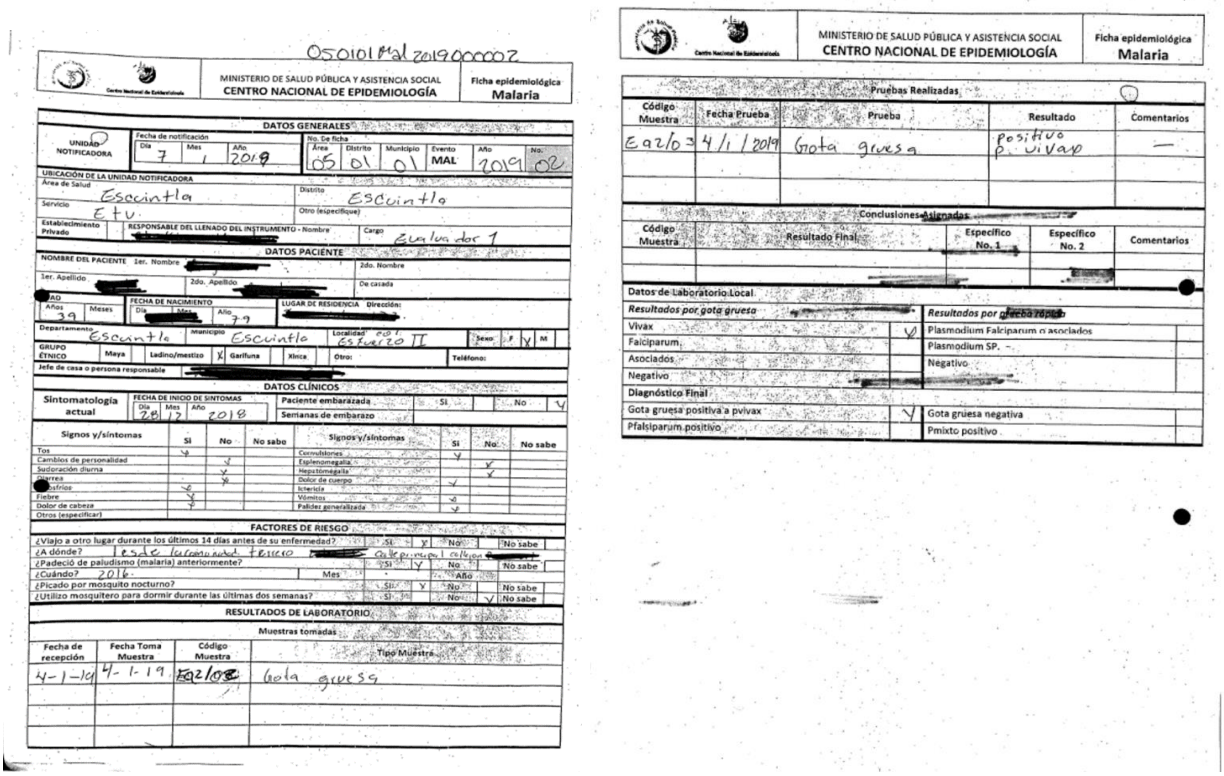
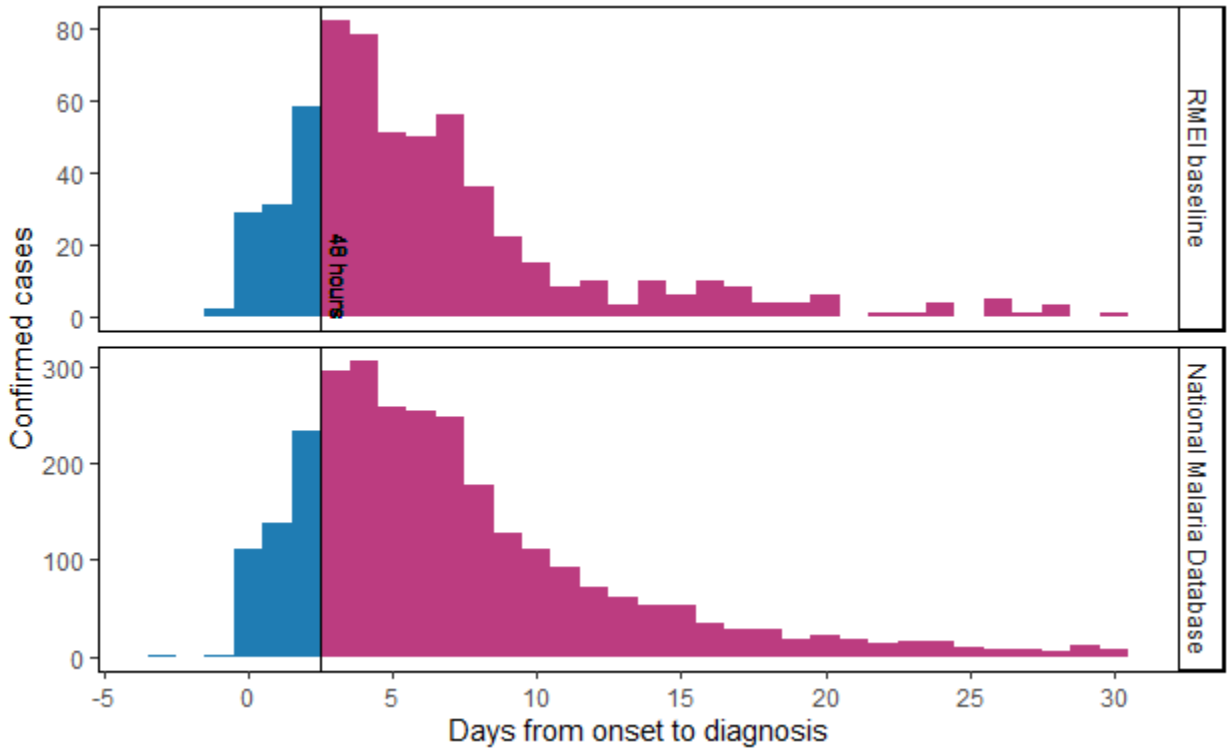


Figure 6.9: Epidemiological investigation form



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 malaria specific individual case notification and the malaria case investigation forms. 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 for paper records reviewed during the RMEI-baseline data collection and the National Malaria Database for all 2018 malaria cases. 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 investigation form or in the survey module). This suspected error affected 34 cases for RMEI-baseline data and 103 cases in the National Malaria Database, which are excluded from the figure.

Figure 6.10: Time from symptom onset to diagnosis, RMEI baseline and surveillance database



The personnel who performed the diagnosis of these confirmed malaria cases are reported in Table 6.17 (diagnosis by RDT) and Table 6.18 (diagnosis by TBF). Many records did not have the personnel recorded (42.1% for records with RDT diagnosis and 36.9% for records with TBF diagnosis). The personnel most commonly recorded as collecting an RDT were vector control staff (26.9%). The personnel most commonly recorded as preparing TBFs were vector control staff (27.5%) and other lab technicians (19.8%).

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

	N	n	%	95% CI
Who took the RDT?				
Not registered	390	164	42.1	(37 - 47)
Vector Control staff	390	105	26.9	(23 - 32)
Lab tech/ microbiologist	390	72	18.5	(15 - 23)
Microscopist	390	44	11.3	(8 - 15)
Community Health Worker (CHW)	390	3	0.8	(0 - 2)
Nurse	390	1	0.3	(0 - 2)

	N	n	%	95% CI
Other	390	1	0.3	(0 - 2)

Table 6.18: Personnel who performed diagnosis of confirmed cases, TBF

	N	n	%	95% CI
Who took the TBF?				
Not registered	662	244	36.9	(33 - 41)
Vector Control staff	662	182	27.5	(24 - 31)
Lab tech/ microbiologist	662	131	19.8	(17 - 23)
Microscopist	662	96	14.5	(12 - 17)
Community Health Worker (CHW)	662	5	0.8	(0 - 2)
Nurse	662	2	0.3	(0 - 1)
Other	662	2	0.3	(0 - 1)

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

Based on the fact finding trip to Guatemala before data collection, it was expected that all DAS units would store investigation and notification forms for confirmed malaria cases. During data collection, the field team visited the Escuintla DAS, interviewed surveillance and vector control staff as well as the facility administration, and discovered that no confirmed case forms from 2018 were filed there. After being entered to the electronic system, the records may have been sent back to the facilities or municipalities where the diagnosis was made, but copies were not kept in the DAS, thus no records of confirmed cases could be reviewed during the data collection in Escuintla. The denominator for performance indicator 4.02 includes the 200 confirmed cases of malaria from 2018 expected and budgeted to be reviewed during the baseline measurement in Escuintla (909 cases total). Because the additional 200 cases could not be located nor reviewed, they are not considered to have dates registered and thus have inadequate time from symptom initiation to diagnosis.

Diagnosis within two days (48 hours) of symptom onset was negotiated as an indicator for RMEI. As shown in Table 6.19, 88.1% of confirmed case records reviewed in Guatemala had both fever/symptom onset and diagnosis dates registered. Only 13.7% were diagnosed within 48 hours of fever/symptom onset, and 18.1% were diagnosed more than a week after fever/symptom onset.

Table 6.19: Indicator 4.02: Fever/symptom onset to diagnosis within 48 hours

	N	n	%	95% CI
Total confirmed malaria cases	909	909	100	(-)
Cases actually collected	909	709	78	(75 - 81)
Excluded due to suspected inscription/data entry error (<-7 day or >30 day window)	909	34	3.7	(3 - 5)
Denominator: Confirmed cases with valid dates	675	675	100	(-)
Fever/symptom onset date registered	675	628	93	(91 - 95)
Diagnosis date registered	675	638	94.5	(93 - 96)
Both dates registered	675	595	88.1	(85 - 90)
Diagnosis before onset (presumptive)	875	2	0.2	(0 - 1)
Cases diagnosed within 48 hours of onset	875	120	13.7	(12 - 16)
3 days	875	82	9.4	(8 - 11)
4-5 days	875	129	14.7	(13 - 17)
6-7 days	875	106	12.1	(10 - 14)
Over 7 days	875	158	18.1	(16 - 21)
Indicator result: Cases diagnosed within 48 hours of onset	875	120	13.7	(12 - 16)

Figure 6.11 shows the same indicator results in a graphic format, with results of the RMEI data collection (upper panel) compared to the Guatemala's National Malaria Database (lower panel). The data from the surveillance database had fewer missing dates, but a similar proportion of cases diagnosed within 48 hours of onset of symptoms.

Figure 6.11: Indictor 4.02: Cases categorized, reviewed and National Malaria Database

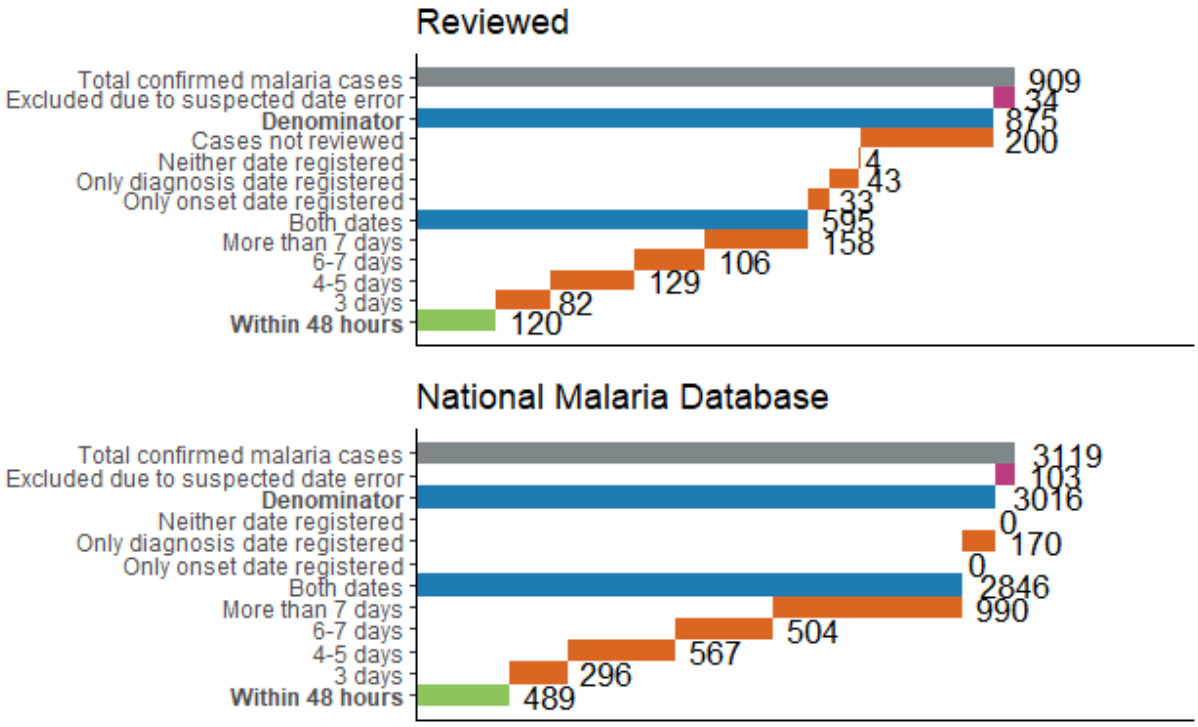


Table 6.20 shows indicator 4.02 by area and Table 6.21 shows the indicator by diagnosis type. Cases diagnosed by TBF and cases diagnosed by RDT were equally likely to be diagnosed within 48 hours of symptom onset.

Table 6.20: Comparison: result by facility area

	N	n	%	95% CI
Diagnosis within 48 hours of symptom onset				
Alta Verapaz	188	62	33	(27 - 40)
Escuintla	200	0	0	(-)
Izabal	196	28	14.3	(10 - 20)
Petén Norte	103	5	4.9	(2 - 11)
Suchitepéquez	188	25	13.3	(9 - 19)
Total	875	120	13.7	(12 - 16)

Table 6.21: Comparison: result by diagnosis test

	N	n	%	95% CI
Diagnosis within 48 hours of symptom onset				
RDT	100	18	18	(12 - 27)
TBF	538	102	19	(16 - 23)
No test date registered	37	0	0	(-)
Total	675	120	17.8	(15 - 21)

6.5.2 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, 63.3% of confirmed case records in Guatemala had both diagnosis and notification dates registered. Only 46.2% were notified within 24 hours of diagnosis.

Figure 6.12: Confirmed cases: source of notification information

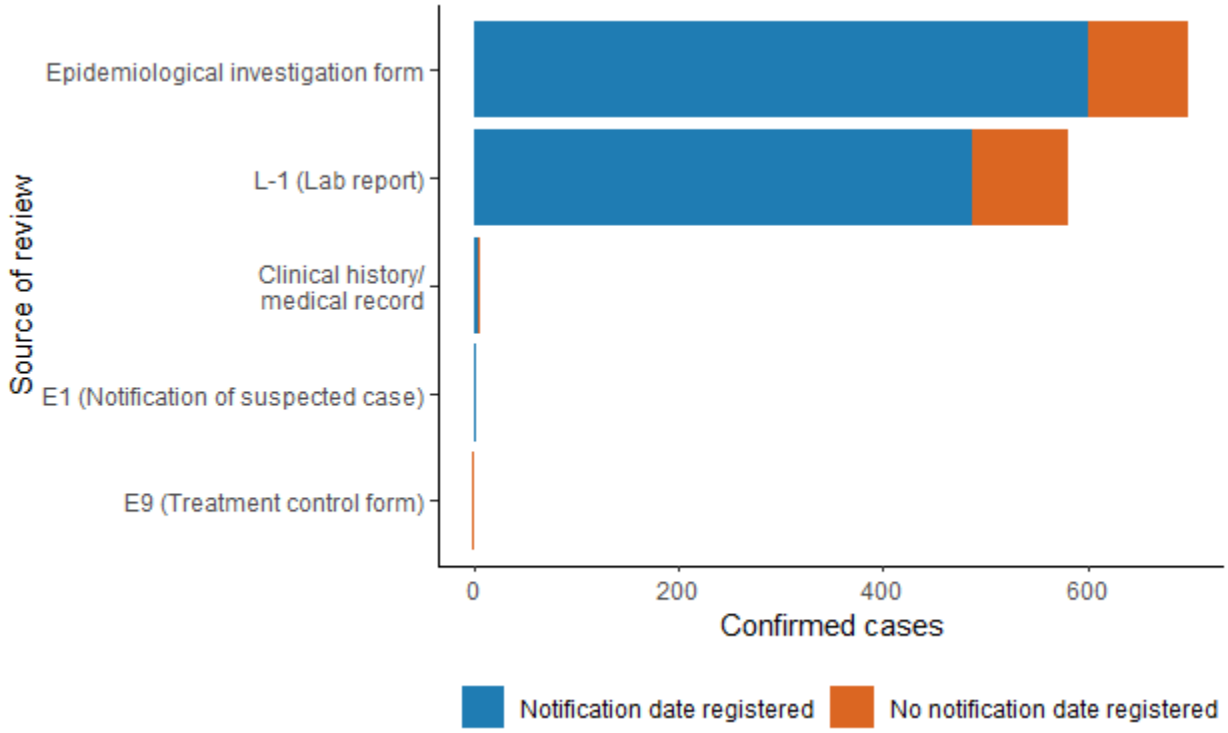


Table 6.22: Indicator E2.04: Notification within 24 hours of diagnosis

	N	n	%	95% CI
Diagnosis date registered	909	672	73.9	(71 - 77)
Notification date registered	909	608	66.9	(64 - 70)
Both dates registered	909	575	63.3	(60 - 66)
Excluded due to suspected inscription/data entry error (<-7 day or >30 day window)	909	26	2.9	(2 - 4)
Notification within 24 hours of diagnosis	883	408	46.2	(43 - 50)

Chapter 7: Malaria treatment

In Guatemala, routine malaria treatment is managed by the vector control program. At the fact-finding visit, IHME learned that primary care facilities and even col-vols may stock a small amount of chloroquine and primaquine in order to administer the first dose upon diagnosis of a new malaria case, but vector control personnel see to the remaining doses, usually delivering them to the patient's home. Supervision of ingestion of all doses is the norm in most areas of Guatemala in order to ensure each patient completes the radical cure. In some cases, col-vols may assist with delivery and supervision of some doses, for example on the weekend or in very remote areas without vector control personnel based in the locality. Occasionally the patient may be expected to visit a health facility in order to receive medication or follow-up malaria tests instead of receiving services through home visits, and to treat severe malaria or chloroquine-resistant *P. falciparum*, the patient may be admitted to the hospital. 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 administrative units except the national reference laboratory). 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 report that they supervise treatment at the facility (40% of primary care facilities) and that facility personnel supervise treatment in the community, as in home visits (30% of primary care facilities).

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	30	2	6.7	(2 - 24)
Provide prescription to external pharmacy	30	5	16.7	(7 - 35)
Give medication to take at home (unsupervised)	30	4	13.3	(5 - 31)
Supervise ingestion (in the facility)	30	12	40	(24 - 59)
Supervise ingestion (in the community)	30	9	30	(16 - 49)
Call or visit the home to ask if treatment was taken (without supervising ingestion)	30	5	16.7	(7 - 35)
None of the above	30	11	36.7	(21 - 55)
Other	30	3	10	(3 - 28)
Health centers: Services provided for malaria treatment				
Prescribe treatment to pharmacy at this facility	16	6	37.5	(17 - 63)
Provide prescription to external pharmacy	16	1	6.3	(1 - 35)
Give medication to take at home (unsupervised)	16	1	6.3	(1 - 35)
Supervise ingestion (in the facility)	16	9	56.2	(32 - 78)
Supervise ingestion (in the community)	16	6	37.5	(17 - 63)
Call or visit the home to ask if treatment was taken (without supervising ingestion)	16	2	12.5	(3 - 40)
None of the above	16	2	12.5	(3 - 40)
Other	16	3	18.8	(6 - 46)

Hospitals: Services provided for malaria treatment				
Prescribe treatment to pharmacy at this facility	6	1	16.7	(2 - 65)
Provide prescription to external pharmacy	6	2	33.3	(8 - 74)
Give medication to take at home (unsupervised)	6	2	33.3	(8 - 74)
Supervise ingestion (in the facility)	6	2	33.3	(8 - 74)
Other	6	3	50	(16 - 84)
DAS: Services provided for malaria treatment				
Give medication to take at home (unsupervised)	5	1	20	(3 - 71)
Supervise ingestion (in the facility)	5	2	40	(10 - 81)
Supervise ingestion (in the community)	5	3	60	(19 - 90)
Call or visit the home to ask if treatment was taken (without supervising ingestion)	5	3	60	(19 - 90)
None of the above	5	1	20	(3 - 71)
Other	5	2	40	(10 - 81)

In countries nearing malaria elimination, it is important to supervise all doses of treatment to ensure the patient completes the radical cure. If the respondent reported that personnel supervise ingestion in-facility, the interviewer asked how many doses are supervised at the facility. At 44% of facilities that supervise treatment regardless of type, all doses are supervised at the facility, and at 28% 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 (Table 7.3). In 10% of the facilities that did not administer all doses in-facility, treatment was administered by community health workers or col-vols, it was administered by vector control personnel in 40% of facilities, and it was prescribed to the patient to take at home in 40% of facilities.

Table 7.2: Doses supervised in-facility

	N	n	%	95% CI
Doses supervised in-facility				
Only the first dose	25	7	28	(14 - 49)
Only some doses	25	3	12	(4 - 32)
All doses	25	11	44	(26 - 64)
Don't know	25	4	16	(6 - 36)

Table 7.3: Personnel responsible for subsequent administrations

	N	n	%	95% CI
Administration of subsequent doses				
Patient was prescribed medication to take at home	10	4	40	(15 - 71)
Treatment is administered by vector control personnel at the patient's home	10	4	40	(15 - 71)
Treatment is supervised at the patient's home by health facility personnel	10	2	20	(5 - 55)
Treatment is administered by community health workers or volunteer collaborators at the patient's home	10	1	10	(1 - 48)
Other	10	2	20	(5 - 55)

All facilities that provide malaria care were asked if personnel ever administer malaria treatment before a positive test result, and 0% replied that they do. Respondents reported that community personnel administer presumptive treatment in only 5.4% of facilities.

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)	43	0	0	(-)
Do community health workers, volunteer collaborators, 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)	56	3	5.4	(2 - 16)

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 administrative units except the national reference laboratory). 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, 10% of primary care facilities, 43.8% of health centers, 0% of hospitals and 100% of DAS reported stock of antimalarials.

Table 7.5: Facility types reporting stock of antimalarials

	N	n	%	95% CI
Facilities reporting antimalarial stock in past 3 months				
Primary care units	30	3	10	(3 - 28)
Health centers	16	7	43.8	(22 - 68)
Hospitals	6	0	0	(-)
DAS	5	5	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 (100% of primary care facilities, 100% of health centers, and 100% of DAS units with any antimalarials) and primaquine (66.7% of primary care facilities, 85.7% 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 40% of primary care facilities that stock chloroquine, and no doses or only expired doses of primaquine were observed in 46.2% of primary care facilities that stock primaquine, suggesting challenges in maintaining supply or replacing expired stock. As malaria case numbers have decreased in Guatemala, many facilities may not use up their supply of chloroquine and primaquine before it expires, creating new challenges to effectively manage pharmaceutical supply from regional and central levels to avoid excess waste and ensure valid doses are accessible where new malaria cases may be diagnosed.

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?	30	3	10	(3 - 28)
Chloroquine	3	3	100	(-)
Primaquine	3	2	66.7	(14 - 96)

Health centers				
Has this facility stocked any antimalarials for at least one day over the past three months?	16	7	43.8	(22 - 68)
Chloroquine	7	7	100	(-)
Primaquine	7	6	85.7	(40 - 98)
DAS & National Lab				
Has this facility stocked any antimalarials for at least one day over the past three months?	5	5	100	(-)
Chloroquine	5	5	100	(-)
Primaquine	5	5	100	(-)

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

	N	n	%	95% CI
Chloroquine tablets observed				
At least one observed and valid	15	9	60	(34 - 81)
At least one observed, but none valid	15	4	26.7	(10 - 54)
Not observed	15	2	13.3	(3 - 42)
Primaquine tablets observed				
At least one observed and valid	13	7	53.8	(27 - 78)
At least one observed, but none valid	13	4	30.8	(12 - 60)
Not observed	13	2	15.4	(4 - 46)

The health facility interview also asked about antimalarial medication stock and administration. Table 7.8 shows some discrepancies with Table 7.5 - facility directors more often reported antimalarial medications in stock than could be confirmed with pharmacy staff, indicating that facility authorities may not be aware of pharmaceutical stock-outs or of changing strategies for treatment storage as malaria transmission decreases.

Table 7.8: Antimalarials medications stored, questionnaire

	N	n	%	95% CI
Questionnaire: Does this facility store medications to treat malaria?				
Primary care units	30	5	16.7	(7 - 35)
Health centers	16	10	62.5	(37 - 83)
Hospitals	6	0	0	(-)
DAS	5	5	100	(-)

Because most health facilities do not store medications to treat severe malaria or chloroquine-resistant malaria, the interview asked how a patient with severe or resistant malaria receives treatment (Table 7.9). Most facilities (regardless of type) informed that the patient is referred to a location that stores medication (40.4% of facilities).

Table 7.9: 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	57	23	40.4	(28 - 54)
Treatment is delivered to this health facility by vector control or malaria program staff	57	12	21.1	(12 - 34)
Treatment is delivered to the patient's home by vector control or malaria program staff	57	3	5.3	(2 - 16)
Other	57	8	14	(7 - 26)
Don't know	57	7	12.3	(6 - 24)

The interview also asked about how antimalarial supplies are managed. As seen in Table 7.10, 20% of primary care facilities and 80% of health centers 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 vector control or malaria program (Table 7.11).

Table 7.10: Determination of malaria medication needs

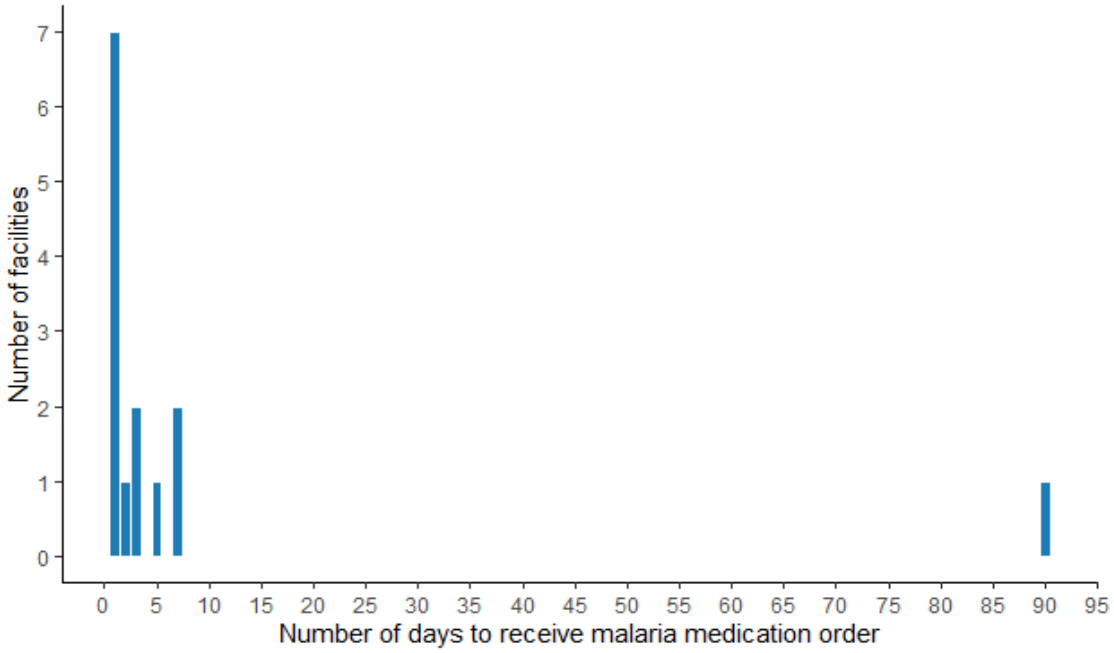
	N	n	%	95% CI
Primary care units: How is the quantity of malaria medication needed by this facility determined?				
The health facility determines the quantity of antimalarials required and orders it	5	1	20	(3 - 71)
The amount of each antimalarial sent to this facility is determined elsewhere	5	3	60	(19 - 90)
Both, sometimes the amount of each antimalarial is determined at this establishment and sometimes it is planned elsewhere and sent	5	1	20	(3 - 71)
Health centers: How is the quantity of malaria medication needed by this facility determined?				
The health facility determines the quantity of antimalarials required and orders it	10	8	80	(45 - 95)
The amount of each antimalarial sent to this facility is determined elsewhere	10	2	20	(5 - 55)
Both, sometimes the amount of each antimalarial is determined at this establishment and sometimes it is planned elsewhere and sent	10	0	0	(-)
Hospitals: How is the quantity of malaria medication needed by this facility determined?				
The health facility determines the quantity of antimalarials required and orders it	0	0		-
The amount of each antimalarial sent to this facility is determined elsewhere	0	0		-
Both, sometimes the amount of each antimalarial is determined at this establishment and sometimes it is planned elsewhere and sent	0	0		-
DAS: 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	0	0	(-)
Both, sometimes the amount of each antimalarial is determined at this establishment and sometimes it is planned elsewhere and sent	5	1	20	(3 - 71)

Table 7.11: 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?				
Local vector control or malaria program personnel	4	1	25	(3 - 77)
Regional vector control or malaria program	4	1	25	(3 - 77)
National malaria program	4	1	25	(3 - 77)
Regional supply or logistics management office	4	0	0	(-)
Other	4	1	25	(3 - 77)
Health centers: Who determines the quantity of malaria medication that are given to this facility?				
Local vector control or malaria program personnel	2	1	50	(5 - 95)
Regional supply or logistics management office	2	1	50	(5 - 95)
Regional vector control or malaria program	2	0	0	(-)
National malaria program	2	0	0	(-)
Other	2	0	0	(-)
Hospitals: Who determines the quantity of malaria medication that are given to this facility?				
Local vector control or malaria program personnel	0	0		-
Regional vector control or malaria program	0	0		-
Regional supply or logistics management office	0	0		-
National malaria program	0	0		-
Other	0	0		-
DAS: Who determines the quantity of malaria medication that are given to this facility?				
National malaria program	1	1	100	(-)
Local vector control or malaria program personnel	1	0	0	(-)
Regional vector control or malaria program	1	0	0	(-)
Regional supply or logistics management office	1	0	0	(-)
Other	1	0	0	(-)

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. Most facilities that stock antimalarials reported that they always or almost always receive the expected quantities of antimalarial medications (Table 7.12). As seen in Table 7.13, if there is a shortage, many facilities reported that it is handled through a special order (60% of primary care facilities that stock antimalarials).

Table 7.12: 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	5	4	80	(29 - 97)
Almost always	5	1	20	(3 - 71)
Almost never	5	0	0	(-)
Health centers: 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	10	5	50	(22 - 78)
Almost always	10	4	40	(15 - 71)
Almost never	10	1	10	(1 - 48)
Hospitals: 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 never	0	0		-
Always	0	0		-
Almost always	0	0		-
DAS: 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 never	5	3	60	(19 - 90)
Always	5	1	20	(3 - 71)
Almost always	5	1	20	(3 - 71)

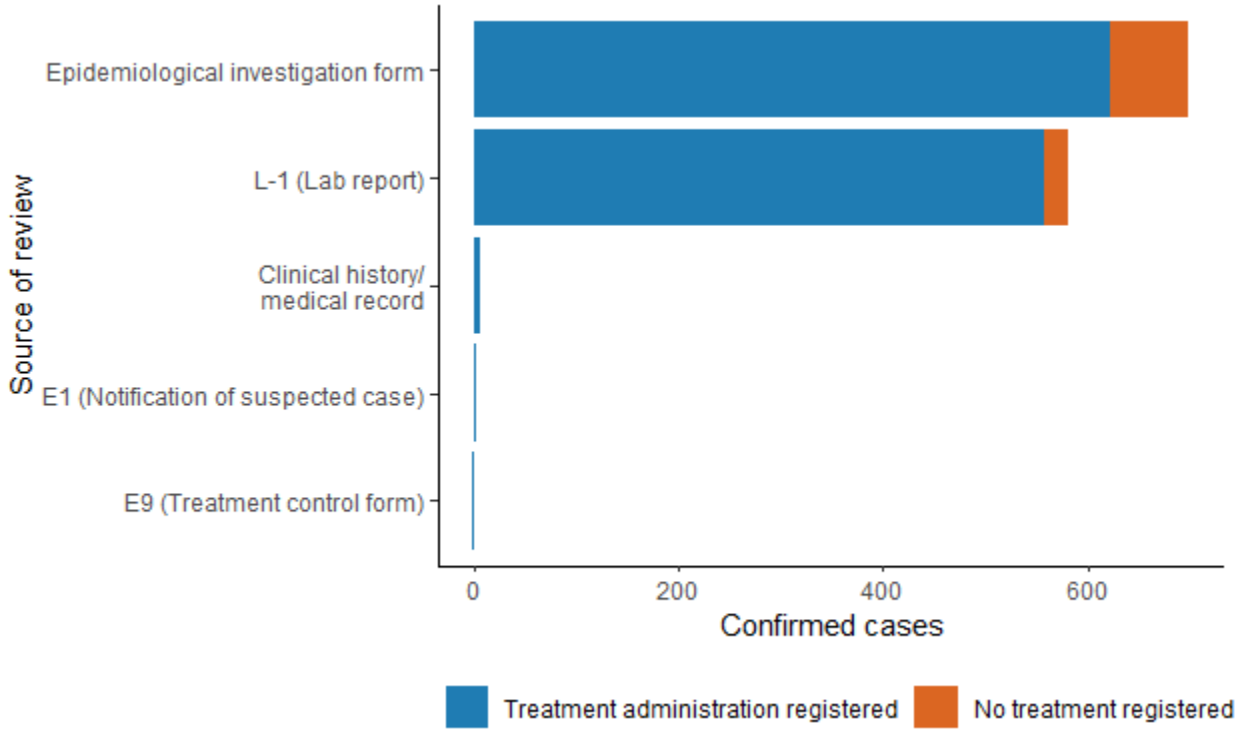
Table 7.13: Malaria medication shortages

	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	5	3	60	(19 - 90)
Borrow from another health facility	5	2	40	(10 - 81)
Health centers: 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	10	6	60	(29 - 85)
Borrow from another health facility	10	5	50	(22 - 78)
Hospitals: 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	0	0		-
Facility purchases	0	0		-
Patients are advised to purchase elsewhere	0	0		-
Borrow from another health facility	0	0		-
DAS: 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	2	40	(10 - 81)
Borrow from another health facility	5	3	60	(19 - 90)

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 and completion, as well as the medications administered, dosage, and the number of doses provided. Figure 7.2 shows that both the epidemiological investigation form and the L-1 lab report form were observed in most confirmed case reviews, and the majority of the forms had some treatment information registered. Both forms have 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 Guatemala, first-line regimens of chloroquine and primaquine are used for both *Plasmodium vivax* malaria and *Plasmodium falciparum* malaria without chloroquine resistance (including all locally transmitted *P. falciparum* cases in the Central American region). For imported *P. falciparum* or mixed infection cases from countries with chloroquine resistance, an artemisinin-based regimen is used. As seen in Table 7.14, 89.3% of *P. vivax* cases had the correct regimen registered. 53 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.

Table 7.14: Confirmed cases: Appropriate treatment by parasite species

	N	n	%	95% CI
Total cases with adequate treatment for species	909	586	64.5	(61 - 68)
P. vivax with adequate treatment for species	656	586	89.3	(87 - 91)
P. falciparum with adequate treatment for species	0	0		-
Mixed cases with adequate treatment for species	0	0		-
Species not registered	709	53	7.5	(6 - 10)

Table 7.15 shows the timing of administration of the first dose of antimalarial treatment for the RMEI baseline measurement data and data from the national malaria surveillance database. In 93.8% of the cases reviewed, both diagnosis and treatment date were registered, compared to 95.3% in the surveillance data, but the cases reviewed were more likely to have treatment within 24 hours of diagnosis registered (75.6% vs. 61.3%). This suggests that some dates (especially diagnosis dates) may be entered to the electronic form even when not recorded on the paper form, while others (especially treatment dates) may be updated on the paper form after treatment begins, but not updated in the

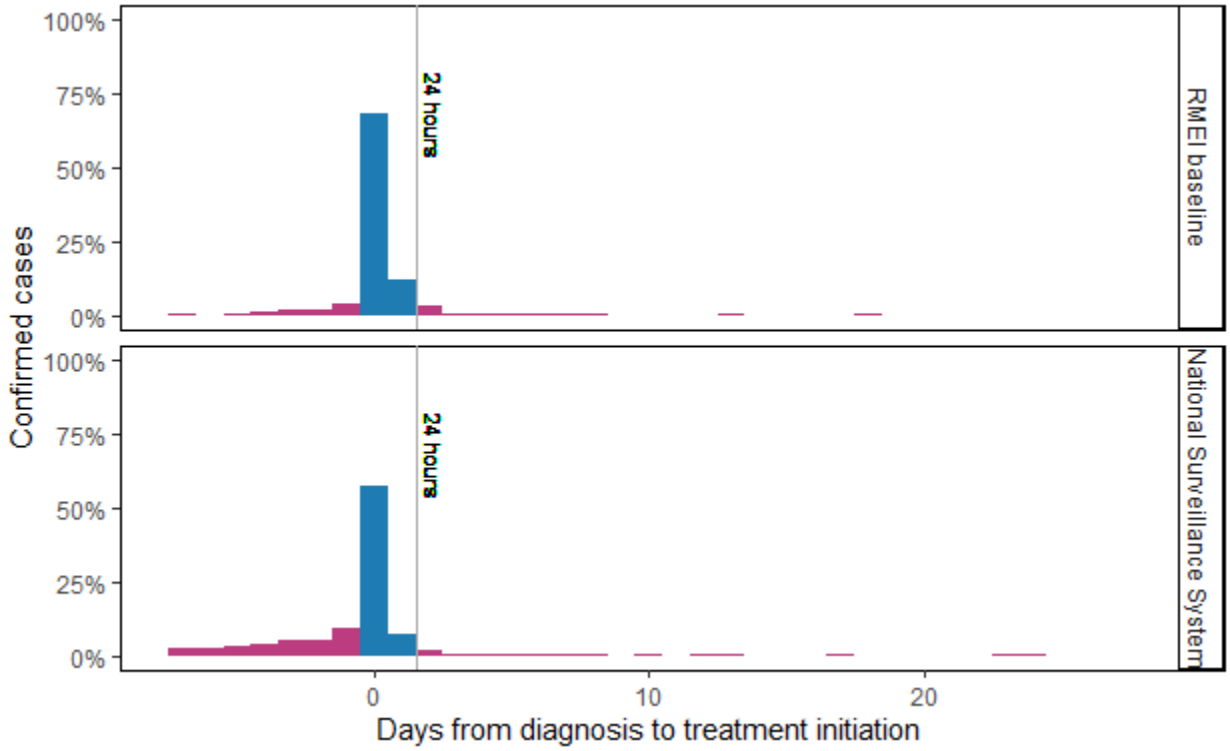
electronic system. The cases in the surveillance data more often had a treatment initiation date preceding the diagnosis date, suggesting either that some cases are treated presumptively or that dates are frequently entered with errors and not detected by internal data validation processes. The discrepancy in the timely treatment results between the two sources could also be due in part to a geographic trend in case management and registration practices. Since Escuintla had more malaria cases in 2018 than any other department, but no paper case forms were available for review in the Escuintla DAS, the overall surveillance system totals will be determined in large part by the cases belonging to Escuintla, while the results of the medical record review indicate that timely treatment is more often achieved in other departments, in particular Izabal and Petén.

Table 7.15: Confirmed cases: Treatment timeliness, comparison RMEI baseline measurement and surveillance data

	N	n	%	95% CI
RMEI baseline				
Diagnosis date registered	709	672	94.8	(93 - 96)
Treatment start date registered	709	701	98.9	(98 - 99)
Both dates registered	709	665	93.8	(92 - 95)
Excluded due to suspected inscription/data entry error (<-7 day or >30 day window)	709	25	3.5	(2 - 5)
Any treatment within 24 hours of diagnosis	684	517	75.6	(72 - 79)
National Surveillance System				
Diagnosis date registered	3119	3119	100	(-)
Treatment start date registered	3119	2971	95.3	(94 - 96)
Both dates registered	3119	2971	95.3	(94 - 96)
Excluded due to suspected inscription/data entry error (<-7 day or >30 day window)	3119	257	8.2	(7 - 9)
Any treatment within 24 hours of diagnosis	2862	1755	61.3	(60 - 63)

Evidence of any antimalarial treatment within one day of diagnosis was found in 75.6% of cases reviewed (Table 7.15). 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 Guatemala. 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 25 cases in the reviewed data and 257 cases in the surveillance 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 7.16. The denominator for this indicator represents the number of confirmed malaria cases that were expected to be reviewed in the DAS visited during the RMEI-Guatemala baseline evaluation, including the 200 cases planned for review in Escuintla but not available there.

Among the cases included in the indicator definition, 64.5% had the antimalarial treatment corresponding to the parasite species registered correctly on the forms. In 58.5% of the cases, the first dose of any treatment was registered as administered within one day (24 hours) of diagnosis, and in 51% of the cases, the first dose of the appropriate treatment was registered as administered within one day of diagnosis. For comparison, Table 7.17 shows the result by area and Table 7.18 shows the result by the diagnosis type.

Table 7.16: Indicator 4.01: Timely treatment initiation

	N	n	%	95% CI
Total malaria cases in the sample	909	909	100	(-)
Total malaria cases reviewed	909	709	78	(75 - 81)
Correct treatment administered for species	909	586	64.5	(61 - 68)
Diagnosis and treatment dates registered	909	665	73.2	(70 - 76)
Excluded due to suspected inscription/data entry error (<-7 day or >30 day window)	909	25	2.8	(2 - 4)
First dose treatment within 24 hours of diagnosis	884	517	58.5	(55 - 62)
Correct treatment administered within 24 hours of diagnosis	884	451	51	(48 - 54)

Table 7.17: Comparison: result by Area

	N	n	%	95% CI
Timely treatment initiation				
Alta Verapaz	191	103	53.9	(47 - 61)
Escuintla	200	0	0	(-)
Izabal	194	161	83	(77 - 88)
Petén Norte	108	85	78.7	(70 - 85)
Suchitepéquez	191	102	53.4	(46 - 60)
Total	884	451	51	(48 - 54)

Table 7.18: Comparison: result by diagnosis type

	N	n	%	95% CI
Timely treatment initiation				
RDT	101	53	52.5	(43 - 62)
TBF	546	398	72.9	(69 - 76)
No test date registered	37	0	0	(-)
Total	684	451	65.9	(62 - 69)

7.4 Confirmed cases: Adequate and complete treatment

In order to ensure radical cure with chloroquine and primaquine, 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. All cases in Guatemala in 2018 with species registered were *P. vivax*, which requires treatment with 3 days of chloroquine and 14 days of primaquine according to country norms.

7.4.1 Completion of malaria treatment

The Guatemala malaria case investigation form does not include space to register treatment administration. The case notification form includes spaces for the number of tablets and the number of days that chloroquine and primaquine (5mg or 15mg presentations) were administered. The L-1 laboratory register includes dates of treatment initiation and completion as well as amount of chloroquine and primaquine administered, but no space to record treatment supervision. Many health areas use department-specific treatment supervision forms, but copies of these forms were generally not available for review at the DAS for cases from 2018.

Table 7.19 shows treatment completion by parasite species as registered on the forms observed at the DAS. Fifty-three of the cases reviewed did not have the parasite species registered, and the 200 cases from Escuintla could not be reviewed, so the corresponding treatment scheme could not be identified and thus treatment is considered incomplete for these 253 cases. *P. vivax* cases had evidence of complete treatment in 5.9% of cases. Considering the cases with incomplete treatment registration because of the failure to record species, 4.3% of all reviewed cases had recorded evidence of adequate and complete treatment.

Table 7.19: Confirmed cases: Complete treatment by malaria species

	N	n	%	95% CI
Total cases with adequate treatment for species	909	39	4.3	(3 - 6)
P. vivax with adequate treatment for species	656	39	5.9	(4 - 8)
Species not registered	909	253	27.8	(25 - 31)

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 Guatemala, treatment supervision forms often were not found with confirmed malaria case records stored at the DAS where record review was carried out. Table 7.20 shows the

indicator results. Only 4.3% of cases reviewed had evidence of complete and adequate treatment, and 0% had any evidence of supervision. This evidence could be a note on the case investigation or L-1 form that one or more doses was supervised, or a separate form included in the patient's record at the DAS. Overall, 0% of cases reviewed had evidence that treatment was adequate, complete, and supervised. The 200 cases planned for review in the Escuintla DAS are included in the denominator for this indicator.

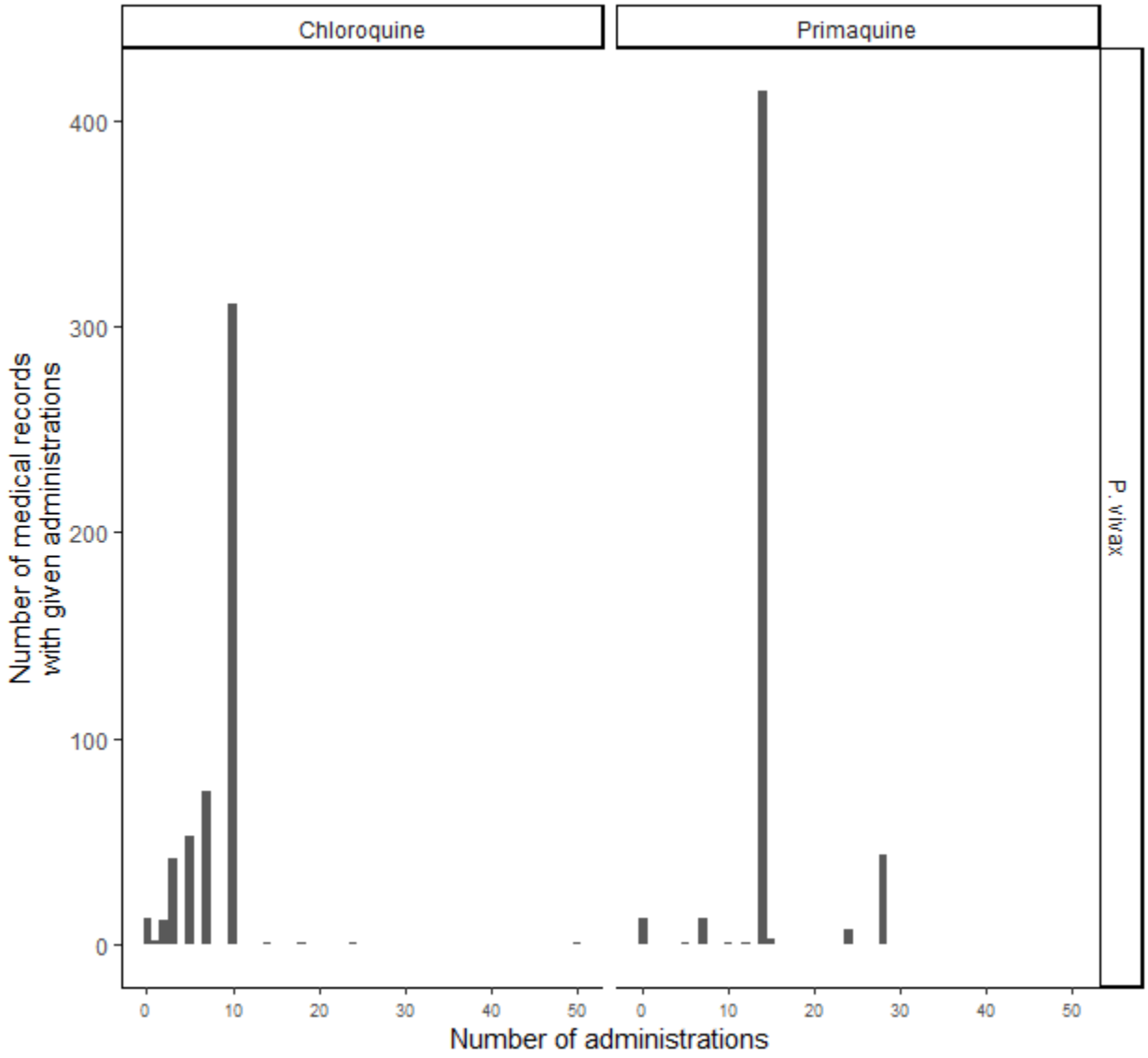
Table 7.20: Indicator 4.03: Complete treatment with supervision

	N	n	%	95% CI
Denominator: Total malaria cases (omitting 1 death on day of diagnosis)	909	909	100	(-)
Adequate treatment and number of doses administered	909	39	4.3	(3 - 6)
Evidence of at least one supervised dose	909	0	0	(-)
Indicator Result: Complete treatment with supervision	909	0	0	(-)

7.4.2 Administration of malaria treatment

Figure 7.4 shows the number of doses administered as recorded in each record reviewed. The results suggest that the vector control technicians filling out notification or L-1 forms may sometimes record the number of tablets taken, rather than the number of complete daily doses administered, as 10 is a frequent number of chloroquine doses recorded on the forms. 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: number of doses administered and supervised



Chapter 8: Management and follow-up of confirmed malaria cases

As a country malaria program enters the elimination phase, it becomes important that every confirmed case be investigated by qualified personnel in order to identify the origin of the case and to plan a local-level response. The aggregate information from case investigations also informs surveillance planning at the regional and national levels. This chapter summarizes information captured during the review of confirmed malaria cases from 2018, which included review of the case investigation form whenever it was available at the DAS, as well as responses to the health facility interview relating to malaria case management.

8.1 Case investigation

8.1.1 Case investigation practices

In Guatemala, the malaria case investigation is usually carried out by a vector control technician and must be completed within seven days of diagnosis. It includes an interview with the patient and an analysis of the information provided in order to classify the malaria case. The epidemiological investigation form is filled with the responses of the interview, as well as health care information such as the date, place, and results of malaria tests (obtained from the provider or laboratory), and tracking of treatment administration and follow-up tests. A copy of the case investigation is filed at the point of detection and at the district and area levels. The information is entered to the “EpiWeb” or “EpiFichas” information system at the district headquarters and transmitted to an electronic database accessible by district, area, and central-level malaria and epidemiology personnel.

8.1.2 Case detection source and classification

During the confirmed case medical record review, field personnel reviewed 709 cases, of which 12 were detected passively, five were detected during active search in the community, and 692 did not have the source of the case registered (Table 8.1).

According to the case investigation forms, 56.4% of malaria cases were autochthonous to Guatemala (Table 8.2).

Table 8.1: Source of confirmed case detection

	N	n	%	95% CI
Case detection source:				
Not registered	709	692	97.6	(96 - 99)
Passive search	709	12	1.7	(1 - 3)
Active search	709	5	0.7	(0 - 2)

Table 8.2: Classification of confirmed malaria cases

Classification	#	%
Autochthonous/indigenous/local	400	56.4%
No space to register in form	172	24.3%
Autochthonous and primo-infection	28	3.9%
Imported	16	2.3%
Primo-infection	4	0.6%
Introduced	3	0.4%
Other	1	0.1%
Not registered	85	12%
Total cases	709	

8.2 Case management

8.2.1 Patient follow-up testing: health facility interview

According to the health facility interview and as shown in Table 8.3, 70% of respondents said that malaria patients receive at least one follow-up test in order to ensure the malaria infection has gone away. Table 8.4 shows that the thick blood film sample is most frequent for follow-up testing.

Table 8.3: 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?	50	35	70	(56 - 81)

Table 8.4: 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	35	30	85.7	(69 - 94)
Both RDT and thick blood film: Samples are routinely taken for both tests at the same time	35	4	11.4	(4 - 27)
Only RDT used more commonly	35	1	2.9	(0 - 19)

The interview also asked how many follow-up tests are routinely administered according to facility practices (Figure 8.1), and when the first and last samples are taken from the patient for follow-up testing (Figure 8.2). Health centers, where the vector control personnel responsible for malaria case management are typically based, report conducting follow-up testing from two to four weeks after diagnosis.

Figure 8.1: Follow-up tests administered according to facility practices

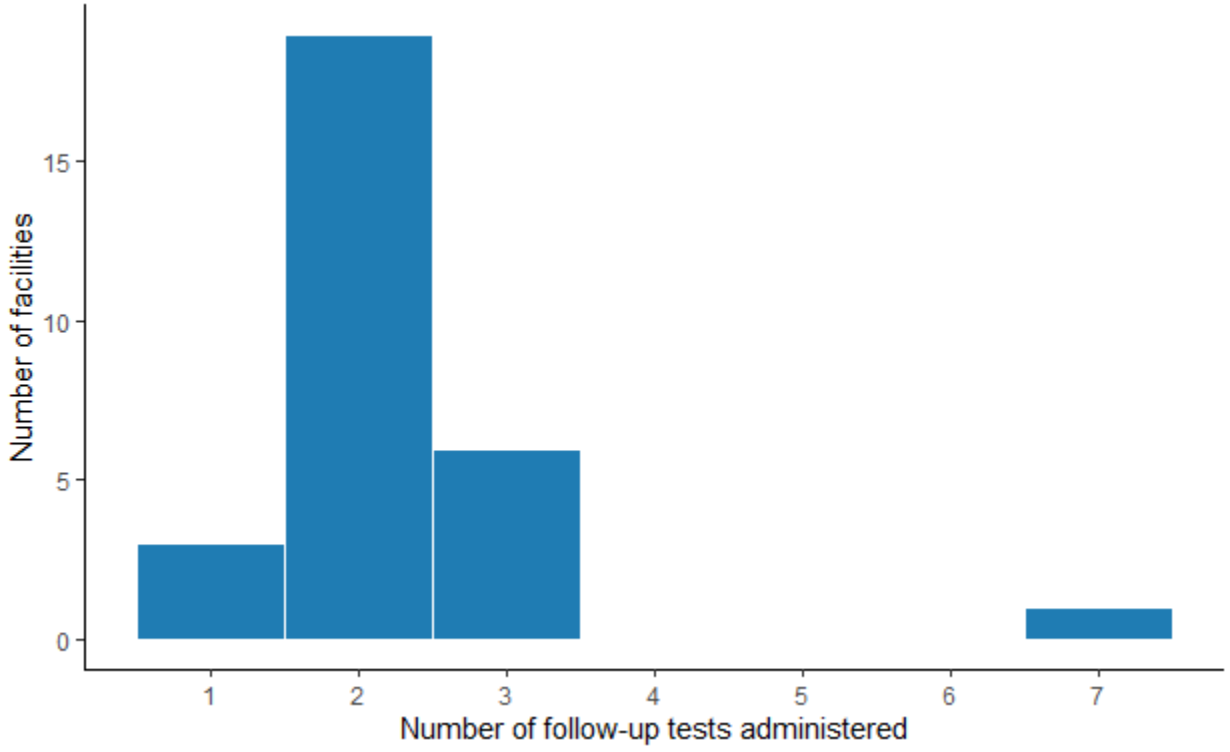
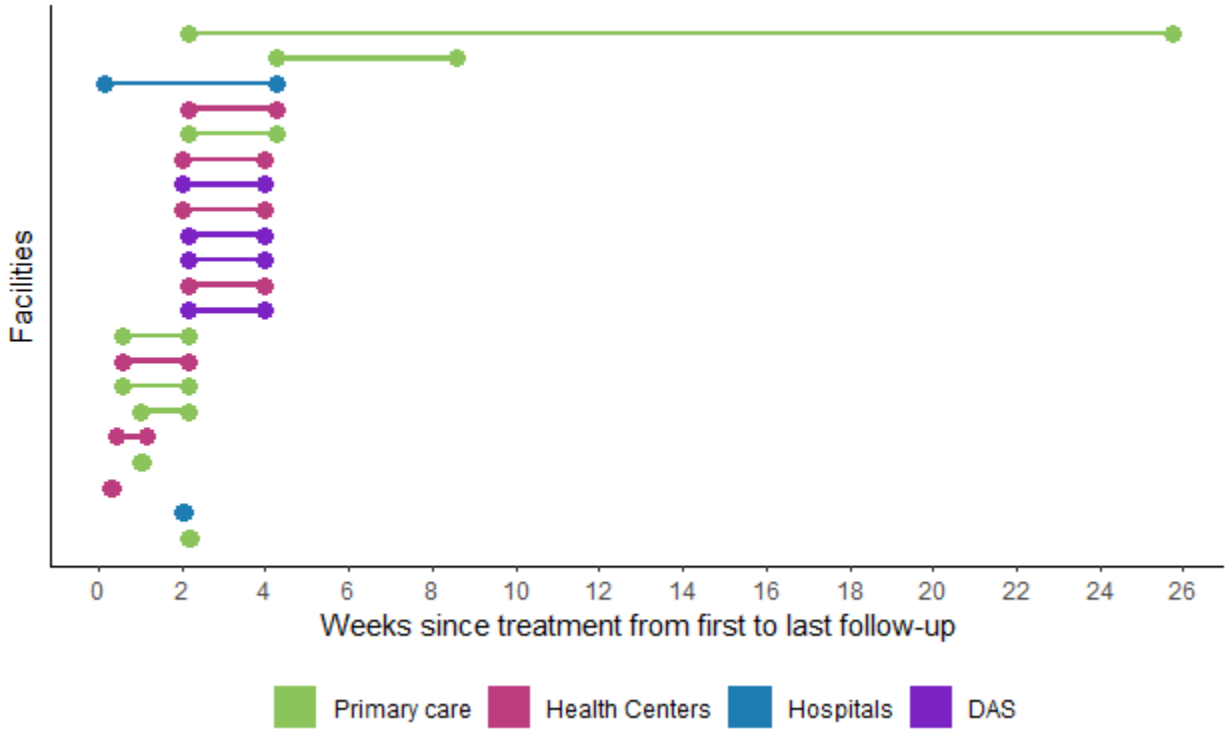


Figure 8.2: Timing from first to last follow-up test



8.2.2 Patient follow-up testing: medical record review

The malaria case investigation form has space to track follow-up malaria testing, though in practice follow-up tests may be tracked on separate, locally-developed forms and never updated on the case investigation form after it is entered to the database and a copy sent to the DAS. Follow-up tests may also be recorded on Lab-1 forms filed at the DAS.

There was evidence of at least one follow-up test for 64.1% of confirmed cases reviewed (Table 8.5). The number of follow-up tests recorded on the forms used for case review is shown in Figure 8.3 - most frequently there is only evidence of one follow-up test. Considering the discrepancy with the information reported in the health facility interview, it is possible that patients receive more than one test, but the dates and results for subsequent tests are not recorded on the case investigation form filed at the DAS. The number of days at which the first follow-up test is taken as registered in confirmed cases reviewed is shown in Figure 8.4.

Table 8.5: Follow-up testing after malaria treatment: medical record review

	N	n	%	95% CI
Received at least one follow-up test for malaria?	39	25	64.1	(48 - 77)

Figure 8.3: Follow-up tests administered: medical record review

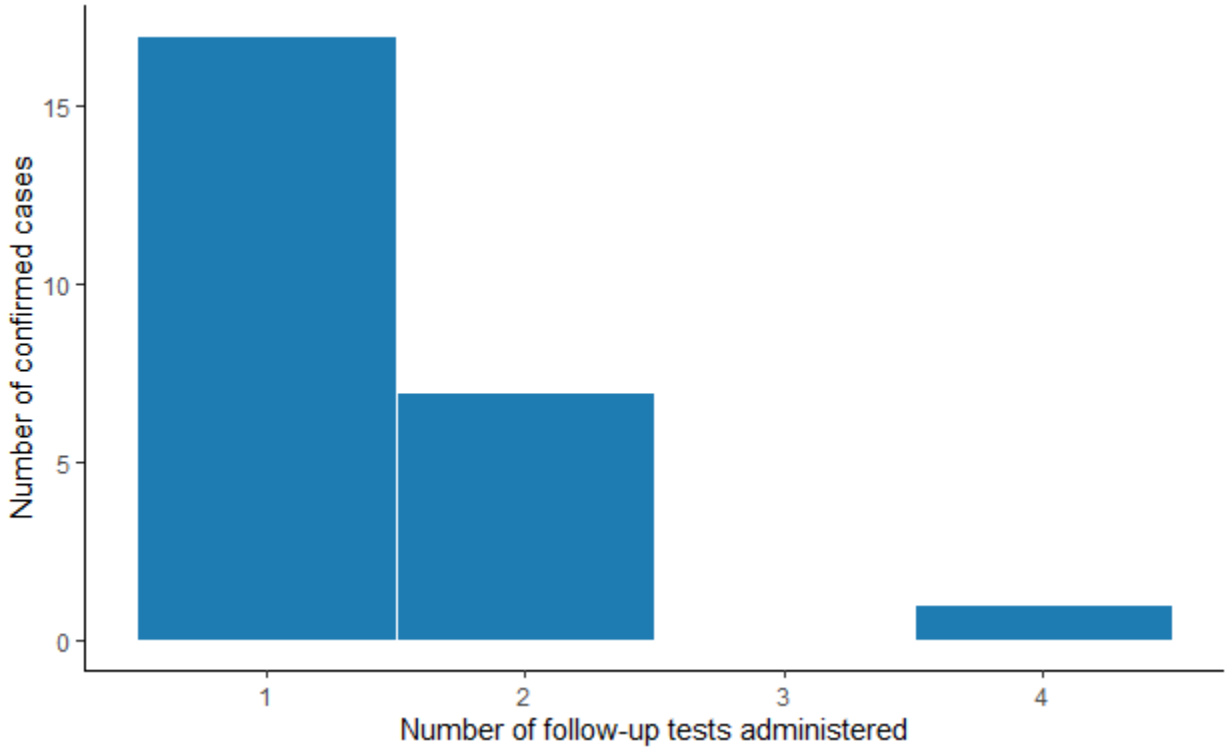
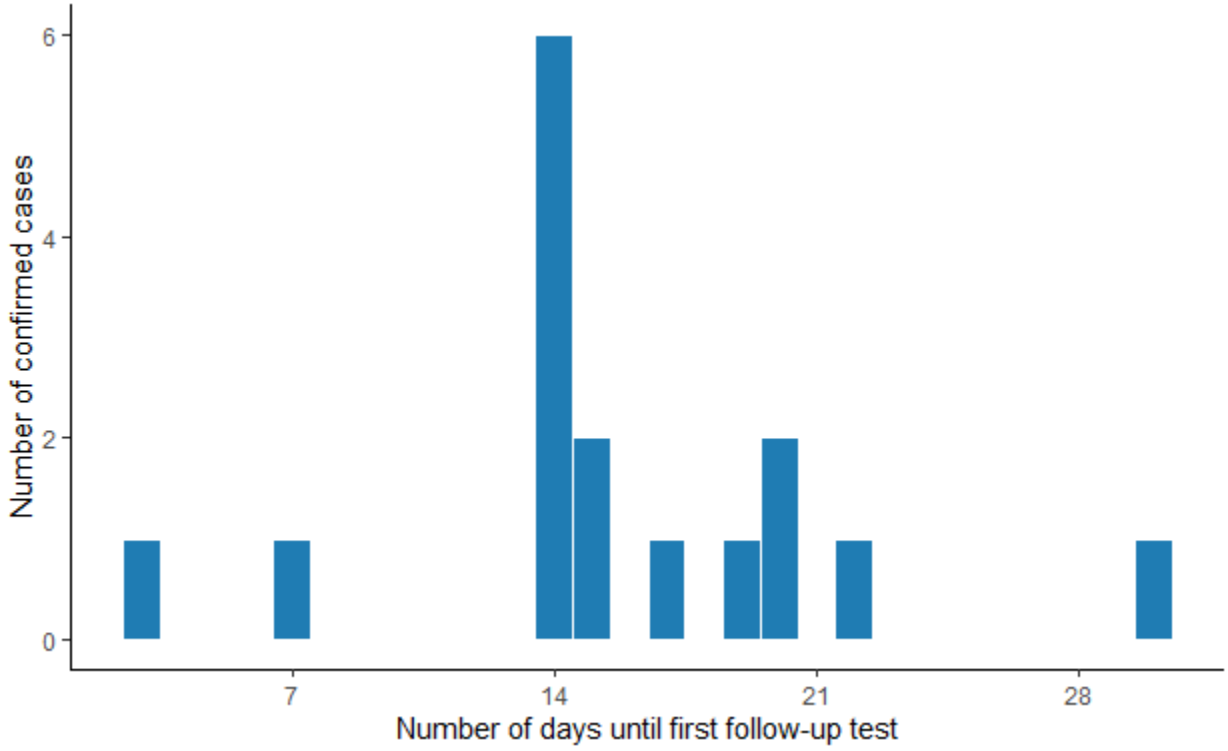


Figure 8.4: Days to first follow-up test: medical record review



Chapter 9: Surveillance, Notification, and Reporting

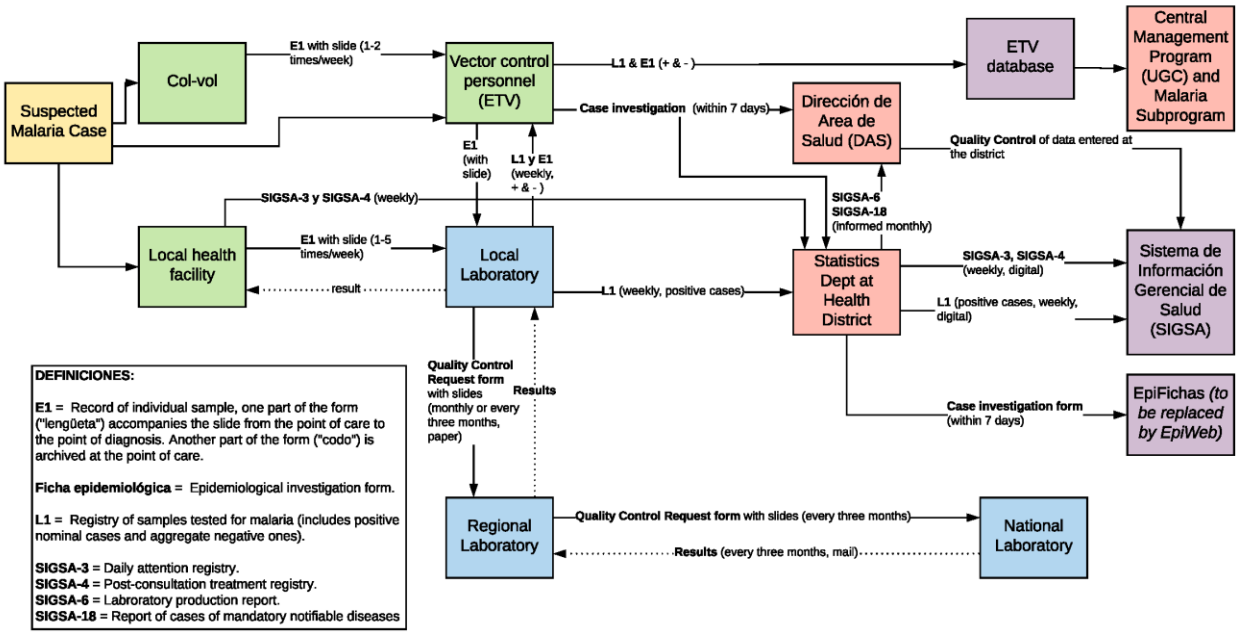
This chapter provides an overview of the malaria surveillance system in Guatemala based on the fact-finding visit and health facility surveys, and summarizes results related to case reporting and laboratory reporting and quality control indicators.

9.1 Background

The fact-finding trip in October 2019 allowed for an understanding of notification and reporting flows at the local, regional, and central levels. The trip focused on identifying how individual cases are 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 regional 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.

Figure 9.1 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 regional 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 vector control program (*enfermedades transmitidas por vectores*, or ETV), at the DAS and laboratory, and at the point where the sample was taken. Any positive results will also be included in aggregate monthly or weekly laboratory reporting. Facilities with capacity to diagnose malaria are obligated to prepare monthly or weekly reports of any cases of notifiable diseases (malaria alongside other illnesses with obligatory notification), and to send these reports to the DAS. In practice, the format and frequency of these case reports varies by health area in Guatemala.

Figure 9.1: Guatemala surveillance system flow diagram



9.2 Notification of malaria test results

9.2.1 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 a microscopy post or laboratory for initial diagnosis. Table 9.1 and Table 9.2 show the method by which a patient is notified of a negative test result among the 13 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. It is frequently health personnel from the facility where the sample was taken who are responsible for notifying the patient of the negative test result (in 61.5% of facilities). Among the eight facilities where facility personnel are responsible to notify at least some patients of the test result, the notification is often in person (in 100% of facilities).

Table 9.1: 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	13	8	61.5	(34 - 84)
Vector control personnel	13	3	23.1	(7 - 53)
The laboratory that tested the sample	13	2	15.4	(4 - 46)
Other	13	3	23.1	(7 - 53)

Table 9.2: 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)				
In person	8	8	100	(-)
Phone call	8	2	25	(6 - 63)

In the case of a positive test result, 15 facilities that send slides elsewhere for examination reported they receive positive test results for the slides they send. Among these facilities, 53.3% are sometimes or always responsible to notify the patient of the positive test result by their own personnel (Table 9.3). Among these eight facilities, the most common modality for notification of a positive test result is in person (Table 9.4).

Table 9.3: 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	15	8	53.3	(29 - 76)
Vector control personnel	15	5	33.3	(14 - 60)
The laboratory that tested the sample	15	3	20	(6 - 48)
Other	15	3	20	(6 - 48)

Table 9.4: 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	8	8	100	(-)
Phone call	8	1	12.5	(2 - 55)

9.2.2 Notification to patient among facilities that examine slides for malaria

Other health facilities reported their own microscopic diagnosis capacity in-house. In these 31 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 61.3% of facilities (Table 9.5). In the case that a positive test result is detected in the facility, 64.5% are sometimes or always responsible to notify the patient of the positive test result by their own personnel.

Table 9.5: 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	31	19	61.3	(43 - 77)
Vector control personnel	31	13	41.9	(26 - 60)
Community health worker/health promotor	31	3	9.7	(3 - 27)
Other	31	2	6.5	(2 - 23)

Table 9.6: 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	31	20	64.5	(46 - 80)
Vector control personnel	31	14	45.2	(28 - 63)
Community health worker/health promoter	31	4	12.9	(5 - 30)
Other	31	3	9.7	(3 - 27)

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

When a case of malaria is confirmed in Guatemala, notification must be sent to health authorities. Among all facilities that either examine TBF slides or perform RDTs, 42.5% notify the Health area authority (DAS) and 30% notify the national malaria program (Table 9.7).

Table 9.7: Notification to health authorities of positive test results

	N	n	%	95% CI
Who is notified when a confirmed case of malaria is detected?				
Health area authority (DAS)	40	17	42.5	(28 - 59)
National malaria program	40	12	30	(18 - 46)
Municipal health authority	40	8	20	(10 - 36)
Local vector control unit	40	7	17.5	(8 - 33)
Regional laboratory	40	4	10	(4 - 24)
National laboratory	40	1	2.5	(0 - 17)
Other	40	10	25	(14 - 41)

9.3 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 9.8. Seventeen percent of primary care facilities, 93.3% of secondary care facilities, and 100% 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 100% of secondary care facilities and 50% of administrative units reported access to a system used for malaria information.

Table 9.8: 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	30	5	16.7	(7 - 35)
Access to an electronic health information system for entering malaria-specific information	4	2	50	(12 - 88)
Health centers				
Access to an electronic health information system for capturing and/or consulting health statistics	15	14	93.3	(63 - 99)
Access to an electronic health information system for entering malaria-specific information	14	14	100	(-)
Hospitals				
Access to an electronic health information system for capturing and/or consulting health statistics	6	6	100	(-)
Access to an electronic health information system for entering malaria-specific information	6	3	50	(16 - 84)
DAS & National Lab				
Access to an electronic health information system for capturing and/or consulting health statistics	6	6	100	(-)
Access to an electronic health information system for entering malaria-specific information	6	6	100	(-)

9.3.1 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 Guatemala that conduct malaria diagnosis (by RDT or microscopy) must send weekly reports to the DAS 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 within the first six business days of the close of each week 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 format of the reports observed during the survey at the facilities responsible to send case reports to health authorities (primary and secondary facilities with diagnostic capacity) where at least one report was observed is shown in Table 9.9. The destination of the reports is shown in Table 9.10, and respondents could indicate more than one destination.

Table 9.9: Format of case notification reports observed

	N	n	%	95% CI
Format of case reports observed				
L1	23	12	52.2	(32 - 72)
E1	23	2	8.7	(2 - 30)
Annex 6: Quality control request for Malaria	23	2	8.7	(2 - 30)
SIGSA-3	23	1	4.3	(1 - 26)
Other	23	9	39.1	(21 - 60)

Table 9.10: Destination of case notification reports observed

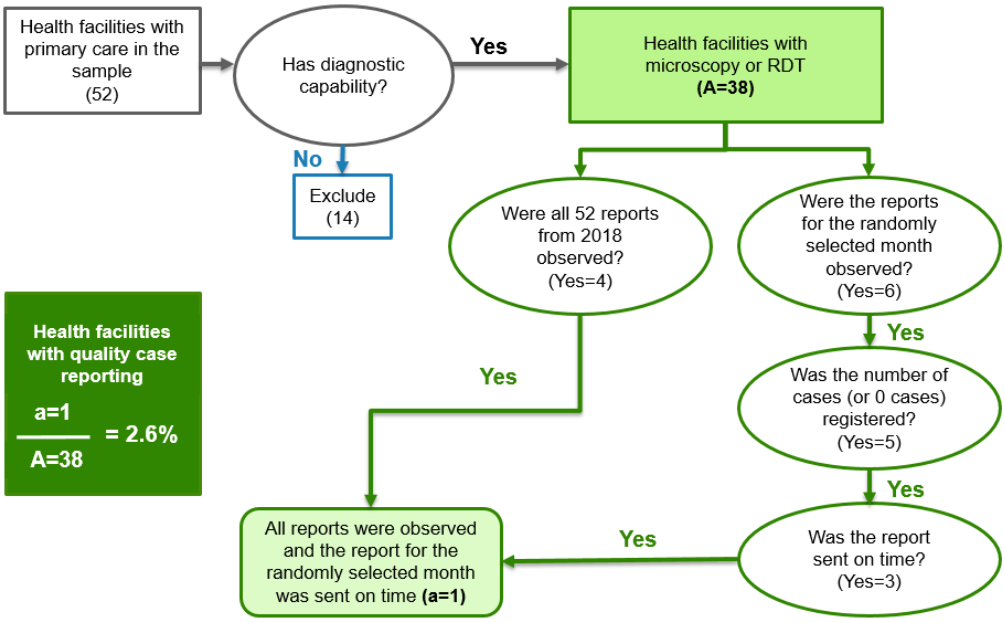
	N	n	%	95% CI
Where are case reports sent?				
Associated DAS	23	14	60.9	(40 - 79)
Health district office	23	4	17.4	(6 - 39)
National lab	23	1	4.3	(1 - 26)
Other	23	4	17.4	(6 - 39)

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 9.2.

Table 9.11 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 during or before the Monday following the end of the week

Figure 9.2: Eligibility of health facilities for Indicator 2.03 (case reporting)



Thirty-eight facilities that provide attention to patients are eligible for consideration in the indicator. The results are shown in Table 9.11 and four units met all the requirements of the indicator. The breakdown of the case reporting component of the indicator is shown in Table 9.12.

Table 9.11: Indicator 2.03: Case reporting

	N	n	%	95% CI
Relevant units	52	52	100	(-)
Units with diagnostic capacity	52	38	73.1	(59 - 84)
Units indicating reporting of malaria cases	38	34	89.5	(75 - 96)
At least one weekly report from 2018 observed[1]	38	9	23.7	(13 - 40)
All 52 weekly reports from 2018 observed	38	4	10.5	(4 - 25)
Four weekly reports for randomly selected month observed	38	6	15.8	(7 - 32)
Number of cases (or zero) recorded for all reports of randomly selected month	38	5	13.2	(5 - 29)
Dates for reports of randomly selected month observed	38	6	15.8	(7 - 32)
Dates for reports of randomly selected month are valid	38	3	7.9	(2 - 22)
Result: Malaria case reporting to standard	38	1	2.6	(0 - 17)

[1]Eight attention units had monthly reports available, for 7 of which all 12 were observed, 5 with dates

Table 9.12: Comparison: result by stratum

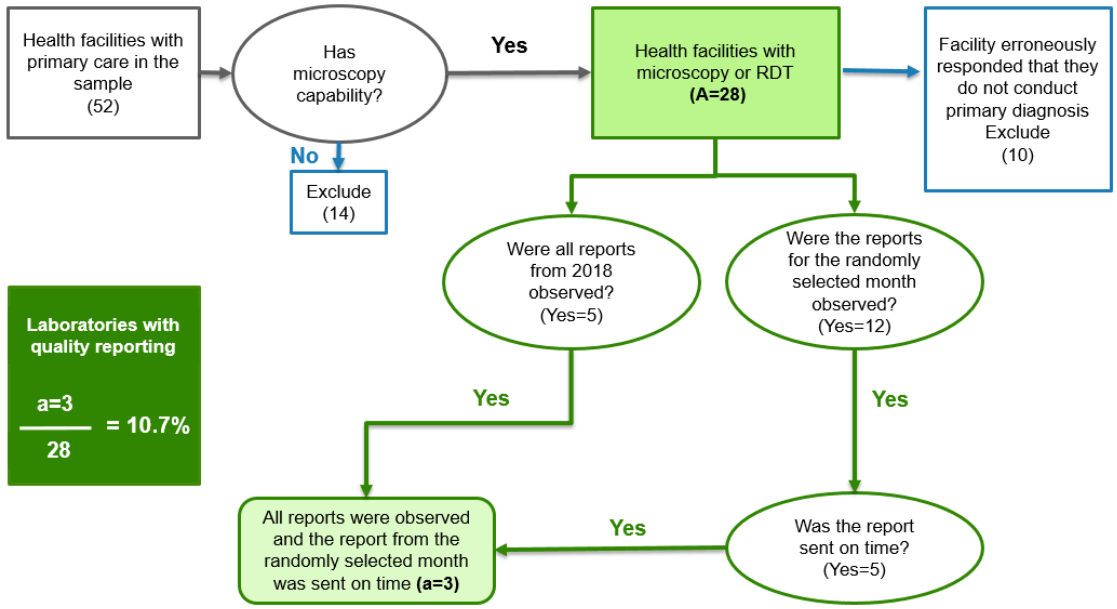
	N	n	%	95% CI
Malaria case reporting to standard				
Stratum 3	7	0	0	(-)
Stratum 4	31	1	3.2	(0 - 21)
Total	38	1	2.6	(0 - 17)

9.3.2 Indicator 2.03: Laboratory production reporting

The other component of Indicator 2.03 is the observation of weekly 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 DAS or regional laboratory the Monday following the close of each week. 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 9.3. The indicator required:

- 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 during or before the Monday following the end of the week

Figure 9.3: Eligibility of health facilities for Indicator 2.03 (laboratory reporting)



Twenty-eight facilities that provide attention to patients are eligible for consideration in the indicator. The results are shown in Table 9.13 and three units met all the requirements of the indicator.

Table 9.13: Indicator 2.03: Lab reporting

	N	n	%	95% CI
Relevant units	52	52	100	(-)
Excluded due to survey error	52	10	19.2	(10 - 33)
Units with diagnostic capacity[1]	42	28	66.7	(51 - 79)
At least one weekly report from 2018 observed	28	13	46.4	(29 - 65)
All 52 weekly reports from 2018 observed	28	5	17.9	(7 - 37)
Four weekly reports for randomly selected month observed[2]	28	12	42.9	(26 - 62)
Dates for reports of randomly selected month observed	28	9	32.1	(17 - 52)
Dates for reports of randomly selected month are valid	28	5	17.9	(7 - 37)
Result: Laboratory production reporting to standard	28	3	10.7	(3 - 29)

[1]Missing data for 10 units
[2]9 attention units had monthly reports available, for 8 of which all 12 were observed and 6 had dates.

9.4 Indicator 3.02: Laboratory quality control

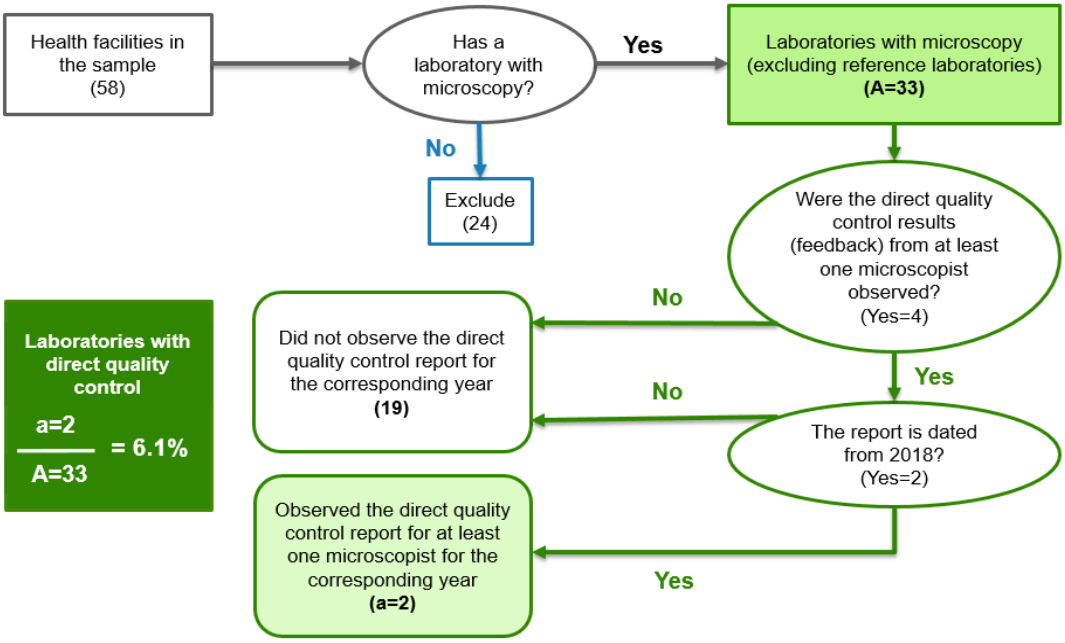
The RMEI indicators also require participation of the national reference laboratory for malaria in an external quality control certification with the Pan American Health Organization, which was observed at the Guatemala national reference laboratory for the year 2018.

Additionally, all laboratories and microscopy posts that diagnose malaria through microscopy must participate in direct and indirect quality control exercises with their corresponding regional reference laboratory, and personnel of the regional laboratory must participate in the same exercises with the

national reference laboratory. Thus, 33 laboratories at the primary, secondary, and regional levels are eligible for 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 9.4. According to Table 9.14, complete evidence of participation in direct quality control was observed at 6.1% of local and regional laboratories. The evidence required was a report of the results of the 2018 exam received back from the reference laboratory with feedback.

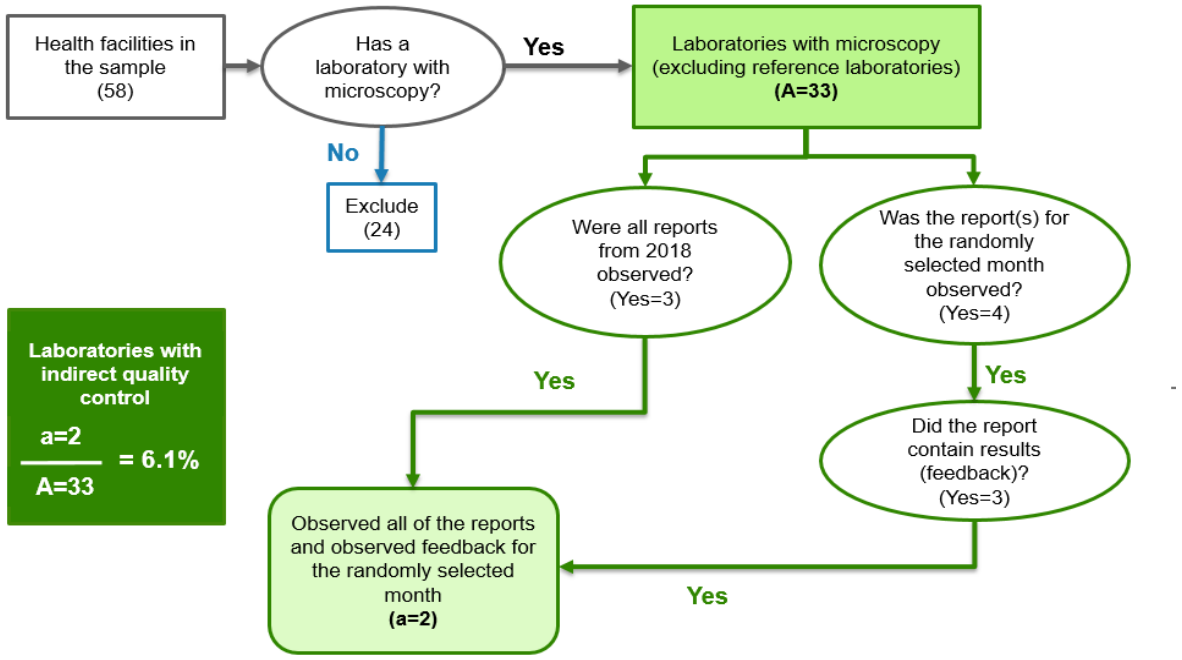
Figure 9.4: Eligibility of health facilities for Indicator 3.02 (direct)



The second exercise, indirect quality control, is a cross-check of a set proportion of the slides initially diagnosed by each local laboratory (or in the case of the regional laboratory, of the slides first cross-checked) by a senior microscopist. In Guatemala, local laboratories must send 10% of the slides with a negative test result for malaria and 100% of the slides with a positive test result to the regional lab for cross-checking each month. The selection method for the 10% of negative slides may vary regionally or locally. Regional laboratories must send 100% of the positive slides cross-checked and 10% of the negative slides received there for cross-checking (thus, 1% of the total negative slides initially diagnosed at the local level) to the national laboratory. Health facility eligibility was determined according to a decision algorithm shown in Figure 9.5. While 15.2% of local and regional laboratories reported participating in quality control, only 6.1% 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), with results or feedback from the reference laboratory.

Figure 9.5: Eligibility of health facilities for Indicator 3.02 (indirect)



The detailed results of the indicator are shown in Table 9.15 and Table 9.16. A breakdown of the direct and indirect components of the indicator by stratum are shown in Table 9.17.

Table 9.14: Indicator 3.02: Quality control

	N	n	%	95% CI
External quality control: 2018 Department/ District Lab Evaluation form observed	1	1	100	(-)
Direct	33	2	6.1	(1 - 22)
Indirect	33	2	6.1	(1 - 22)

Table 9.15: Indicator 3.02: Indirect and direct quality control

	N	n	%	95% CI
Facilities with microscopy (excluding national lab)	58	33	56.9	(44 - 69)
Facilities passing direct quality control (DQC) component	33	2	6.1	(1 - 22)
Facilities that report participating in DQC	33	11	33.3	(19 - 51)
Feedback for at least one assessment in 2018 was observed	33	4	12.1	(4 - 29)
Feedback report with results was dated 2018	33	2	6.1	(1 - 22)
Facilities passing indirect quality control (IDQC) component	33	2	6.1	(1 - 22)
Facilities that report participating in IDQC	33	21	63.6	(46 - 78)
Randomly selected month report was observed	33	4	12.1	(4 - 29)
Cross-checked results and feedback were observed on randomly selected report	33	3	9.1	(3 - 25)
All reports observed for 2018	33	3	9.1	(3 - 25)
Facilities passing both direct and indirect quality control	33	1	3	(0 - 20)

Table 9.16: Indicator 3.02: Indirect quality control in detail

	N	n	%	95% CI
Facilities who have microscopy (excluding department/ district reference labs)	58	33	56.9	(44 - 69)
At least one report was observed for 2018	33	10	30.3	(17 - 48)
Reports are quarterly	33	5	15.2	(6 - 32)
1 report observed	33	2	6.1	(1 - 22)
2 reports observed	33	1	3	(0 - 20)
3 reports observed	33	1	3	(0 - 20)
4 reports observed	33	1	3	(0 - 20)
Reports are monthly	33	5	15.2	(6 - 32)
1-3 reports observed	33	1	3	(0 - 20)
8-11 reports observed	33	2	6.1	(1 - 22)
12 reports observed	33	2	6.1	(1 - 22)
All reports observed for 2018	33	3	9.1	(3 - 25)

Table 9.17: Comparison: result by stratum

	N	n	%	95% CI
Stratum 3				
Facilities passing direct quality control (DQC) component	5	0	0	(-)
Facilities passing indirect quality control (IDQC) component	5	0	0	(-)
Facilities passing both direct and indirect quality control	5	0	0	(-)
Stratum 4				
Facilities passing direct quality control (DQC) component	28	2	7.1	(2 - 25)
Facilities passing indirect quality control (IDQC) component	28	2	7.1	(2 - 25)
Facilities passing both direct and indirect quality control	28	1	3.6	(0 - 22)

Chapter 10: Challenges, Conclusions, and Recommendations

10.1 Challenges and limitations

10.1.1 Challenges for health facility data collection

In Guatemala, field personnel were generally able to gain authorization to interview in selected health facilities and to observe relevant service areas. In one health area, the DAS did not grant authorization to complete the survey after repeated attempts, which resulted in two selected health facilities and one selected community not being surveyed.

In a few cases where the laboratorist was on leave or otherwise not available during the week of the visit, it was challenging to access laboratories and to observe laboratory forms. Interviewers were able to conduct revisits within the span of a few days if key personnel were not available at the initial visit, but did encounter some extended laboratory closures. 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.

First-line malaria medications and reagents were observed at relatively few facilities, and records of stock were often not available or insufficiently detailed to determine stock-out over a three-month period. Laboratory supplies for malaria diagnosis and malaria treatments may be tracked under a separate system from other pharmacy and lab inputs, and sometimes stock records are not maintained at the local facility, but rather through the vector control program at the district headquarters or the DAS.

10.1.2 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 health facilities. Because most facilities in the sample did not keep lists of fever cases nor International Classification of Diseases (ICD) code databases for electronic extraction that could be used as a sampling frame, the field team usually had to select the sample of suspected cases based on daily attention registries (SIGSA-3). Often, the total number of eligible attentions in the year 2018 barely exceeded the quota for record revision. Sometimes, facilities did not keep medical records except for maternity patients, and the only information recorded during fever visits was that available on the SIGSA-3 registry itself or in Lab-1 records.

10.1.3 Challenges for confirmed case review

In Guatemala, malaria case investigation and Lab-1 forms were generally found for most confirmed cases of malaria and could be reviewed at the DAS. The information found on these forms was sufficient to measure most indicators, with two exceptions. Sometimes the species of the parasite was not registered on the forms, making it impossible to determine what treatment scheme should have been followed. Additionally, treatment records were often not sufficiently complete to measure complete and continuous treatment, and evidence of treatment supervision was not often found. From the fact-finding visit, we anticipated these obstacles to measurement. Most areas have treatment follow-up formats in use in the field, but these forms are not usually sent to the DAS archive.

The biggest barrier to completing the confirmed case review was that the Escuintla DAS did not have 2018 malaria case files available for review. Vector control and surveillance staff informed the field team that the confirmed cases had been entered to the electronic surveillance system, but paper files were maintained only at the point of care or possibly at some health district offices. Because confirmed case review was agreed during the fact-finding visit to take place at the DAS level, and it was uncertain whether or where any paper records could be located, no cases from Escuintla were reviewed in the confirmed case sample and the 200 cases planned for the measurement were included in the denominators of the confirmed case indicators. Because more malaria cases occurred in Escuintla during 2018 than in any other department, we suspect that case management practices and indicator results

may be different there than in health areas with lower malaria burden, but the baseline measurement was unable to capture any such differences.

10.1.4 Challenges for case and lab reporting review

In Guatemala, standard formats are in use for aggregate reporting of malaria cases and laboratory production, but the forms do not typically include the date sent or received, complicating the attempt to evaluate timeliness of submission. Sometimes, the reports are prepared only at the district health center rather than by each individual primary care facility in the district. Additionally, field personnel were sometimes unable to observe the reports or the laboratory quality control forms from the year 2018 when archives had not been maintained since 2018 or facility personnel were unable to find the files. This was a particular problem where there had been changes in lab or statistics personnel since 2018.

10.1.5 Challenges for household data collection

Household data collection in Guatemala encountered few logistical challenges. The field team sought approval from the community development council (COCODES) in each community selected to the sample. In only one case, the council refused participation and the community was substituted with another. 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.

10.2 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 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 regional 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. Different groups manage different activities for case detection, case management, and vector control, and there is not always a clear coordination plan. 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 in Guatemala, in particular adherence to aggregate notification requirements and laboratory quality control participation, and in terms of 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, 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 Mesoamerican region.

Appendix A: Indicator Matrices

A.1 Performance indicator matrix

#	Indicator	N	%	CI
P2.02	Fever cases with blood sample	89	12.4	(6 - 25)
P2.03	Case reporting with quality	38	2.6	(0 - 17)
	Lab production reporting	28	10.7	(3 - 29)
P3.02	Quality control (external)	1	100	(-)
	Quality control (direct)	33	6.1	(1 - 22)
	Quality control (indirect)	33	6.1	(1 - 22)
P4.02	Diagnosis within 48 hours	875	13.7	(12 - 16)
P4.01	Treatment within 24 hours	884	51	(48 - 54)
P4.03	Treatment complete and supervised	909	0	(-)
P6.01	Vector control coverage	3648	83.8	(78 - 88)
P7.01	Equipment and instruments for diagnosis and treatment	56	7.1	(3 - 18)

A.2 Monitoring indicator matrix

#	Indicator	N	%	CI
M2.01	Suspected cases with malaria test (MRR)	1196	5.2	(4 - 7)
E2.04	Notified within 24 hours of detection	883	46.2	(43 - 50)
E3.03	Equipment and instruments for sampling and diagnosis	51	31.4	(20 - 46)
E4.05	Health facilities without stockouts of first-line treatments	42	0	(-)
E6.03	Population protected by IRS	3758	17.2	(16 - 18)
E6.05	Population protected by ITNs	3789	79	(78 - 80)

#	Indicator	N	Median	CI
E4.03	Median time between onset of symptoms and start of treatment (days): surveillance type not registered	651	5	(-)
	Median time between onset of symptoms and start of treatment (days): passive surveillance	12	5	(-)
	Median time between onset of symptoms and start of treatment (days): active surveillance	5	2	(-)

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. Health facility in stratum 3 + documented patient residence in strata 1, 2, or 3 + documented lack of travel history to stratum 4 nor endemic country + no evidence of intermittent symptoms (fever+chills+sweating)

2. Diagnoses ineligible without a documented fever:

All health facilities:

Sampling by ICD code

1. A41.9 Sepsis, unspecified organism
2. B34.9 Viral infection, unspecified
3. G03.9 Meningitis, unspecified
4. R68 Other general symptoms and signs
5. R68.8 Other general symptoms and signs
6. A27 Leptospirosis
7. A27.0 Leptospirosis icterohemorrhagica
8. A27.8 Other forms of leptospirosis

9. A27.9 Leptospirosis, unspecified

Sampling by presumptive or final diagnosis

1. Leptospirosis
2. Viral infection, unspecified
3. Meningitis

Only health facilities in stratum 3:

Sampling by ICD code

1. R16 Hepatomegaly and splenomegaly, not elsewhere classified
2. R16.1 Splenomegaly, not elsewhere classified
3. R16.2 Hepatomegaly with splenomegaly, not elsewhere classified
4. R17.X Unspecified jaundice
5. R51X Headache

Sampling by presumptive or final diagnosis

1. Hepatomegaly
2. Splenomegaly
1. Diagnoses ineligible for record review (febrile illnesses with defined etiology):
1. Arbovirus with positive viral test
    1. Dengue
    2. Chikungunya
    3. Zika
    4. Acute respiratory infection
2. Gastrointestinal infection
3. Fever of neurological origin
4. Skin lesion
5. Urinary infection
6. Findings in soft tissues
7. Focal infection
8. Other parasitological infection

P2.02: Fever cases with blood sample

Source: Household survey

Denominator: People in stratum 3 and 4 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

1. Reports list the aggregate number of malaria cases or report of zero cases
2. Reports observed for all 52 weeks of the year 2018
3. Reports in randomly selected month list sending date
4. All observed dates during or before the Monday following the end of the week

Exclusions: Dirección de área de salud, national 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 weekly laboratory production reports observed

1. Reports list the malaria samples taken (thick blood film or RDT)
2. Reports observed for all 52 weeks of the year 2018
3. Reports in randomly selected month list sending date
4. All observed dates during or before the Monday following the end of the week

Exclusions: Dirección de área de salud, national reference laboratory. Ten eligible health facilities where this information was not captured due to an error in the survey logic are excluded from this component of the indicator.

P3.02a: National laboratory participates in external quality control

Source: Health facility observation

Denominator: National 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

P3.02b: 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: National reference laboratory

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

1. Reports observed for all 4 quarters, 12 months, or 52 weeks of the year 2018
2. Reports in randomly selected month/quarter have results and feedback from the reference laboratory

Exclusions: National reference laboratory

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

Source: Medical record review of 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 or investigation forms

1. *P. vivax* or *P. falciparum* from areas without chloroquine resistance: chloroquine + primaquine
2. Imported *P. falciparum* cases from areas with documented resistance to chloroquine: artemisinin-based treatment (artemether + lumefantrine) + primaquine
3. 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 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 or investigation 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

P4.03: Malaria cases with complete and supervised treatment

Source: Medical record review of 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 or investigation forms

1. For *P. vivax* cases: 3 days of chloroquine and 14 days of primaquine
2. For *P. falciparum* cases without documented resistance to chloroquine: 3 days of chloroquine and one day of primaquine
3. For mixed infections cases without documented resistance to chloroquine: 3 days of chloroquine and 14 days of primaquine
4. For imported *P. falciparum* cases from areas with documented resistance to chloroquine: 3 days of artemisinin-based treatment (artemether + lumefantrine) and one day of primaquine

5. 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 and Social Assistance)

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

1. Respondent informed that interior walls of dwelling were sprayed in the 12 months prior to the survey
2. 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) without stockout in the three months prior to the survey

1. All stratum 4 centro de convergencia, puesto de salud, centro de salud, CAIMI, CAP, and hospitals; all stratum 1, 2, and 3 dirección de área de salud (none included in baseline sample)

Antimalarial medications for severe malaria: Quinine or Artesunate [tablets, IV, or rectal]

1. All stratum 1, 2, and 3 dirección de área de salud (none included in baseline sample)

Antimalarial medications for cases of P. falciparum from areas of known chloroquine resistant malaria:* Derivatives or artemisinin (artemether + lumefantrine)

1. All stratum 1, 2, and 3 dirección de área de salud (none included in baseline sample)

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

1. All stratum 3 and 4 centro de convergencia, puesto de salud, centro de salud, CAIMI, CAP, and hospitals

Forms for sending slide samples

1. All stratum 3 and 4 centro de convergencia, puesto de salud, centro de salud, CAIMI, CAP, and hospitals

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

1. All health facilities that reported microscopic diagnostic capacity, including dirección de área de salud and the national laboratory

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

1. All health facilities that reported microscopic diagnostic capacity, including dirección de área de salud and the national laboratory

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

1. All health facilities that reported microscopic diagnostic capacity, including dirección de área de salud and the national laboratory

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

1. Five eligible establishments where this information was not captured due to an error in the survey logic are excluded from this component of the indicator.

Forms for sending slide samples

1. Forty-five eligible establishments where this information was not captured due to an error in the survey logic 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 Guatemala 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 fact-finding 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 Guatemala, 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

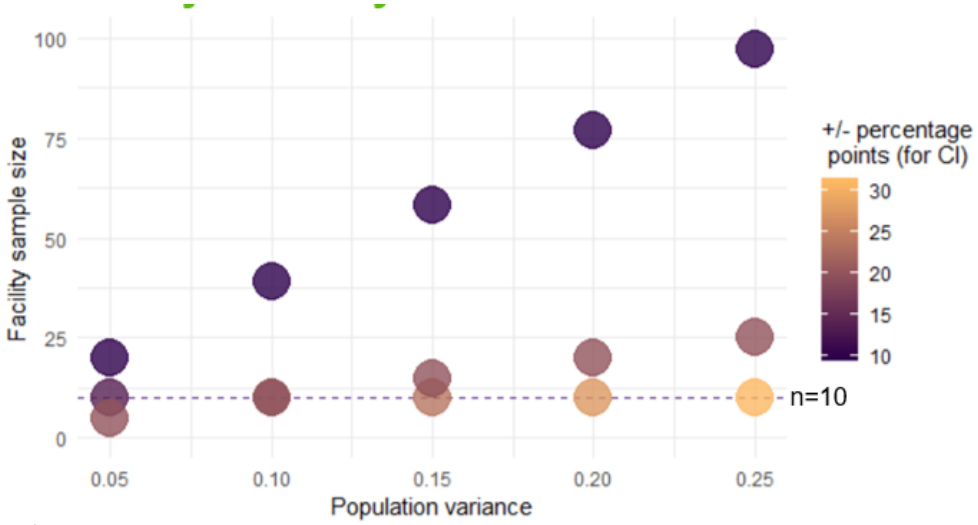


Figure 1. Facility sample sizes and corresponding margins of error across different levels of population variance. Potentially acceptable margins of error range from +/-10 ppts (ideal) to +/-30 ppts (considered high) on either side of the point estimate.

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 (*"puestos de salud," "centros de convergencia,"* and *"unidades mínimas de salud"*) in municipalities in malaria strata 3 and 4 based on referral networks and facility lists provided by the Guatemala Ministry of Health and Social Assistance. Eligible facilities were listed according to whether or not they provide malaria diagnosis by microscopy. Additionally, they 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 and Social Assistance provided to IHME. Primary care facilities were sorted by a random variable and a sample was drawn in three strata: with microscopy capacity in malaria strata 3 and 4 combined, without microscopy capacity in malaria stratum 3, and without microscopy capacity in malaria stratum 4.

Facilities with vector control activities carried out in the catchment area during 2018 or 2019 had first priority for selection in each sampling stratum. If all facilities with vector control activity had been selected in a given stratum and spaces still remained in the sample, facilities were selected at random among all eligible facilities in the stratum until the full sample size was reached. Two additional facilities per municipality 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 municipal health centers (*centros de salud*, CAP, CAIMI, and CENAPA), health area offices, 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, municipal health center, health area offices, and hospitals, was sorted by a random variable and the first facilities in the list selected up to a fixed sample size by facility type. The remaining facilities not selected from the sampling frame were ordered and listed to use as an alternate sample in case a facility could not be surveyed and required substitution. We assigned each administrative unit (*dirección de área de salud*) to the maximum stratum found in its service area (health areas with any municipalities in stratum 4 are therefore assigned to stratum 4). The national reference laboratory for malaria was selected with certainty.

C.2.2 Selecting suspected cases of malaria

The data collection team was responsible for compiling and reviewing the full random sample of medical records at each facility. The sample may be selected in one of three ways, depending on the resources of the facility and the type of registries maintained. First, where the facility keeps a list or registry of all fever attentions, this list can serve as the sampling frame. Second, where there is access to a coded digital database of attentions or diagnoses, the sampling frame is extracted based on a list of eligible codes as seen in Appendix B, Indicator 2.01. If there is no fever list nor electronic database, the sample is selected from daily registries or logbooks of all types of attentions, identifying the eligible complaints or diagnoses in the process. In Guatemala, the attention registry used for sampling at most primary care facilities is the registry system called "SIGSA-3", either from paper records or the associated electronic database. The time window for the baseline measurement was the calendar year 2018.

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

In selected DAS where the number of malaria cases during 2018 did not exceed the assigned quota of 200 cases, interviewers reviewed all malaria cases from 2018. In selected DAS where the number of malaria cases during 2018 exceeded the assigned quota, interviewers selected a sample of confirmed cases manually by first entering the total number of confirmed cases in that area during 2018 to the Quotas Module to receive a randomly generated start date during 2018 and a calculated skip interval to use to select records. Using a registry or folders of the malaria case forms sorted by week, they began at the provided start date, and then skipped through the list or the stack of forms according to the provided skip interval. Information from each selected case was extracted but identifiable patient information was never entered to the survey modules.

C.2.4 Selecting communities

IHME used information about vector control interventions and referral networks received from the Ministry of Health and Social Assistance to select one community in the catchment area of each of the 32 primary care facilities for the household survey. 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. A second community from the catchment area was selected as backup 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 24 to 31 households. Counts of absent households range from 0 to 18 households. Counts of refused households range from 0 to 6 households.

C.3 Sampling weights for the household survey

Household data are 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) Guatemala 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.

IHME Team

Rebecca Cogen, BA
Data Analyst, IHME

Charbel El Bcheraoui, PhD, MSc
Assistant Professor, IHME

Katie Panhorst Harris, MPA
Evaluation Scientist, IHME

Bernardo Hernandez, MS, DSc
Associate Professor, IHME

Casey Johanns, MPH
Research Manager, IHME

Ali H. Mokdad, PhD, *Principal Investigator*
Professor, IHME

Paulami Naik, MSPH
Data Analyst, IHME

Emily Linebarger, BA
Data Analyst, IHME

Erin Palmisano, MPH
Senior Research Manager, IHME

Max Thom, BS
Data Specialist, IHME

Acknowledgements

The Regional Malaria Elimination Initiative and this measurement are funded by the Bill & Melinda Gates Foundation, the Carlos Slim Foundation, and the Global Fund to Fight AIDS, Tuberculosis, and Malaria. RMEI is administered by the Inter-American Development Bank (IDB) in collaboration with the Pan American Health Organization (PAHO) and the Clinton Health Access Initiative (CHAI) in close coordination with the Council of Ministers of Central America and the Dominican Republic (COMISCA) and with the Project Mesoamerica. We thank all the health personnel and families who willingly participated in the study. We thank central and local governments for the support they extended to the study teams and their facilitation of access to communities and health facilities. We extend our gratitude to UNIMER for their implementation of data collection in Guatemala for this project.