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Regional Malaria Elimination Initiative
El Salvador

Baseline Measurement (2019-20)

September 2020

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Acronyms

BMGF - Bill & Melinda Gates Foundation
CAPI - Computer-assisted personal interview
CHAI - Clinton Health Access Initiative
Col-vol - *Colaborador voluntario* (volunteer collaborator)
COMISCA - Council of Ministers of Central America and the Dominican Republic
CSF - Carlos Slim Foundation
DTI-R - Detection, Diagnosis, Treatment, Investigation, and Response
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
SIBASI - *Sistema básico de salud integral* (Basic integrated health system)
TBF - Thick blood film
UCSF - *Unidad comunitaria de salud familiar* (Community family health unit)
VIGEPES - *Sistema nacional de vigilancia epidemiológica de El Salvador* (National epidemiological surveillance system)

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 El Salvador, with input from the Ministry of Health. The measurement included a health facility survey consisting of interview, observation, and records review components and a Lot Quality Assurance Sampled (LQAS) household survey in the catchment area of selected health facilities. The health facility survey sample was selected among eligible primary care facilities in malaria focus areas of El Salvador. 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 El Salvador baseline measurement is summarized in Table E1. The information sought as a part of the measurement varied by facility type.

Table E1: El Salvador data collection summary

Point of data collection	Number completed	Measurement completed
Health Units and Hospitals	19	Suspected case medical record review
		Supplies and equipment
		Aggregate case and lab production reporting (if diagnostic capacity)
		Lab certification and quality control (if diagnostic capacity)
Suspected malaria cases reviewed	*809*	
SIBASI	8	Supplies and equipment
		Aggregate case and lab production reporting
		Confirmed case medical record review: diagnosis and treatment
Confirmed malaria cases reviewed	*2*	
Regional Offices	2	Supplies and equipment
		Aggregate case and lab production reporting
National Reference Laboratory	1	Supplies and equipment
		Lab certification and quality control

Point of data collection	Number completed	Measurement completed
Communities	16	Fever and confirmed malaria cases
		Vector control coverage
Households interviewed	*401*	

Summary of results

Malaria prevention

In order to protect the populations most at risk of malaria infection, the public health system in El Salvador 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
Spray	4	0.3%	5.7%
None	12	0%	7.1%

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	2	0	0	(-)
Sampling and biosafety equipment	19	6	31.6	(14 - 56)
Sample submission forms	10	5	50	(21 - 79)
Microscopy equipment	11	6	54.5	(25 - 81)
Equipment for staining and testing	11	7	63.6	(32 - 87)
Reagents for staining	11	6	54.5	(25 - 81)
Units with all required equipment and medications	**24**	**5**	**20.8**	**(8 - 43)**

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)	21	7	33.3	(15 - 58)
Suspected case with malaria test (medical record review)	516	71	13.8	(11 - 17)

Diagnosis of malaria cases

The RMEI baseline measurement also included a review of confirmed cases of malaria based on case notification and investigation forms. The review captured the only two malaria cases diagnosed in El Salvador during 2018. The indicator for timely diagnosis of malaria compares the date of initiation of fever or other symptoms with the date of diagnosis (if the patient received both an RDT and a TBF, the indicator is calculated using the earlier diagnosis date) as shown in Table E5.

Table E5: Diagnosis within two days, Confirmed case review

	N	n	%	95% CI
Denominator: Confirmed cases	2	2	100	(-)
Only diagnosis date registered	2	1	50	(0 - 100)
Both dates registered	2	1	50	(0 - 100)
Over 7 days from symptom onset to diagnosis (14 days)	2	1	50	(0 - 100)
Indicator result: Cases diagnosed within 48 hours of onset	2	0	0	(-)

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	2	2	100	(-)
First dose treatment within 24 hours of diagnosis	2	2	100	(-)
Correct treatment administered within 24 hours of diagnosis	2	2	100	(-)

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 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	2	1	50	(0 - 100)
Evidence of at least one supervised dose	2	1	50	(0 - 100)
Indicator Result: Complete treatment with supervision	2	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.

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	8	0	0	(-)
Laboratory production reporting to standard	8	1	12.5	(2 - 57)
External quality control: 2018 National Lab Evaluation form observed	1	0	0	(-)
Facilities passing direct quality control (DQC) component	10	3	30	(9 - 64)
Facilities passing indirect quality control (IDQC) component	10	0	0	(-)

Key findings

The results of the El Salvador 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 El Salvador draws closer to malaria elimination.

Chapter 1: Introduction

1.1 Overview

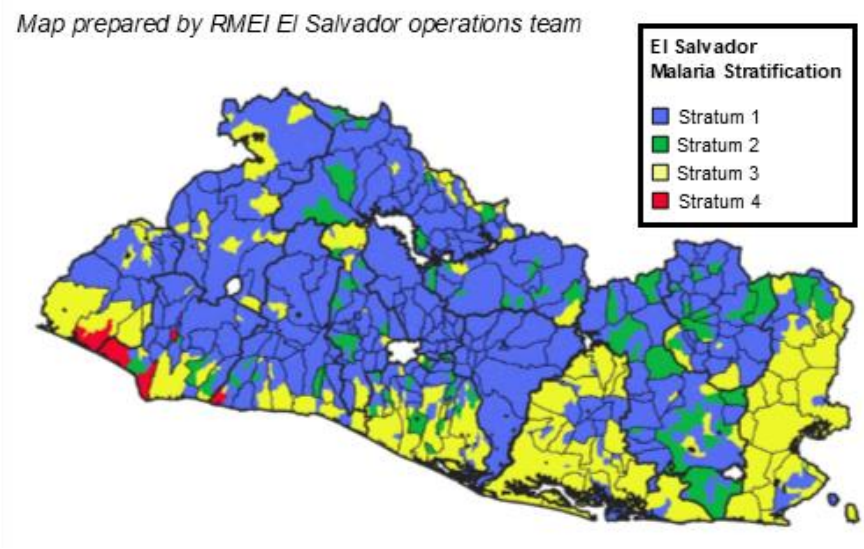
The Regional Malaria Elimination Initiative (RMEI) is a regional public-private partnership administered by the Inter-American Development Bank (IDB) seeking to accelerate progress toward malaria elimination in Mesoamerica, the Dominican Republic, and Colombia. One of its defining features is the application 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 El Salvador, 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 El Salvador, residual and inactive foci were defined, and each *cantón* (municipal subdivision) 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. *Cantones* may be redefined with updated stratum classification in subsequent points on the Initiative as their level of importation risk evolves or if autochthonous transmission is reestablished. The malaria program in El Salvador carries out household-level vector control interventions such as indoor residual spraying (IRS) and distribution of long-lasting insecticide-treated nets (ITNs) which may be expanded and will be 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.

Table 1.1: El Salvador malaria stratification: Definition and distribution of strata

Stratum	Number of cantons	Definition
1	1367	Non-receptive
2	161	Receptive, no autochthonous cases, no risk of importation
3	558	Receptive, risk of importation, no autochthonous cases
4	8	Receptive, presence of autochthonous cases in last 3 years

Figure 1.1: El Salvador malaria stratification: national



In El Salvador, malaria burden declined over recent decades and the most recent autochthonous malaria case was diagnosed in November 2016, meaning that El Salvador is now eligible to apply for World Health Organization certification of malaria-free status. In 2018, the reference year for the baseline measurement, El Salvador had two imported cases of malaria according to national public health surveillance data provided by the Ministry of Health. El Salvador has historically depended on a vertically integrated malaria program that operates in close coordination with programs for other vector-transmitted diseases. El Salvador has an established network of community health volunteers called *"colaboradores voluntarios"* ("col-vol", volunteer collaborator) who collaborate in case detection in communities with malaria transmission and with limited access to health services. In the malaria elimination phase, El Salvador is transitioning 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 El Salvador 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 regional 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 El Salvador 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 two regions of El Salvador in July 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 El Salvador, the sample includes primary care facilities, hospitals, departmental health headquarters (SIBASI, *Sistema Básico de Salud Integral*), regional health offices, 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
Health Units and Hospitals	Suspected case medical record review
	Supplies and equipment
	Aggregate case and lab production reporting (if diagnostic capacity)
	Lab certification and quality control (if diagnostic capacity)
SIBASI	Supplies and equipment
	Aggregate case and lab production reporting
	Confirmed case medical record review: diagnosis and treatment
Regional Offices	Supplies and equipment
	Aggregate case and lab production reporting
National Reference Laboratory	Supplies and equipment
	Lab certification and quality control
Households	Fever and confirmed malaria cases
	Vector control coverage

Another point of care critical to systems of malaria detection and treatment in El Salvador is the *"colaborador voluntario"* (col-vol). These volunteer community health workers provide fever screening and malaria testing via 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 and keep registers of patients tested. 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 will be filed at a health facility or vector control office 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.

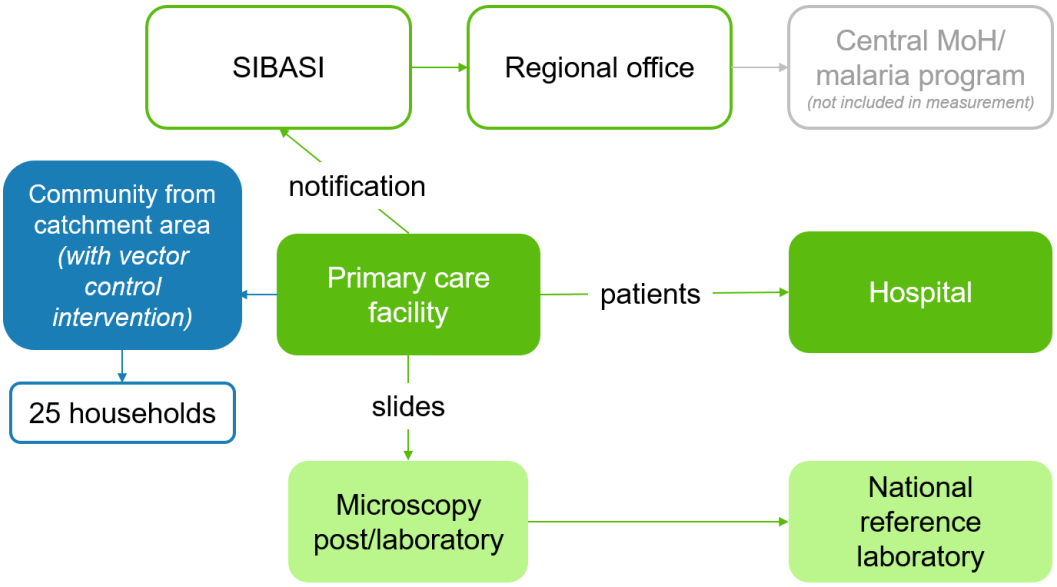
Chapter 2: Survey Methodology

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 countries with ongoing malaria transmission and preventing reintroduction in receptive and vulnerable areas. We expect to return to some of these zones in future measurement rounds to monitor changes in practice. In El Salvador, the sample is made up of facilities and communities in malaria strata 2, 3 and 4 (see strata definitions in Table 1.1). We focused on the zones with risk for malaria transmission 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 (*"unidad comunitaria de salud familiar"*, UCSF or "community family health unit") 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 SIBASI and regional offices 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-El Salvador baseline health system structure



2.1.1 Health facility sample selection

Malaria stratification was completed at the *cantón* level in El Salvador. UCSF facilities in *cantones* classified as malaria stratum 2, 3 or 4 were eligible to enter the sampling frame. The six UCSF facilities in stratum 4 (including four facilities serving communities with vector control measures implemented) were selected with certainty. Because patients with fever may seek care at any health facility, but only a fraction of these facilities has microscopy capacity, the random sample of primary care facilities was drawn separately for facilities with and without microscopy, ensuring a sufficient denominator to measure indicators for laboratory inputs, equipment, and reporting. Thus, the remainder of the sample of primary

care facilities was selected at random among ambulatory facilities in malaria strata 2 and 3, in two additional sampling strata: facilities with and without microscopy capabilities.

The sampling frame was built based on referral networks and facility lists provided by the El Salvador Ministry of Health. Each health facility eligible to be selected for the sample was assigned to a malaria stratum 1 through 4 based on the *cantón* where it is located. We assigned each administrative unit (SIBASI and health region headquarters) to the maximum stratum found in its service area (regions with any *cantones* in stratum 4 are therefore assigned to stratum 4).

The initial sampling frame for the health facility survey is the list of UCSF 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 (SIBASI, regional offices, 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 and the SIBASI 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 SIBASI to review confirmed cases of malaria and household measurement in the zones with history of 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. No replacements of facilities in the sample were necessary during the El Salvador baseline measurement.

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 16 UCSF 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, as determined by the facility staff and community selection module during data collection. If no communities received vector control interventions or intervention status was unknown, a community was selected at random among all communities in the catchment area. Field staff used an automated survey module to enter information about eligible communities in the catchment area, provided by personnel at each selected facility. The module automated the selection of one eligible community and provided the random and calculated inputs (random starting point, calculated skip interval) for field random selection of households. Communities were substituted with another locality in the catchment area of the same facility in three cases due to flooding and security concerns.

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 and replacement households				
Complete	541	401	74.1	(70 - 78)
Members absent	541	98	18.1	(15 - 22)
Unoccupied dwelling	541	28	5.2	(4 - 7)
Refused	541	14	2.6	(2 - 4)

2.1.4 Confirmed case review sample selection

For confirmed cases of malaria, the sample was designed to include review of both confirmed cases from 2018 in the SIBASI offices where case paperwork was expected to be stored based on the fact-finding visit and malaria surveillance data. However, neither case was found in the corresponding SIBASI office. Instead, the cases were reviewed at the health facilities where they were diagnosed. Field staff collected information from all documents available at the facility, including case notification and investigation forms, lab records, and treatment follow-up forms.

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 2.2 shows the total number of suspected cases reviewed (613), the number of cases selected based on diagnosis or principal complaint but found to be ineligible based on final diagnosis (196), and the cases selected and requested at facilities for which no paperwork could be located for review (33).

The quota of suspected cases was increased during data collection when it was observed that many health facilities were not meeting the set quota of cases or did not have capacity for suspected case review. Despite this increase, the anticipated quota of 900 suspected medical records was not met in El Salvador. In many facilities in El Salvador, all eligible cases from the entire year 2018 were selected for review, because there were relatively few attentions with eligible diagnoses recorded.

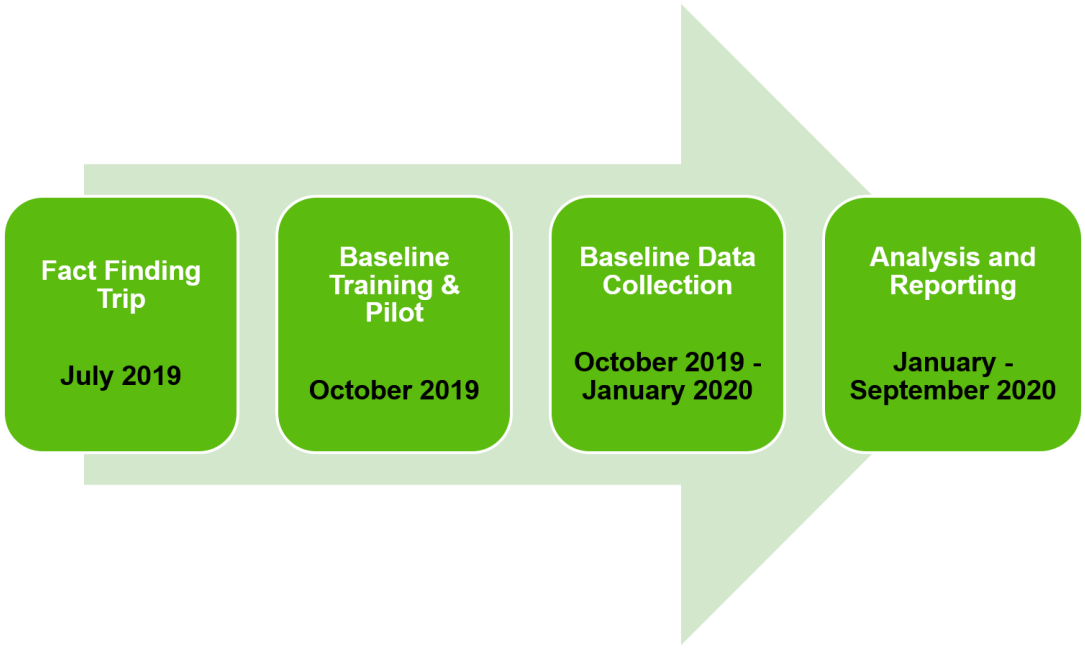
Table 2.2: Suspected case collection

	#
Total suspected cases selected for review	842
Suspected cases selected but could not be located for review	33
All suspected cases screened for eligibility	809
Ineligible suspected cases discarded	196
Eligible suspected cases collected	613

2.2 Survey implementation

In El Salvador, baseline data was collected between October 2019 and January 2020. The timeline of baseline measurement activities is shown in Figure 2.2.

Figure 2.2: RMEI-El Salvador 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 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 Chortis, Lenca, Náhuat, Nawat, and Ulua 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. An additional module is used to capture information about the catchment area of the facility and to select the community to be enumerated in the household survey.

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 El Salvador between October 7 and October 12, 2019. The local agency contracted for data collection in El Salvador, UNIMER, hired eight medical professionals and two 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 El Salvador Ministry of Health 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. UNIMER continued providing retraining throughout data collection to maintain homogeneity and quality standards of the data collection teams over time. During the data collection launch from October 14 - 15, 2019, an IHME staff member observed active household and health facility data collection and provided feedback to data collectors.

2.2.4 Data analysis and report writing

IHME conducted data analysis using STATA versions 14 and 15 and R versions 3 and 4. This report provides data summaries for the baseline measurement in health facilities and households in El Salvador. 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 El Salvador Ministry of Health.

2.2.5 Ethical considerations

The study received authorization from by the El Salvador Ministry of Health to conduct data collection in health facilities and by local authorities to collect data in communities. The study was approved, receiving non-human subjects research determination by the Institutional Review Board of the University of Washington given that no personally identifiable information was collected as a part of any of the survey modules. All respondents to the household survey, and the senior responsible staff member at participating health facilities, signed informed consent forms prior to data collection. Signed consent forms were collected and managed by 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-El Salvador 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.

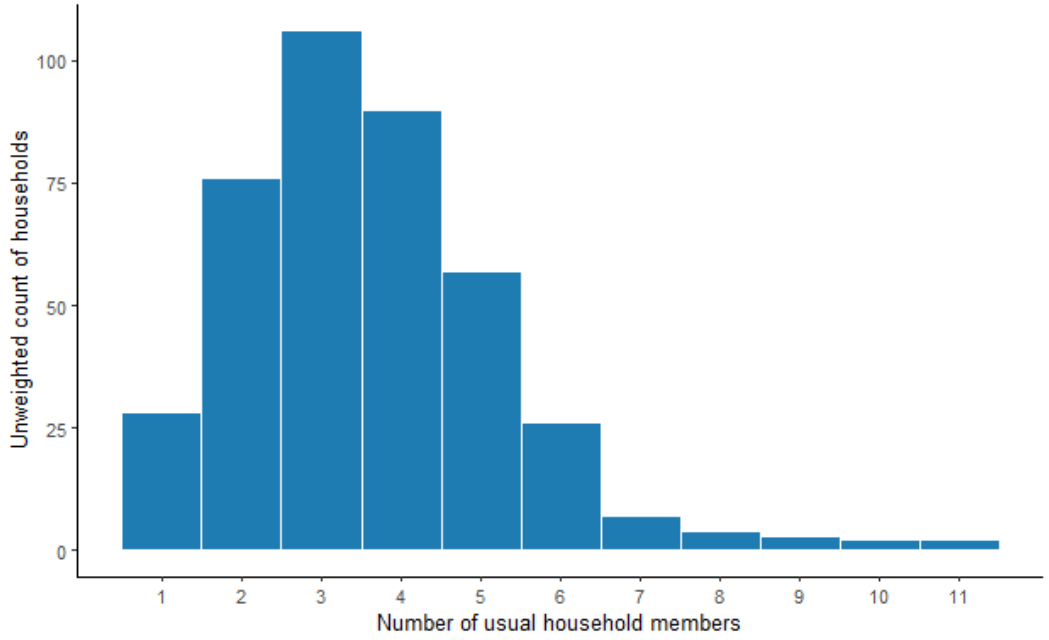
3.1 Characteristics of participating households

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

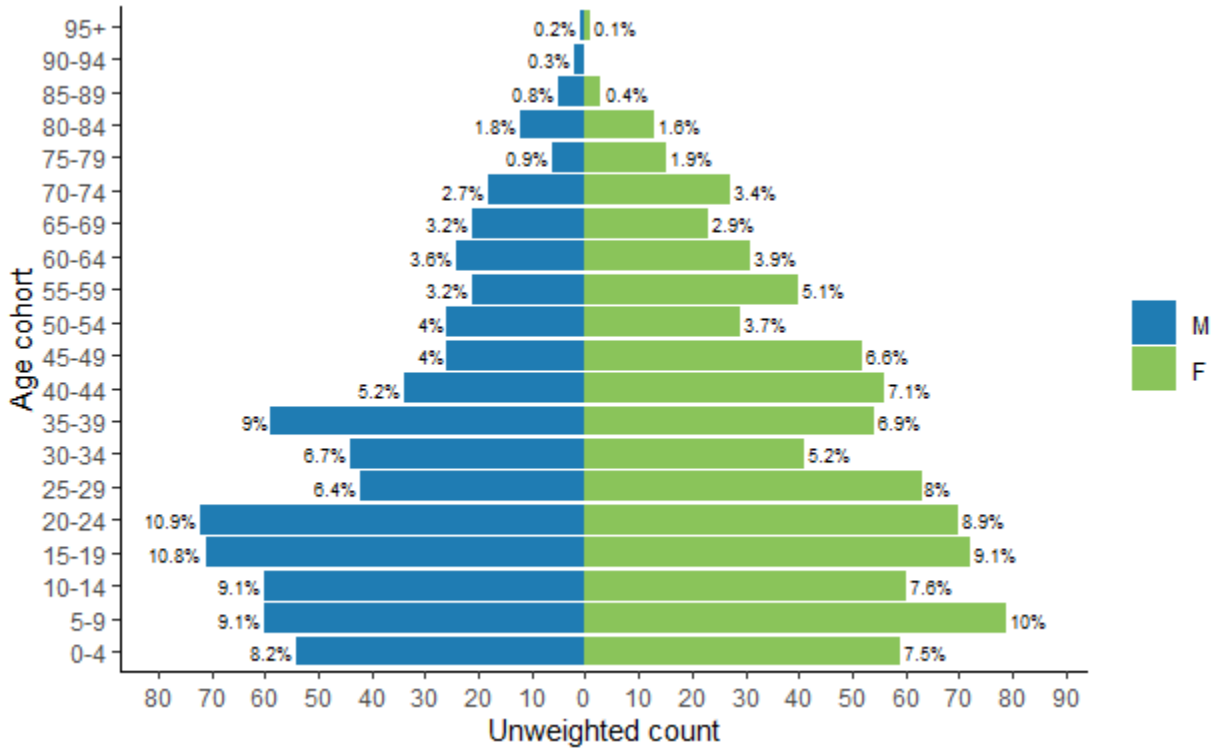
A total of 401 households in the El Salvador baseline survey completed the interview. The unweighted distribution of the number of members by household is shown in Figure 3.1. The survey sample for El Salvador has a median household size of 3 and an unweighted average household size of 3.6.

Figure 3.1: Household size, unweighted percent distribution



The unweighted distribution of the de facto household population in the surveyed households in El Salvador by five-year age groups and by sex is shown in Figure 3.2. El Salvador 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, 26% of the population in the baseline is under age 15 years, more than half (64%) of the population is in the economically productive age range (15-64), and the remaining 10% 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 El Salvador, 19.5% of household members had no formal schooling, and 34.6% completed only primary education. The following demographic tables show weighted proportions.

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	1074	223	19.5	(14 - 26)
Primary	1074	374	34.6	(30 - 39)
Secondary	1074	415	39.1	(32 - 46)
University	1074	46	4.9	(2 - 13)
Specialty	1074	2	0.1	(0 - 1)
Masters	1074	3	0.5	(0 - 4)
Don't know	1074	11	1.1	(1 - 3)

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	1074	1074	100	(-)
English	1074	7	0.6	(0 - 2)

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[1]				
Mestiza	1073	635	60	(46 - 72)
Blanca	1073	72	8.6	(6 - 11)
None	1073	10	0.8	(0 - 3)
Nahua-Pipil	1073	4	0.3	(0 - 2)
Lenca	1073	2	0.1	(0 - 0)
Mulata	1073	3	0	(-)
Don't know	1073	350	30.2	(19 - 45)
Decline to respond	1073	1	0.2	(0 - 1)

[1]Indigeneity not captured for one usual household member over 15 years of age.

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 El Salvador, as seen in Table 3.4, Table 3.5, and Table 3.6, most homes are built with walls of cement block, sheet metal (zinc/alucin) roofs, and cement brick or tile floors.

Table 3.4: Exterior wall material as observed

	N	n	%	95% CI
Main material of exterior walls of dwelling				
Cement block	401	200	47.1	(38 - 57)
Brick/covered adobe	401	85	18	(12 - 26)
Uncovered adobe	401	31	8.7	(4 - 17)
Stone with lime/cement	401	15	4	(2 - 9)
Plywood	401	11	3.2	(1 - 10)
Prefabricated material	401	6	2.6	(1 - 9)
Cane/palm/trunks	401	7	1.4	(0 - 5)
Palm/bamboo	401	7	1.4	(0 - 4)
Polished wood	401	4	1.1	(0 - 4)
Quarry stone	401	2	0.7	(0 - 3)
"Bahareque"/wattle-and-daub (mud plaster and cane)	401	2	0.7	(0 - 3)
Cardboard/waste material	401	1	0.2	(0 - 2)
Other	401	30	10.9	(6 - 18)

Table 3.5: Roofing material as observed

	N	n	%	95% CI
Main material of roof of dwelling				
Sheet metal (zinc/Alucin)	401	275	65.9	(51 - 78)
Clay tile	401	57	15.8	(7 - 32)
Cement fiber/asbestos sheet	401	32	8	(3 - 17)
Thatch/palm leaf/cane	401	10	2.4	(1 - 8)
Cement tile	401	4	0.7	(0 - 3)
No roof	401	1	0.5	(0 - 4)
Cardboard/waste material	401	2	0.3	(0 - 2)
Concrete	401	2	0.1	(0 - 1)

	N	n	%	95% CI
Other	401	18	6.3	(2 - 17)

Table 3.6: Flooring material as observed

	N	n	%	95% CI
Main material of floor of dwelling				
Cement brick or tile	401	106	28	(21 - 36)
Cement sheet/board	401	103	25	(19 - 32)
Earth/sand	401	74	21.2	(13 - 32)
Ceramic tiles	401	69	14.4	(9 - 23)
Mud brick	401	18	5.1	(3 - 9)
"Embarrada"	401	18	3.6	(1 - 9)
Wood planks	401	2	0.6	(0 - 3)
Parquet or polished wood	401	2	0.3	(0 - 2)
Granite/stone	401	2	0.1	(0 - 1)
Other	401	7	1.6	(0 - 8)

Many houses (57.1%) have open roof eaves. Most have no glass in windows (65.9%), screens in windows (83.2%), 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[1]	400	215	57.1	(44 - 69)

[1]Roof eave observation not captured for one household.

Table 3.8: Glass in windows as observed

	N	n	%	95% CI
Do windows have glass panes?				
None	401	262	65.9	(53 - 77)
Yes, in all windows	401	84	18.7	(11 - 30)
There are no windows in the house	401	44	13	(7 - 22)
Yes, but only in some windows	401	11	2.4	(1 - 5)

Table 3.9: Screens in windows as observed

	N	n	%	95% CI
Do windows have screens?				
None	401	338	83.2	(75 - 89)
There are no windows in the house	401	44	13.3	(8 - 22)
Yes, in all windows	401	10	1.8	(1 - 5)
Yes, but only in some windows	401	9	1.7	(1 - 4)

Table 3.10: Screens in doors as observed

	N	n	%	95% CI
Do doors have screens?				
None	401	397	99.1	(97 - 100)
Yes, in all doors	401	2	0.7	(0 - 3)
Yes, but only in some doors	401	2	0.2	(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 77.3% of homes had clean surroundings without standing water on the day of the survey, 2.1% 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	401	314	77.3	(71 - 83)
Trash, tires, or other refuse present, but no standing water	401	49	11.7	(8 - 16)
Yes, water collected in trash, tires, or other small containers	401	21	7	(5 - 9)
Yes, puddles	401	10	2.9	(1 - 10)
Yes, pond or other natural water body	401	11	2.1	(1 - 6)
Other	401	2	0.5	(0 - 4)

Table 3.12 shows the principal water source of the household as reported by the respondent; 72.4% of households have water piped to their house. The most common type of sanitation facility is a pit latrine (53.6% 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	401	277	72.4	(57 - 84)
Tube well or borehole	401	38	7.3	(3 - 19)
Protected dug well	401	33	6	(3 - 14)
Piped to yard/plot	401	11	2	(1 - 7)
Public tap/standpipe	401	4	1.5	(0 - 6)
Unprotected dug well	401	6	1.4	(0 - 8)
Tanker truck	401	4	1.4	(0 - 5)
Rainwater	401	5	1.1	(0 - 5)
Protected spring	401	2	0.4	(0 - 2)
Bottled water	401	2	0.3	(0 - 2)
Unprotected spring	401	1	0.2	(0 - 2)
Surface water (river/dam/lake/pond/stream/canal/irrigation channel)	401	1	0.2	(0 - 2)
Large jug of purified water	401	1	0.1	(0 - 1)
Other	401	16	5.5	(2 - 17)

Table 3.13: Type of sanitation facility used

	N	n	%	95% CI
Type of toilet used				
Pit latrine	401	214	53.6	(38 - 69)
Flush toilet	401	139	34.9	(18 - 56)
Pour flush toilet	401	37	7.3	(4 - 12)
Dry latrine	401	1	0.5	(0 - 3)
No facility/bush/field	401	2	0.5	(0 - 4)
Other	401	8	3.3	(2 - 7)

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

Table 3.14: Cooking fuel source

	N	n	%	95% CI
Principal cooking fuel				
Gas tank	401	348	85.3	(74 - 92)
Wood	401	243	62.4	(44 - 78)
Electricity	401	9	1.8	(0 - 7)
Charcoal	401	4	1.2	(0 - 5)
Straw/shrubs/grass	401	1	0.1	(0 - 1)
No food cooked in household	401	1	0.1	(0 - 1)
Other	401	1	0.5	(0 - 3)

Table 3.15: Cooking location

	N	n	%	95% CI
Where cooking is done[1]				
In the house	400	270	66.8	(57 - 75)
In a separate building	400	101	25.1	(20 - 32)
Outdoors	400	23	5.7	(3 - 10)
Other	400	6	2.4	(1 - 6)

[1]Cooking location not captured for one 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 (94.1%) have electricity. Of the 139 households that own livestock, most own poultry (94.9% 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	401	380	94.1	(90 - 97)
Radio	401	151	35.2	(30 - 41)
Sound system	401	180	45.5	(36 - 55)
Television	401	331	82.4	(78 - 86)
Home telephone	401	49	13.1	(5 - 29)
Mobile phone	401	329	82.9	(75 - 89)
Refrigerator	401	274	65.4	(53 - 76)
Washing machine	401	36	9	(3 - 24)
Computer	401	49	12.3	(6 - 23)
Electric fan	401	179	40.4	(26 - 57)
Air conditioner	401	8	1.8	(1 - 5)
Watch	401	163	42.2	(35 - 50)
Guitar	401	32	9.4	(6 - 14)
Bike	401	191	44.3	(35 - 54)
Motorcycle or scooter	401	66	14.5	(11 - 20)
Animal-drawn cart	401	3	0.6	(0 - 2)

	N	n	%	95% CI
Car	401	54	14.4	(9 - 22)
Truck	401	11	2.4	(1 - 5)
Motor boat	401	16	3.5	(1 - 14)
Bank account[1]	377	67	18.4	(10 - 31)

[1]Twenty-four heads of household responded 'do not know' or 'decline to respond' to household bank accounts.

Table 3.17: Livestock ownership

	N	n	%	95% CI
Does this household own any livestock?	401	139	33	(22 - 46)
Cattle	139	25	20.1	(8 - 42)
Horses, donkeys or mules	139	6	5.9	(2 - 19)
Goats or sheep	139	4	3.6	(1 - 9)
Chickens or other poultry	139	132	94.9	(92 - 97)
Pigs	139	11	5.7	(2 - 14)

Table 3.18: Ownership of agricultural land

	N	n	%	95% CI
Does any member of the household own, rent, or share agricultural land?				
No	401	338	82.5	(72 - 90)
Yes, own	401	32	8.5	(5 - 15)
Yes, rent	401	23	6.9	(4 - 12)
Yes, share	401	2	0.5	(0 - 4)
Don't know	401	6	1.6	(1 - 5)

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.

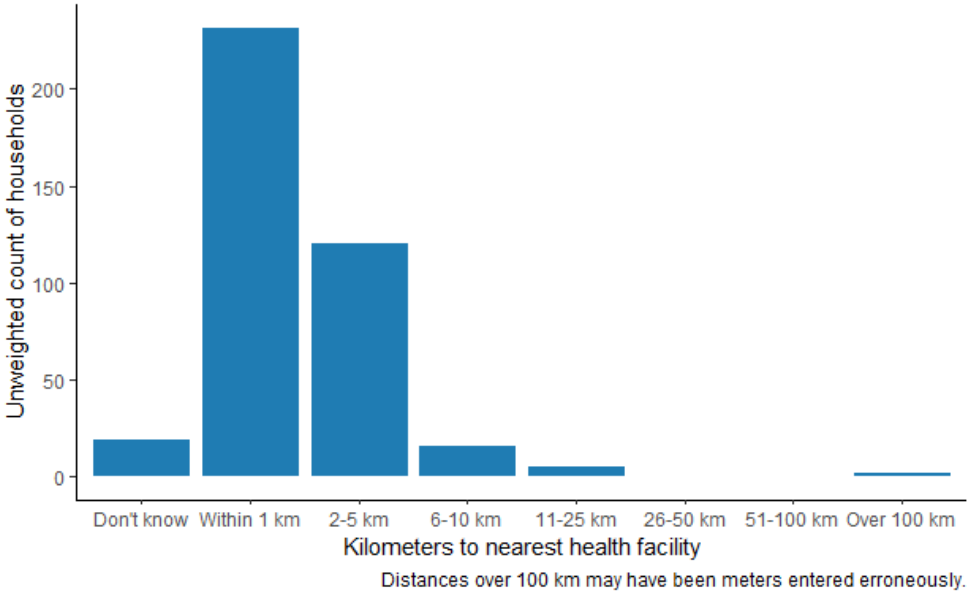
Table 3.19: Monthly household income, all sources

	N	n	%	95% CI
Monthly household income, USD[1]				
Less than 50 USD	317	25	8.1	(4 - 14)
51 - 150 USD	317	102	33.5	(28 - 40)
151 - 250 USD	317	76	22.6	(16 - 32)
251 - 350 USD	317	60	18.1	(12 - 26)
351 - 450 USD	317	20	6.2	(3 - 12)
451 - 550 USD	317	9	4.2	(2 - 11)
551 - 650 USD	317	3	1.2	(0 - 4)
751 - 850 USD	317	1	0	(-)
Don't know	317	12	2	(1 - 5)
Decline to respond	317	9	4	(2 - 8)

[1]Household income not captured for 84 households.

The interview also asked respondents the distance (km) to the health facility nearest their home. Long distances and travel times to health establishments can discourage households in remote locations from seeking medical care. Figure 3.3 shows the unweighted distribution of distances reported in the survey.

Figure 3.3: 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 (61.8%). 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[1]	371	234	61.8	(52 - 71)

[1]Thirty heads of household responded 'do not know' to whether they had heard of malaria.

Table 3.21: Knowledge of cause of malaria

	N	n	%	95% CI
In your opinion, what causes malaria?				
Mosquito bites	234	202	81.6	(72 - 89)
Eating dirty food/drinking dirty water	234	2	1.8	(0 - 12)
Anopheles mosquito bite	234	1	0.2	(0 - 1)
Other	234	2	1.3	(0 - 5)
Don't know	234	27	15.1	(10 - 23)

Table 3.22: Knowledge of malaria transmission

	N	n	%	95% CI
How is malaria transmitted?				
By mosquitoes	234	200	79.4	(67 - 88)
Stagnant water	234	6	2.7	(1 - 7)

	N	n	%	95% CI
Eating dirty food/drinking dirty water	234	3	2.2	(0 - 10)
Poor personal hygiene	234	3	2	(1 - 6)
Contaminated air	234	1	0.4	(0 - 4)
Don't know	234	31	18.4	(9 - 33)

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 3.23: Knowledge of malaria symptoms

	N	n	%	95% CI
Main sign or symptom of malaria known				
Fever	234	193	83.1	(73 - 90)
Chills	234	86	33.5	(28 - 39)
Headache	234	75	31.9	(26 - 39)
Body ache or joint pain	234	39	16.2	(9 - 28)
Nausea and vomiting	234	26	11.8	(8 - 16)
Loss of appetite	234	8	4.2	(1 - 14)
Body weakness	234	9	3.8	(1 - 10)
Diarrhea	234	10	2.6	(1 - 7)
Pale eyes or skin	234	5	2	(1 - 7)
Sweating	234	3	1.6	(0 - 10)
Cough	234	1	0.9	(0 - 6)
Dizziness	234	6	0.6	(0 - 2)
Other	234	2	1.8	(0 - 11)
Don't know	234	35	14.2	(9 - 22)

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 3.24).

Table 3.24: 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	234	200	85.3	(76 - 92)
One person	234	1	0.9	(0 - 7)
2-4 people	234	1	0.4	(0 - 4)
Don't know	234	32	13.4	(7 - 24)

3.2.2 Knowledge of malaria messages

Malaria programs and public health systems carry out education campaigns to help people who live in areas with malaria transmission know how to protect themselves from the disease, and what to do if they become sick. Respondents were asked to list the messages they had heard about malaria in the last year, and interviewers sorted their answers among the available responses in the survey. In all, 22.5% had heard messages about malaria during the last year. Of those who had heard messages, the specific information heard is detailed in Table 3.25. 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 3.26.

Table 3.25: Malaria messages heard in last year

	N	n	%	95% CI
Messages seen or heard in last year				
If have fever go to health facility	53	38	81.4	(61 - 92)
Sleep under an insecticide-treated mosquito net	53	8	18.5	(11 - 30)
Eliminate breeding sites/clean up trash	53	11	12.9	(6 - 26)
Always test before treating malaria	53	4	7.9	(3 - 19)
Nets are used to protect from mosquitoes	53	3	6.5	(2 - 19)
Malaria kills	53	1	4	(1 - 21)
Sleep under a net every night to protect yourself against malaria	53	1	4	(1 - 21)
Don't know	53	2	2.2	(0 - 19)

Table 3.26: Source of malaria messages

Source of messages, among those who heard them	N	n	%	95% CI
On the radio	53	11	22.5	(13 - 36)
On TV	53	30	67	(46 - 83)
On a poster or billboard	53	6	12.1	(5 - 27)
From a community health worker	53	19	38.6	(27 - 52)
From personnel at a health facility	53	22	42	(31 - 54)
At a community event[1]	52	9	17.1	(11 - 26)
At school	53	4	4.4	(1 - 15)
On the internet or social media	53	5	9.5	(4 - 20)
Somewhere else	53	2	3.3	(1 - 16)

[1]Discrepant denominators due to excluded 'do not know' responses.

3.2.3 Knowledge of community resources

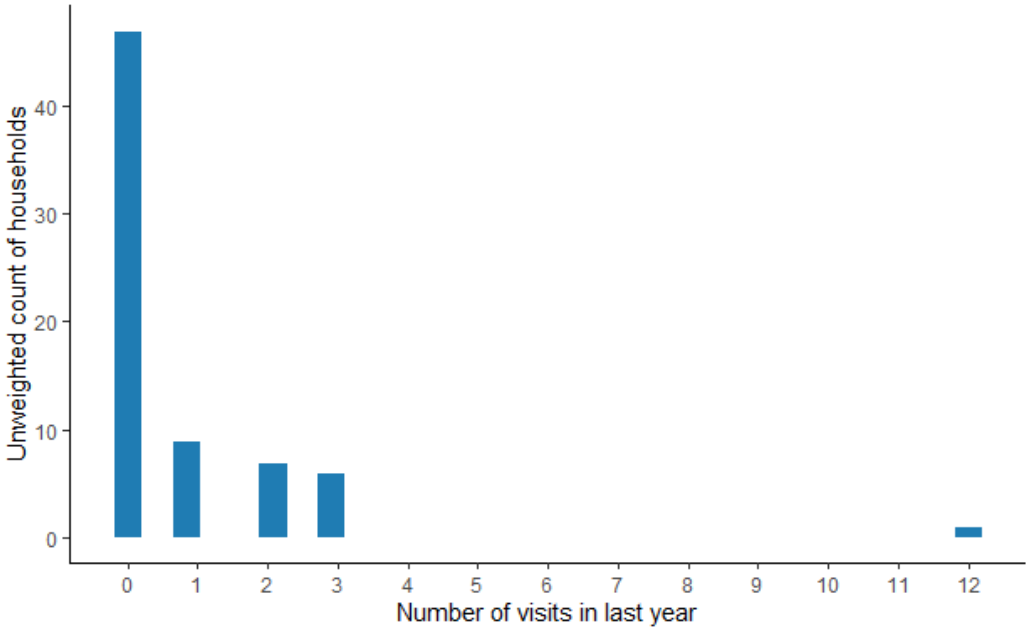
A key component of malaria detection in many departments in El Salvador is the volunteer collaborator program. Volunteer collaborators (*colaboradores voluntarios*), or “col-vols”, are community members who are trained to carry out malaria detection activities such as screening, taking blood samples for thick blood film or rapid tests, and referring patients to health facilities or to community-based vector control technicians. They or other community health workers known as *medicadores* also sometimes oversee malaria treatment after a malaria case has been confirmed. In the El Salvador baseline survey, 24.2% of households know of a col-vol in their community. Of those who knew of a col-vol, 40.7% reported receiving a home visit by that volunteer during the year before the date of the survey (Table 3.27). The number of visits received from the col-vol is shown in Figure 3.4.

Table 3.27: Knowledge of col-vols

	N	n	%	95% CI
Know of col-vol in own community[1]	331	76	24.2	(17 - 33)
Visited by col-vol in last year[2]	74	28	40.7	(26 - 57)

[1]70 households responded that they 'do not know' of col-vols in the community.
[2]Two households responded that they 'do not know' of col-vol visit in last year.

Figure 3.4: Number of visits from col-vols in last year, among households that know of col-vol in community



Malaria testing and treatment is provided free of charge through the Ministry of Health in El Salvador, and 75.3% of respondents are aware of this benefit (Table 3.28). 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 3.29, Table 3.30).

Table 3.28: Knowledge of free-of-cost malaria healthcare

	N	n	%	95% CI
Aware malaria diagnosis and treatment are provided free by the government[1]	212	159	75.3	(64 - 84)

[1]22 heads of household responded 'do not know' to free-of-cost malaria healthcare.

Table 3.29: 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	234	194	84.5	(77 - 90)
Public Sector: Government hospital	234	25	8.9	(6 - 14)
Public Sector: mobile clinic	234	3	1.2	(0 - 6)
Public Sector: Fieldworker/Community Health Worker	234	4	1.1	(0 - 4)
Private medical sector: Private hospital/clinic	234	1	0.9	(0 - 6)
Private medical sector: Private doctor	234	1	0.9	(0 - 6)
Other	234	4	3.6	(1 - 13)
Don't know	234	10	4.9	(2 - 10)

Table 3.30: 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	218	193	90.3	(88 - 92)
Public Sector: Government hospital	218	30	14.7	(9 - 23)
Public Sector: mobile clinic	218	4	1.8	(0 - 6)
Private medical sector: Private doctor	218	3	1.5	(0 - 6)
Other private sector	218	1	1	(0 - 6)
Private medical sector: Pharmacy	218	1	0.7	(0 - 6)
Private medical sector: Private hospital/clinic	218	1	0.4	(0 - 3)
Other	218	1	1	(0 - 7)
Don't know	218	1	1	(0 - 7)

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 3.31). Among individuals in surveyed households, 6.1% reported travel outside the community in the last two weeks (Table 3.32). According to respondents, most household members did not participate in any of the risk activities listed in Table 3.33 in the two months prior to the survey.

Table 3.31: Temporal migration within surveyed households

	N	n	%	95% CI
At least one member migrates seasonally[1]	400	25	7.7	(3 - 21)
At least one member migrates weekly	401	16	4	(2 - 10)

[1]One head of household responded 'do not know' to whether at least one household member migrates seasonally.

Table 3.32: Recent travel by individuals in surveyed households

	N	n	%	95% CI
Individual traveled outside community in last 2 weeks	1446	93	6.1	(3 - 11)

Table 3.33: Exposure to risky activities by individuals in surveyed households

	N	n	%	95% CI
Individuals participating in malaria risk activities				
None of these	1446	1072	72.9	(60 - 83)
Cultivating crops or working in the fields	1446	259	19.1	(12 - 30)
Gathering firewood in the forest	1446	102	7.7	(4 - 16)
Collecting shellfish	1446	73	4.2	(1 - 15)
Working in timber/lumber industries in the forest	1446	17	0.9	(0 - 2)
Sleeping outdoors overnight	1446	10	0.8	(0 - 3)
Producing charcoal	1446	4	0.5	(0 - 2)
Working in a mine	1446	0	0	(-)
Don't know	1446	3	0.3	(0 - 1)

Respondents were also asked what can be done to protect against malaria (Table 3.34), and what practices they follow in their own households (Table 3.35). 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 some responses also referred to use of mosquito nets or other practices that protect against all mosquito vectors. Only 0.8% of households said they do not use any malaria prevention measures at home.

Table 3.34: Protective measures known by household

	N	n	%	95% CI
Methods known to protect against malaria				
Eliminate mosquito breeding areas (tires, bottles, or others)	203	160	81.3	(69 - 89)
Add bleach temephos (Abate) to the water tank	203	89	41.3	(27 - 57)
Clean water storage tanks with bleach	203	60	32.2	(20 - 48)
Keep house surroundings clean	203	51	30.2	(17 - 47)
Sleep under a mosquito net	203	25	17.4	(7 - 38)
Cut the grass around the house	203	10	4.2	(2 - 8)
Can't be prevented	203	8	3.9	(2 - 10)
Fumigate or spray house with insecticides	203	4	3.8	(1 - 11)
Fill in puddles (stagnant water)	203	8	2.8	(1 - 9)
Avoid mosquito bites	203	3	2.6	(1 - 12)
Use insect repellent	203	2	1.6	(0 - 6)
Put mosquito screens on the windows	203	1	0.4	(0 - 3)
Use mosquito coils	203	1	0.4	(0 - 4)
Sleep under an insecticide-treated mosquito net	203	0	0	(-)
Take preventive medication	203	0	0	(-)
Other	203	4	3.1	(1 - 11)
Don't know	203	10	3.4	(1 - 11)

Table 3.35: 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)	203	162	83.9	(74 - 91)
Clean water storage tanks with bleach	203	81	43.4	(31 - 57)
Add bleach or temephos (Abate) to the water tank	203	94	41.9	(29 - 56)
Keep house surroundings clean	203	53	27.5	(16 - 43)
Sleep under a mosquito net	203	21	15.4	(7 - 32)
Fill in puddles (stagnant water)	203	10	7.1	(3 - 16)
Fumigate or spray house with insecticides	203	12	6.1	(3 - 13)
Cut the grass around the house	203	6	2.2	(1 - 6)
Avoid mosquito bites	203	3	1.9	(0 - 7)
Use mosquito coils	203	3	1.8	(1 - 5)
Organize community cleaning work days	203	3	1.4	(0 - 12)
Use insect repellent	203	4	1.3	(0 - 5)
Does nothing to protect from malaria	203	2	0.8	(0 - 6)
Take preventive medication	203	1	0.5	(0 - 5)
Put mosquito screens on the windows	203	0	0	(-)

	N	n	%	95% CI
Sleep under an insecticide-treated mosquito net	203	0	0	(-)
Other	203	5	3.3	(1 - 10)
Don't know	203	6	2.3	(1 - 6)

Chapter 4: Vector control activities

This chapter provides a descriptive summary of vector control measures used in the households selected for the RMEI-El Salvador 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 El Salvador households

Vector control plans in El Salvador in 2019 included offering IRS or ITN measures to households in six residual malaria foci in two departments. 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 entomological surveillance or to malaria transmission, for example in the case of reactive measures to a new outbreak.

In El Salvador, the community sample was designed to capture data from 16 communities with and without vector control measures implemented during 2019. Health facilities were listed for selection to the sample based on malaria stratum. The four facilities serving residual inactive focus communities (assumed to have vector control interventions in the catchment area) were all classified as malaria stratum 4 and selected with certainty. One community from the catchment area of each of the 16 surveyed primary care facilities was selected to the sample for the household survey.

According to data collected at the local-level health facilities via the Community Selection Module, four of 16 facilities surveyed had IRS carried out in the catchment area, but only two of these facilities coincided with the list of four facilities provided by the central level Ministry of Health. There are a few feasible explanations for the discrepancies between the information from the central versus the local level: the assumption that every residual focus had vector control measures planned during 2019 may have been inaccurate, and the selected facility may have served no communities with interventions; the intervention activity may have been planned in a selected community, but not yet carried out at the date of the survey; or the intervention activity may have been planned and carried out, but the health facility staff was not aware of it. It is not certain which of these scenarios explains the discrepancies, as some of the four communities reported to have IRS at the local health facility had evidence of spraying reported in households, but at relatively low coverage levels.

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.

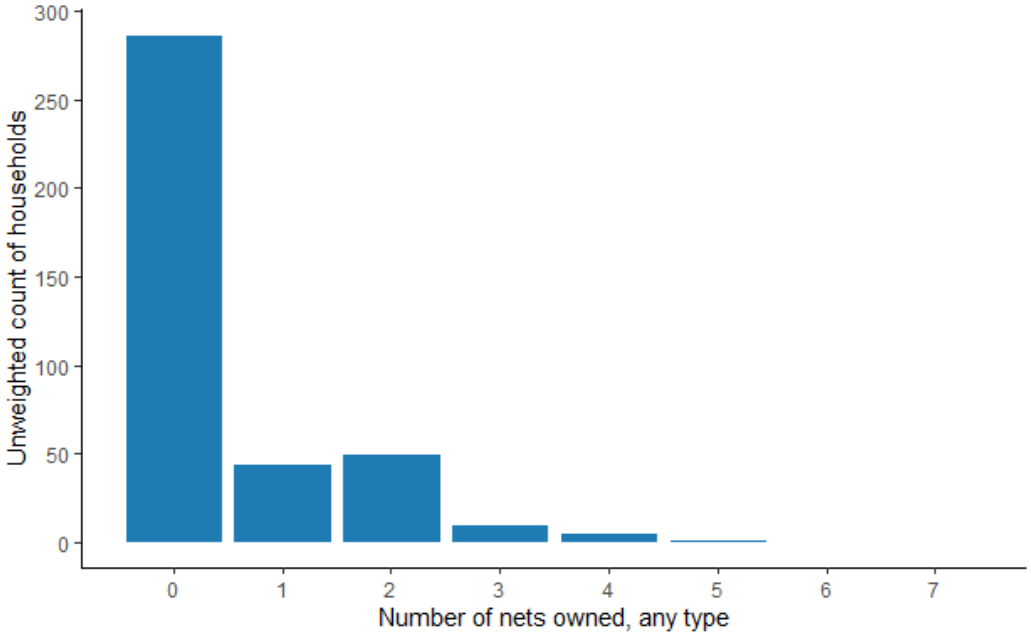
4.2.1 Ownership of nets by surveyed households

As Table 4.1 shows, 29.4% 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	401	115	29.4	(22 - 37)

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. Most untreated nets were purchased in a store (79.6%, in Table 4.3).

Table 4.2: Source of insecticide-treated nets

	N	n	%	95% CI
Source of net				
Vector control or malaria program	5	3	60	(20 - 90)
Government health facility	5	1	20	(3 - 69)
Shop / market	5	1	20	(3 - 69)

Table 4.3: Source of untreated nets

	N	n	%	95% CI
Source of net				
Shop / market	211	168	79.6	(74 - 85)
Mobile vendor	211	22	10.4	(7 - 15)
Gifted by friend / family / acquaintance	211	13	6.2	(4 - 10)
NGO / local organization	211	5	2.4	(1 - 6)
Home-made	211	2	0.9	(0 - 4)
Don't know	211	1	0.5	(0 - 3)

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	207	176	85	(79 - 89)
Only thumb-sized holes	207	19	9.2	(6 - 14)
Net never used	207	10	4.8	(3 - 9)
At least one fist or head-sized hole	207	2	1	(0 - 4)

Table 4.5: Reported condition of nets not observed

	N	n	%	95% CI
Condition of mosquito net as reported				
Net never used	9	5	55.6	(25 - 82)
No holes	9	3	33.3	(11 - 67)
Don't know	9	1	11.1	(2 - 50)

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)

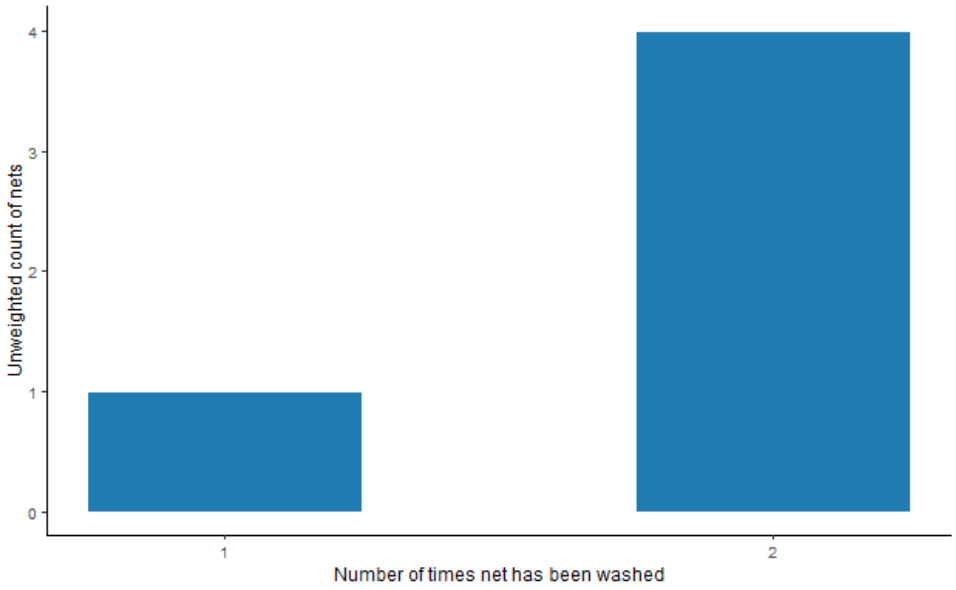


Table 4.6: Care of insecticide-treated nets - drying

	N	n	%	95% CI
Method of drying net				
In the shade	5	4	80	(31 - 97)
In the sun	5	1	20	(3 - 69)

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, 0.1% 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, 0% were reported to have slept under a net treated with insecticide and 38.3% were reported to have slept under an untreated net.

Table 4.7: Use of net for sleeping previous night

	N	n	%	95% CI
Total				
Slept under treated net	1422	1	0.1	(0 - 1)
Slept under untreated net	1422	226	16.1	(13 - 20)
Under 5				
Slept under treated net	113	0	0	(-)
Slept under untreated net	113	40	38.3	(26 - 53)
Pregnant				
Slept under treated net	9	0	0	(-)
Slept under untreated net	9	3	53.3	(13 - 90)
Reported usually sleeping under net during pregnancy	9	3	53.3	(13 - 90)

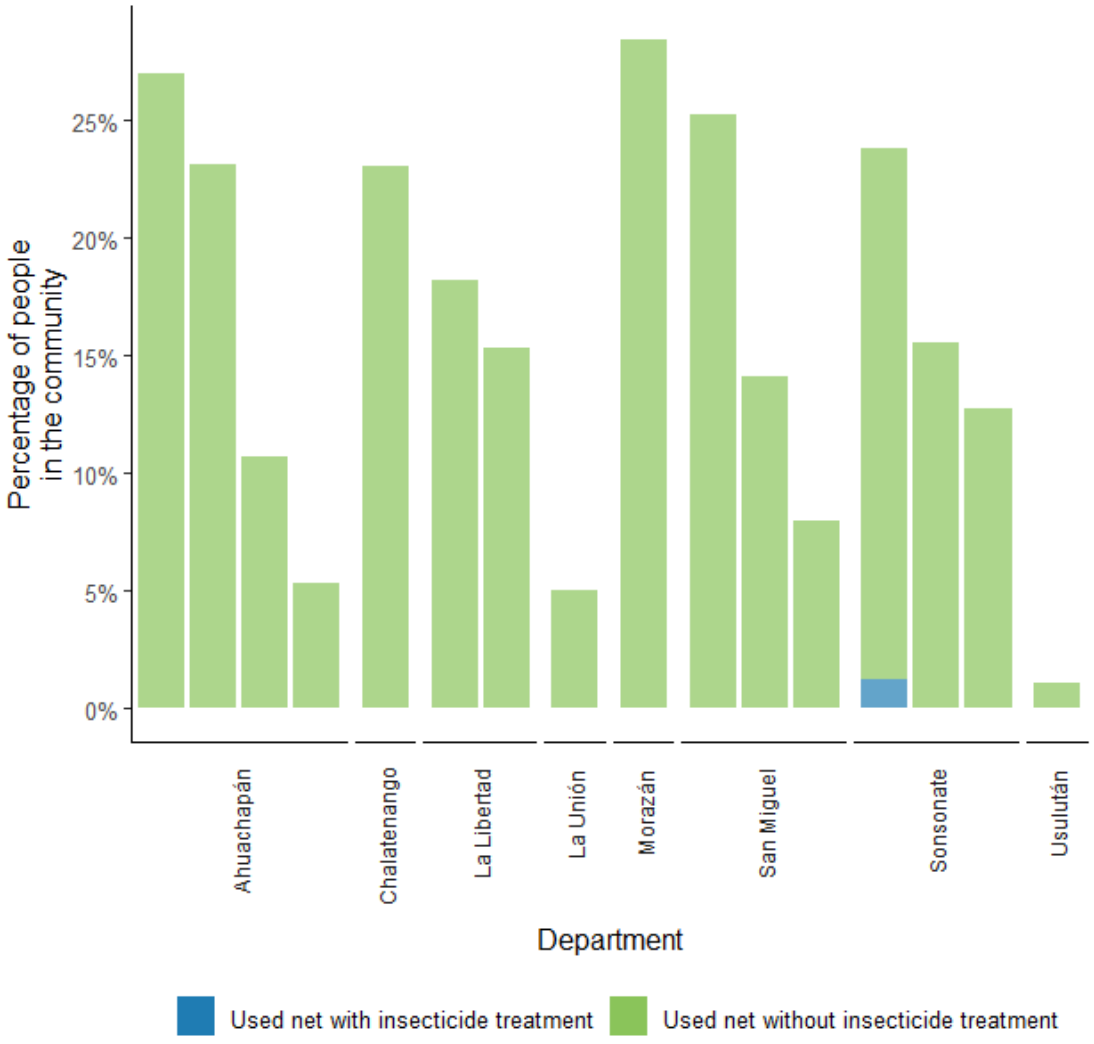
When households had nets that were not used the previous night, or reported that not all household members slept under a net, they were asked why they do not sleep under a mosquito net. The reasons given are shown in Table 4.8. Most frequently, households reported that it was too hot to sleep under a net. In the few cases when respondents specified an “other” response, they specified that they generally did not like using the nets.

Table 4.8: Reasons for not using net

	N	n	%	95% CI
Reasons for not sleeping under mosquito net				
Too hot	72	51	73.9	(62 - 83)
No mosquitoes	72	7	12.3	(6 - 23)
It is bad for the skin, it causes irritation	72	4	9.2	(3 - 26)
Don't have enough nets	72	5	9.1	(4 - 19)
Feel closed in/afraid	72	8	8	(3 - 22)
Net too small	72	2	3.2	(1 - 12)
Net too expensive	72	3	1.9	(0 - 9)
No malaria now	72	1	1.3	(0 - 10)
Net not available last night/net being washed	72	2	1.1	(0 - 5)
Extra net/more nets available than sleeping areas	72	1	0.5	(0 - 4)
Not necessary, using fan instead	72	1	0.5	(0 - 4)
Other	72	2	2.2	(0 - 13)
Don't know	72	1	1.3	(0 - 10)

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. No communities were indicated to have received the net intervention according to the health facility catchment data. In El Salvador, net use is generally low, and nets used are rarely treated with insecticides.

Figure 4.3: Net use by department and community



as indicated to have received mosquito net intervention according to information available at health facilities.

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, 11.4% of households were offered IRS, and spraying was carried out in 55% 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 8.5% of households that received IRS. The response “don’t know” was given to the question about observing evidence of IRS completion in 1 household.

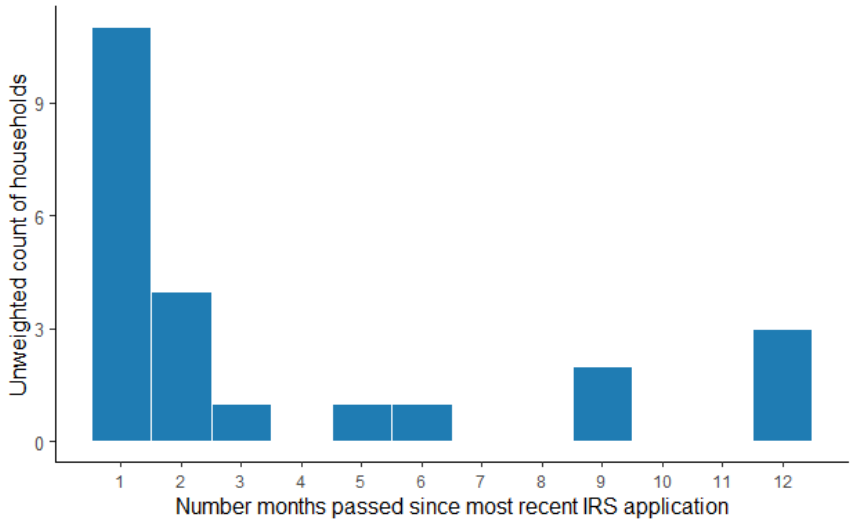
Table 4.9: Households offered and accepting spraying

	N	n	%	95% CI
Offered indoor residual spraying[1]	399	42	11.4	(7 - 19)
Indoor residual spraying occurred[2]	40	25	55	(31 - 76)
Evidence observed (card, sticker, mark)[3]	24	1	8.5	(1 - 48)

[1]Two households responded 'do not know' to IRS offer.
[2]Two households responded 'do not know' to whether spraying occurred.
[3]One household responded 'do not know' to evidence of spraying.

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.

Table 4.10: Reasons for not accepting spraying

	N	n	%	95% CI
Reason house was not sprayed				
Personnel did not carry out/return to conduct spraying	15	10	73	(45 - 90)
Causes ill health effects	15	1	4.9	(1 - 34)
Didn't have time/visit time was not convenient	15	1	4.2	(0 - 33)
Don't like smell	15	1	2.8	(0 - 27)
Don't know	15	1	10.2	(2 - 36)
Decline to respond	15	1	4.9	(1 - 34)

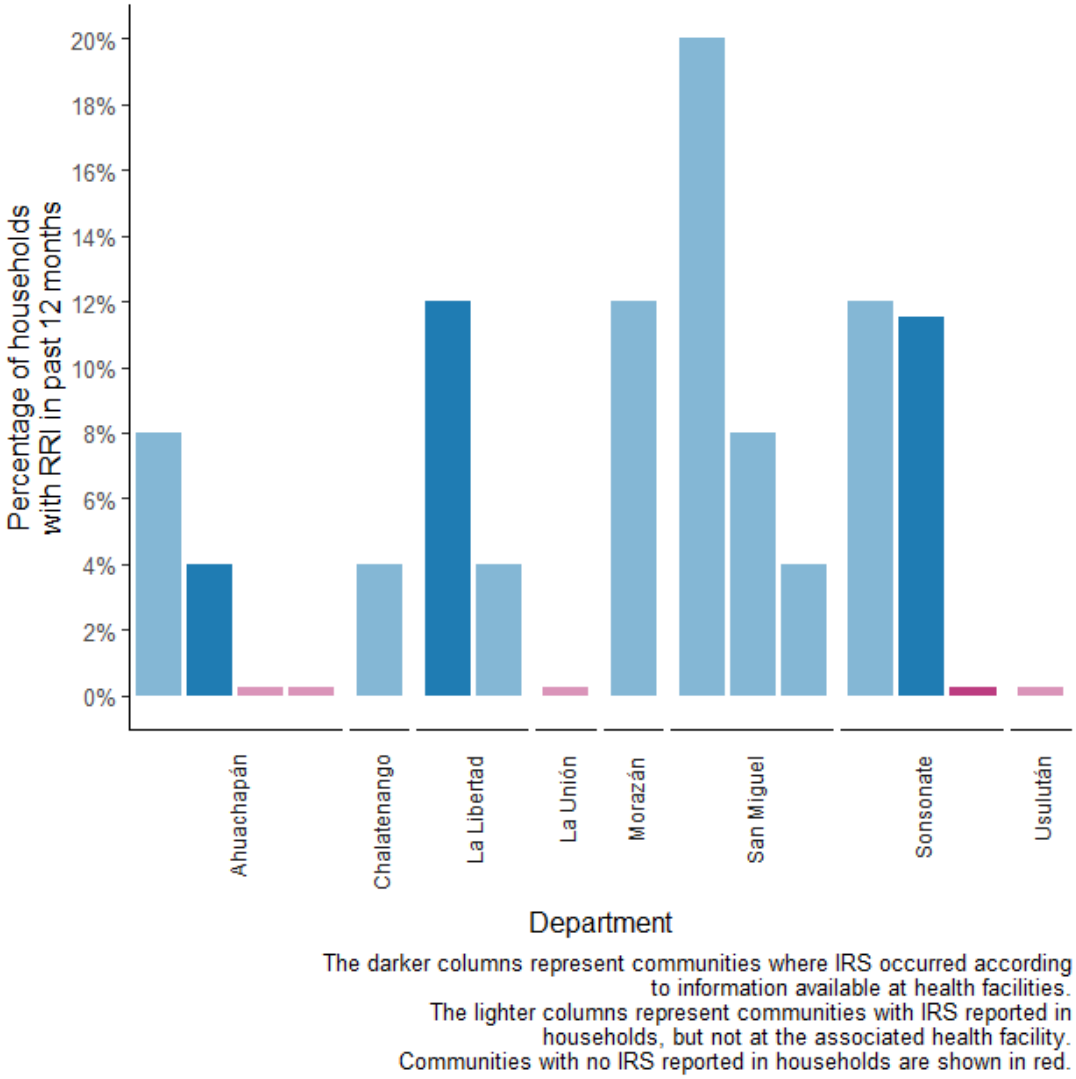
Households receiving IRS were asked whether they washed, painted, or plastered any walls since the most recent application (which diminishes the effectiveness of the insecticide), as shown in Table 4.11.

Table 4.11: Post-spraying practices

	N	n	%	95% CI
Walls painted since last IRS	25	3	8.1	(2 - 27)
Walls washed since last IRS	25	2	5.2	(1 - 26)
Walls plastered since last IRS	25	1	4	(0 - 28)

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. In each of the four communities expected to receive IRS (all located in malaria stratum 4), coverage was measured below 15%.

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 many target communities, as seen in Table

4.12). Table 4.13 shows the indicator results, with 6% of individual usual household members in target communities covered by one of the two interventions.

Table 4.12: Vector control received by reported intervention

Vector control reported	Communities	Used treated net	House sprayed
Spray	4	0.3%	5.7%
None	12	0%	7.1%

Table 4.13: Vector control indicator

	N	n	%	95% CI
Usual household members in vector control communities who slept in house last night	359	353	98.5	(98 - 99)
Slept under insecticide treated net	353	1	0.4	(0 - 2)
House sprayed with mosquito treatment past 12 months	353	20	5.6	(2 - 15)
Omitted from household spraying calculations due to 'do not know' responses	353	0	0	(-)
Received either vector control to standard	353	21	6	(2 - 14)

The variation in vector control coverage in target communities by department can be seen in Table 4.14.

Table 4.14: Vector control indicator: result by department

	N	n	%	95% CI
Received either vector control to standard				
Ahuachapán	82	3	3.7	(4 - 4)
La Libertad	85	6	7.1	(7 - 7)
Sonsonate	186	12	6.5	(2 - 20)
Total	353	21	6	(2 - 14)

Chapter 5: Malaria Diagnostic Capacity

This chapter provides a descriptive summary of the health facilities surveyed for the RMEI-El Salvador 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 30 facilities of various types as shown in Table 5.1. Sixteen of the surveyed facilities provide primary level care, and three are secondary level services, though they may also provide primary attention. The remaining facilities in the sample are administrative units: SIBASI health region headquarters that manage malaria programming and reporting for the entire department and were visited for review of confirmed malaria cases, and regional offices that manage malaria treatment stock. The measurement also included the national marlaria reference laboratory.

Table 5.1: Health facility survey sample by facility type

	Facility Type	#
Primary care	Health unit	16
Secondary care	Hospital	3
Administrative unit/ National Lab	SIBASI	8
	Regional Office	2
	National Reference Laboratory	1
Total		30

Table 5.2 shows the basic primary care services provided by facilities in the sample. Provision of commonly-demanded health services is likely to influence people's familiarity and confidence to seek care at a local health facility when they experience symptoms of a febrile illness like malaria.

Table 5.2: Primary care services provided

	N	n	%	95% CI
Health units				
Child care	16	16	100	(-)
Child immunization services	16	16	100	(-)
Family planning services	16	16	100	(-)
Pregnancy testing	16	14	87.5	(59 - 97)
Antenatal care	16	16	100	(-)
Hospitals				
Child care	3	3	100	(-)
Child immunization services	3	3	100	(-)
Family planning services	3	3	100	(-)
Pregnancy testing	3	3	100	(-)
Antenatal care	3	3	100	(-)
Attend normal deliveries	3	3	100	(-)

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

Table 5.3: Workweek of facility

	N	n	%	95% CI
Health units: Days of the week service is provided				
Monday	16	16	100	(-)
Tuesday	16	16	100	(-)
Wednesday	16	16	100	(-)
Thursday	16	16	100	(-)
Friday	16	16	100	(-)
Saturday	16	9	56.2	(31 - 79)
Sunday	16	8	50	(26 - 74)
Hospitals: Days of the week service is provided				
Monday	3	3	100	(-)
Tuesday	3	3	100	(-)
Wednesday	3	3	100	(-)
Thursday	3	3	100	(-)
Friday	3	3	100	(-)
Saturday	3	3	100	(-)
Sunday	3	3	100	(-)

Table 5.4: Hours of operation

	N	n	%	95% CI
Health units: Hours of operation				
Open less than 24 hours	16	13	81.2	(53 - 94)
Open 24 hours	16	3	18.8	(6 - 47)
Hospitals: Hours of operation				
Open 24 hours	3	3	100	(-)

Survey respondents indicated the type and number of personnel employed at the health facility. Table 5.5 shows the proportion of facilities that employ at least one of each personnel type. Physicians are employed at 93.7% of primary level facilities and at all secondary level facilities. In terms of laboratory diagnosis, lab technicians are emplyed at all hospitals, but only 31.3% of primary care units. Only 6.3% of primary level units employ epidemiology personnel, and 31.3% employ other statistics personnel, important functions for malaria notification and reporting.

Table 5.5: Facility personnel

	N	n	%	95% CI
Health units				
General physician	16	15	93.7	(64 - 99)
Pediatrician	16	3	18.8	(6 - 47)
Nutritionist /dietician	16	3	18.8	(6 - 47)
Pharmacist	16	2	12.5	(3 - 41)
Auxiliary nurse	16	14	87.5	(59 - 97)
Practical nurse	16	6	37.5	(17 - 64)
Registered nurse	16	14	87.5	(59 - 97)
Microbiologist (laboratory)	16	1	6.3	(1 - 36)
Lab technician	16	5	31.3	(13 - 58)
Dispenser at pharmacy	16	12	75	(47 - 91)
Epidemiology personnel	16	1	6.3	(1 - 36)
Other personnel specific for statistics and reporting	16	5	31.3	(13 - 58)

	N	n	%	95% CI
Hospitals				
General physician	3	3	100	(-)
Pediatrician	3	3	100	(-)
Nutritionist /dietician	3	2	66.7	(14 - 96)
Pharmacist	3	2	66.7	(14 - 96)
Auxiliary nurse	3	3	100	(-)
Practical nurse	3	2	66.7	(14 - 96)
Registered nurse	3	3	100	(-)
Social worker	3	3	100	(-)
Lab technician	3	3	100	(-)
Dispenser at pharmacy	3	3	100	(-)
Epidemiology personnel	3	3	100	(-)
Other personnel specific for statistics and reporting	3	3	100	(-)

5.2 Rapid diagnostic tests

Rapid diagnostic tests (RDT) have been introduced in El Salvador as a part of the Initiative 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 El Salvador 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. Use of RDTs was observed to be near zero in the El Salvador baseline survey, which matched expectations based on the fact-finding visit. Only one primary care facility reported storage of RDTs, while none indicated they conducted malaria testing with RDTs (Table 5.6).

Table 5.6: Rapid diagnostic testing according to interview and observation

	N	n	%	95% CI
Health units and hospitals				
Unit stores RDTs	19	1	5.3	(1 - 32)
Unit conducts RDT testing	19	0	0	(-)
Administrative units (excluding national lab)				
Unit stores RDTs	10	0	0	(-)
Unit conducts RDT testing	10	0	0	(-)

5.3 Malaria microscopy

The gold standard for malaria diagnosis is by microscopy. A TBF sample is prepared on a laboratory slide, stained, then examined under a microscope for presence of malaria parasites. The preparation of the slide is simple and is carried out by nurses 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 El Salvador, all facilities providing primary care to patients are expected to have the capacity to prepare TBF slides. In the health facility interview and observation, 100% of primary care facilities were found to

take TBF samples. Administrative units sometimes have this capacity as well, when the unit has vector control technicians affiliated (20%, as in Table 5.7). The health facility survey (interview and observation) determined microscopic diagnostic capacity at 42.1% of primary and secondary care facilities and 20% of administrative units.

Table 5.7: Microscopy and thick blood film sampling according to interview + observation

	N	n	%	95% CI
Health units and hospitals				
Unit takes thick blood film samples	19	19	100	(-)
Unit has microscopy capacity	19	8	42.1	(22 - 66)
Administrative units (excluding national lab)				
Unit takes thick blood film samples	10	2	20	(5 - 56)
Unit has microscopy capacity	10	2	20	(5 - 56)

According to the interview alone and as seen in Table 5.8, 100% of primary and secondary care facilities have personnel that take TBF samples in-facility, and 31.6% have personnel that take TBF samples in the community. Among administrative units visited, 50% have personnel that take TBF samples in the community.

Table 5.8: Thick blood film sampling according to interview

	N	n	%	95% CI
Health units and hospitals				
Health personnel in this facility take thick blood film samples in-facility	19	19	100	(-)
Health personnel take thick blood film samples in the community	19	6	31.6	(14 - 56)
Administrative units (excluding national lab)				
Health personnel in this facility take thick blood film samples in-facility	10	2	20	(5 - 56)
Health personnel take thick blood film samples in the community	10	5	50	(21 - 79)

As shown in Table 5.9, 47.4% of primary and secondary care facilities and 50% of administrative units that take malaria samples conduct initial diagnosis of malaria according to the interview. Facilities that do not conduct initial diagnosis do not have microscopic diagnostic capacity. Of those 9 primary and secondary care facilities that report conducting initial diagnosis, 11.1% also examine samples taken by community health workers or volunteer collaborators, and 55.6% sometimes send slides elsewhere for initial diagnosis (for example, when the sole laboratorist is on leave). Among the 10 primary and secondary care facilities that do not conduct initial diagnosis, all send samples to another facility for initial diagnosis.

Among facilities that send samples to another facility (sometimes or always), the location where samples are sent is shown in Table 5.10.

Table 5.9: Sampling and microscopy capacity in facility according to interview, among facilities taking blood samples

	N	n	%	95% CI
Health units and hospitals				
Thick blood film samples examined for initial diagnosis of malaria in-facility	19	9	47.4	(26 - 70)
Thick blood film samples taken by community health workers (health promotors/volunteer collaborators) examined for malaria in-facility	9	1	11.1	(1 - 53)

	N	n	%	95% CI
Samples sometimes sent elsewhere for initial diagnosis of malaria, among facilities with capacity	9	5	55.6	(24 - 83)
Samples sent elsewhere for initial diagnosis of malaria, among facilities without capacity	10	10	100	(-)
Administrative units (excluding national lab)				
Thick blood film samples examined for initial diagnosis of malaria in-facility	2	1	50	(5 - 95)
Thick blood film samples taken by community health workers (health promotors/volunteer collaborators) examined for malaria in-facility	1	1	100	(-)
Samples sometimes sent elsewhere for initial diagnosis of malaria, among facilities with capacity	1	1	100	(-)
Samples sent elsewhere for initial diagnosis of malaria, among facilities without capacity	1	1	100	(-)

Table 5.10: Samples sent elsewhere: location

	N	n	%	95% CI
Health units: Location of initial diagnosis				
National laboratory	14	4	28.6	(10 - 58)
Another health facility	14	4	28.6	(10 - 58)
Departmental laboratory	14	4	28.6	(10 - 58)
Regional laboratory	14	1	7.1	(1 - 40)
Other	14	1	7.1	(1 - 40)
Hospitals: Location of initial diagnosis				
National laboratory	1	1	100	(-)

Facilities that reported conducting initial diagnosis were asked about the personnel responsible for examining slides, and respondents could indicate more than one type. In only 16.7% of primary care facilities there is at least one malaria microscopist, 16.7% of primary care facilities have at least one microbiologist who conducts malaria diagnosis, while most (83.3%) have other lab personnel that read malaria slides (Table 5.11).

Table 5.11: Personnel responsible for malaria microscopy testing

	N	n	%	95% CI
Health units: Personnel responsible for TBF examination				
Other lab technician	6	5	83.3	(34 - 98)
Malaria microscopist	6	1	16.7	(2 - 66)
Microbiologist (laboratory)	6	1	16.7	(2 - 66)
Hospitals: Personnel responsible for TBF examination				
Other lab technician	3	3	100	(-)

5.3.2 Performance 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 5.12.

Table 5.12: Indicator P7.01: Required components by facility type

Component	Health Units (16)	Hospitals (3)	SIBASI (8)	Regional Offices (2)	National Lab (1)
Medications (basic)				All	
Medications (severe malaria)				All	
Sampling equipment	All	All			
Forms for sending samples	All	All			
Microscopy equipment	If reported microscopy capacity (5/16)	If reported microscopy capacity (3/3)	If reported microscopy capacity (2/8)	If reported microscopy capacity (none)	If reported microscopy capacity (1/1)
Staining and sample reading equipment	If reported microscopy capacity (5/16)	If reported microscopy capacity (3/3)	If reported microscopy capacity (2/8)	If reported microscopy capacity (none)	If reported microscopy capacity (1/1)
Staining reagents	If reported microscopy capacity (5/16)	If reported microscopy capacity (3/3)	If reported microscopy capacity (2/8)	If reported microscopy capacity (none)	If reported microscopy capacity (1/1)

The performance indicator results are shown in Table 5.13. Only 20.8% of all the facilities in the sample had all of the inputs required for the corresponding facility type. Table 5.14 shows, for comparison, the results in malaria stratum 4 versus malaria stratum 3.

Table 5.13: Indicator P7.01: Equipment and medications

	N	n	%	95% CI
Antimalarial medications	2	0	0	(-)
Medications for basic treatment: Chloroquine	2	0	0	(-)
Medications for basic treatment: Primaquine (5 or 15 mg tablets)	2	0	0	(-)
Medication for treatment of severe malaria: Quinine / Artesunate	2	0	0	(-)
No stockout of chloroquine or primaquine in past 3 months	2	0	0	(-)
Sampling and biosafety equipment	19	6	31.6	(14 - 56)
Disposable gloves	19	8	42.1	(22 - 66)
Lancets	19	6	31.6	(14 - 56)
Microscope slides (frosted or non-frosted)	19	8	42.1	(22 - 66)
Sample submission forms[1]	10	5	50	(21 - 79)
Microscopy equipment	11	6	54.5	(25 - 81)
Binocular microscope (with 100x retractable lens)	11	11	100	(-)
Cell counter (manual or automatic)	11	6	54.5	(25 - 81)
Equipment for staining and testing	11	7	63.6	(32 - 87)
Immersion oil	11	8	72.7	(39 - 92)
Staining tray/ container	11	8	72.7	(39 - 92)
Laboratory stopwatch	11	8	72.7	(39 - 92)
Container for mixing dye/ stain	11	7	63.6	(32 - 87)
Pipettes/ droppers/ syringes	11	8	72.7	(39 - 92)
Reagents for staining	11	6	54.5	(25 - 81)
GIEMSA solution (or alternative: Methylene blue + Solution A + Solution B + Methanol)	11	8	72.7	(39 - 92)

	N	n	%	95% CI
Buffer solution or buffered water	11	7	63.6	(32 - 87)
No stockout of reagents in past 3 months	11	6	54.5	(25 - 81)
Units with all required equipment and medications	24	5	20.8	(8 - 43)

[1]Sample submission forms were captured in only 10/19 facilities

Table 5.14: Comparison: result by facility type

	N	n	%	95% CI
Health units & Hospitals				
Sampling and biosafety equipment	19	6	31.6	(14 - 56)
Sample submission forms[1]	10	5	50	(21 - 79)
Microscopy equipment	8	5	62.5	(27 - 88)
Equipment for staining and testing	8	5	62.5	(27 - 88)
Reagents for staining	8	4	50	(19 - 81)
Units with all required equipment and medications	19	4	21.1	(8 - 46)
SIBASI				
Microscopy equipment	2	0	0	(-)
Equipment for staining and testing	2	1	50	(5 - 95)
Reagents for staining	2	1	50	(5 - 95)
Units with all required equipment and medications	2	0	0	(-)
Regional offices				
Antimalarial medications	2	0	0	(-)
Units with all required equipment and medications	2	0	0	(-)
National lab				
Microscopy equipment	1	1	100	(-)
Equipment for staining and testing	1	1	100	(-)
Reagents for staining	1	1	100	(-)
Units with all required equipment and medications	1	1	100	(-)

[1]Sample submission forms were captured in only 10/19 facilities

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 5.15 and Table 5.16 show the proportion of facilities where each item for sample-taking and microscopy, respectively, was observed on the day of the survey. Some supplies for sample-taking (alcohol swabs, cotton-wool swabs, acetone or acetone alcohol, needles, vacutainer-type needles, capillary tubes) were sought for observation only in facilities with a microscopy post or laboratory.

Table 5.15: Sample-taking supplies observed, health units and hospitals

	N	n	%	95% CI
Disposable gloves	19	8	42.1	(22 - 66)
Alcohol swabs	19	4	21.1	(8 - 46)
Cotton-wool swabs	19	5	26.3	(11 - 51)
Acetone or Acetone alcohol (antiseptic)	19	7	36.8	(18 - 61)
Lancets	19	6	31.6	(14 - 56)

	N	n	%	95% CI
Syringes (for taking blood)	19	7	36.8	(18 - 61)
Needles	19	8	42.1	(22 - 66)
Vacutainer-type needles	19	6	31.6	(14 - 56)
Capillary tubes	19	5	26.3	(11 - 51)
Sharps box	19	6	31.6	(14 - 56)
Microscope slides (not frosted)	19	4	21.1	(8 - 46)
Frosted microscope slides	19	8	42.1	(22 - 66)

Table 5.16: Microscopy equipment and supplies observed, among all facilities reporting microscopy capacity

	N	n	%	95% CI
Lens-cleaning tissues	11	7	63.6	(32 - 87)
Spare bulbs (for microscopes)	11	4	36.4	(13 - 68)
Spare fuses (for microscopes)	11	0	0	(-)
Immersion oil	11	8	72.7	(39 - 92)
Oil immersion lens-cleaning solution	11	2	18.2	(4 - 53)
Staining rack	11	6	54.5	(25 - 81)
Drying rack (or sheet)	11	7	63.6	(32 - 87)
Measuring cylinder/disposable graduated cylinder	11	5	45.5	(19 - 75)
Glass or plastic bottles with a lid, that do not allow the passage of light	11	5	45.5	(19 - 75)
Filter paper (or other input to act as filter paper)	11	7	63.6	(32 - 87)
Slide holders or wooden dowels	11	8	72.7	(39 - 92)
Containers for mixing dye or stain	11	4	36.4	(13 - 68)
Concave staining surface	11	2	18.2	(4 - 53)
Glass petri dish	11	5	45.5	(19 - 75)
Plastic petri dish	11	4	36.4	(13 - 68)
Syringes	11	5	45.5	(19 - 75)
Disposable droppers	11	6	54.5	(25 - 81)
Test tubes	11	7	63.6	(32 - 87)
Safety glasses (including the over-spectacle type)	11	6	54.5	(25 - 81)
Gowns	11	7	63.6	(32 - 87)
Markers	11	7	63.6	(32 - 87)
Detergents	11	8	72.7	(39 - 92)
Timer in laboratory	11	6	54.5	(25 - 81)

Each microscope present at facilities in the sample was observed separately for characteristics. The number of microscopes at each facility is detailed in Figure 5.1. The observed characteristics, by microscope, are shown in Table 5.17.

Figure 5.1: Functional microscopes per facility

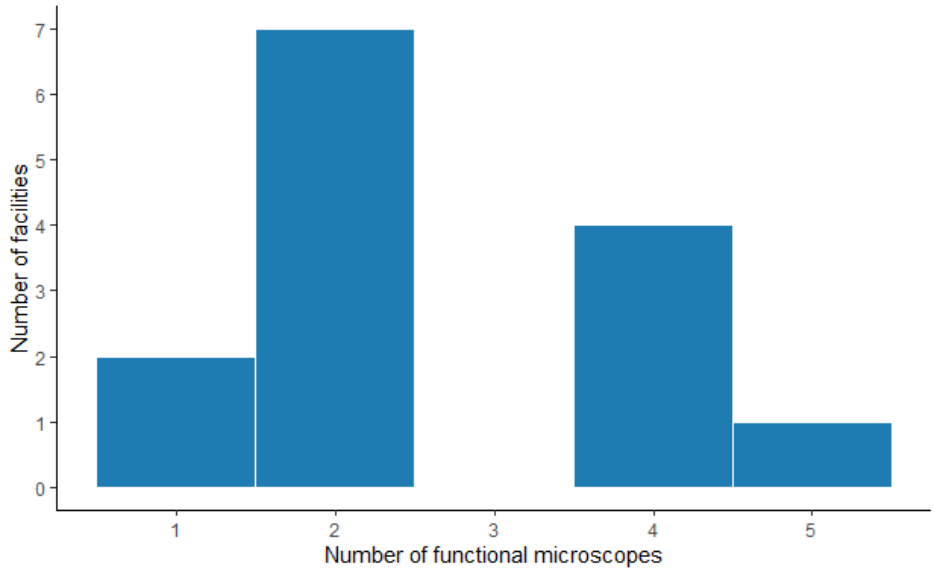


Table 5.17: Microscope characteristics among all observed microscopes

	N	n	%	95% CI
Is this a binocular microscope?	37	37	100	(-)
Is this a light microscope?	37	31	83.8	(67 - 93)
Is this a fluorescence microscope?	37	8	21.6	(11 - 39)
Is this a dark field microscope?	37	2	5.4	(1 - 20)
Lens observed: 4x	37	34	91.9	(77 - 98)
Lens observed: 10x	37	36	97.3	(82 - 100)
Lens observed: 20x	37	6	16.2	(7 - 33)
Lens observed: 40x	37	34	91.9	(77 - 98)
Lens observed: 100x	37	34	91.9	(77 - 98)
Lens observed: 1000x	37	2	5.4	(1 - 20)
Does the binocular microscope have an oil immersion lens?	37	35	94.6	(80 - 99)

Chapter 6: Malaria Case Detection

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 El Salvador, active case detection is carried out by vector control personnel both through planned activities and in response to imported malaria cases. Passive case detection relies on health facilities to suspect and test for malaria in patients who present with fever or other malaria symptoms, and is a key component of malaria program strategy in the elimination phase.

In El Salvador, clinical and community health personnel are trained to suspect and test for malaria in patients with high fever in zones with history of local transmission or among patients who have traveled to countries with endemic malaria. Other signs that suggest malaria are history of recent fever, chills, and sweating, particularly in an alternating pattern. In addition, zones with a history of malaria 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 Community case detection and malaria prevention activities

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

Table 6.1: Affiliated malaria personnel

	N	n	%	95% CI
Health units and hospitals				
Vector control personnel	19	3	15.8	(5 - 41)
Community health workers/volunteer collaborators	19	10	52.6	(30 - 74)
Other personnel involved in malaria diagnosis or treatment	18	4	22.2	(8 - 48)
Administrative units (excluding national lab)				
Vector control personnel	10	10	100	(-)
Community health workers/volunteer collaborators	10	6	60	(28 - 85)

As shown in Table 6.2, 57.9% of primary and secondary care facilities and 70% of administrative units reported that facility personnel participate in active searches for malaria. Some administrative units also reported storing mosquito nets for distribution (60%) and employing personnel involved with indoor residual spraying (60%). Educational campaigns about malaria were conducted by 63.2% of health units and hospitals and 80% of administrative units.

Table 6.2: Active case detection and community activities

	N	n	%	95% CI
Health units and hospitals				
Conducts active search for malaria cases	19	11	57.9	(34 - 78)
Stores insecticide-treated mosquito nets for distribution in the community	19	2	10.5	(2 - 36)
Performs indoor residual spraying	18	3	16.7	(5 - 43)
Conducts educational campaigns about malaria in the community	19	12	63.2	(39 - 82)

	N	n	%	95% CI
Other malaria outreach activities	19	10	52.6	(30 - 74)
Administrative units (excluding national lab)				
Conducts active search for malaria cases	10	7	70	(36 - 91)
Stores insecticide-treated mosquito nets for distribution in the community	10	6	60	(28 - 85)
Performs indoor residual spraying	10	6	60	(28 - 85)
Conducts educational campaigns about malaria in the community	10	8	80	(44 - 95)
Other malaria outreach activities	10	7	70	(36 - 91)

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 daily (50% of facilities). The breakdown of health facilities that complete active case detection after there is a case of malaria in the catchment area and health facilities that schedule active case detection on a periodic bases 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?				
Daily	18	9	50	(27 - 73)
On a scheduled periodic basis	18	5	27.8	(11 - 53)
Based on seasonality	18	4	22.2	(8 - 48)
After there is a case of malaria in the catchment area	18	3	16.7	(5 - 43)
When events (market, celebrations, vacations) are happening in the community	18	1	5.6	(1 - 33)
When directed from health authorities	18	1	5.6	(1 - 33)
Other	18	1	5.6	(1 - 33)

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

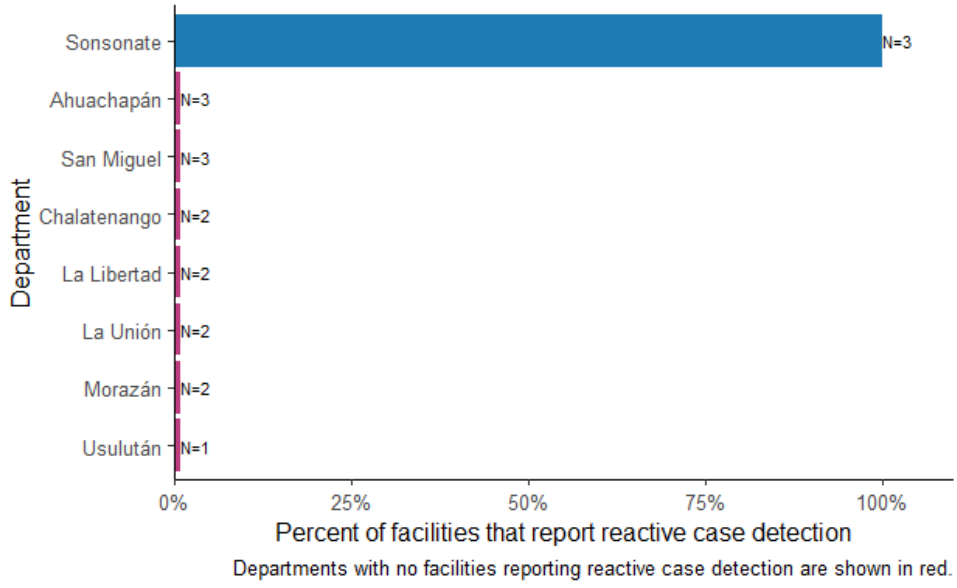
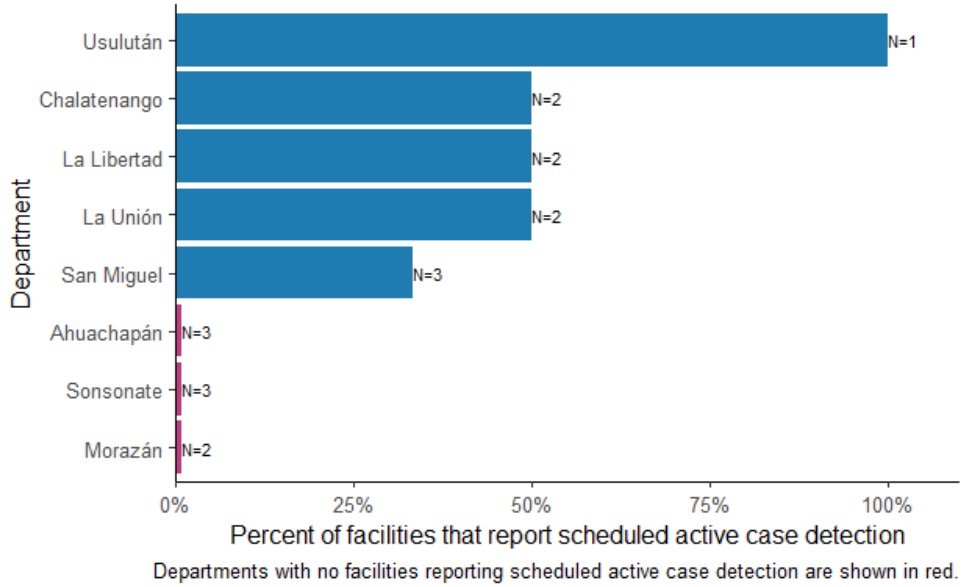


Figure 6.2: Active case detection scheduled on a periodic basis, by department



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 6.4.

Table 6.4: Community net distribution

	N	n	%	95% CI
Mode of treated net distribution				
Vector control personnel distributes the nets in the community	8	5	62.5	(27 - 88)
Personnel from this health facility distributes the nets in the community	8	3	37.5	(12 - 73)
Other	8	2	25	(6 - 65)

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, 10.5% of health units and hospitals received referrals from col-vols or other community health workers to treat malaria. Diagnosis activities were common, with 36.8% of primary and secondary care facilities receiving referrals for malaria testing.

Table 6.5: Community malaria activities - questionnaire

	N	n	%	95% CI
Health units and hospitals				
Do you receive referred patients from community health workers or volunteer collaborators for malaria testing?	19	7	36.8	(18 - 61)
Do you receive referred patients from community health workers or volunteer collaborators for malaria treatment?	19	2	10.5	(2 - 36)
Do health personnel take thick blood film samples in the community?	19	6	31.6	(14 - 56)
Administrative units (excluding national lab)				
Do health personnel take thick blood film samples in the community?	10	5	50	(21 - 79)

6.2 Passive case detection practices as measured in 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 suspicious symptoms will have a sample taken, usually of capillary blood, to prepare a TBF slide. If the *Plasmodium* parasite is detected, treatment with the first-line regimen corresponding to the parasite species begins and the case is notified to local vector control personnel and entered to the VIGEPES (*Sistema Nacional de Vigilancia Epidemiológica de El Salvador*) database. 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 blood sample information form (E-6) 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 and clinical 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 6.6 shows that doctors order the test in 62.5% of primary care facilities and 100% of secondary care facilities, and nurses order the test or take the sample at triage in 62.5% of primary care facilities and 33.3% of secondary care facilities. The hospital “other” response corresponded to general unspecified facility personnel who conduct malaria testing.

Table 6.6: Malaria testing by facility personnel among facilities conducting testing

	N	n	%	95% CI
Health units: Who decides whether a patient presenting at this facility will receive a malaria test?				
Nurse at triage or pre-clinic	16	10	62.5	(36 - 83)
Doctor during consult	16	10	62.5	(36 - 83)
Lab staff or microscopy staff	16	1	6.3	(1 - 36)
Hospitals: Who decides whether a patient presenting at this facility will receive a malaria test?				
Nurse at triage or pre-clinic	3	1	33.3	(4 - 86)
Doctor during consult	3	3	100	(-)
Other	3	1	33.3	(4 - 86)

Next, respondents were asked to mention what criteria are used to determine whether a patient gets a malaria test, at triage (Table 6.7) and at consult (Table 6.8). The respondent answered with the criteria they use at the facility and the interviewer marked the corresponding options in the survey without reading them aloud. In both triage and consult, high fever was an important criterion that determined testing (100%). No respondents mentioned travel history as a determining factor for malaria testing.

Table 6.7: Malaria testing criteria at triage

	N	n	%	95% CI
Health units: What criteria must a patient meet in order to get a blood sample taken for malaria test during triage or pre-clinic?				
High fever	10	10	100	(-)
History of recent fever	10	4	40	(15 - 72)
Chills	10	2	20	(5 - 56)
Sweating	10	2	20	(5 - 56)
General malaise	10	2	20	(5 - 56)
Fever for more than 3 days	10	1	10	(1 - 50)
Profuse sweating	10	1	10	(1 - 50)
Hospitals: What criteria must a patient meet in order to get a blood sample taken for malaria test during triage or pre-clinic?				
High fever	1	1	100	(-)

Table 6.8: Malaria testing criteria at consultation

	N	n	%	95% CI
Health units: What criteria must a patient meet in order for the doctor to order a malaria test during the consultation?				
High fever	10	10	100	(-)
History of recent fever	10	3	30	(9 - 64)
Chills	10	3	30	(9 - 64)
Sweating	10	3	30	(9 - 64)
General malaise	10	3	30	(9 - 64)
Profuse sweating	10	1	10	(1 - 50)
Other	10	1	10	(1 - 50)
Hospitals: What criteria must a patient meet in order for the doctor to order a malaria test during the consultation?				
High fever	3	3	100	(-)
Chills	3	1	33.3	(4 - 86)
General malaise	3	1	33.3	(4 - 86)
Other	3	1	33.3	(4 - 86)

6.3 Suspected malaria cases with test as measured in households

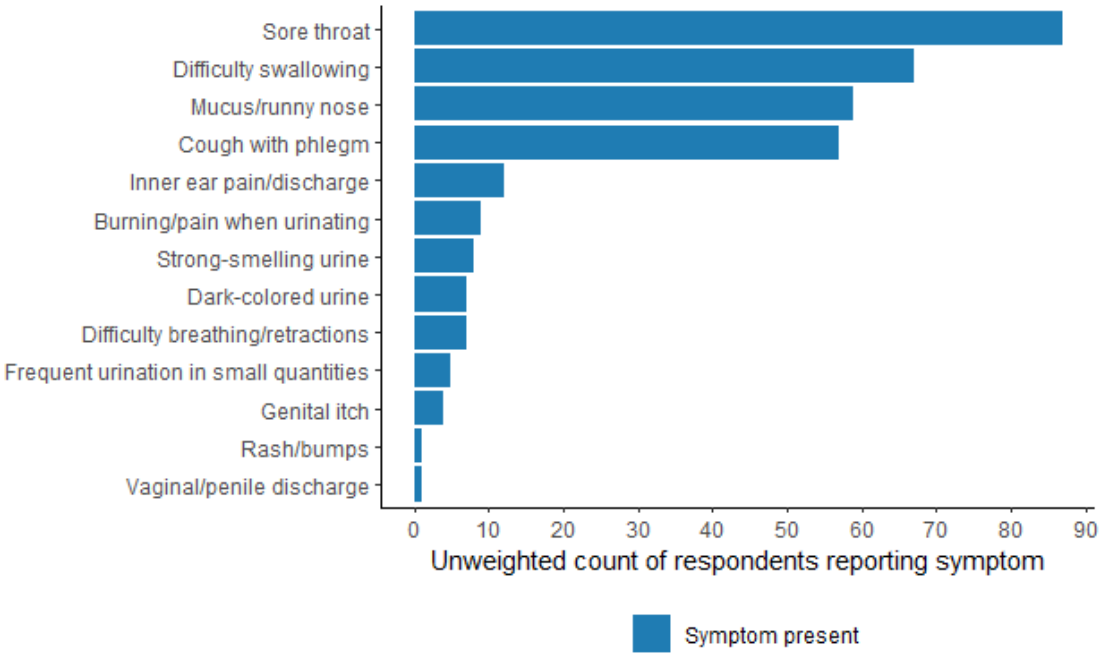
In the community survey (LQAS), interviews with households included questions about history of fever during the two weeks prior to the survey for all usual members of the household. The estimates from the LQAS survey reported in this section are not weighted due to the very small size of the sub-sample 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 6.9, 8.9% 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 129 respondents who reported experiencing fever, the majority experienced other symptoms that suggested a condition other than malaria. Only 22 people, or 17.1% 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 6.9: Eligible fever cases reported in LQAS household survey

	N	n	%	95% CI
LQAS respondents	1444	1444	100	(-)
Fever cases	1444	129	8.9	(7 - 11)
Fever without exclusion symptoms	129	22	17.1	(12 - 23)

Figure 6.3: Exclusion symptoms experienced by respondents reporting fever



6.3.1 Indicator 2.02: Suspected malaria cases with test (household)

In El Salvador, case detection is measured as an indicator for RMEI in the LQAS survey. 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 6.10, 33.3% of respondents with an eligible fever (with no exclusion symptoms) had a blood sample taken. The indicator result by malaria stratum is shown in Table 6.11.

Table 6.10: Indicator 2.02: Fevers with blood sample

	N	n	%	95% CI
Fever cases in past two weeks	1444	129	8.9	(7 - 11)
Fevers with no exclusion symptoms	129	22	17.1	(12 - 23)
Omitted due to 'do not know' responses	22	1	4.5	(1 - 30)
Fevers with any blood sample	21	7	33.3	(15 - 58)
Capillary blood test	21	3	14.3	(3 - 50)
Venal blood test	21	6	28.6	(11 - 56)

Table 6.11: Indicator 2.02: result by facility stratification

	N	n	%	95% CI
Fevers with any blood sample				
Stratum 2 (5 communities)	7	2	28.6	(10 - 60)
Stratum 3 (3 communities)	6	2	33.3	(11 - 67)
Stratum 4 (6 communities)	8	3	37.5	(7 - 83)
Total	21	7	33.3	(15 - 58)

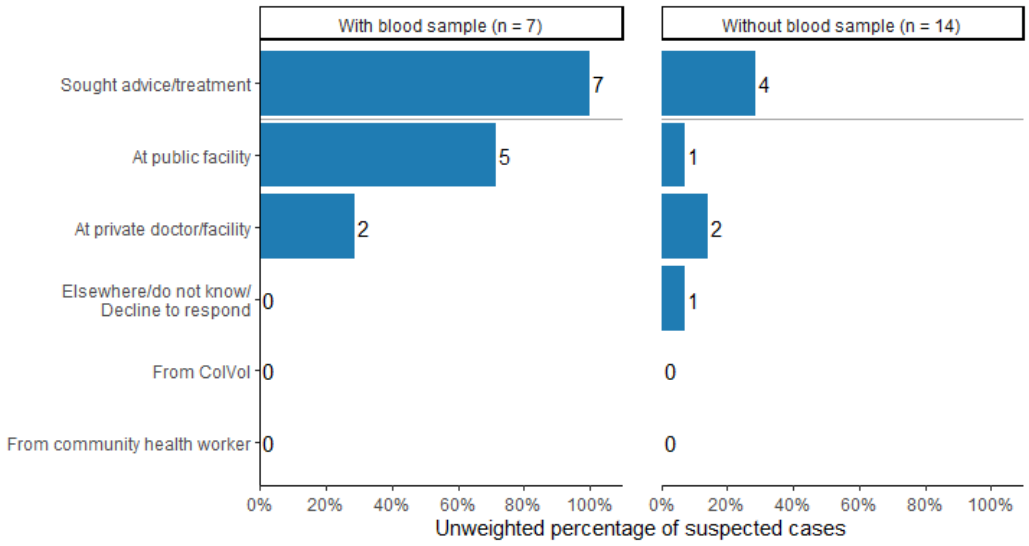
Respondents who reported a blood sample draw were asked whether their blood was tested for malaria, and if so, the result of the test. As seen in Table 6.12, only one respondent with a blood sample reported a malaria test, but the result was unknown.

Table 6.12: Result of blood tests, LQAS fevers

	N	n	%	95% CI
Blood tested for malaria	7	1	14.3	(1 - 66)
Result of malaria test				
Don't know	1	1	100	(-)

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 6.13 both excluding cases with symptoms suggesting an illness other than malaria (33.3%) and including all fever cases reported from the past two weeks (18.5%).

Table 6.13: Indicator 2.02: Fevers with blood sample, with and without exclusion symptoms

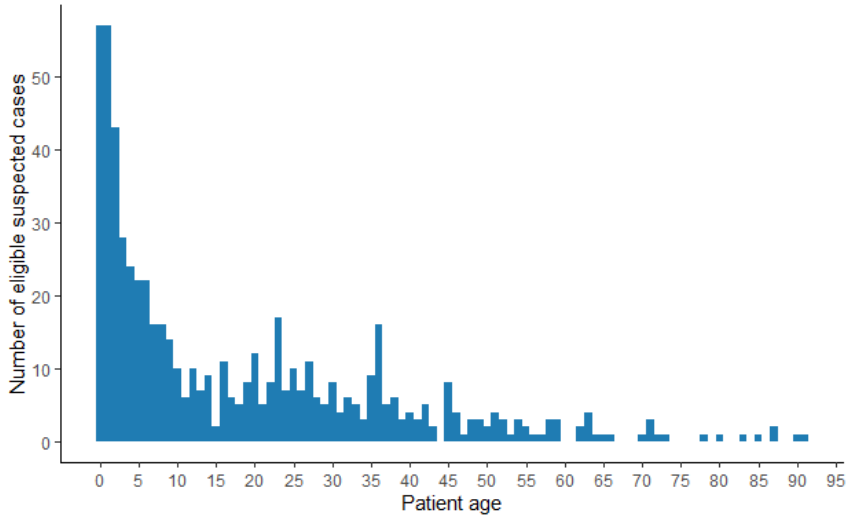
	N	n	%	95% CI
Fevers (with no exclusion symptoms) with any blood sample	21	7	33.3	(15 - 58)
All fevers with any blood sample	124	23	18.5	(10 - 32)

6.4 Suspected malaria cases with test as measured in 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 fever lists, attention registries or diagnosis databases according to the process described in 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

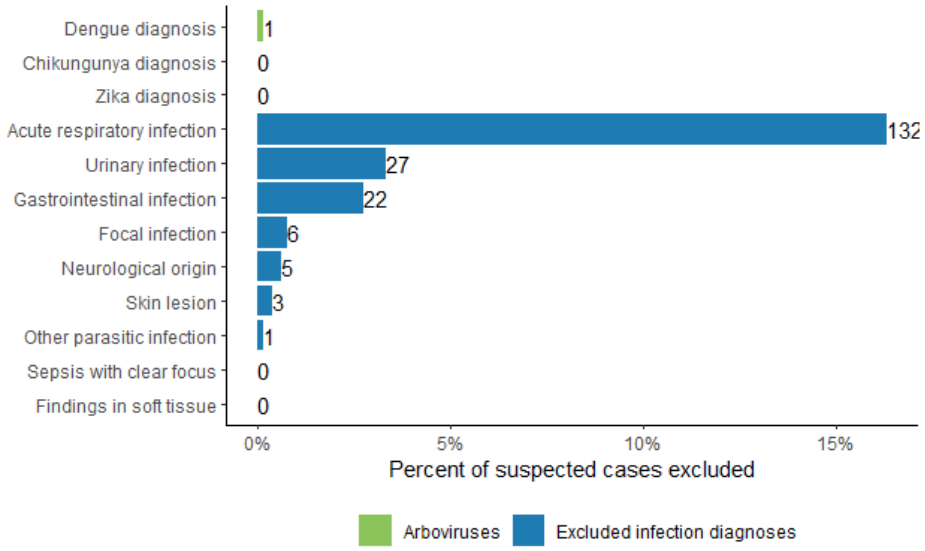
each case, field staff reviewed attention registries, laboratory records, and patient medical records as available and entered information related to the diagnosis, symptoms, and lab tests to the electronic survey module. No information that could identify the patients was collected. The patient age distribution of eligible suspected cases can be seen in Figure 6.5. Many of the suspected cases identified were in patients under age 10, likely because fevers are more prevalent in children or heath care is sought for them more often than for adults.

Figure 6.5: Suspected cases patient age



Some of the sampled records were eligible to be selected from a list of all febrile patients or 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 6.6. 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.

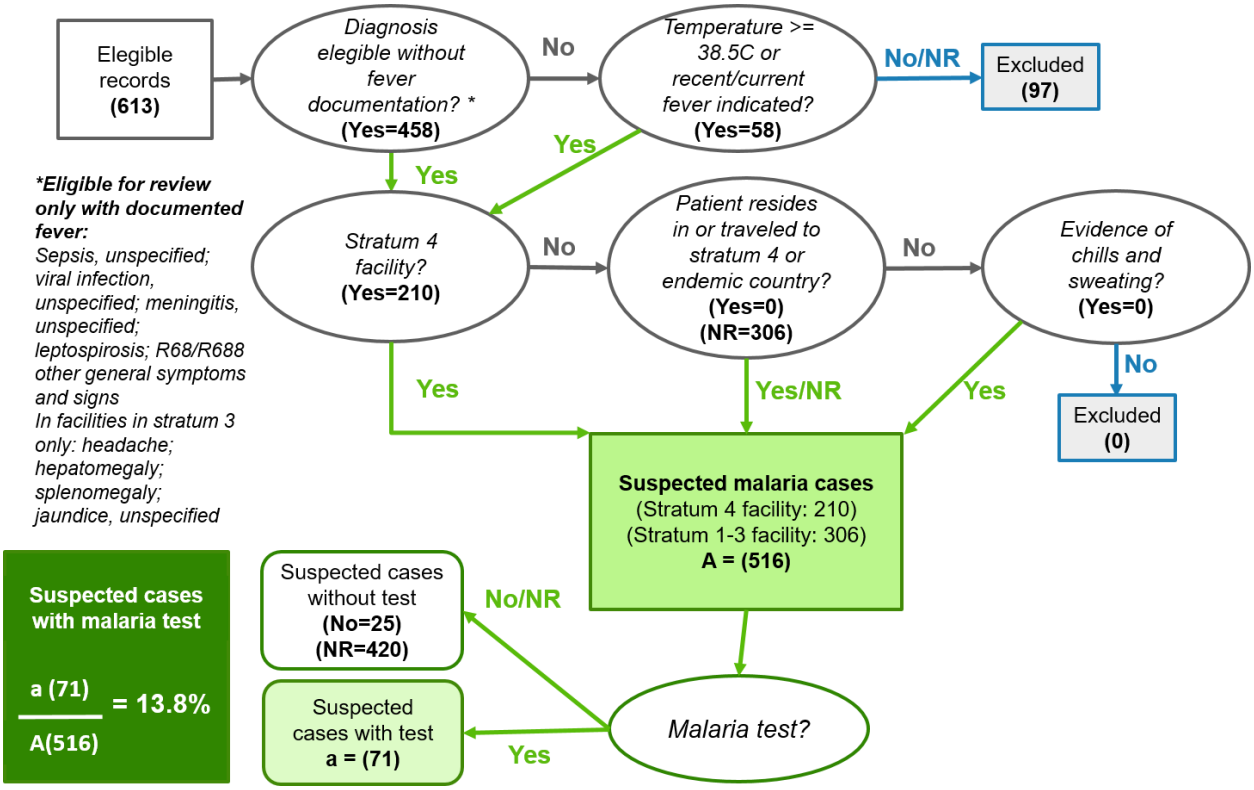
Figure 6.6: Exclusion diagnoses for review of suspected malaria cases



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 6.7. Facilities in malaria stratum 4 are subject to a different suspected malaria case definition than facilities in malaria strata 3, 2, and 1, 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 6.7: Eligibility of suspected cases reviewed for Indicator 2.01



In total in El Salvador, 516 of the 613 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. Either a rapid diagnostic test or thick blood film was acceptable for the indicator, though no patients had evidence of an RDT in the record. As shown in Table 6.14, 13.8% of patients with suspected malaria had evidence that a malaria test was received. Table 6.15 shows the results by malaria stratum for comparison. Suspected case records were reviewed at two hospitals in stratum 1, however these hospitals provide services by referral to catchment areas in malaria strata 3 and 4. Figure 6.8 shows the indicator result by department.

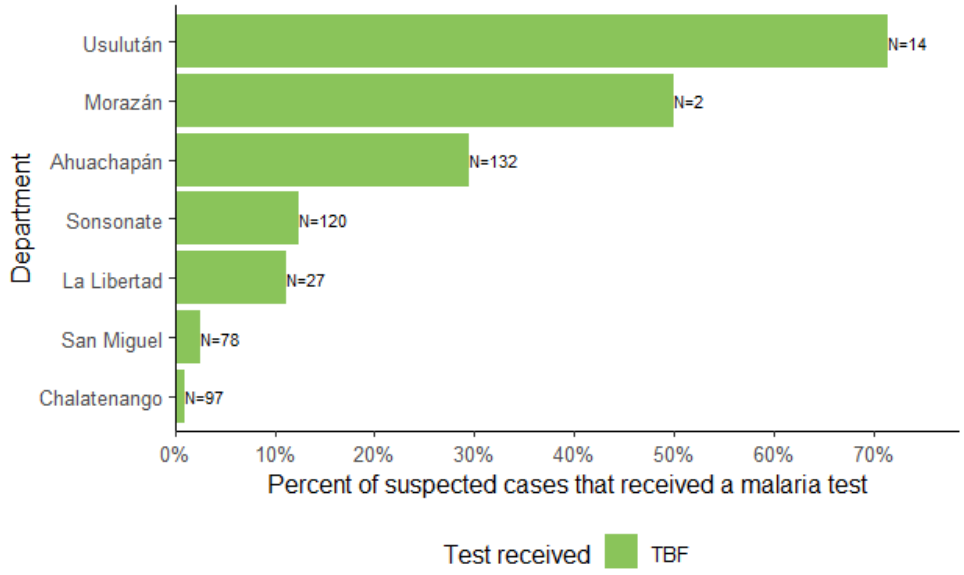
Table 6.14: Indicator 2.01: Suspected cases with malaria test

	N	n	%	95% CI
Suspected case with malaria test	516	71	13.8	(11 - 17)
Rapid diagnostic test	71	0	0	(-)
Thick blood film	71	71	100	(-)

Table 6.15: Indicator 2.01: result by facility stratification

	N	n	%	95% CI
Suspected cases with malaria test				
Stratum 4	210	52	24.8	(19 - 31)
Stratum 3	82	12	14.6	(8 - 24)
Stratum 2	104	3	2.9	(1 - 9)
Stratum 1	120	4	3.3	(1 - 9)
Total	516	71	13.8	(11 - 17)

Figure 6.8: Indicator 2.01: result by department



6.5 Timely diagnosis of confirmed malaria cases as measured in 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. Both confirmed malaria cases that occurred in El Salvador during 2018 were located and all available records were reviewed, including case notification forms, case investigation forms, and any patient charts, laboratory records, or treatment forms. Details for each case are described in Table 6.16. These cases were initially expected to be found at the SIBASI headquarters of the department of detection, however data collectors in the field were unable to locate the relevant records at those locations. Instead, data collectors visited the health facilities where the cases were diagnosed and treated to find the required forms. In the *P. falciparum* case, the records were found at a social security hospital where the patient was diagnosed and sought treatment.

Table 6.16: El Salvador confirmed cases description

	Case 1	Case 2
Department	Sonsonate	San Salvador
Species	P. vivax	P. falciparum
Classification	Imported	Imported
Probable location of infection	Not registered	Senegal (possibly chloroquine-resistant)
Source of detection	Active search	Passive search (social security hospital)
Forms reviewed	• Medical record/ clinical history • VIGEPES-01 notification form • VIGEPES-03 investigation form	Medical record/ clinical history
Location of record review	Health unit where case was detected	General Hospital (Instituto Salvadoreño del Seguro Social)
Stratum of facility where reviewed	4	1
Diagnostic test	Thick blood film	Thick blood film

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

Diagnosis within two days (48 hours) of symptom onset was negotiated as an indicator for RMEI. As shown in Table 6.17, only one of the confirmed case records in El Salvador had both fever/symptom onset and diagnosis dates registered, and neither were diagnosed within 48 hours of fever/symptom onset. The case with both dates registered showed diagnosis occured 14 days after symptom onset.

Table 6.17: Indicator 4.02: Fever/symptom onset to diagnosis within 48 hours

	N	n	%	95% CI
Denominator: Confirmed cases with valid dates	2	2	100	(-)
Fever/symptom onset date registered	2	1	50	(0 - 100)
Diagnosis date registered	2	2	100	(-)
Both dates registered	2	1	50	(0 - 100)
Cases diagnosed within 48 hours of onset	2	0	0	(-)
3 days	2	0	0	(-)
4-5 days	2	0	0	(-)
6-7 days	2	0	0	(-)
Over 7 days	2	1	50	(0 - 100)
Indicator result: Cases diagnosed within 48 hours of onset	2	0	0	(-)

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. While the VIGEPES-01 notification form was only found and reviewed for one case, both cases had notification dates recorded and notification occured within 24 hours of diagnosis in both cases.

Table 6.18: Indicator E2.04: Notification within 24 hours of diagnosis

	N	n	%	95% CI
Diagnosis date registered	2	2	100	(-)
Notification date registered	2	2	100	(-)
Both dates registered	2	2	100	(-)
Notification within 24 hours of diagnosis	2	2	100	(-)

Chapter 7: Malaria treatment

In El Salvador, routine malaria treatment is managed by the malaria program but administered by health facility personnel. Treatment is stored at the health region and if a malaria case is confirmed, vector control personnel will deliver the medication to the health facility to be administered to the patient. Supervision of ingestion of all doses is the norm in much of El Salvador in order to ensure each patient completes the radical cure. The patient may visit the health facility for each dose of treatment, facility personnel may deliver the doses to the patient's home, or the patient may be given the full course of treatment to self-administer, in which case vector personnel check that the treatment has been taken when they visit the patient's home to conduct malaria follow-up tests. All cases of complicated malaria and *P. falciparum* are hospitalized until the full course of treatment has been completed according to the national norm. 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 diagnose malaria cases infrequently).

7.1 Treatment administration practices

The health facility interview includes questions about malaria service provision. 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). Some facilities report that they prescribe treatment via their own pharmacies (25% of primary care facilities), supervise treatment at the facility (18.8% of primary care facilities), and more often that facility personnel supervise treatment in the community, as in home visits (50% of primary care facilities). "Other" responses generally stated that the facility has not seen any cases of malaria.

Table 7.1: Services provided by facilities for malaria treatment

	N	n	%	95% CI
Health units: Services provided for malaria treatment				
Prescribe treatment to pharmacy at this facility	16	4	25	(9 - 53)
Supervise ingestion (in the facility)	16	3	18.8	(6 - 47)
Supervise ingestion (in the community)	16	8	50	(26 - 74)
None of the above	16	6	37.5	(17 - 64)
Other	16	2	12.5	(3 - 41)
Hospitals: Services provided for malaria treatment				
None of the above	3	2	66.7	(14 - 96)
Other	3	1	33.3	(4 - 86)

In the malaria elimination phase, 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 all primary care facilities that supervise treatment, all doses are supervised at the facility.

Table 7.2: Doses supervised in-facility

	N	n	%	95% CI
Health units: Doses supervised in-facility				
All doses	3	3	100	(-)

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 7.3, only one primary care facility reported stock of antimalarials.

Table 7.3: Facility types reporting stock of antimalarials

	N	n	%	95% CI
Facilities reporting antimalarial stock in past 3 months				
Health units	16	1	6.3	(1 - 36)
Hospitals	3	0	0	(-)

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 7.4. At the facility that reported stocking any antimalarials, primaquine and chloroquine were observed. 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 7.5, valid doses of both chloroqine and primaquine were observed.

Table 7.4: Reported stock of antimalarials

	N	n	%	95% CI
Health units and hospitals				
Has this facility stocked any antimalarials for at least one day over the past three months?	19	1	5.3	(1 - 32)
Chloroquine	1	1	100	(-)
Primaquine	1	1	100	(-)

Table 7.5: Antimalarials observed in facility, among those reporting stock

	N	n	%	95% CI
Chloroquine tablets observed				
At least one observed and valid	1	1	100	(-)
Primaquine tablets observed				
At least one observed and valid	1	1	100	(-)

The health facility interview also asked about antimalarial medication stock and administration. Table 7.6 shows some discrepancies with Table 7.3 - 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. Administrative units did not report stock of antimalarials.

Table 7.6: Antimalarials medications stored, questionnaire

	N	n	%	95% CI
Questionnaire: Does this facility store medications to treat malaria?				
Health units and hospitals	19	4	21.1	(8 - 46)
Administrative units (excluding national lab)	10	0	0	(-)

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 7.7). Most facilities informed that the patient is referred to a location that stores medication (78.9% of health units and hospitals). Respondents who indicated “other” generally specified that the patient is referred to a hospital (hospitals do not store treatment in El Salvador; it is delivered from the regional or central level when required).

Table 7.7: Antimalarial delivery for severe or chloroquine-resistant cases

	N	n	%	95% CI
Health units and hospitals: 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	19	15	78.9	(54 - 92)
Other	19	5	26.3	(11 - 51)
Administrative units (excluding national lab): 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?				
Treatment is delivered to the patient's home by vector control or malaria program staff	10	2	20	(5 - 56)
Other	10	6	60	(28 - 85)
Don't know	10	2	20	(5 - 56)

The interview also asked about how antimalarial supplies are managed. As seen in Table 7.8, 75% of primary care facilities that reported antimalarial stock generally order their own antimalarials. Among these facilities, all reported that stock orders are typically received within one day and that the delivery is always the full requested amount. At the facility that does not determine its own antimalarial supplies, the supply is determined by the local vector control or malaria program personnel (Table 7.9).

Table 7.8: Determination of malaria medication needs

	N	n	%	95% CI
Health units: How is the quantity of malaria medication needed by this facility determined?				
Facility determines quantity and orders	4	3	75	(21 - 97)
Quantity determined elsewhere	4	0	0	(-)
Both methods used	4	1	25	(3 - 79)
Hospitals: How is the quantity of malaria medication needed by this facility determined?				
Facility determines quantity and orders	0	0		-
Quantity determined elsewhere	0	0		-
Both methods used	0	0		-

Table 7.9: Determination of malaria medication needs: authority

	N	n	%	95% CI
Health units: Who determines the quantity of malaria medication that are given to this facility?				
Local vector control or malaria program personnel	1	1	100	(-)

Table 7.10: Medication order reliability

	N	n	%	95% CI
Health 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	4	4	100	(-)
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)?				
Always	0	0		-

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. In both confirmed 2018 cases in El Salvador, both the diagnosis and treatment dates were recorded.

Antimalarial treatment is prescribed according to the test result. In El Salvador, 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. Both El Salvador cases were imported, but only one of them was *P. falciparum*. Since the likely infection location of this case was Senegal, an area with the chloroquine-resistant *P. falciparum* species, this case required the artemisinin treatment.

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 7.11. Both cases reviewed had the correct treatment administered within 24 hours of diagnosis. In one case, treatment was administered on the day of diagnosis. For the other, treatment was administered the day following diagnosis. The *P. falciparum* case was administered the COARTEM combined artemeter and lumefantrine antimalarial.

Table 7.11: Indicator 4.01: Timely treatment initiation

	N	n	%	95% CI
Total malaria cases	2	2	100	(-)
Correct treatment administered for species	2	2	100	(-)
Diagnosis and treatment dates registered	2	2	100	(-)
First dose treatment within 24 hours of diagnosis	2	2	100	(-)
Correct treatment administered within 24 hours of diagnosis	2	2	100	(-)

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. In El Salvador, the national norm requires treatment according to parasite species, following these regimens:

- For *P. vivax* cases and *P. ovale* cases: 3 days of chloroquine and 7 or 14 days of primaquine
- For *P. falciparum* cases without documented resistance to chloroquine: 3 days of chloroquine and one day of primaquine
- For mixed infections cases without documented resistance to chloroquine: 3 days of chloroquine and 7 or 14 days of primaquine
- 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
- For mixed infections cases from areas with documented resistance to chloroquine: 3 days of artemisinin-based treatment (artemether + lumefantrine) and 7 or 14 days of primaquine
- For severe malaria cases: If IV treatment with artesunate started, when completed: 3 days of artemisinin-based treatment (artemether + lumefantrine)and one day of primaquine

7.4.1 Completion of malaria treatment

Table 7.12 shows treatment completion by parasite species as registered on the medical records and other forms observed for each case. Only the *P. falciparum* case had evidence of complete treatment (three doses). The *P. vivax* case had evidence that 13 doses of treatment were received, but 14 doses of primaquine are required for the treatment to be considered adequate.

Table 7.12: Confirmed cases: Complete treatment by malaria species

	N	n	%	95% CI
Total cases with adequate treatment complete	2	1	50	(0 - 100)
P. vivax case with adequate treatment complete	1	0	0	(-)
Chloroquine-resistant area P. falciparum case with adequate treatment complete	1	1	100	(-)

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. Table 7.13 shows the indicator results. Neither case had evident of complete and supervised treatment, as the *P. falciparum* case did not have evidence of dose supervision registered. While the *P. vivax* case did have evidence of supervision, it did not receive adequate treatment according to the vivax treatment scheme. Details of the treatment administered for each case are shown in Table 7.14.

Table 7.13: Indicator 4.03: Complete treatment with supervision

	N	n	%	95% CI
Denominator: Total malaria cases	2	2	100	(-)
Adequate treatment and number of doses administered	2	1	50	(0 - 100)
Evidence of at least one supervised dose	2	1	50	(0 - 100)
Indicator Result: Complete treatment with supervision	2	0	0	(-)

Table 7.14: Indicator 4.03: Case treatment details

	Case 1 (P. vivax)	Case 2 (P. falciparum with chloroquine resistance)
Administrations of chloroquine registered	13	6
Administrations of primaquine registered	13	1
Administrations of artemisinin (COARTEM) registered	-	3
Evidence of at least one supervised dose	Yes	No (The patient was hospitalized for the duration of treatment, but supervision was not registered in the medical record)

7.5 Case investigation

In the elimination phase, every confirmed case of malaria must 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.

7.5.1 Case investigation practices

In El Salvador, the malaria environmental investigation is usually carried out by a vector control technician after diagnosis is made. It includes an interview with the patient and an analysis of the information provided in order to classify the malaria case. The VIGEPES-03 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 SIBASI and regional levels. In El Salvador, the VIGEPES-03 case investigation form was only observed for one of the two 2018 malaria cases reviewed.

7.5.2 Case detection source and classification

During the confirmed case medical record review, field personnel reviewed two cases, one of which was detected through active search and the other through passive search at a social security hospital where the patient sought care. Both cases were classified as imported to El Salvador (Table 7.15).

Table 7.15: Confirmed case detection

	Case 1	Case 2
Department	Sonsonate	San Salvador
Species	P. vivax	P. falciparum
Classification	Imported	Imported
Probable location of infection	Not registered	Senegal (possibly chloroquine-resistant)
Source of detection	Active search	Passive search (social security hospital)
Forms reviewed	• Medical record/ clinical history • VIGEPES-01 notification form • VIGEPES-03 investigation form	Medical record/ clinical history

7.6 Case management

7.6.1 Patient follow-up testing: health facility interview

According to the health facility interview and as shown in Table 7.16, 82.4% of respondents at primary and secondary care facilities said that malaria patients receive at least one follow-up test in order to ensure the malaria infection has gone away. As expected in El Salvador, only thick blood film sampling is used for follow-up malaria testing. (Table 7.17).

Table 7.16: 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?				
Health units and hospitals[1]	17	14	82.4	(55 - 95)
Administrative units (excluding national lab)	10	7	70	(36 - 91)

[1]One health unit and one hospital responded 'do not know' to follow-up practices and are excluded.

Table 7.17: 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	21	21	100	(-)

The interview also asked how many follow-up tests are routinely administered according to facility practices (Figure 7.1), and when the first and last samples are taken from the patient for follow-up testing (Figure 7.2). Follow-up testing typically occurs within one month after treatment.

Figure 7.1: Follow-up tests administered according to facility practices

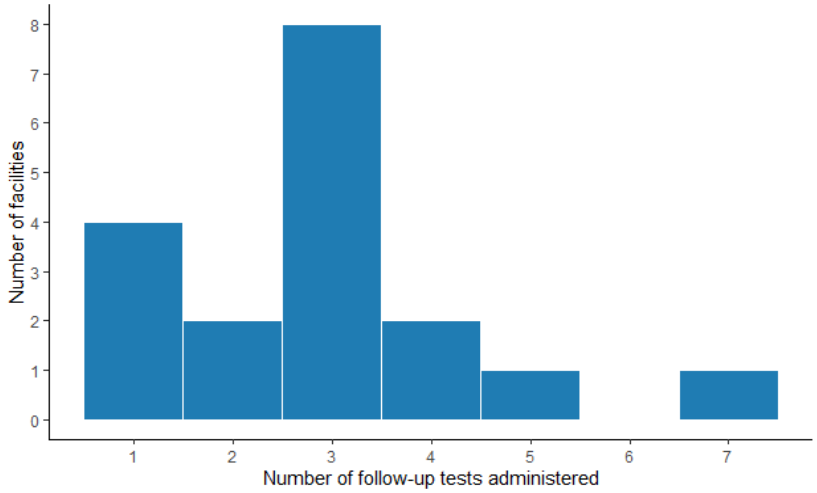
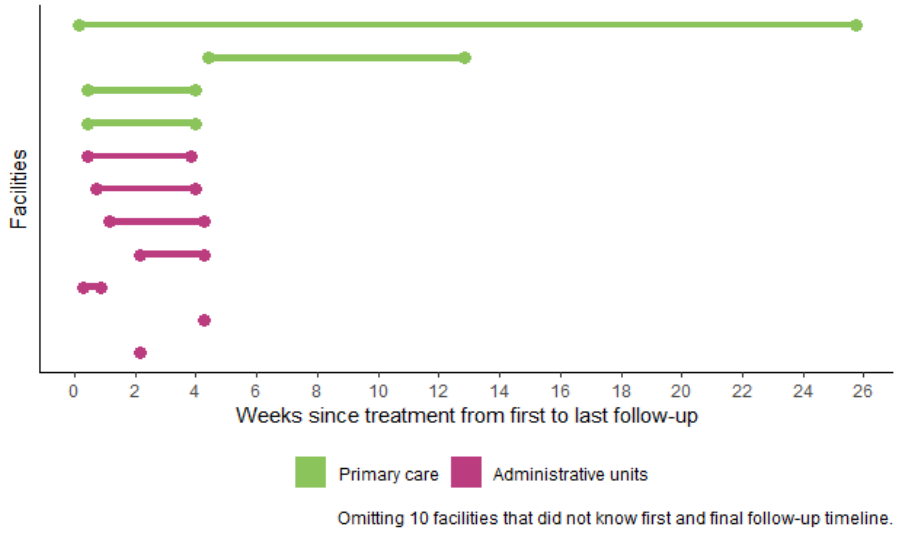


Figure 7.2: Timing from first to last follow-up test



7.6.2 Patient follow-up testing: medical record review

Both confirmed cases reviewed in El Salvador had evidence of follow-up testing conducted post-treatment. The follow-up testing scheme for the case treated at a public health unit (case 1) generally aligned with the process described in health facility interviews, with the final follow-up test occuring just under one month from treatment.

Table 7.18: Follow-up testing after malaria treatment: medical record review

	Case 1 (P. vivax)	Case 2 (P. falciparum)
Received follow-up testing	Yes	Yes
Number of follow-up tests	2	4
Days from treatment to first follow-up test	3	2
Days from treatment to final follow-up test	28	4
Result of final follow-up test	Negative for malaria	Negative for malaria

7.7 Case response

Information extracted from the case investigation also allows vector control programs to plan community activities in response to a confirmed malaria case. For the single case in El Salvador where the case investigation form was observed, no information about vector control responses was registered. However, data regarding active case detection performed in response to the confirmed case was recorded. Details on the case investigation for the *P. vivax* confirmed case are displayed in Table 7.19. All family members were tested for malaria and a reactive search was conducted in nearby households.

Table 7.19: Medical record review case response

	Case 1 (P. vivax)
Case investigation completed?	Yes
Patient used/slept under insecticide-treated net?	Not registered
House sprayed?	Not registered
Family members tested for malaria	3/3 (0 positive)
Active case detection conducted?	Yes
Households visited for active case detection	112
TBF malaria tests conducted during active case detection	112

Chapter 8: Surveillance, Notification, and Reporting

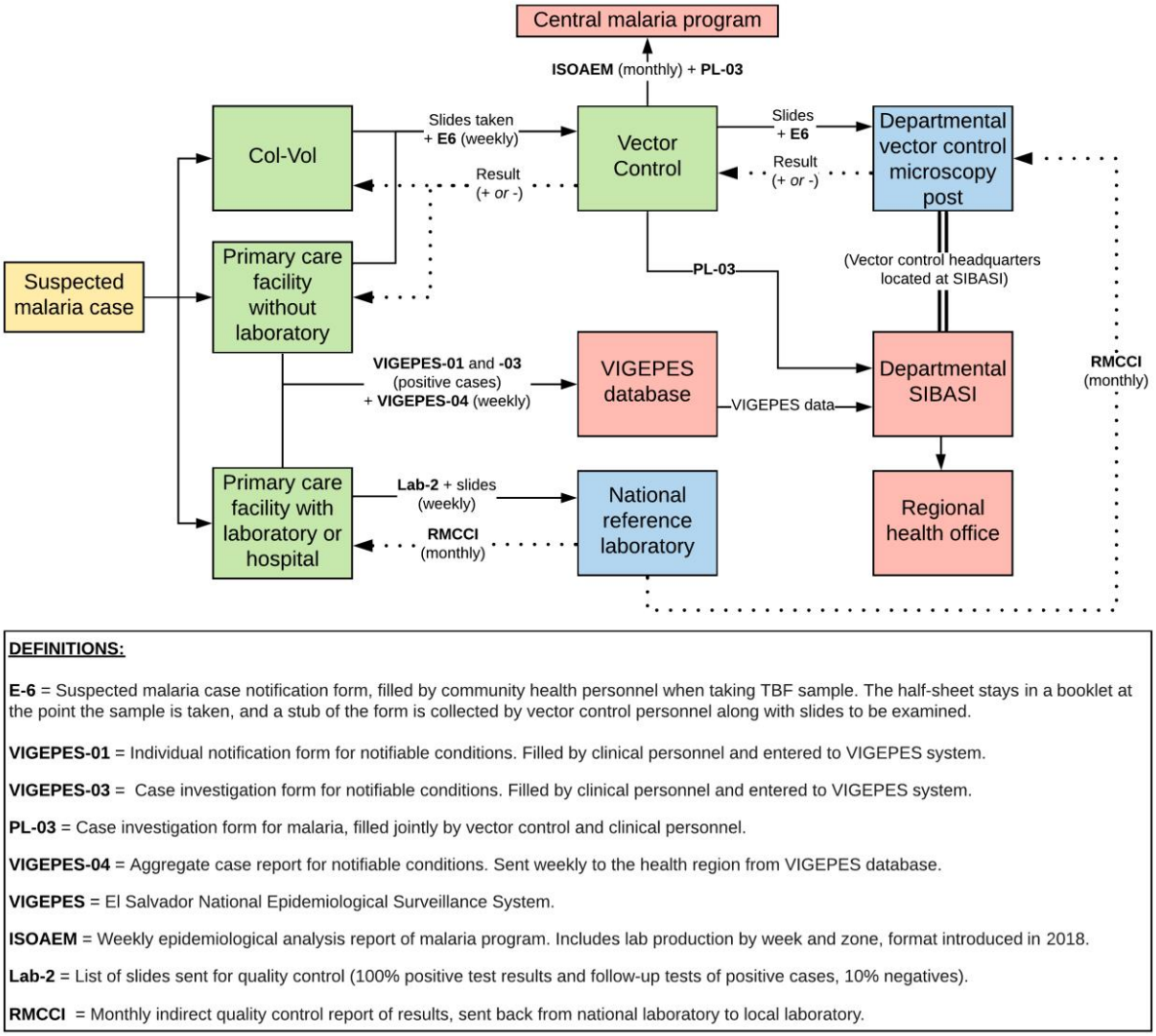
This chapter provides an overview of the malaria surveillance system in El Salvador based on the fact-finding visit and health facility surveys, and summarizes results related to case reporting and laboratory reporting and quality control indicators.

8.1 Background

The fact-finding trip in July 2019 allowed for an understanding of 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 8.1 shows the information flows beginning with a patient with malaria symptoms. The left side of the diagram shows sample-taking and examination practices, already discussed in Chapters 5 and 6. Once a slide has been examined, the patient must be informed of the test result. Additionally, the laboratory is obligated to inform the national reference laboratory of malaria test results. Negative results are informed in aggregate, once weekly or once monthly. Positive results must be entered to the VIGEPES system (*Sistema nacional de vigilancia epidemiológica de El Salvador*, national electronic surveillance system) immediately by clinical or statistics personnel in the facility conducting the diagnosis, which constitutes an automated notification to the malaria program at all levels. Confirmed cases are notified to the corresponding SIBASI office immediately, and clinical, epidemiological, and vector control personnel fill the PL-03 malaria case investigation form. Any positive results will also be included in aggregate weekly laboratory reporting. Facilities with capacity to diagnose malaria are obligated to prepare weekly case reports for notifiable diseases (malaria alongside other illnesses with obligatory notification, VIGEPES-04), and to submit these reports via the VIGEPES system. As a part of RMEI, the malaria program introduced a weekly report analyzing laboratory production, but the format was not widely used during 2018.

Figure 8.1: El Salvador surveillance system flow diagram



8.2 Notification of malaria test results

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

The health facility interview included questions about notification of malaria test results. As described in Chapter 5, health facilities that do not have microscopic diagnostic capacity in-facility (or have it in-facility only at certain days or hours) may send thick blood film slides to another health facility or laboratory for initial diagnosis. Table 8.1 and Table 8.2 show the method by which a patient is notified of a negative test result among the six 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 83.3% of facilities). Among the five facilities where facility personnel are responsible to notify at least some patients of the test result, the notification is often in person (in 80% of facilities). “Other” responses indicated that the negative test result is recorded in the patient’s medical record by statistics personnel.

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

	N	n	%	95% CI
Who notifies the patient of a negative test result?				
Health personnel from this facility	6	5	83.3	(34 - 98)
Other	6	2	33.3	(8 - 75)

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

	N	n	%	95% CI
How is the patient notified of a negative test result? (among those notified by facility personnel)				
In person	5	4	80	(28 - 98)
Other	5	1	20	(2 - 72)

In the case of a positive test result, ten facilities that send slides elsewhere for examination reported they receive positive test results for the slides they send. Among these facilities, 80% are sometimes or always responsible to notify the patient of the positive test result by their own personnel (Table 8.3). Among these eight facilities, the most common modality for notification of a positive test result is in person (Table 8.4). Text responses for “other” entries for personnel who notify the patient of positive test results show that a doctor informed the patient of the results, without specifying where the doctor was located.

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

	N	n	%	95% CI
Who notifies the patient of a positive test result?				
Health personnel from this facility	10	8	80	(44 - 95)
The laboratory that tested the sample	10	1	10	(1 - 50)
Vector control personnel	10	1	10	(1 - 50)
Community health worker	10	1	10	(1 - 50)
Other	10	2	20	(5 - 56)

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

	N	n	%	95% CI
How is the patient notified of a positive test result? (among those notified by facility personnel)				
In person	8	8	100	(-)

8.2.2 Notification to patient among facilities that examine slides for malaria

Other health facilities reported their own microscopic diagnosis capacity in-house. In these 10 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 70% of facilities (Table 8.5). In the case that a positive test result is detected in the facility, 80% are sometimes or always responsible to notify the patient of the positive test result by their own personnel. Text responses for “other” show that personnel from the affiliated SIBASI or hospital notify the patient of the test result.

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

	N	n	%	95% CI
Who notifies the patient of a negative test result?				
Health personnel from this facility	10	7	70	(36 - 91)
The patient is not notified	10	1	10	(1 - 50)
Other	10	4	40	(15 - 72)

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

	N	n	%	95% CI
Who notifies the patient of a positive test result?				
Health personnel from this facility	10	8	80	(44 - 95)
Community health worker/health promoter	10	1	10	(1 - 50)
Vector control personnel	10	1	10	(1 - 50)
Other	10	5	50	(21 - 79)

8.2.3 Notification to health authorities among facilities that examine slides for malaria

When a case of malaria is confirmed in El Salvador, notification must be sent to health authorities. Among all facilities that examine TBF slides, 50% notify the epidemiological surveillance unit and 40% notify the national laboratory (Table 8.7).

Table 8.7: Notification to health authorities of positive test results

	N	n	%	95% CI
Who is notified when a confirmed case of malaria is detected?				
Epidemiological surveillance unit	10	5	50	(21 - 79)
National laboratory	10	4	40	(15 - 72)
Local vector control unit	10	4	40	(15 - 72)
Regional laboratory	10	3	30	(9 - 64)
Regional health authority	10	2	20	(5 - 56)
National malaria program	10	1	10	(1 - 50)
Other	10	1	10	(1 - 50)

8.3 Malaria surveillance data and reporting

All health facilities in the sample were asked if they have access to an electronic health information system as shown in Table 8.8. Eighty-four percent of health units and hospitals and 90% 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 75% of health units and hospitals and 88.9% of administrative units reported access to a system used for malaria information.

Table 8.8: Access to electronic information systems

	N	n	%	95% CI
Health units and hospitals				
Access to an electronic health information system for capturing and/or consulting health statistics	19	16	84.2	(59 - 95)
Access to an electronic health information system for entering malaria-specific information	16	12	75	(47 - 91)
Administrative units (excluding national lab)				
Access to an electronic health information system for capturing and/or consulting health statistics	10	9	90	(50 - 99)
Access to an electronic health information system for entering malaria-specific information	9	8	88.9	(47 - 99)

8.3.1 Indicator 2.03: Malaria case reporting

RMEI indicator 2.03 has two parts: case reporting and laboratory reporting. According to the negotiated definition for case reporting, health units in El Salvador that conduct malaria diagnosis must prepare monthly reports 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 five business days of the following month 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.

Table 8.9: Format of case notification reports observed

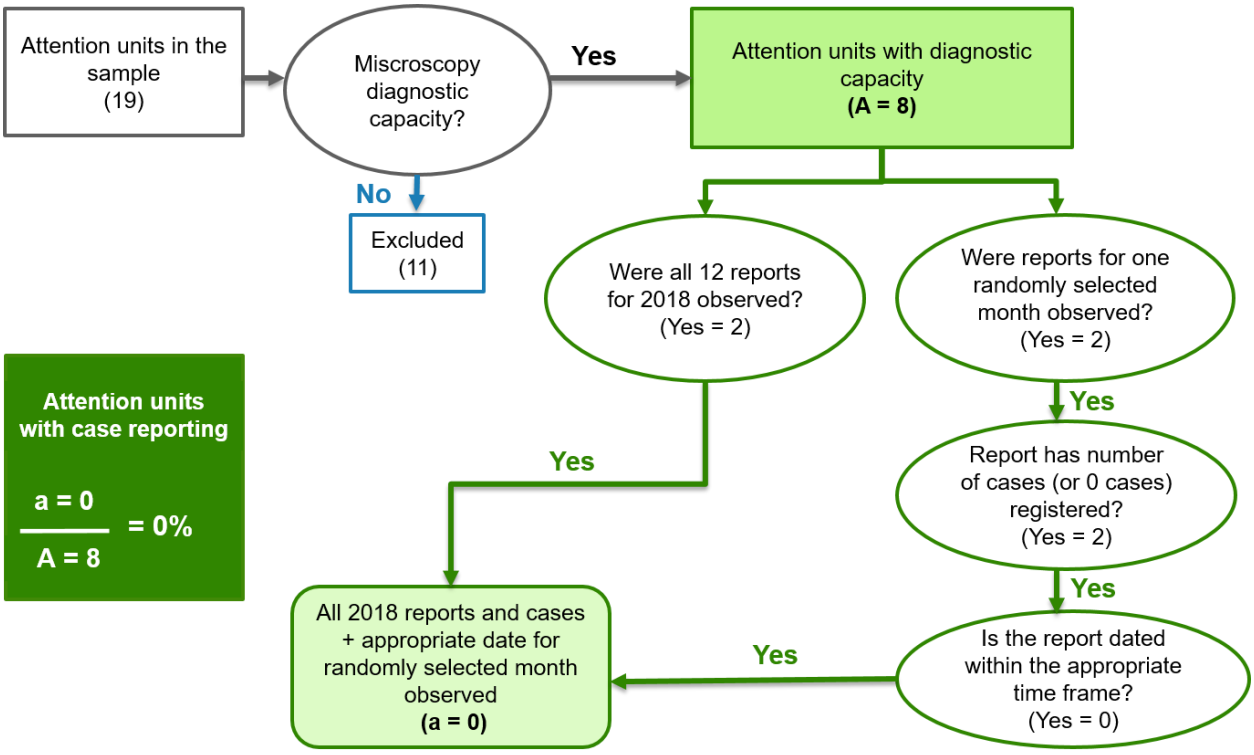
	N	n	%	95% CI
Format of case reports observed				
E-6	12	6	50	(23 - 77)
Lab-2	12	5	41.7	(17 - 71)
VIGEPES-04	12	1	8.3	(1 - 44)
Other	12	2	16.7	(4 - 50)

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

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

- that the reports be in a monthly format
- that all 12 reports be observed for the year 2018
- that the report be observed for the selected month with send date
- that the send date is verified to be within the first five business days of the following month

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



Eight facilities that provide attention to patients are eligible for consideration in the indicator. The results are shown in Table 8.10 and none of the surveyed units met all the requirements of the indicator.

Table 8.10: Indicator 2.03: Case reporting

	N	n	%	95% CI
Relevant units	19	19	100	(-)
Units with diagnostic capacity	19	8	42.1	(22 - 66)
Units indicating reporting of malaria cases	8	8	100	(-)
At least one monthly report from 2018 observed	8	4	50	(19 - 81)
All 12 monthly reports from 2018 observed	8	2	25	(6 - 64)
Report for randomly selected month observed	8	2	25	(6 - 64)
Number of cases (or zero) recorded for report of randomly selected month*	8	2	25	(6 - 64)
Date for report of randomly selected month observed	8	2	25	(6 - 64)
Date for report of randomly selected month is valid	8	0	0	(-)
Result: Malaria case reporting to standard	8	0	0	(-)

*Four attention units had weekly reports available, for only 1 of which all 52 were observed

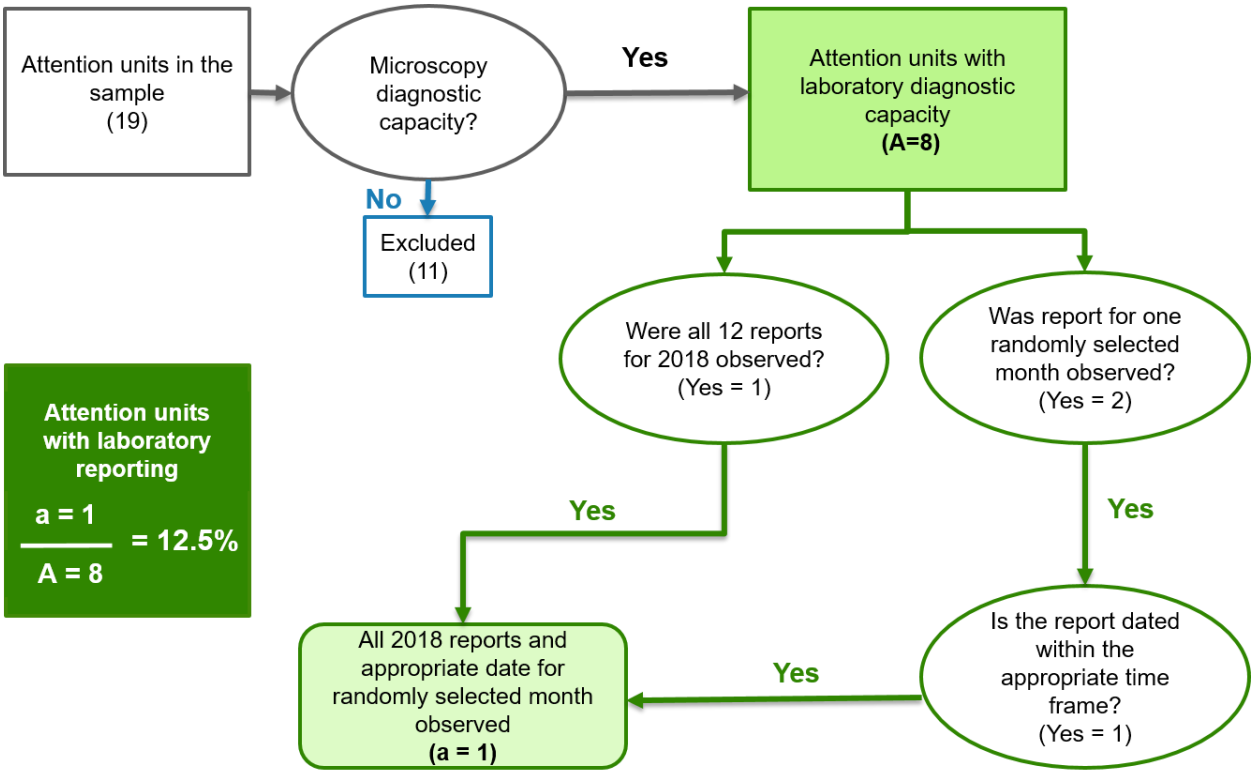
8.3.2 Indicator 2.03: Laboratory production reporting

The other component of Indicator 2.03 is the observation of monthly laboratory production reports that show the number of TBF slides examined and the number of RDTs performed. All facilities that conduct malaria diagnosis must submit these reports to the national laboratory within the first 15 business days of the following month. The observation of the laboratory reports during the survey was conducted in the same way as the case reports, and electronic reports were acceptable provided evidence of the date of

submission was observed. Health facility eligibility and completion of indicator according to a decision algorithm is shown in Figure 8.3. The indicator required:

- that the reports be in a monthly format
- that all 12 reports be observed for the year 2018
- that the report be observed for the randomly selected month with send date
- that the send date is verified to be within the first 15 business days of the following month

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



Eight facilities that provide attention to patients are eligible for consideration in the indicator. The results are shown in Table 8.11; one unit met all the requirements of the indicator.

Table 8.11: Indicator 2.03: Lab reporting

	N	n	%	95% CI
Relevant units	19	19	100	(-)
Units with diagnostic capacity	19	8	42.1	(22 - 66)
At least one monthly report from 2018 observed	8	2	25	(6 - 64)
All 12 monthly reports from 2018 observed	8	1	12.5	(2 - 57)
Report for randomly selected month observed	8	2	25	(6 - 64)
Date for report of randomly selected month observed	8	2	25	(6 - 64)
Date for report of randomly selected month is valid	8	1	12.5	(2 - 57)
Result: Laboratory production reporting to standard	8	1	12.5	(2 - 57)

The destination where laboratory production reports are sent is shown in Table 8.12. Respondents could indicate more than one answer to this question.

Table 8.12: Destination of lab production reports observed

	N	n	%	95% CI
Where are laboratory production reports sent?				
SIBASI	15	8	53.3	(28 - 77)
Regional office	15	3	20	(6 - 49)
National reference lab	15	3	20	(6 - 49)
Other	15	4	26.7	(10 - 55)

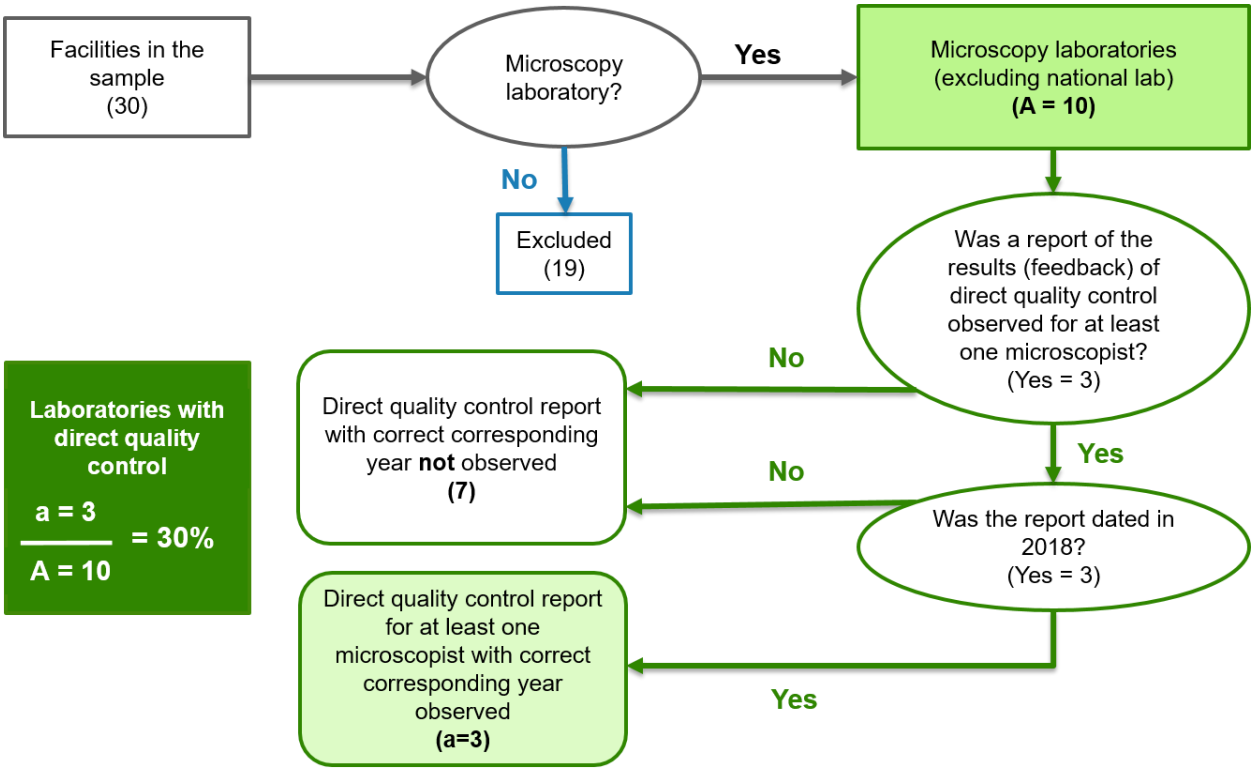
8.4 Indicator 3.02: Laboratory quality control

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 to be observed at the El Salvador national reference laboratory for the year 2018. However, the external quality control report was not procured or observed at the national reference laboratory in El Salvador.

Additionally, all laboratories and microscopy posts that diagnose malaria through microscopy must participate in direct and indirect quality control exercises with the national reference laboratory. Thus, 10 laboratories at health units and hospitals 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. Based on the fact-finding visit, we expected that this assessment would not be conducted in all laboratories every year in El Salvador due to limited availability of positive samples to use in the panel. Health facility eligibility was determined according to a decision algorithm shown in Figure 8.4. According to Table 8.13, complete evidence of participation in direct quality control was observed at 30% of laboratories. The evidence required was a report of the results of the 2018 exam received back from the reference laboratory with feedback.

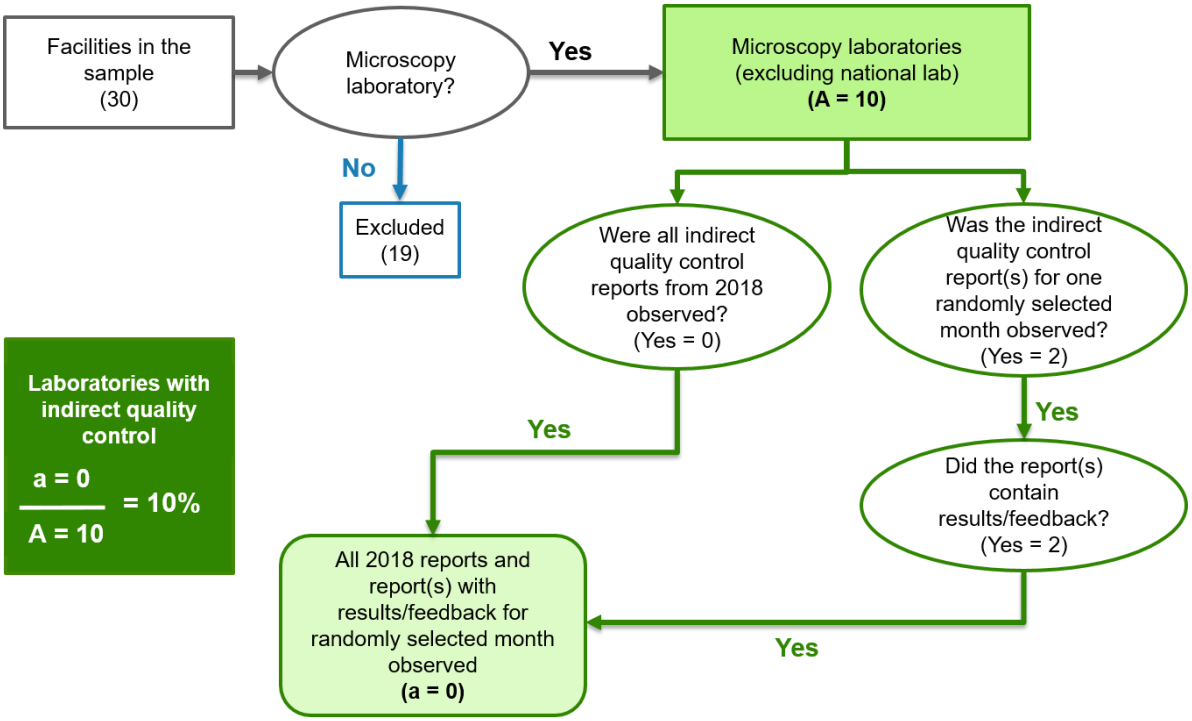
Figure 8.4: Eligibility of health facilities for Indicator 3.02 (direct)



The second exercise, indirect quality control, is a cross-check of a set proportion of the slides initially diagnosed by each local laboratory by a senior microscopist. In El Salvador, local laboratories must send 10% of the slides with a negative test result for malaria to the national lab for cross-checking each month. Any slides with a positive test result are sent to the national laboratory immediately for confirmation, and all follow-up tests for positive cases are sent for cross-checking. The selection method for the 10% of negative slides may vary regionally or locally. Health facility eligibility was determined according to a decision algorithm shown in Figure 8.5. While 40% of laboratories reported participating in quality control, none 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 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 8.5: Eligibility of health facilities for Indicator 3.02 (indirect)



The detailed results of the indicator are shown in Table 8.14 and Table 8.15.

Table 8.13: Indicator 3.02: Quality control

	N	n	%	95% CI
External quality control: 2018 National Lab Evaluation form observed	1	0	0	(-)
Direct	10	3	30	(9 - 64)
Indirect	10	0	0	(-)

Table 8.14: Indicator 3.02: Indirect and direct quality control

	N	n	%	95% CI
Facilities with microscopy (excluding national lab)	31	10	32.3	(18 - 51)
Facilities passing direct quality control (DQC) component	10	3	30	(9 - 64)
Facilities that report participating in DQC	10	6	60	(28 - 85)
Feedback for at least one assessment in 2018 was observed	10	3	30	(9 - 64)
Feedback report with results was dated 2018	10	3	30	(9 - 64)
Facilities passing indirect quality control (IDQC) component	10	0	0	(-)
Facilities that report participating in IDQC	10	9	90	(50 - 99)
Randomly selected month report was observed	10	2	20	(5 - 56)
Cross-checked results and feedback were observed on randomly selected report	10	2	20	(5 - 56)
All reports observed for 2018	10	0	0	(-)
Facilities passing both direct and indirect quality control	10	0	0	(-)

Table 8.15: Indicator 3.02: Indirect quality control in detail

	N	n	%	95% CI
Facilities who have microscopy (excluding national lab)	31	10	32.3	(18 - 51)
At least one report was observed for 2018	10	4	40	(15 - 72)
Reports are monthly	10	4	40	(15 - 72)
1-3 reports observed	10	0	0	(-)
4-7 reports observed	10	3	30	(9 - 64)
8-11 reports observed	10	1	10	(1 - 50)
12 reports observed	10	0	0	(-)
All reports observed for 2018	10	0	0	(-)

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

The RMEI indicators also require detailed review of the indirect quality control reports and the response from the reference laboratory with results of the slide cross-check. The indicator definition was updated considering the data collected in the field and is pending discussion with the El Salvador Ministry of Health to update the indicator manual and determine the final definition.

Indirect quality control is a cross-check of a proportion of the slides initially diagnosed by each local laboratory by a senior microscopist. In El Salvador, local laboratories must send 10% of the slides reviewed with a negative test result for malaria and 100% of the slides reviewed with a positive test result to the national reference laboratory for cross-checking each week or month. In cases where fewer than 10 negative cases are reviewed in the week or month, at least one slide should be sent to the national reference laboratory for cross-check. The evidence required was:

- the report sent from the local laboratory with original diagnosis observed for a randomly selected month in 2018 (or the corresponding four epidemiological weeks)
- the report with results or feedback from the diagnosis at the reference laboratory
- the results or feedback from the reference laboratory indicated 100% of positive and 10% of negative slides were cross-checked

Due to COVID-19, indicator 3.01 could not be captured in the El Salvador baseline measurement. Upon completion of data collection, IHME organized a re-visit to the national laboratory for the interviewers in the beginning of March 2020 in order to collect the appropriate information for this indicator. The team successfully captured the number of original diagnoses at each facility from reports that were sent from local labs to the national laboratory, but were unable to capture the number of cross-checked results. At the time an interviewer was scheduled to revisit the national laboratory in order to collect the cross-checked results, the El Salvador government imposed the first lock-down mandate.

Chapter 9: Challenges, Conclusions, and Recommendations

9.1 Challenges and limitations

9.1.1 Challenges for health facility data collection

In El Salvador, field personnel were able to gain authorization to interview in selected health facilities. First-line malaria medications were observed at very few facilities, and records of stock were sometimes not available or insufficiently detailed to determine stock-out over a three-month period. Many facilities and some laboratories did not have supplies for sample taking (slides, lancets) or reagents for malaria tests in stock. Laboratory supplies for malaria diagnosis and malaria treatments may be tracked under a separate system from other pharmacy and laboratory inputs. Sometimes stock records are not maintained at the local facility, but rather at the SIBASI or regional headquarters of the malaria program.

9.1.2 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. After substitutions to health facilities in the sample are taken into consideration, 19 primary and secondary care facilities from the sample were expected to complete suspected case medical record review.

Because many 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 (*"Registro diario de atenciones médicas"*). Often, the total number of eligible attentions in the year 2018 was smaller than the quota for record revision. Occasionally, health facility personnel had difficulty locating selected records for review (for example, when medical record number was left blank on the attention registry).

Out of the 19 facilities, only six were able to meet the assigned quota of suspected cases. Thirteen facilities had medical records and the field team reviewed all eligible medical records from 2018, but did not meet the quota. Due to the low number of medical records available for review at the beginning of data collection, the quota was increased for the remaining facilities, but the overall quota of 900 completed suspected case medical records was not met.

9.1.3 Challenges for confirmed case review

Based on the fact-finding trip and the surveillance reporting process, we expected that paper copies of malaria confirmed case reports (malaria notification, treatment, and investigation forms) would be stored at the local health facility, SIBASI vector control office, health region, and central malaria program. The field team sought to review the two confirmed cases of malaria from 2018 at the corresponding SIBASI office but were informed that the relevant paperwork was not stored there. In the end, they were able to review the cases at the facilities where they were treated: a public UCSF in the sample, and an *Instituto Salvadoreño de Seguro Social* hospital that was not in the sample. While clinical records were observed for both cases, malaria notification and investigation forms were filed with only one of the cases.

9.1.4 Challenges for case and laboratory reporting review

In El Salvador, there are nationally standard forms for case and laboratory reporting, but reports from 2018 were observed at few facilities. The official source for case counts of notifiable diseases is electronic (VIGEPES), but the RMEI indicator requires copies be filed on paper or electronically at the sending health facility. VIGEPES official reporting is prepared weekly, but the RMEI indicator requires a monthly report be observed. The malaria program introduced a new malaria-specific report in 2019, but it was not in use during 2018.

Evidence of quality control participation to standard was also observed at relatively few laboratories. Based on the fact-finding trip, we anticipated that participation in direct quality control would be low

because the assessment is not administered to each laboratory on an annual basis due to a shortage of positive malaria slides to use in the panel.

Case and laboratory reporting formats do not typically include the date sent or received, complicating the attempt to evaluate timeliness of submission. Additionally, field personnel were sometimes unable to observe the forms from the year 2018 when facility personnel were unable to find the files. This was a particular problem where there had been changes in laboratory or statistics personnel since 2018.

9.1.5 Challenges for household data collection

Household data collection in El Salvador encountered few logistical challenges. Three selected communities had to be replaced with substitutes due to security and weather reasons. 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 remarkably small.

9.2 Key findings and recommendations

Migration to electronic information systems must take into account the effectiveness of current paper-based practices, and must ensure that updated information is recorded in the electronic system but also on archived paper forms. Forms 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 quality data is accessible at all relevant levels of the system (point of care, SIBASI, region, and central). The emphasis must be on ensuring complete and precise data at the lowest levels of information, and in enabling effective data storage, processing, quality control, and analysis for decision-making at the department, region, 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. Vector control teams in the field must inform to the malaria program, while patients visit health facilities that are part of a separate reporting chain. To sustain malaria elimination, stakeholders will have to work to bridge gaps and reduce fragmentation in service provision.

Some practices and procedures are not standardized in El Salvador, in particular adherence to aggregate case 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
P2.01	Suspected cases with malaria test (MRR)	516	13.8	(11 - 17)
P2.03	Case reporting with quality	8	0	(-)
	Lab production reporting	8	12.5	(2 - 57)
P3.02	Quality control (external)	1	0	(-)
	Quality control (direct)	10	30	(9 - 64)
	Quality control (indirect)	10	0	(-)
P4.01	Treatment within 24 hours	2	100	(-)
P6.01	Vector control coverage	353	6	(2 - 14)
P7.01	Equipment and instruments for diagnosis and treatment	24	20.8	(8 - 43)

A.2 Monitoring indicator matrix

#	Indicator	N	%	CI
M2.02	Fever cases with blood sample	21	33.3	(15 - 58)
E2.04	Notified within 24 hours of detection	2	100	(-)
E3.03	Equipment and instruments for sampling and diagnosis	22	22.7	(9 - 46)
M4.02	Diagnosis within 48 hours	2	0	(-)
M4.03	Treatment complete and supervised	2	0	(-)
E4.05	Health facilities without stockouts of first-line treatments	2	0	(-)
E6.03	Population protected by IRS (strata 3+4)	975	5.3	(4 - 7)
E6.05	Population protected by ITNs (strata 3+4)	986	0.1	(0 - 1)

#	Indicator	N	Median	CI
E4.03	Median time between onset of symptoms and start of treatment (days): active surveillance - Reactive	1	15	(-)
	Median time between onset of symptoms and start of treatment (days): active surveillance - Undefined	1	NA	(-)

Appendix B: Indicator Definitions

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

P2.01: 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

1. A41.9 Sepsis, unspecified organism
2. A68 Relapsing fevers
3. A68.9 Relapsing fever, unspecified
4. A98.5 Hemorrhagic fever with renal syndrome
5. B34.9 Viral infection, unspecified
6. B50 *Plasmodium falciparum* malaria
7. B50.0 *Plasmodium falciparum* malaria with cerebral complications
8. B50.8 Other severe and complicated *Plasmodium falciparum* malaria
9. B50.9 *Plasmodium falciparum* malaria, unspecified
10. B51 *Plasmodium vivax* malaria
11. B51.0 *Plasmodium vivax* malaria with rupture of spleen
12. B51.8 *Plasmodium vivax* malaria with other complications
13. B51.9 *Plasmodium vivax* malaria without complication
14. B52 *Plasmodium malariae* malaria
15. B52.0 *Plasmodium malariae* malaria with nephropathy
16. B52.8 *Plasmodium malariae* malaria with other complications
17. B52.9 *Plasmodium malariae* malaria without complication
18. B53 Other specified malaria
19. B53.0 *Plasmodium ovale* malaria
20. B53.1 Malaria due to simian plasmodia
21. B53.8 Other malaria, not elsewhere classified
22. B54.X Unspecified malaria
23. G03.9 Meningitis, unspecified
24. R16 Hepatomegaly and splenomegaly, not elsewhere classified
25. R16.1 Splenomegaly, not elsewhere classified
26. R16.2 Hepatomegaly with splenomegaly, not elsewhere classified
27. R17.X Unspecified jaundice
28. R50 Fever of other and unknown origin
29. R50.0 Fever with chills
30. R50.1 Persistent fever
31. R50.8 Other specified fever
32. R50.9 Fever, unspecified
33. R51.X Headache
34. R68 Other general symptoms and signs
35. R68.8 Other general symptoms and signs

36. A27 Leptospirosis
37. A27.0 Leptospirosis icterohemorrhagica
38. A278 Other forms of leptospirosis
39. A279 Leptospirosis, unspecified
40. A90.X Dengue fever [classical dengue]
41. A91.X Dengue hemorrhagic fever
42. A92 Other mosquito-borne viral fevers
43. A92.0 Chikungunya virus disease
44. A92.8 Other specified mosquito-borne viral fevers
45. A92.9 Mosquito-borne viral fever, unspecified

Sampling by presumptive or final diagnosis - diagnoses eligible for review

1. Fever (acute, relapsing, persistent, unspecified, etc.)
2. Malaria (*P. falciparum*, *P. vivax* or unspecified)
3. Leptospirosis
4. Dengue (classical, hemorrhagic or unspecified)
5. Chikungunya
6. Mosquito-borne fever
7. Viral infection, unspecified
8. Meningitis
9. Hepatomegaly
10. Splenomegaly

Sampling by principal complaint - motives eligible for review

1. Fever
2. Malaria
3. Dengue
4. Chikungunya

Numerator: Cases with evidence a malaria test was ordered

Exclusions:

1. Health facility in strata 1, 2, or 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

10.

Sampling by presumptive or final diagnosis

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

Only health facilities in strata 1, 2, and 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

M2.02: Fever cases with blood sample

Source: Household survey

Denominator: People in strata 2, 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

Numerator: Health facilities with monthly epidemiological surveillance reports observed (paper or electronic reports acceptable)

1. Reports list the aggregate number of malaria cases or report of zero cases
2. Reports observed for all 12 months of the year 2018
3. Reports in randomly selected month list sending date
4. All observed dates within first 5 business days of the following month

Exclusions: SIBASI, regional offices, and national reference laboratory

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

Source: Health facility observation

Denominator: Health facilities with self-reported diagnostic capacity

Numerator: Health facilities with monthly laboratory production reports observed (paper or electronic reports acceptable)

1. Reports list the malaria samples taken
2. Reports observed for all 12 months of the year 2018
3. Reports in randomly selected month list sending date
4. All observed dates within first 15 business days of the following month

Exclusions: SIBASI, regional offices, and national reference laboratory

P3.01: Slides sent to reference laboratory for indirect quality control (cross-check verification) - 100% positive and 10% negative slides

Source: Health facility observation

Denominator: Health facilities with self-reported microscopic diagnostic capacity

Numerator: Health facilities with observation of slide cross-check report and feedback report observed at the reference laboratory with 100% positive and 10% negative slides sent for cross-check verification during the randomly selected month, dated 2018

Exclusions: National reference laboratory

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 (paper or electronic reports acceptable)

1. Reports observed for all 12 months or 52 weeks of the year 2018
2. Reports in randomly selected month 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

M4.02: 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

M4.03: 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 7 or 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 7 or 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)

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 CCSS)

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 regional offices

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

1. All regional offices

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

1. All health units and hospitals

Forms for sending slide samples

1. All health units and hospitals

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

1. All health facilities and administrative units that reported microscopic diagnostic capacity, including 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 and administrative units that reported microscopic diagnostic capacity, including 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 and administrative units that reported microscopic diagnostic capacity, including national laboratory

Appendix C: Sample design and methods

C.1 Sample size

The size of the sample of health facilities for El Salvador was defined as a part of the funding proposal to cover 30 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 30 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 16 communities with 25 households surveyed in each, or a total of 400 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 El Salvador, 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

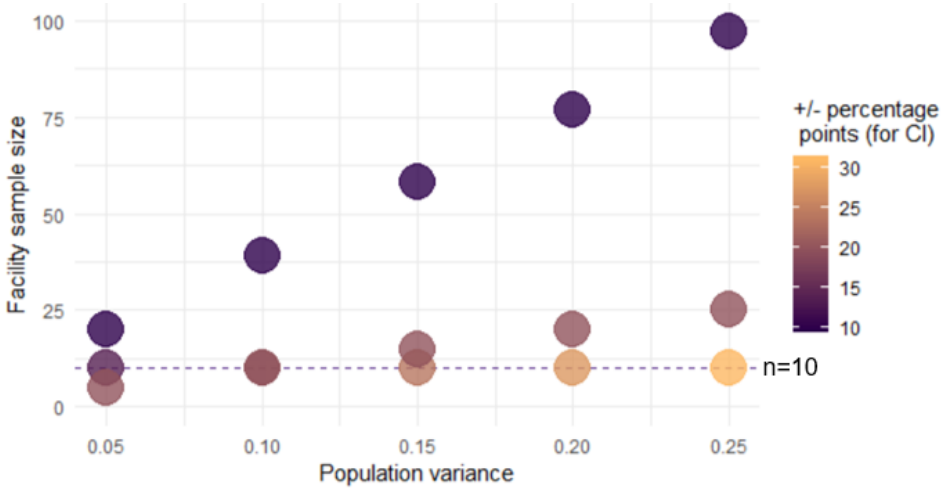


Figure 1. Facility sample sizes and corresponding margins of error across different levels of population variance. Potentially acceptable margins of error range from +/-10 ppts (ideal) to +/-30 ppts (considered high) on either side of the point estimate.

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 (*"unidad comunitaria de salud familiar"*, UCSF) in *cantones* in malaria strata 2, 3, and 4 based on referral networks and facility lists provided by the El Salvador Ministry of Health. 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. Facilities serving malaria foci as noted in a list that the Ministry of Health provided to IHME were considered to have vector control interventions carried out in those foci. The six UCSF facilities in malaria stratum 4 (including four facilities serving communities with vector control measures implemented) were selected with certainty. Primary care facilities were sorted by a random variable and a sample was drawn in two additional strata: with microscopy capacity in malaria strata 2 and 3, and without microscopy capacity in malaria strata 2 and 3. 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 SIBASI offices, regional offices, and referral hospitals according to the referral network, including each facility for which corresponding primary care units were already selected to the sample. This sampling frame consisting of, respectively, SIBASI offices, regional 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 (SIBASI and health region headquarters) to the maximum stratum found in its service area (regions with any *cantones* 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 El Salvador, the sample was drawn from all three sources depending on recordkeeping practices in each facility. 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 communities

At each of the 16 selected primary care facilities, the field supervisor asked for information about the facility's catchment area, including the number of communities served, name and population of each community, and recent vector control activity in each community (IRS or distribution of ITN). The supervisor input the information to a Sample Selection Module which automated the process of selecting at random among eligible communities served by the facility. If any facilities in the catchment area had

received vector control interventions, a community was selected at random among those with interventions. If no communities received interventions or the intervention status of all communities was unknown, a community in the catchment area was selected at random. A second community from the catchment area was selected as a 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.2.4 Selecting households

In order to achieve the desired sample size of 400 households, we sought to complete interviews with residents of 25 randomly selected households in each of the 16 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. For each community, the Sample Selection Module discussed in the previous section output a random integer between 1 and 9 and a randomly selected cardinal direction to use as a starting point, and calculated a skip interval 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 output 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 25 to 26 households. Counts of absent households range from 0 to 27 households. Counts of refused households range from 0 to 5 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) El Salvador 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

Erin Palmisano, MPH
Senior Research Manager, IHME

Max Thom, BS
Data Specialist, IHME

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