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# Regional Malaria Elimination Initiative Costa Rica

# Baseline Measurement (2019)

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**September 2020**

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## Acronyms

**ATAP**: *Asistente técnico en atención primaria*
**BMGF** - Bill & Melinda Gates Foundation
**CAPI** - Computer-assisted personal interview
**CCSS** - *Caja Costarricense de Seguro Social* (Costa Rican Social Security Administration)
**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
**EBAIS** - *Equipos Básicos de Atención Integral en Salud*
**EDUS** - *Expediente Digital Único en Salud*
**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
**SISVE** - *Sistema de Vigilancia Epidemiológica*
**TBF** - Thick blood film

# Executive summary

## Introduction

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

## RMEI baseline measurement

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

IHME designed survey instruments based on the Initiative indicator manual and findings from the fact-finding visit to distinct points of the health system in Costa Rica, with input from the Ministry of Health and Social Security Administration (*Caja Costarricense de Seguro Social*, CCSS). 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 *área de salud* clinics in malaria focus areas of Costa Rica. Hospitals in the malaria service provision network and *área rectora* offices corresponding to selected *área de salud* clinics 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 Costa Rica baseline measurement is summarized in Table E1. The information sought as a part of the measurement varied by facility type.

*Table E1: Costa Rica data collection summary*

| Point of data collection | Number completed | Measurement completed |
|---|---|---|
| Área de salud clinics | 21 | Health facility questionnaire and observation |
| | | Medical record review of suspected cases of malaria |
| | | Treatment stock |
| | | Laboratory supplies/reports |
| | | Aggregate case and laboratory production reporting |
| | | Household measurement in catchment area |
| Hospitals | 4 | Health facility questionnaire and observation |
| | | Medical record review of suspected cases of malaria |
| | | Treatment stock |
| | | Laboratory supplies/reports |
| *Suspected malaria cases reviewed* | *844* | |
| Área rectora offices | 4 | Aggregate case and laboratory production reporting |
| | | Record review of confirmed cases of malaria |
| *Confirmed malaria cases reviewed* | *91* | |

| Point of data collection | Number completed | Measurement completed |
|---|---|---|
| National malaria reference laboratory | 1 | Laboratory supplies and reporting |
| | | Laboratory certification and quality control |
| Communities | 16 | Coverage of vector control interventions |
| | | Fever cases with malaria test |
| | | Treatment of confirmed malaria cases |
| *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 Costa Rica 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 | 2 | 6.1% | 7.3% |
| None | 14 | 0.7% | 11% |

### 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 | 25 | 5 | 20 | (8 - 41) |
| Sampling and biosafety equipment | 19 | 15 | 78.9 | (54 - 92) |
| Sample submission forms | 20 | 18 | 90 | (66 - 98) |
| Microscopy equipment | 20 | 20 | 100 | ( - ) |
| Equipment for staining and testing | 20 | 18 | 90 | (66 - 98) |
| Reagents for staining | 20 | 16 | 80 | (56 - 93) |
| **Units with all required equipment and medications** | **26** | **4** | **15.4** | **(6 - 36)** |

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 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) | 2 | 1 | 50 | (5 - 95) |
| Suspected case with malaria test (medical record review) | 364 | 2 | 0.5 | (0 - 2) |

### Diagnosis of malaria cases

The RMEI baseline measurement also included a review of confirmed cases of malaria based on the case notification and investigation forms available at the *área rectora* offices. The indicator for timely diagnosis of malaria compares the date of initiation of fever or other symptoms with the date of diagnosis as shown in Table E5. Cases with diagnosis two days or less after symptom initiation are considered to have timely diagnosis. Cases with fever/symptom initiation date or diagnosis date not registered are not considered to have timely treatment initiation.

*Table E5: Diagnosis within two days, Confirmed case review*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Cases diagnosed within 48 hours of onset | 90 | 8 | 8.9 | (4 - 17) |
| 3 days | 90 | 4 | 4.4 | (2 - 11) |
| 4-5 days | 90 | 24 | 26.7 | (18 - 37) |
| 6-7 days | 90 | 14 | 15.6 | (9 - 25) |
| Over 7 days | 90 | 18 | 20 | (13 - 30) |
| Indicator result: Cases diagnosed within 48 hours of onset* | 90 | 8 | 8.9 | (4 - 17) |

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

### Treatment of malaria cases

The review of confirmed malaria cases also captured all available information about malaria treatment administered to patients from case investigation forms or treatment logs. The indicator for timely treatment of malaria compares the date of diagnosis 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 | 91 | 44 | 48.4 | (38 - 59) |
| First dose treatment within 24 hours of diagnosis* | 91 | 35 | 38.5 | (29 - 49) |
| Correct treatment administered within 24 hours of diagnosis* | 91 | 30 | 33 | (24 - 43) |

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

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

*Table E7: Complete and supervised treatment, Confirmed case review*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Adequate treatment and number of doses administered | 91 | 36 | 39.6 | (30 - 50) |
| Evidence of at least one supervised dose | 91 | 46 | 50.5 | (40 - 61) |
| Indicator Result: Complete treatment with supervision | 91 | 36 | 39.6 | (30 - 50) |

**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 *área de salud* clinics 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 | 19 | 0 | 0 | ( - ) |
| Laboratory production reporting to standard | 19 | 5 | 26.3 | (11 - 51) |
| External quality control: 2018 National Lab Evaluation form observed | 1 | 1 | 100 | ( - ) |
| Facilities passing direct quality control (DQC) component | 19 | 9 | 47.4 | (26 - 70) |
| Facilities passing indirect quality control (IDQC) component | 19 | 5 | 26.3 | (11 - 51) |

## Key findings

The results of the Costa Rica 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 and the limitations of maintaining parallel reporting systems in the Ministry of Health and the CCSS.

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 in the CCSS who play an increasingly important role in detection and management of cases as Costa Rica 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 Costa Rica and harness the existing partnership with PAHO. 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 Costa Rica, active, residual, and inactive foci were defined, and each locality 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. Localities will be redefined with updated stratum classification in subsequent points on the Initiative as their level of importation risk and number of autochthonous cases evolves. The malaria program in Costa Rica carries out household-level vector control interventions such as indoor residual spraying (IRS) and distribution of long-lasting insecticide-treated nets (ITNs) which are to be expanded and monitored as a part of the Initiative. Other interventions focus on providing training, disseminating standards for clinical care, improving record-keeping with medical providers country-wide, and improving surveillance capacity by reviewing existing practices, expanding use of digital information systems, and standardizing reporting for case detection.

*Table 1.1: Costa Rica malaria stratification: Definition and distribution of strata*

| Stratum | Number of localities | Definition |
|---|---|---|
| 1 | 1350 | Non-receptive |
| 2 | 1562 | Receptive, no autochthonous cases, no risk of importation |
| 3 | 1792 | Receptive, risk of importation, no autochthonous cases |
| 4 | 13 | Receptive, presence of autochthonous cases |

In Costa Rica, local malaria transmission has resumed in northern and Caribbean coast regions since late 2016 after nearly three years without autochthonous cases. In 2018, the reference year for the baseline measurement, Costa Rica had 108 confirmed cases of malaria according to national public health surveillance data provided by the Ministry of Health. Costa Rica has historically depended on a vertically integrated malaria program in the Ministry of Health that operates in close coordination with programs for other vector-transmitted diseases. In the malaria elimination phase, Costa Rica has transitioned 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 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 Costa Rica 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 *área rectora* offices.

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 Costa Rica 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 health regions of Costa Rica in July 2019. During the exploratory visit, the team visited *área de salud* clinics, *área rectora* offices, and hospitals providing services to 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 Costa Rica, the sample includes *área de salud* clinics, hospitals, *área rectora* offices, and the national reference laboratory. Households within the catchment area of *área de salud* clinics 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 |
|---|---|
| Área de salud clinics | Health facility questionnaire and observation |
| | Medical record review of suspected cases of malaria |
| | Treatment stock |
| | Laboratory supplies/reports |
| | Aggregate case and laboratory production reporting |
| | Household measurement in catchment area |
| Hospitals | Health facility questionnaire and observation |
| | Medical record review of suspected cases of malaria |
| | Treatment stock |
| | Laboratory supplies/reports |
| Área rectora offices | Record review of confirmed cases of malaria |
| | Aggregate case and laboratory production reporting |
| National laboratory | Laboratory supplies and reporting |
| | Laboratory certification and quality control |
| Households | Coverage of vector control interventions |
| | Fever cases with malaria test |
| | Treatment of confirmed malaria cases |

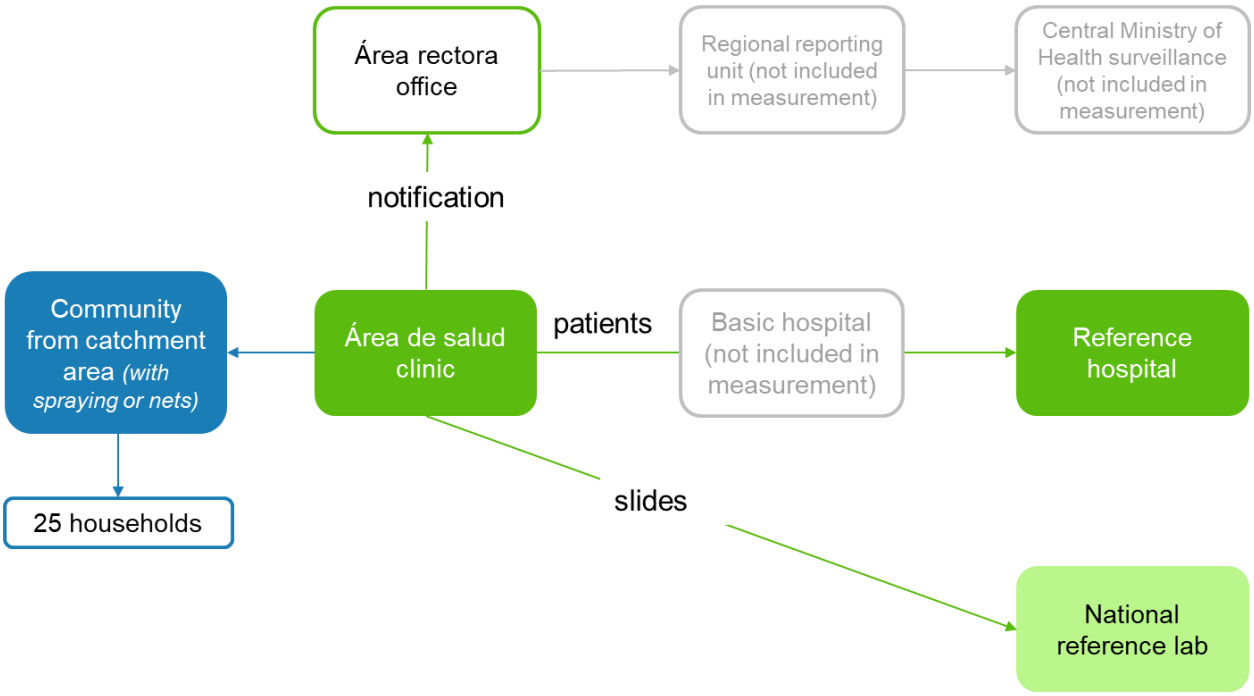
# Chapter 2: Survey Methodology

## 2.1 Sample selection and description

The RMEI baseline measurement aims to measure performance of the health system in zones that play an important role in malaria prevention, detection, and treatment. Since malaria activities are more intensive in endemic and vulnerable areas, the sample is targeted toward presenting representative estimates for the focus areas identified for interventions through the Initiative. Since the Initiative aims to eliminate malaria, its success depends on reducing the burden in zones with ongoing malaria transmission. We expect to return to some of these zones in future measurement rounds to monitor changes in practice. In Costa Rica, the sample is made up of facilities and communities in malaria strata 3 and 4 (see strata definitions in Table 1.1). We focused on zones with autochthonous malaria cases in order to maximize our sample size from these zones.

The set of indicators defined and negotiated for the baseline measurement necessitates data collection at several distinct points of the health system. To draw the sample, we selected an *área de salud* clinic 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 *área rectora* 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 *área de salud* clinics.

*Figure 2.1: RMEI-Costa Rica baseline health system structure*




### 2.1.1 Health facility sample selection

In Costa Rica, primary health care is administered through "*Equipos Básicos de Atención Integral en Salud*" (EBAIS, basic integral health care team). They are primary care teams assigned a fixed service area with a certain number of households and may be located at the main clinic of the corresponding *área de salud* clinic, or may have a small installation in more remote communities. EBAIS located away from the main clinic refer patients for services they do not provide, such as malaria and other laboratory testing. EBAIS staff includes clinical personnel as well as *"asistentes técnicos de atención primaria"*

("ATAP", primary care technical assistants) who visit communities to provide home health care and can administer and supervise malaria treatment.

For the RMEI baseline measurement, the unit of selection was determined to be the *área de salud* clinic rather than the individual EBAIS associated with it, because of the necessity to measure supply stocks, provision of malaria testing, and reporting functions that are carried out only at the main *área de salud* clinic. Because Costa Rica employs an electronic medical record system ("*Expediente Digital Único en Salud*", EDUS), the records of patients from each EBAIS in the *área de salud* clinics are accessible from the main clinic, including those belonging to EBAIS with satellite installations. Thus, the medical record review measurement includes patients of all EBAIS in each area, and the facility interview and observation measure common functions (pharmacy, laboratory, and epidemiology services) shared among all EBAIS but conducted in the main clinic.

Malaria stratification was completed at the local level in Costa Rica. Because most *áreas de salud* include localities in two or more strata, each *área de salud* clinic was assigned to the maximum stratum among its localities (*área de salud* clinics and *área rectora* offices with any localities in stratum 4 are therefore assigned to stratum 4). While only *área de salud* clinics with at least one locality classified as malaria stratum 3 or malaria stratum 4 were eligible to enter the sampling frame, a substantial number of communities in malaria stratum 2 are also served by the facilities in the sampling frame, even though *área de salud* clinics with all localities in malaria strata 1 and 2 are excluded. The sampling frame was built based on referral networks and facility lists provided by the Costa Rica Ministry of Health and CCSS. The five *área de salud* clinics with localities in malaria stratum 4 or with localities with vector control measures (IRS) implemented were selected with certainty. The remainder of the sample was selected at random among *área de salud* clinics with at least one locality in malaria stratum 3.

Based on the fact-finding visit and information provided by the Ministry of Health, the measurement was planned with the expectation that all *área de salud* clinics had malaria microscopy capacity, so the sample was not stratified according to microscopy capacity. During data collection, several clinics in the sample were determined not to have malaria microscopy capacity.

After selecting the sample of *área de salud* clinics that provide primary care services for malaria, in order to ensure necessary information is captured for all indicators, we selected ancillary units from the reporting chain (*área rectora* offices where confirmed malaria cases are investigated and filed, and referral hospitals) associated with the *área de salud* clinics selected for measurement, up to a fixed sample size defined to balance budget considerations with statistical power for analysis. In Costa Rica, the four *área rectora* offices with autochthonous malaria cases during 2018 and the four hospitals that provide care for severe or complicated malaria were included with certainty and no other *área rectora* offices nor hospitals were eligible for selection. The national malaria reference laboratory was selected with certainty. 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 *área rectora* offices to review confirmed cases of malaria in the zones with the most autochthonous transmission.

### 2.1.2 Substitutions within the sample

We kept all remaining eligible *área de salud* clinics in the sampling frame after the initial selection as backup facilities in case sampled facilities could not be interviewed due to security or logistic concerns. When replacement was required, we replaced with a clinic within the same canton or a neighboring canton when possible. If substitutes were not available in the same province, we replaced with a randomly selected clinic from the same malaria stratum. In the Costa Rica baseline, two *área de salud*

clinics were replaced during data collection. Both *área de salud* clinics that were replaced were due to refusals to participate in the survey by the clinic director.

### 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 16 *área de salud* clinics selected to the facility sample in malaria strata 3 and 4. Within the catchment area of the selected *área de salud* clinic, IHME selected a community that had received ITN or IRS interventions since the start of 2018 at random among all communities with vector control interventions based on information received from the Ministry of Health. If no communities received vector control interventions, a community was selected at random among all communities in the catchment area. As a part of the sample, field staff were provided a random starting point and a skip interval for systematic selection of households calculated based on the number of households or population within the community (according to documentation provided by the Ministry of Health and CCSS). Along with the selected community, two backup communities in the same *área de salud* clinic were provided for each primary care facility selected for the LQAS survey. These replacements were only to be used in cases when the selected community was inaccessible or there were security concerns.

Twenty-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.

The rate of refusal is fairly high for this baseline evaluation due to high refusal rates in two communities that were visited at the beginning of data collection. These two communities are urban and largely composed of immigrants who thought the interviewers were gathering information for the Costa Rica government and did not wish to provide personal information.

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

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Status of selected and replacement households | | | | |
| Complete | 738 | 401 | 54.3 | (51 - 58) |
| Members absent | 738 | 184 | 24.9 | (22 - 28) |
| Refused | 738 | 118 | 16 | (14 - 19) |
| Unoccupied dwelling | 738 | 34 | 4.6 | (3 - 6) |
| Postponed | 738 | 1 | 0.1 | (0 - 1) |

### 2.1.4 Confirmed case review sample selection

For confirmed cases of malaria, the sample was designed to include review of all confirmed cases from 2018 in the selected *área rectora* offices serving stratum 4. Field staff collected information from all documents available at the *área rectora* office, including case notification and investigation forms, lab records, and treatment follow-up forms. Table 2.2 shows an estimate of cases expected at each *área rectora* office in the sample and the number of case reviews completed during data collection. Because initial estimates were based on a nominal surveillance database of malaria cases during 2018 that included the name of the facility that diagnosed the case, but did not specify the corresponding health area, these estimates may be imprecise if patients were diagnosed in a health area where they did not reside, in a hospital, or in a private health facility.

*Table 2.2: Confirmed case collection*

| Health area | Confirmed cases expected from surveillance data | Confirmed cases captured during collection |
|---|---|---|
| Los Chiles | 4 | 12 |
| Puntarenas | 1 | 1 |
| San Carlos | 89 | 78 |
| Total | 94 | 91 |

### 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 *área de salud* clinics and hospitals selected to the sample. Eligible attentions were identified in-facility using attention registries or diagnosis databases. Sampling for suspected cases of malaria was completed at many health facilities using the EDUS electronic registry. 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, paper or electronic medical records, and lab records. Table 2.3 shows the total number of suspected cases reviewed (844), the number of cases selected based on diagnosis or principal complaint but found to be ineligible based on final diagnosis (19), and the cases selected and requested at facilities for which no medical records could be located for review (120). For these 120 cases, the visit noted in the EDUS system could not be successfully located electronically or the method to search for records was not functioning correctly, so it was substituted with another eligible record.

Data collection personnel were not authorized by CCSS to access the EDUS system independently, so all medical record reviews were conducted under the supervision of CCSS facility personnel.

During data collection, there was a national system failure of the statistics and record control function (CUBOS) within the EDUS system that lasted for one week. Due to this system failure and inability to sample records without the CUBOS system, the field team was unable to sample and review suspected case medical records at two *área de salud* clinics.

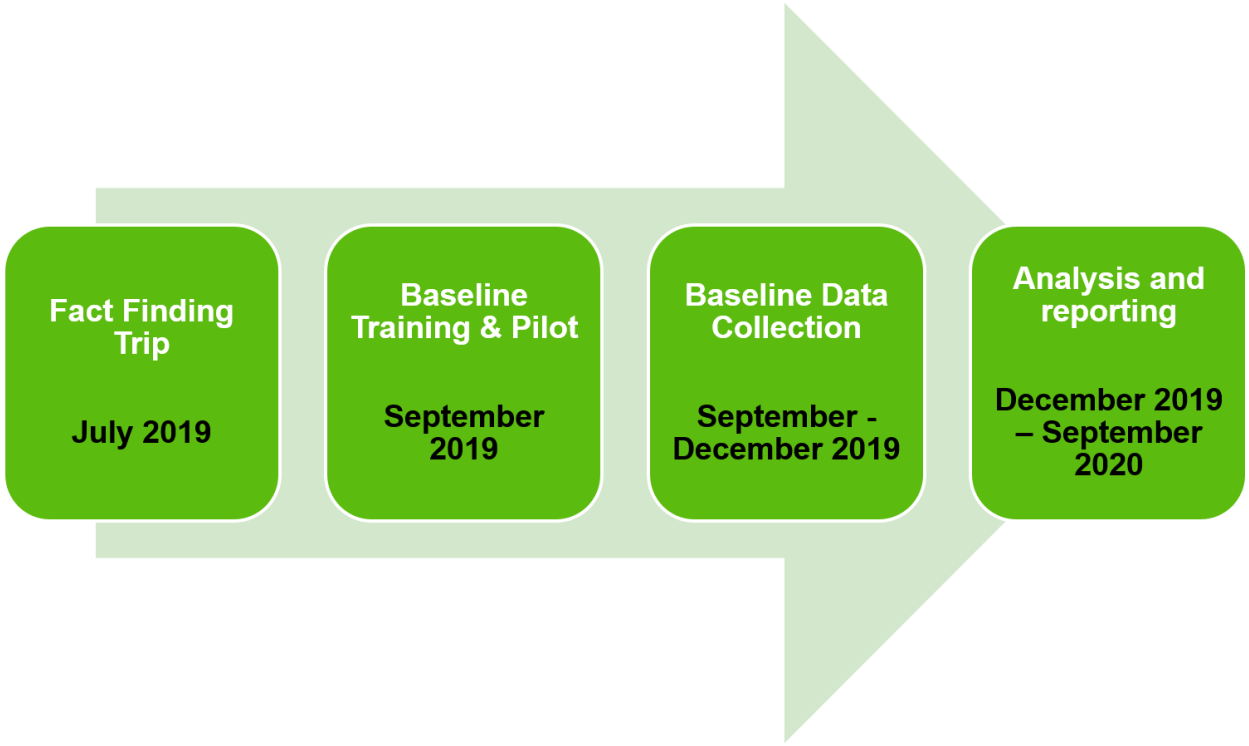
*Table 2.3: Suspected case collection*

| | # |
|---|---|
| Total suspected cases selected for review | 983 |
| Suspected cases selected but could not be located for review | 120 |
| All suspected cases screened for eligibility | 863 |
| Ineligible suspected cases discarded | 19 |
| Eligible suspected cases collected | 844 |

## 2.2 Survey implementation

In Costa Rica, baseline data was collected between September and December 2019. The timeline of baseline measurement activities is shown in Figure 2.2.

*Figure 2.2: RMEI-Costa Rica 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 Maléku, Cabécar, Bribri, Guaymí, and Buglere 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.

Original health facility survey modules contained questions regarding stock and use of malaria rapid diagnostic tests (RDTs), which are being introduced in Costa Rica as a part of the Initiative. At the request of the Costa Rica Ministry of Health and CCSS, these questions were removed from the surveys

prior to the start of data collection and information regarding RDTs was not captured in the baseline measurement.

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 Costa Rica between September 23 and September 29, 2019. The local agency contracted for data collection in Costa Rica, Borge y Asociados, hired four doctors, four nurses, 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 two-day pilot where they applied the health facility questionnaire, conducted observation exercises, and practiced medical record sampling and review for suspected and confirmed cases of malaria, as well as household sample selection and interviews. Representatives from IHME, IDB, and the Costa Rica Ministry of Health and CCSS provided oversight during pilot exercises. IHME and Borge y Asociados 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. Borge y Asociados continued providing retraining throughout data collection to maintain homogeneity and quality standards of the data collection teams over time. During a supervisory trip from October 28 - November 2, 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 Costa Rica. 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 Costa Rica Ministry of Health and CCSS.

### 2.2.5 Ethical considerations

The study received authorization from by the Costa Rica Ministry of Health and CCSS 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 Borge y Asociados, 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-Costa Rica Baseline LQAS Survey in households. All estimates reported in this chapter are weighted by the inverse probability of selection (see details in Appendix C) and account for clustering in variance calculations, except where otherwise noted. For this reason, many proportions reported are not equal to the ratio of numerator to denominator.

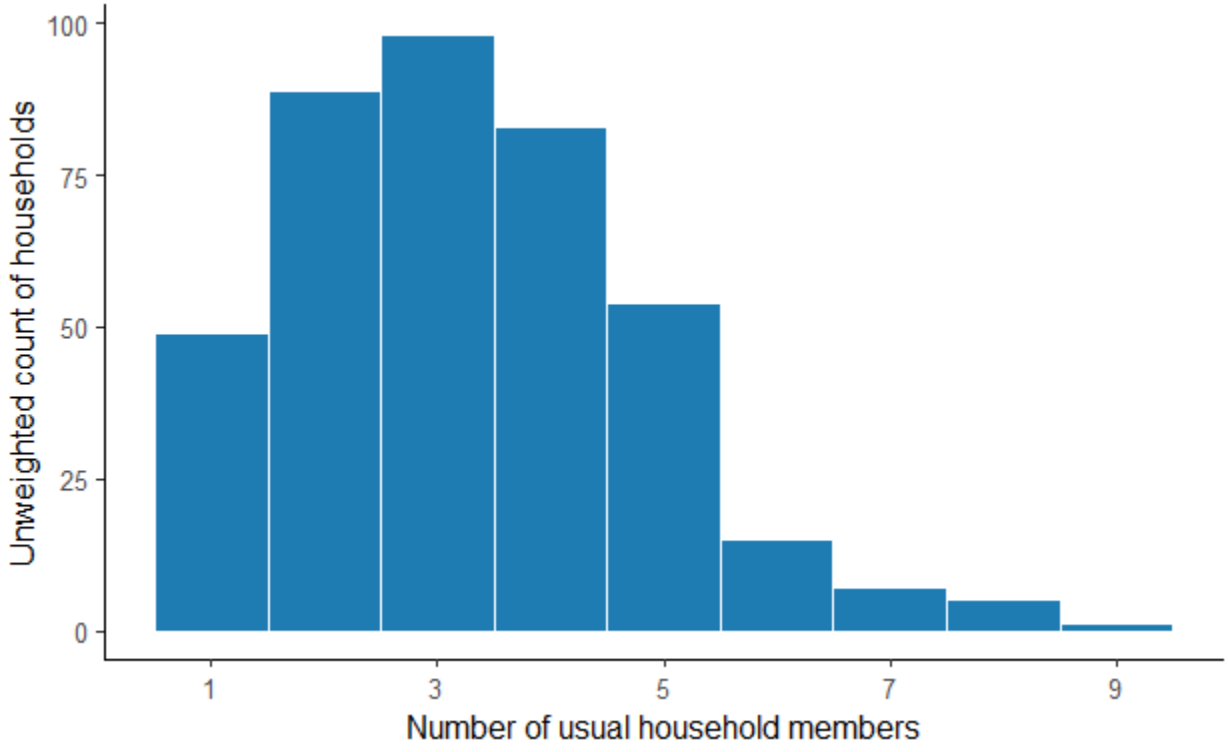
## 3.1 Characteristics of participating households

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

### 3.1.1 Household composition and household member characteristics

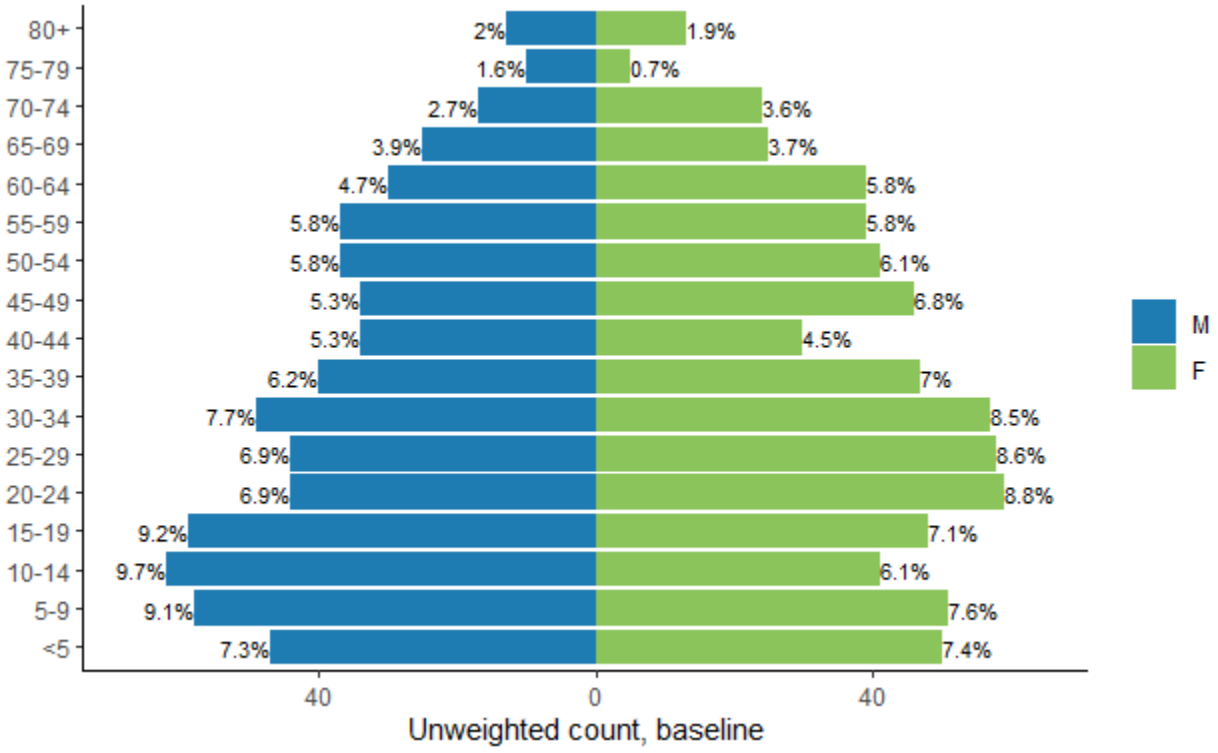
A total of 401 households in the Costa Rica baseline survey completed the interview. The unweighted distribution of the number of members by household is shown in Figure 3.1. The survey sample for Costa Rica has a median household size of 3 and an unweighted average household size of 3.3.

*Figure 3.1: Household size, unweighted percent distribution*




The unweighted distribution of the de facto household population in the surveyed households in Costa Rica by five-year age groups and by sex is shown in Figure 3.2. Costa Rica 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, 24% of the population in the baseline is under age 15 years, more than half (66%) 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 and languages spoken for all usual household members aged 15 or older. Respondents could indicate multiple languages spoken. The results are shown in Table 3.1 and Table 3.2 respectively. In Costa Rica, 3.2% of household members had no formal schooling, and 44.2% completed only primary education. One-hundred percent speak Spanish.

*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 | 1004 | 33 | 3.2 | (1 - 7) |
| Primary | 1004 | 461 | 44.2 | (38 - 51) |
| Secondary | 1004 | 383 | 38.2 | (35 - 42) |
| University | 1004 | 112 | 13.1 | (8 - 20) |
| Don't know | 1004 | 15 | 1.3 | (1 - 2) |

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

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Languages spoken by household members age 15 and older | | | | |
| Spanish | 1004 | 1003 | 99.9 | (99 - 100) |
| English | 1004 | 44 | 4.7 | (3 - 8) |
| Other | 1004 | 2 | 0.2 | (0 - 1) |
| Don't know | 1004 | 1 | 0.1 | (0 - 1) |

### 3.1.2 Dwelling characteristics

The quality of building materials used in houses is related to malaria protection for those living within. Dwellings that offer more protection have no slits or gaps where mosquitoes can enter, glassed or screened-in windows, and closed eaves. Field personnel observed building materials as a part of the survey. In Costa Rica, 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 ceramic tile floors.

*Table 3.4: Exterior wall material as observed*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Main material of exterior walls of dwelling | | | | |
| Cement block | 401 | 262 | 67.1 | (56 - 77) |
| Plywood | 401 | 68 | 16.3 | (9 - 27) |
| Prefabricated material | 401 | 24 | 5.7 | (3 - 11) |
| No walls | 401 | 7 | 1.4 | (0 - 6) |
| Polished wood | 401 | 5 | 0.9 | (0 - 3) |
| Stone with lime/cement | 401 | 6 | 0.5 | (0 - 2) |
| Palm/bamboo | 401 | 2 | 0.4 | (0 - 4) |
| Cardboard/waste material | 401 | 2 | 0.4 | (0 - 4) |
| "Bahareque"/wattle-and-daub (mud plaster and cane) | 401 | 2 | 0.2 | (0 - 1) |
| Other | 401 | 23 | 7.1 | (3 - 16) |

*Table 3.5: Roofing material as observed*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Main material of roof of dwelling | | | | |
| Sheet metal (zinc/Alucin) | 401 | 364 | 93.4 | (87 - 97) |
| Wood planks | 401 | 30 | 5.6 | (3 - 11) |
| Cement fiber/asbestos sheet | 401 | 2 | 0.5 | (0 - 3) |
| Concrete | 401 | 5 | 0.4 | (0 - 2) |

*Table 3.6: Flooring material as observed*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Main material of floor of dwelling | | | | |
| Ceramic tile | 401 | 203 | 51.4 | (40 - 63) |
| Cement sheet/board | 401 | 82 | 21.6 | (15 - 30) |
| Cement brick or tile | 401 | 52 | 11.9 | (7 - 19) |
| Wood planks | 401 | 22 | 6.1 | (3 - 14) |
| Earth/sand | 401 | 9 | 2.3 | (1 - 6) |
| Not observed | 401 | 4 | 1.6 | (0 - 6) |
| Mud brick | 401 | 5 | 1.4 | (0 - 6) |
| Parquet or polished wood | 401 | 9 | 1 | (0 - 4) |
| Granite/stone | 401 | 1 | 0.2 | (0 - 2) |
| Other | 401 | 14 | 2.5 | (1 - 9) |

Many houses (55.5%) have open roof eaves. Most have glass in all windows (70.1%), no screens in windows (88.3%), and no screens in doors (98.1%).

*Table 3.7: Open or closed roof eave as observed*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Open gap between wall and roof eave | 394 | 227 | 55.5 | (39 - 71) |

*Table 3.8: Glass in windows as observed*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Do windows have glass panes? | | | | |
| Yes, in all windows | 401 | 276 | 70.1 | (57 - 81) |
| None | 401 | 102 | 23.1 | (14 - 35) |
| Yes, but only in some windows | 401 | 14 | 4 | (1 - 12) |
| There are no windows in the house | 401 | 9 | 2.9 | (1 - 8) |

*Table 3.9: Screens in windows as observed*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Do windows have screens? | | | | |
| None | 401 | 355 | 88.3 | (80 - 94) |
| Yes, in all windows | 401 | 25 | 5.7 | (4 - 8) |
| Yes, but only in some windows | 401 | 16 | 4 | (1 - 12) |
| There are no windows in the house | 401 | 5 | 2 | (1 - 7) |

*Table 3.10: Screens in doors as observed*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Do doors have screens? | | | | |
| None | 401 | 388 | 98.1 | (96 - 99) |
| Yes, but only in some doors | 401 | 8 | 1.1 | (0 - 3) |
| Yes, in all doors | 401 | 5 | 0.8 | (0 - 2) |

*Aedes* mosquitoes, which spread arboviruses like dengue, zika, and chikungunya, breed in small deposits of water like puddles, flowerpots, and old tires. *Anopheles* mosquitoes, which spread malaria, breed in water bodies like lagoons, rivers, and canals. After the interview, field personnel observed the surroundings of each surveyed dwelling for potential breeding areas. Table 3.11 shows that 83.5% of homes had clean surroundings without standing water on the day of the survey, and only 1.9% 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 | 343 | 83.5 | (78 - 88) |
| Trash, tires, or other refuse present, but no standing water | 401 | 30 | 8.9 | (5 - 15) |
| Yes, puddles | 401 | 28 | 7.7 | (4 - 16) |
| Yes, pond or other natural water body | 401 | 8 | 1.9 | (1 - 4) |
| Yes, water collected in trash, tires, or other small containers | 401 | 4 | 0.7 | (0 - 2) |
| Other | 401 | 2 | 1 | (0 - 3) |

Table 3.12 shows the principal water source of the household as reported by the respondent; 100% of households have water piped to their house. The most common type of sanitation facility is a flush toilet (99% 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 | 401 | 100 | ( - ) |

*Table 3.13: Type of sanitation facility used*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Type of toilet used | | | | |
| Flush toilet | 401 | 397 | 99 | (97 - 100) |
| Pit latrine | 401 | 2 | 0.5 | (0 - 3) |
| Pour flush toilet | 401 | 1 | 0.2 | (0 - 2) |
| Don't know | 401 | 1 | 0.3 | (0 - 2) |

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

*Table 3.14: Cooking fuel source*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Principal cooking fuel | | | | |
| Gas tank | 401 | 285 | 67.9 | (50 - 82) |
| Electricity | 401 | 121 | 32.9 | (19 - 51) |
| Wood | 401 | 32 | 9.5 | (4 - 20) |
| Charcoal | 401 | 1 | 0.1 | (0 - 1) |
| No food cooked in household | 401 | 1 | 0.1 | (0 - 1) |
| Straw/shrubs/grass | 401 | 0 | 0 | ( - ) |
| Agricultural crop | 401 | 0 | 0 | ( - ) |
| Other | 401 | 0 | 0 | ( - ) |

*Table 3.15: Cooking location*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Where cooking is done | | | | |
| In the house | 400 | 384 | 96.6 | (94 - 98) |
| In a separate building | 400 | 8 | 1.8 | (1 - 4) |
| Outdoors | 400 | 8 | 1.6 | (1 - 4) |

### 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. Nearly all households (99.3%) have electricity. Of the 37 households that own livestock, most own poultry (88.4% 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 | 399 | 99.3 | (97 - 100) |
| Radio | 401 | 197 | 49.3 | (45 - 54) |
| Sound system | 401 | 171 | 39.4 | (35 - 44) |
| Television | 400 | 378 | 93.8 | (91 - 96) |
| Home telephone | 401 | 81 | 18.1 | (12 - 26) |
| Mobile phone | 400 | 385 | 96.5 | (95 - 98) |
| Refrigerator | 401 | 386 | 96.2 | (93 - 98) |
| Washing machine | 401 | 384 | 95 | (91 - 97) |
| Computer | 400 | 137 | 39.5 | (32 - 48) |

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Electric fan | 400 | 343 | 79.9 | (57 - 92) |
| Air conditioner | 401 | 27 | 5.9 | (2 - 15) |
| Watch | 399 | 220 | 56.6 | (46 - 67) |
| Guitar | 400 | 40 | 12 | (7 - 20) |
| Bike | 400 | 252 | 57.9 | (45 - 70) |
| Motorcycle or scooter | 400 | 93 | 19.8 | (14 - 27) |
| Animal-drawn cart | 401 | 2 | 0.5 | (0 - 4) |
| Car | 400 | 131 | 33.5 | (24 - 45) |
| Truck | 401 | 9 | 1.6 | (1 - 3) |
| Motor boat | 401 | 15 | 2.7 | (0 - 13) |
| Bank account | 383 | 234 | 64.2 | (49 - 77) |

*The denomintor varies due to omission of 'don't know' and 'decline to respond' responses.

*Table 3.17: Livestock ownership*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Cattle | 37 | 16 | 37.1 | (24 - 52) |
| Horses, donkeys or mules | 38 | 6 | 15.7 | (5 - 41) |
| Goats or sheep | 38 | 2 | 8.3 | (3 - 21) |
| Chickens or other poultry | 37 | 30 | 88.4 | (70 - 96) |
| Pigs | 38 | 9 | 18.8 | (7 - 42) |

*The denomintor varies due to omission of 'don't know' and 'decline to respond' responses.

*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 | 386 | 94.6 | (87 - 98) |
| Yes, own | 401 | 13 | 5.1 | (2 - 13) |
| Yes, rent | 401 | 1 | 0 | ( - ) |
| Don't know | 401 | 1 | 0.3 | (0 - 2) |

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

*Table 3.19: Monthly household income, all sources*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Monthly household income, Costa Rican Colón (CRC) | | | | |
| Less than 100,000 CRC | 401 | 54 | 13.9 | (7 - 24) |
| 100,001 - 250,000 CRC | 401 | 108 | 28 | (24 - 32) |
| 250,001 - 500,000 CRC | 401 | 48 | 11.1 | (6 - 19) |
| 500,001 - 700,000 CRC | 401 | 24 | 6.9 | (2 - 19) |
| 700,001 - 1,000,000 CRC | 401 | 7 | 2.5 | (1 - 5) |
| 1,000,001 - 1,500,000 CRC | 401 | 6 | 1.2 | (0 - 5) |
| 1,500,001 - 2,000,000 CRC | 401 | 2 | 0.7 | (0 - 3) |
| Don't know | 401 | 81 | 19.3 | (13 - 28) |
| Decline to respond | 401 | 71 | 16.3 | (11 - 24) |

The interview also asked respondents the distance (km) to the health facility nearest their home. Long distances and travel times to health establishments can discourage households in remote locations from seeking medical care. Figure 3.3 shows the unweighted distribution of distances reported in the survey. Figure 3.4 shows the unweighted distribution of travel time (minutes) reported in the survey. The survey sample for Costa Rica has an unweighted average distance of 2.6 kilometers and an unweighted average travel time of 14.9 minutes by usual mode of travel to the nearest health facility.

*Figure 3.3: Distance to nearest health facility, unweighted count*

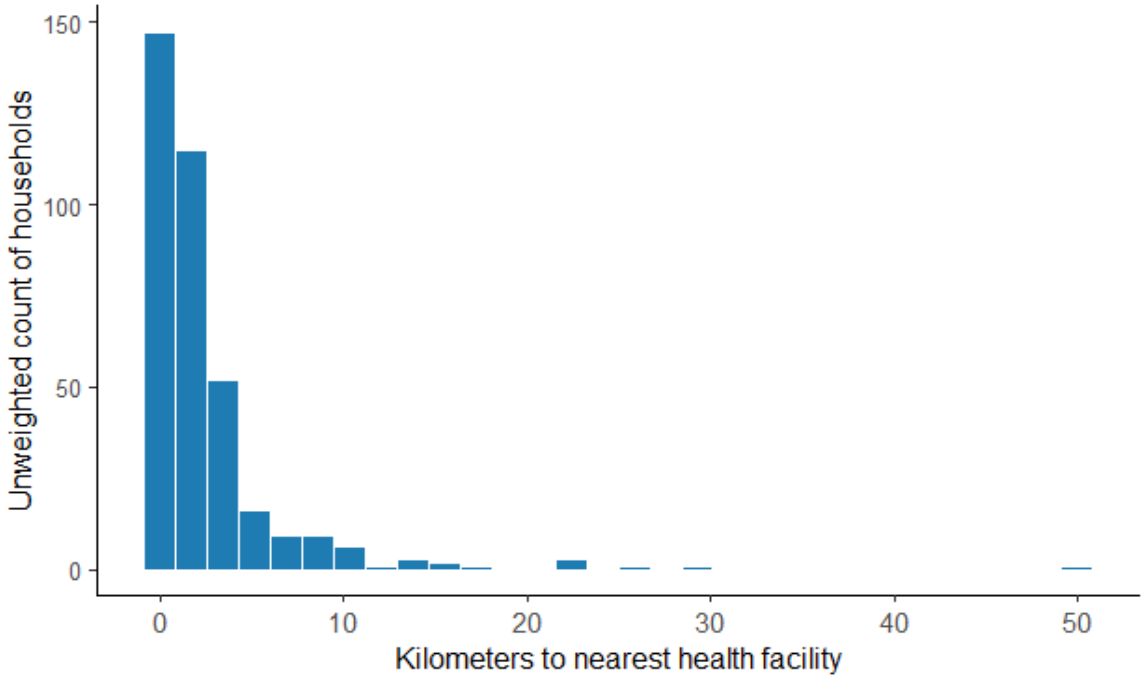
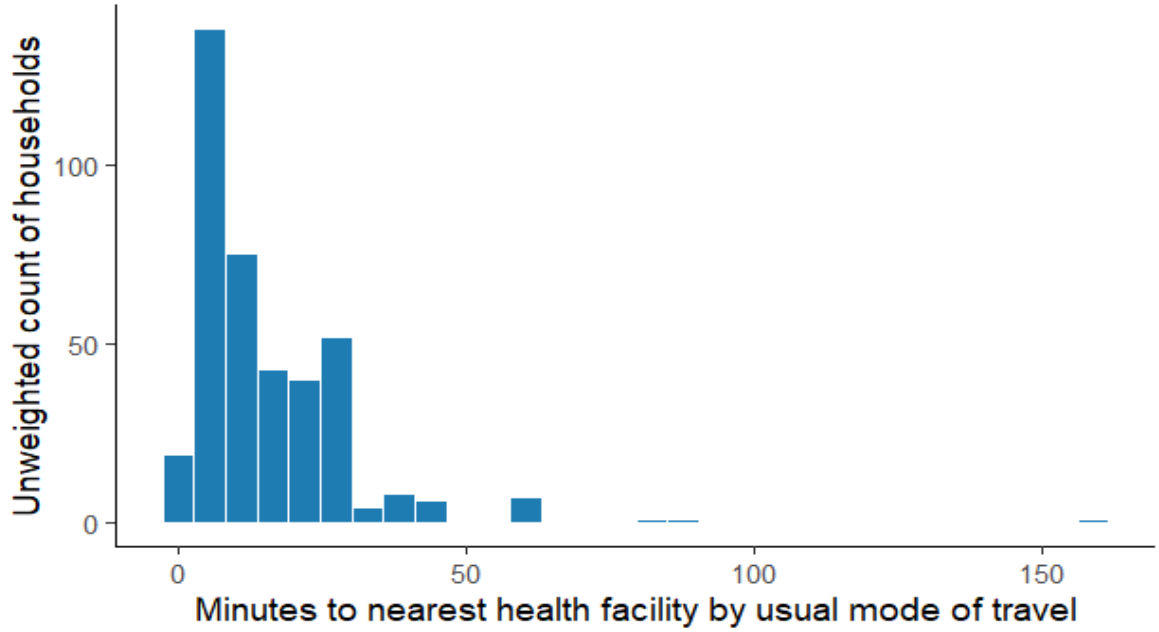



*Figure 3.4: Travel time to nearest health facility, unweighted count*



## 3.2 Malaria knowledge

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

### 3.2.1 Disease knowledge

As Table 3.21 shows, most respondents had heard of malaria before (84.4%). Respondents were asked the cause of malaria (Table 3.22) and the mode of transmission of malaria (Table 3.23) and interviewers could register more than one response. Most respondents are aware of the role of mosquitoes in malaria transmission.

*Table 3.21: Malaria awareness*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Heard of illness called malaria | 400 | 332 | 84.4 | (80 - 88) |

*Table 3.22: Knowledge of cause of malaria*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| In your opinion, what causes malaria? | | | | |
| Mosquito bites | 332 | 204 | 62 | (56 - 68) |
| Stagnant water | 332 | 25 | 7.9 | (4 - 16) |
| Dirty surroundings | 332 | 15 | 5.4 | (2 - 11) |
| Anopheles mosquito bite | 332 | 7 | 1.7 | (1 - 4) |
| Eating dirty food/drinking dirty water | 332 | 7 | 1.6 | (0 - 5) |
| Malaria parasite (plasmodium) | 332 | 1 | 0.4 | (0 - 4) |
| Weedy surroundings | 332 | 4 | 0.4 | (0 - 2) |
| Working in the forest or the fields | 332 | 1 | 0.1 | (0 - 1) |
| Other | 332 | 8 | 2.4 | (1 - 6) |
| Don't know | 332 | 93 | 29 | (23 - 36) |

*Table 3.23: Knowledge of malaria transmission*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| How is malaria transmitted? | | | | |
| By mosquitoes | 332 | 219 | 66.3 | (54 - 77) |
| Poor personal hygiene | 332 | 9 | 3.8 | (1 - 9) |
| Eating dirty food/drinking dirty water | 332 | 9 | 3.6 | (1 - 9) |
| Passes from one person to another | 332 | 3 | 1.1 | (0 - 6) |
| Contaminated air | 332 | 3 | 1.1 | (0 - 4) |
| Stagnant water | 332 | 2 | 0.8 | (0 - 4) |
| Other | 332 | 11 | 1.3 | (0 - 4) |
| Don't know | 332 | 91 | 26.2 | (18 - 37) |

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

*Table 3.24: Knowledge of malaria symptoms*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Main sign or symptom of malaria known | | | | |
| Fever | 332 | 250 | 76.2 | (69 - 82) |
| Headache | 332 | 109 | 32.6 | (25 - 41) |
| Chills | 332 | 67 | 18.7 | (13 - 27) |
| Body ache or joint pain | 332 | 60 | 18.2 | (13 - 26) |
| Nausea and vomiting | 332 | 58 | 16.6 | (10 - 25) |
| Body weakness | 332 | 20 | 7.2 | (5 - 10) |
| Pale eyes or skin | 332 | 23 | 6.8 | (4 - 12) |
| Diarrhea | 332 | 18 | 6.4 | (3 - 12) |
| Dizziness | 332 | 12 | 3.4 | (2 - 7) |
| Loss of appetite | 332 | 7 | 1.9 | (1 - 5) |
| Sweating | 332 | 4 | 0.4 | (0 - 2) |
| Cough | 332 | 1 | 0.3 | (0 - 3) |
| Seizures | 332 | 1 | 0.3 | (0 - 3) |
| Other | 332 | 22 | 5.5 | (3 - 11) |
| Don't know | 332 | 72 | 21.2 | (16 - 27) |

*Table 3.25: Multiple common symptoms of malaria known*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Fever and chills | 332 | 63 | 19 | (15 - 24) |
| Fever and sweating | 332 | 4 | 1.2 | (0 - 3) |
| Fever, chills, and sweating | 332 | 1 | 0.3 | (0 - 2) |

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

*Table 3.26: Knowledge of community transmission*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| In your community, during the last year, how many people do you know who had a case of malaria? | | | | |
| None | 332 | 314 | 95.3 | (89 - 98) |
| One person | 332 | 2 | 0.9 | (0 - 3) |
| 2-4 people | 332 | 5 | 1.3 | (0 - 4) |
| 11-100 people | 332 | 1 | 0.2 | (0 - 2) |
| Don't know | 332 | 10 | 2.3 | (1 - 6) |

### 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, 27.5% had heard messages about malaria during the last year. Of those who had heard messages, the specific information heard is detailed in Table 3.27. Some of the responses indicate that people may confuse messages about preventing dengue or other arboviruses with malaria prevention messages. However, some respondents had learned to seek medical attention for fevers and about using a mosquito net.

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

each, among respondents who had heard any messages about malaria in the past year, are in Table 3.28.

*Table 3.27: Malaria messages heard in last year*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Messages seen or heard in last year | | | | |
| Eliminate breeding sites/clean up trash | 94 | 53 | 59.9 | (48 - 70) |
| If have fever go to health facility | 94 | 16 | 15 | (7 - 28) |
| Always test before treating malaria | 94 | 8 | 10.2 | (4 - 23) |
| Sleep under an insecticide-treated mosquito net | 94 | 7 | 5.1 | (2 - 13) |
| Anopheles mosquitoes transmit malaria by biting people at night | 94 | 2 | 1.8 | (0 - 8) |
| Sleep under a net every night to protect yourself against malaria | 94 | 1 | 1.6 | (0 - 13) |
| Nets are used to protect from mosquitoes | 94 | 1 | 1.1 | (0 - 10) |
| Be sure to tuck the borders of the net under the mattress | 94 | 1 | 0.6 | (0 - 6) |
| Other | 94 | 16 | 14.8 | (8 - 27) |
| Don't know | 94 | 15 | 16.6 | (8 - 31) |

*Table 3.28: Source of malaria messages*

| Source of messages, among those who heard them | N | n | % | 95% CI |
|---|---|---|---|---|
| On the radio | 93 | 23 | 21.8 | (11 - 40) |
| On TV | 94 | 81 | 84.9 | (74 - 92) |
| On a poster or billboard | 93 | 29 | 30.4 | (19 - 45) |
| From a community health worker | 93 | 29 | 32.1 | (21 - 46) |
| From personnel at a health facility | 93 | 34 | 36.4 | (23 - 52) |
| At a community event | 93 | 15 | 15.8 | (8 - 30) |
| At school | 92 | 18 | 15.8 | (8 - 28) |
| On the internet or social media | 92 | 26 | 26.2 | (15 - 41) |
| Somewhere else | 92 | 4 | 4.8 | (1 - 15) |

*The denomintor varies due to omission of 'don't know' and 'decline to respond' responses.

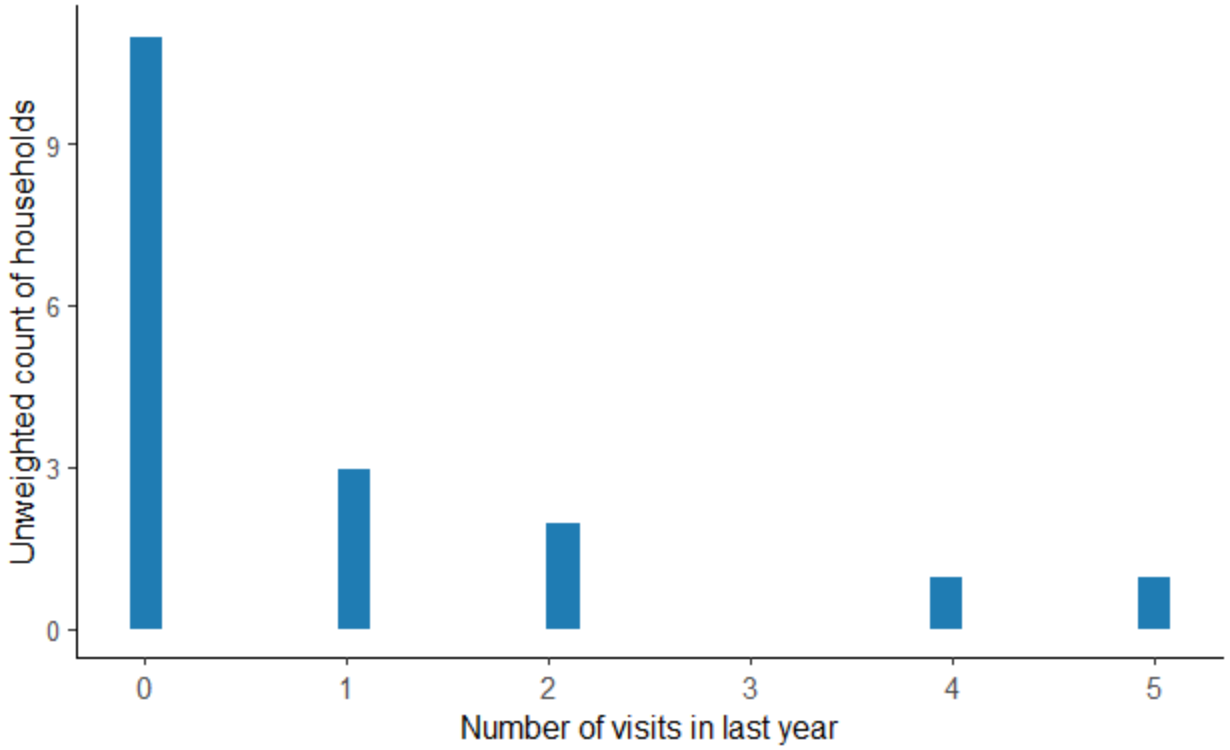
### 3.2.3 Knowledge of community resources

Several countries in Central America rely on “volunteer collaboarator” programs as a key component of malaria detection. Volunteer collaborators (*colaboradores voluntarios*, “col-vols”) are community members who are trained to carry out malaria detection activities such as screening and referring patients to health facilities or to community-based vector control technicians. In Costa Rica, a similar model has been introduced in recent years in zones with malaria transmission such as certain communities bordering Nicaragua. In Costa Rica, the volunteer community health workers (CHW) are known as “community malaria leaders” (*líderes comunitarios de malaria*). In the Costa Rica baseline survey, 5% of households knew of a col-vol or malaria leader in their community. Of those who knew of a col-vol, 47.3% reported receiving a home visit by that volunteer during the year before the date of the survey (Table 3.29). The number of visits received from the col-vol or community malaria leaders among respondents who knew of one in their community is shown in Figure 3.5.

*Table 3.29: Knowledge of col-vols/community malaria leaders*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Know of col-vol/malaria leader in own community | 357 | 20 | 5 | (2 - 11) |
| Visited by col-vol/malaria leader in last year | 20 | 9 | 47.3 | (11 - 87) |

*Figure 3.5: Number of visits from col-vols/community malaria leaders in last year*




Malaria testing and treatment is provided free of charge through the Ministry of Health and CCSS in Costa Rica, and 63.8% of respondents are aware of this benefit (Table 3.30). Because cost and knowledge of where services are available may be barriers to seeking care, the survey asked respondents where someone could access testing and treatment. Respondents could indicate multiple health facility types they knew provided the service, and interviewers classified them according to the options in the survey. A majority of households knew that they could seek malaria care at public hospitals (Table 3.31, Table 3.32). Knowledge of col-vol or community malaria leaders by province is shown in Table 3.33. The baseline measurement was not designed to produce representative estimates at the province level, so results by province should be interpreted with discretion.

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

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Aware malaria diagnosis and treatment are provided free by the government | 310 | 197 | 63.8 | (53 - 74) |

*Table 3.31: Knowledge of where to go for malaria testing*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Where can someone go to be tested for malaria? | | | | |
| Public Sector: Government hospital | 332 | 162 | 58 | (41 - 73) |
| Public Sector: Área de salud clinic | 332 | 195 | 46.1 | (28 - 66) |
| Private medical sector: Private doctor | 332 | 16 | 4.9 | (3 - 8) |
| Public Sector: Fieldworker/Community Health Worker (ATAP) | 332 | 1 | 0.3 | (0 - 3) |
| Private medical sector: Pharmacy | 332 | 2 | 0.3 | (0 - 3) |
| Public Sector: mobile clinic | 332 | 0 | 0 | ( - ) |
| Traditional healer | 332 | 0 | 0 | ( - ) |

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Other | 332 | 5 | 1.8 | (1 - 5) |
| Don't know | 332 | 6 | 2.8 | (1 - 6) |

*Table 3.32: Knowledge of where to go for malaria treatment*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Where can someone receive treatment for malaria? | | | | |
| Public Sector: Government hospital | 295 | 166 | 65.1 | (46 - 80) |
| Public Sector: Área de salud clinic | 295 | 163 | 46.2 | (28 - 65) |
| Private medical sector: Private doctor | 295 | 12 | 5.7 | (3 - 11) |
| Public Sector: Fieldworker/Community Health Worker (ATAP) | 295 | 6 | 2.1 | (1 - 7) |
| Private medical sector: Pharmacy | 295 | 7 | 2.1 | (1 - 5) |
| Traditional healer | 295 | 1 | 0.7 | (0 - 5) |
| Public Sector: mobile clinic | 295 | 1 | 0.3 | (0 - 2) |
| Other | 295 | 1 | 0.5 | (0 - 4) |
| Don't know | 295 | 3 | 1 | (0 - 4) |

*Table 3.33: Knowledge of col-vols/community malaria leaders by province*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Alajuela (5 communities) | | | | |
| Know of col-vol/malaria leader in own community | 105 | 3 | 3.1 | (0 - 20) |
| Visited by col-vol/malaria leader in last year | 3 | 0 | 0 | ( - ) |
| ATAP/ CHW conduct testing for malaria | 102 | 1 | 0.7 | (0 - 6) |
| ATAP/ CHW provide treatment for malaria | 88 | 1 | 0.8 | (0 - 8) |
| Guanacaste (3 communities) | | | | |
| Know of col-vol/malaria leader in own community | 73 | 4 | 2.5 | (0 - 17) |
| Visited by col-vol/malaria leader in last year | 4 | 1 | 37.8 | (15 - 68) |
| ATAP/ CHW conduct testing for malaria | 62 | 0 | 0 | ( - ) |
| ATAP/ CHW provide treatment for malaria | 55 | 1 | 3.7 | (2 - 8) |
| Heredia (1 community) | | | | |
| Know of col-vol/malaria leader in own community | 22 | 0 | 0 | ( - ) |
| Visited by col-vol/malaria leader in last year | 0 | 0 | | - |
| ATAP/ CHW conduct testing for malaria | 20 | 0 | 0 | ( - ) |
| ATAP/ CHW provide treatment for malaria | 18 | 0 | 0 | ( - ) |
| Limón (1 community) | | | | |
| Know of col-vol/malaria leader in own community | 22 | 2 | 9.1 | (9 - 9) |
| Visited by col-vol/malaria leader in last year | 2 | 1 | 50 | (50 - 50) |
| ATAP/ CHW conduct testing for malaria | 21 | 0 | 0 | ( - ) |
| ATAP/ CHW provide treatment for malaria | 21 | 0 | 0 | ( - ) |
| Puntarenas (6 communities) | | | | |
| Know of col-vol/malaria leader in own community | 135 | 11 | 9.4 | (5 - 17) |

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Visited by col-vol/malaria leader in last year | 11 | 7 | 69.9 | (14 - 97) |
| ATAP/ CHW conduct testing for malaria | 127 | 0 | 0 | ( - ) |
| ATAP/ CHW provide treatment for malaria | 113 | 4 | 3.6 | (0 - 25) |

## 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 3.34). Among individuals in surveyed households, 17.1% reported travel outside the community in the last two weeks (Table 3.35). According to respondents, most household members did not participate in any of the risk activities listed in Table 3.36 in the two months prior to the survey.

*Table 3.34: Temporal migration within surveyed households*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| At least one member migrates seasonally | 401 | 27 | 6.8 | (3 - 14) |
| At least one member migrates weekly | 400 | 20 | 5.2 | (3 - 10) |

*Table 3.35: Recent travel by individuals in surveyed households*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Individual traveled outside community in last 2 weeks | 1313 | 221 | 17.1 | (14 - 21) |

*Table 3.36: Exposure to risky activities by individuals in surveyed households*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Individuals participating in malaria risk activities | | | | |
| None of these | 1313 | 1141 | 87.5 | (80 - 93) |
| Cultivating crops or working in the fields | 1313 | 117 | 9.4 | (5 - 17) |
| Gathering firewood in the forest | 1313 | 22 | 1.7 | (1 - 3) |
| Collecting shellfish | 1313 | 30 | 1.4 | (0 - 8) |
| Sleeping outdoors overnight | 1313 | 10 | 0.7 | (0 - 2) |
| Working in timber/lumber industries in the forest | 1313 | 6 | 0.5 | (0 - 1) |
| Producing charcoal | 1313 | 4 | 0.3 | (0 - 1) |
| Working in a mine | 1313 | 1 | 0 | ( - ) |
| Don't know | 1313 | 6 | 0.2 | (0 - 1) |
| Decline to respond | 1313 | 1 | 0 | ( - ) |

Respondents were also asked what can be done to protect against malaria (Table 3.37), and what practices they follow in their own households (Table 3.38). The respondent replied in free form, and the interviewer classified the answers according to the options in the survey. The responses again show evidence of some conflation of malaria prevention measures with arbovirus prevention measures, though many responses also referred to use of insect deterrent measures that protect against all mosquito vectors. Only 3.6% of households said they do not use any malaria prevention measures at home.

*Table 3.37: Protective measures known by household*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Methods known to protect against malaria | | | | |
| Eliminate mosquito breeding areas (tires, bottles, or others) | 241 | 135 | 54.8 | (48 - 62) |
| Use insect repellent | 241 | 58 | 22.9 | (14 - 34) |
| Keep house surroundings clean | 241 | 41 | 16.6 | (10 - 26) |
| Fumigate or spray house with insecticides | 241 | 24 | 11.4 | (8 - 15) |
| Sleep under a mosquito net | 241 | 19 | 9.5 | (3 - 27) |
| Fill in puddles (stagnant water) | 241 | 20 | 9.3 | (6 - 14) |
| Avoid mosquito bites | 241 | 21 | 8.9 | (6 - 13) |
| Sleep under an insecticide-treated mosquito net | 241 | 13 | 6.4 | (3 - 12) |
| Use mosquito coils | 241 | 11 | 4.6 | (3 - 8) |
| Put mosquito screens on the windows | 241 | 6 | 4.2 | (1 - 12) |
| Cut the grass around the house | 241 | 9 | 3.9 | (2 - 6) |
| Clean water storage tanks with bleach | 241 | 9 | 2.5 | (1 - 5) |
| Can't be prevented | 241 | 4 | 2.3 | (1 - 7) |
| Add bleach temephos (Abate) to the water tank | 241 | 13 | 2.2 | (1 - 5) |
| Take preventive medication | 241 | 5 | 1.7 | (0 - 6) |
| Other | 241 | 11 | 5.7 | (3 - 12) |
| Don't know | 241 | 17 | 7.7 | (3 - 17) |

*Table 3.38: 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) | 241 | 173 | 71.3 | (64 - 78) |
| Keep house surroundings clean | 241 | 68 | 26 | (18 - 36) |
| Fumigate or spray house with insecticides | 241 | 42 | 16.3 | (11 - 23) |
| Fill in puddles (stagnant water) | 241 | 30 | 13.6 | (8 - 22) |
| Use insect repellent | 241 | 31 | 12.7 | (6 - 24) |
| Sleep under a mosquito net | 241 | 15 | 8 | (1 - 33) |
| Use mosquito coils | 241 | 10 | 4.7 | (2 - 9) |
| Clean water storage tanks with bleach | 241 | 17 | 4.4 | (2 - 10) |
| Cut the grass around the house | 241 | 15 | 4 | (2 - 8) |
| Does nothing to protect from malaria | 241 | 6 | 3.6 | (2 - 8) |
| Add bleach or temephos (Abate) to the water tank | 241 | 14 | 3.1 | (1 - 7) |
| Put mosquito screens on the windows | 241 | 6 | 2.4 | (1 - 5) |
| Sleep under an insecticide-treated mosquito net | 241 | 4 | 2.3 | (1 - 5) |
| Avoid mosquito bites | 241 | 3 | 1.7 | (1 - 5) |
| Take preventive medication | 241 | 4 | 1.7 | (1 - 6) |
| Organize community cleaning work days | 241 | 0 | 0 | ( - ) |
| Other | 241 | 20 | 9 | (6 - 14) |
| Don't know | 241 | 1 | 0.8 | (0 - 5) |

# Chapter 4: Vector control activities

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

Vector control plans in Costa Rica included offering IRS to households in a few communities in malaria-endemic areas. ITN interventions are not a part of the current strategy except in special circumstances. 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. Interventions are planned and budgeted to cover a full community at the same time, with a set goal for acceptance or uptake rate. Intervention plans can sometimes be dynamic to malaria transmission, for example in the case of reactive measures to a new outbreak.

In Costa Rica, the community sample was designed to capture data from one community in each *área de salud* clinic with vector control measures implemented during 2019. Health facilities were listed for selection to the sample based on whether interventions were carried out in the communities in their service area according to data received from the central-level Ministry of Health and CCSS. According to these data, nine communities across two *área de salud* clinic should have received spraying and none received net interventions. Thus, two communities with planned IRS interventions were selected for the LQAS survey.

## 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.

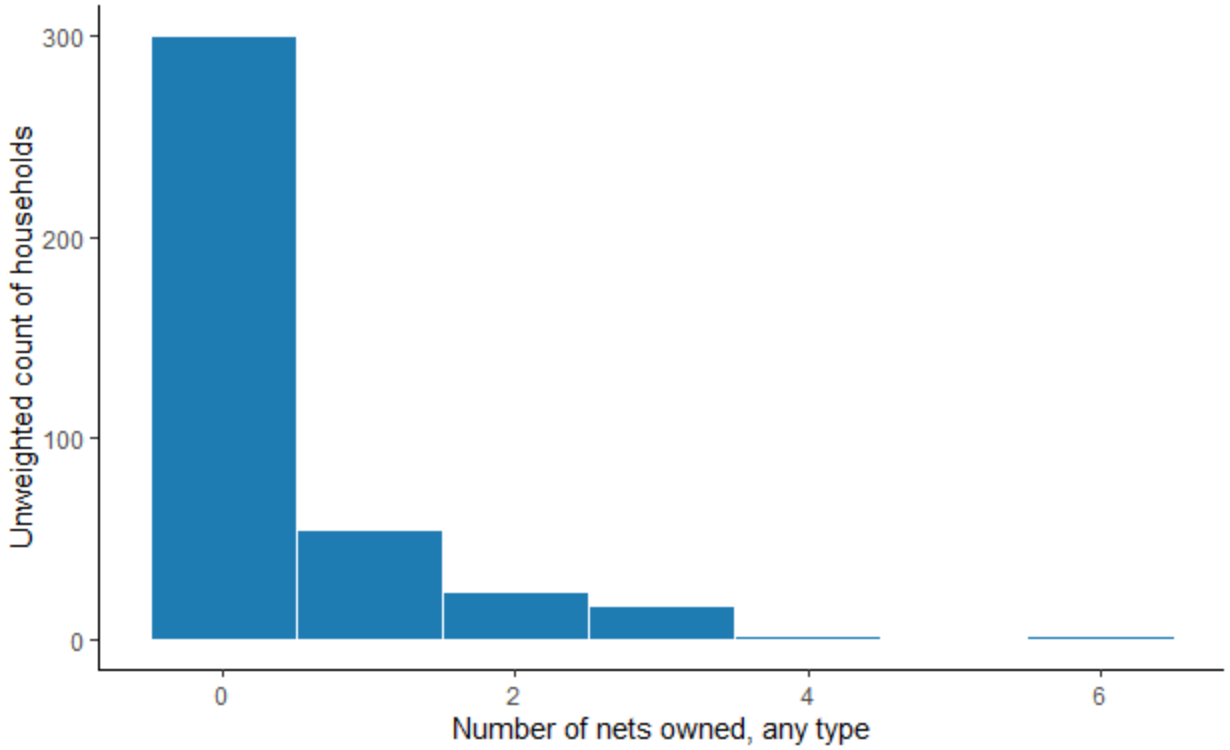
### 4.2.1 Ownership of nets by surveyed households

As Table 4.1 shows, 27.1% 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 | 101 | 27.1 | (15 - 44) |

*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 a health facility. Most untreated nets were purchased in a store (53%, in Table 4.3). Other options for how respondents obtained untreated nets include peddlers, as gifts, and nets created and sold by a local woman.

*Table 4.2: Source of insecticide-treated nets*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Source of net | | | | |
| Government health facility | 14 | 8 | 57.1 | (31 - 80) |
| Shop/market | 14 | 2 | 14.3 | (4 - 43) |
| Pharmacy | 14 | 1 | 7.1 | (1 - 37) |
| Other | 14 | 3 | 21.4 | (7 - 50) |

*Table 4.3: Source of untreated nets*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Source of net | | | | |
| Shop/market | 166 | 88 | 53 | (45 - 61) |
| Pharmacy | 166 | 13 | 7.8 | (5 - 13) |
| Other | 166 | 62 | 37.3 | (30 - 45) |
| Don't know | 166 | 3 | 1.8 | (1 - 6) |

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 | 107 | 92 | 86 | (78 - 91) |
| Only thumb-sized holes | 107 | 14 | 13.1 | (8 - 21) |
| Net never used | 107 | 1 | 0.9 | (0 - 6) |

*Table 4.5: Reported condition of nets not observed*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Condition of mosquito net as reported | | | | |
| No holes | 73 | 61 | 83.6 | (73 - 90) |
| Only thumb-sized holes | 73 | 3 | 4.1 | (1 - 12) |
| Net never used | 73 | 1 | 1.4 | (0 - 9) |
| Don't know | 73 | 7 | 9.6 | (5 - 19) |

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*

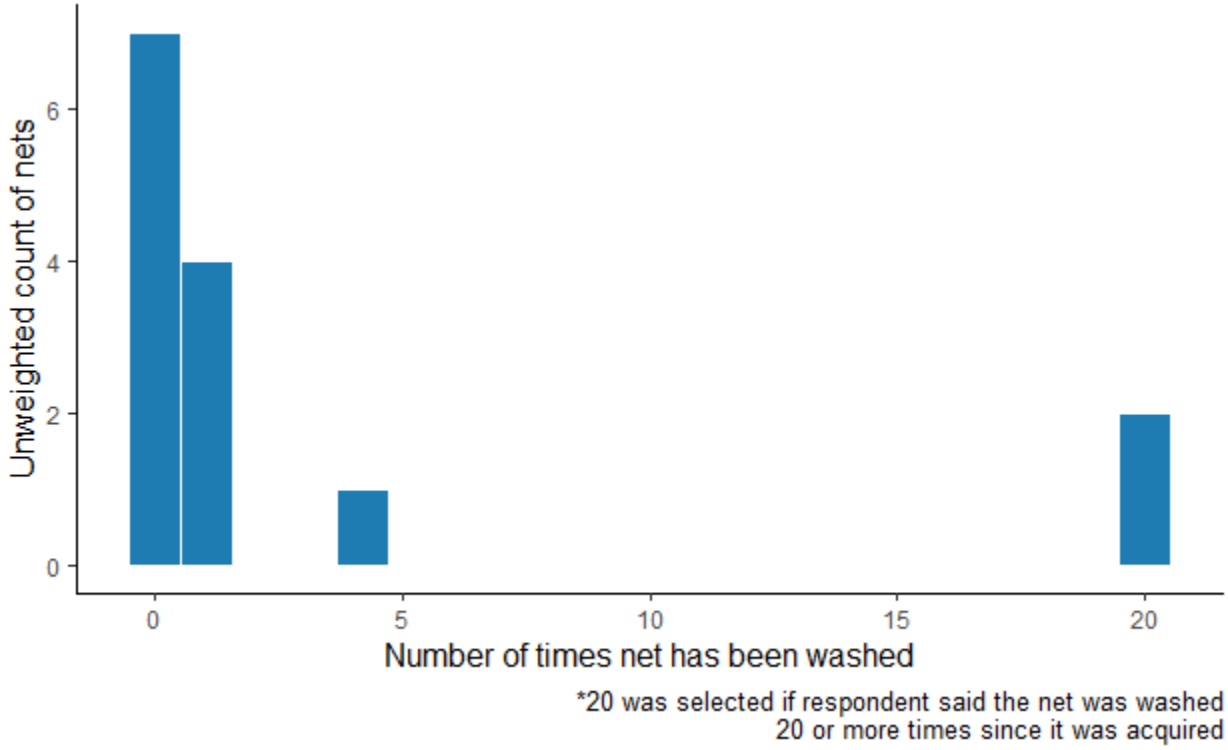


*Table 4.6: Care of insecticide-treated nets - drying*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Method of drying net | | | | |
| In the shade | 7 | 4 | 57.1 | (23 - 86) |
| In the sun | 7 | 2 | 28.6 | (7 - 68) |
| In a dryer | 7 | 1 | 14.3 | (2 - 59) |
| Indoors | 7 | 0 | 0 | ( - ) |

### 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, 1.4% 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, 2.1% were reported to have slept under a net treated with insecticide.

*Table 4.7: Use of net for sleeping previous night*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Total | | | | |
| Slept under treated net | 1240 | 18 | 1.4 | (0 - 4) |
| Slept under untreated net | 1240 | 192 | 17.4 | (8 - 35) |
| Under 5 | | | | |
| Slept under treated net | 93 | 2 | 2.1 | (0 - 9) |
| Slept under untreated net | 93 | 27 | 29.3 | (13 - 52) |
| Pregnant | | | | |
| Slept under treated net | 11 | 1 | 18.5 | (2 - 71) |
| Slept under untreated net | 11 | 0 | 0 | ( - ) |
| Reported usually sleeping under net during pregnancy | 10 | 1 | 22.8 | (3 - 76) |

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 using a net is too hot or they prefer to use a fan instead. When respondents specified an “other” response, they reported that only some family members slept under a net, that they did not know how to set up the net, or the net got tangled while sleeping making it difficult to use.

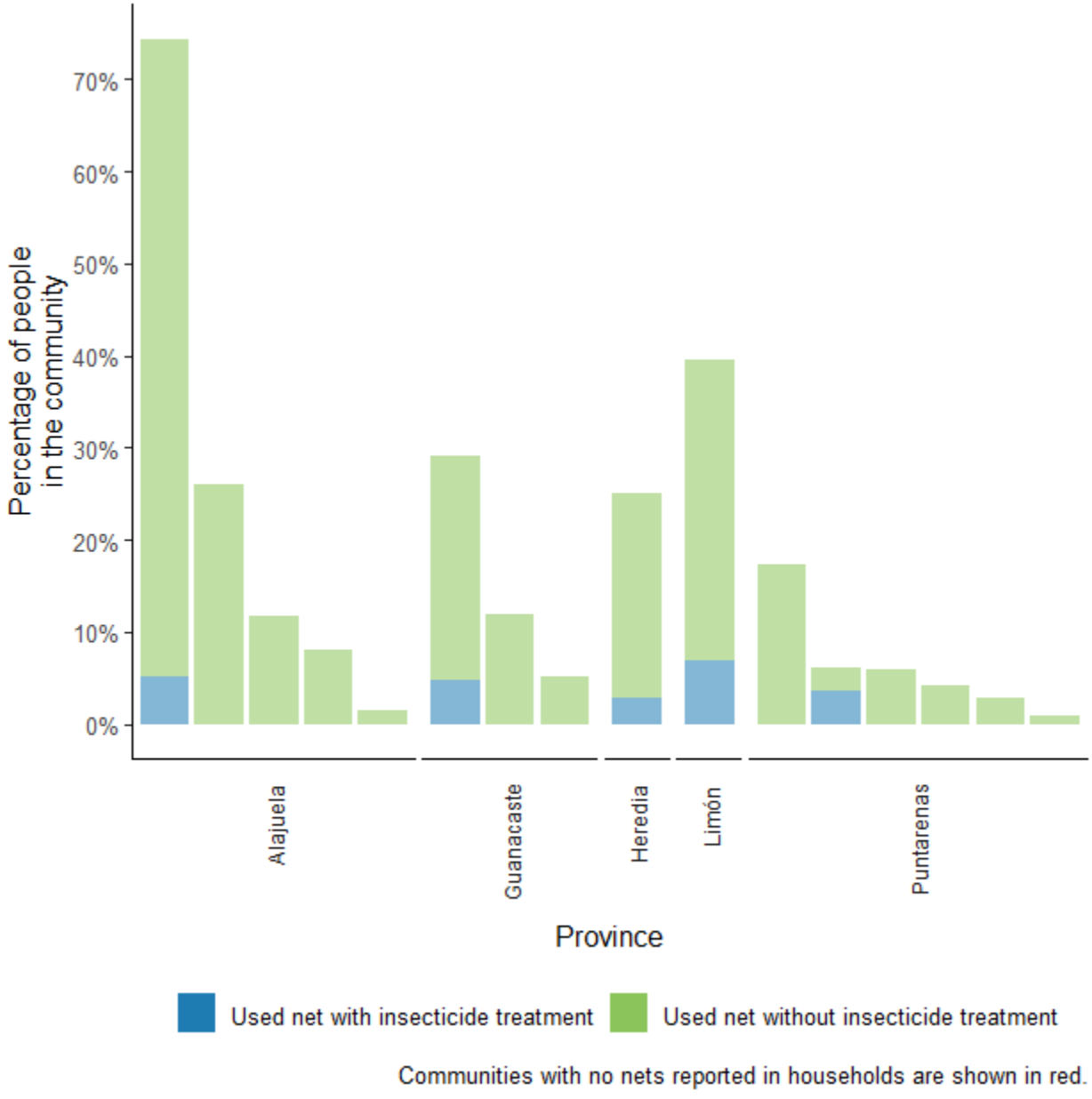
*Table 4.8: Reasons for not using net*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Reasons for not sleeping under mosquito net | | | | |
| Too hot | 62 | 12 | 18.8 | (9 - 34) |
| Not necessary, using fan or air conditioning instead | 62 | 11 | 18.4 | (10 - 31) |
| Don't have enough nets | 62 | 9 | 13.8 | (6 - 28) |
| No mosquitoes | 62 | 9 | 12.5 | (4 - 32) |
| Extra net/more nets available than sleeping areas | 62 | 3 | 6 | (1 - 22) |
| Net too expensive | 62 | 3 | 5.1 | (1 - 19) |
| Not necessary, using mosquito repellent instead | 62 | 2 | 4.7 | (1 - 21) |
| Saving net for later | 62 | 1 | 2.4 | (0 - 13) |

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Net too small | 62 | 2 | 1.9 | (0 - 8) |
| Net too old/torn | 62 | 1 | 1.3 | (0 - 10) |
| No malaria now | 62 | 1 | 0.2 | (0 - 2) |
| Other | 62 | 6 | 11.8 | (6 - 21) |
| Don't know | 62 | 5 | 8.8 | (4 - 19) |

Figure 4.3 shows by province the proportion of individuals who slept in the household the previous night using a mosquito net in each of the communities surveyed. Untreated net use is notable in some communities. The baseline measurement was not designed to produce representative estimates at the province level, so results by province should be interpreted with discretion.

*Figure 4.3: Net use by province and community*



## 4.3 Indoor Residual Spraying

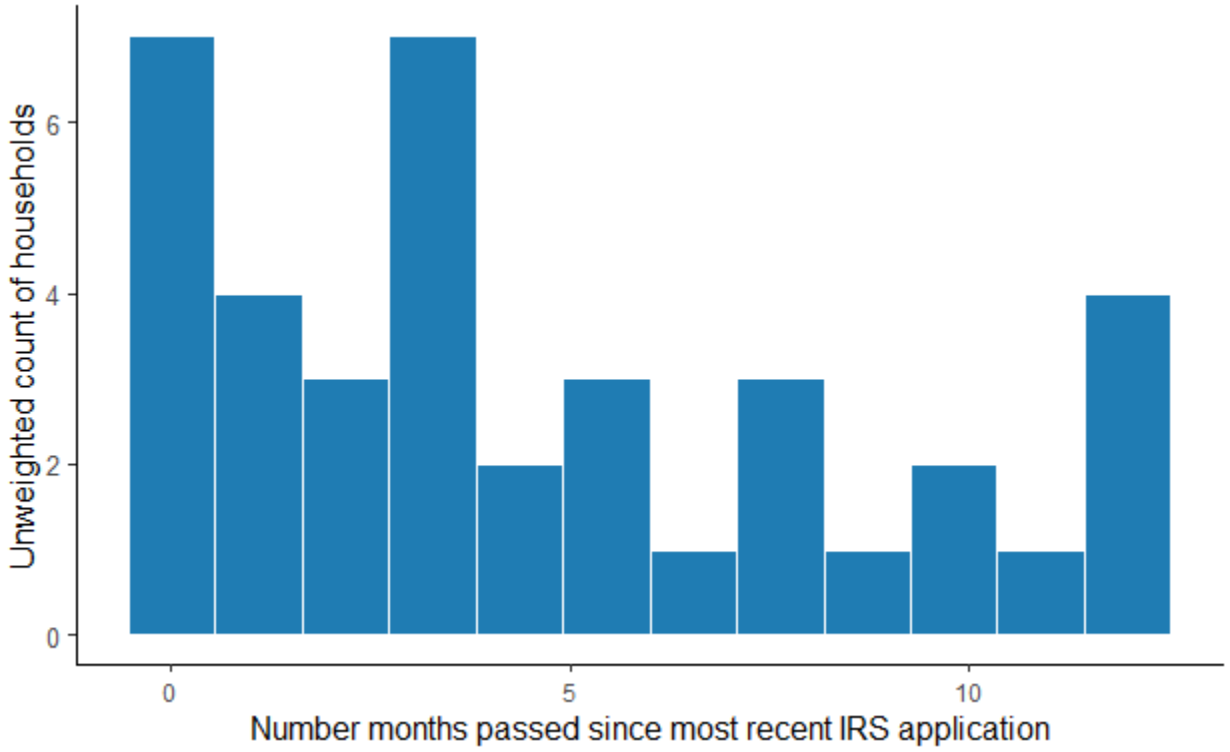
The other key vector control intervention of the Initiative is to offer to spray the interior walls of the dwelling against mosquitoes (usually with deltamethrin or a comparable insecticide). Insecticide application is usually carried out by staff or contractors of the vector control program every 4 to 6 months during the intervention time frame. The interviewer asked respondents if their household had been offered insecticide application to the interior of the dwelling during the last year. As seen in Table 4.9, 10.9% of households were offered IRS, and spraying was carried out in 80.5% 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 6.7% 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 | 397 | 49 | 10.9 | (6 - 20) |
| Accepted indoor residual spraying | 49 | 41 | 80.5 | (65 - 90) |
| Evidence observed (card, sticker, mark) | 40 | 5 | 6.7 | (1 - 26) |

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, unweighted count*




Respondents who were offered IRS, but whose house was not sprayed, were asked why the spraying was not carried out, an uncommon circumstance. The results are shown in Table 4.10. Some “other” responses given included allergy to the spraying chemical and the personnel providing the service not returning to complete the spraying.

*Table 4.10: Reasons for not accepting spraying*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Reason house was not sprayed | | | | |
| Didn't have time/visit time was not convenient | 8 | 1 | 6.9 | (1 - 45) |
| Other | 8 | 4 | 75.1 | (38 - 94) |
| Don't know | 8 | 3 | 18 | (4 - 53) |

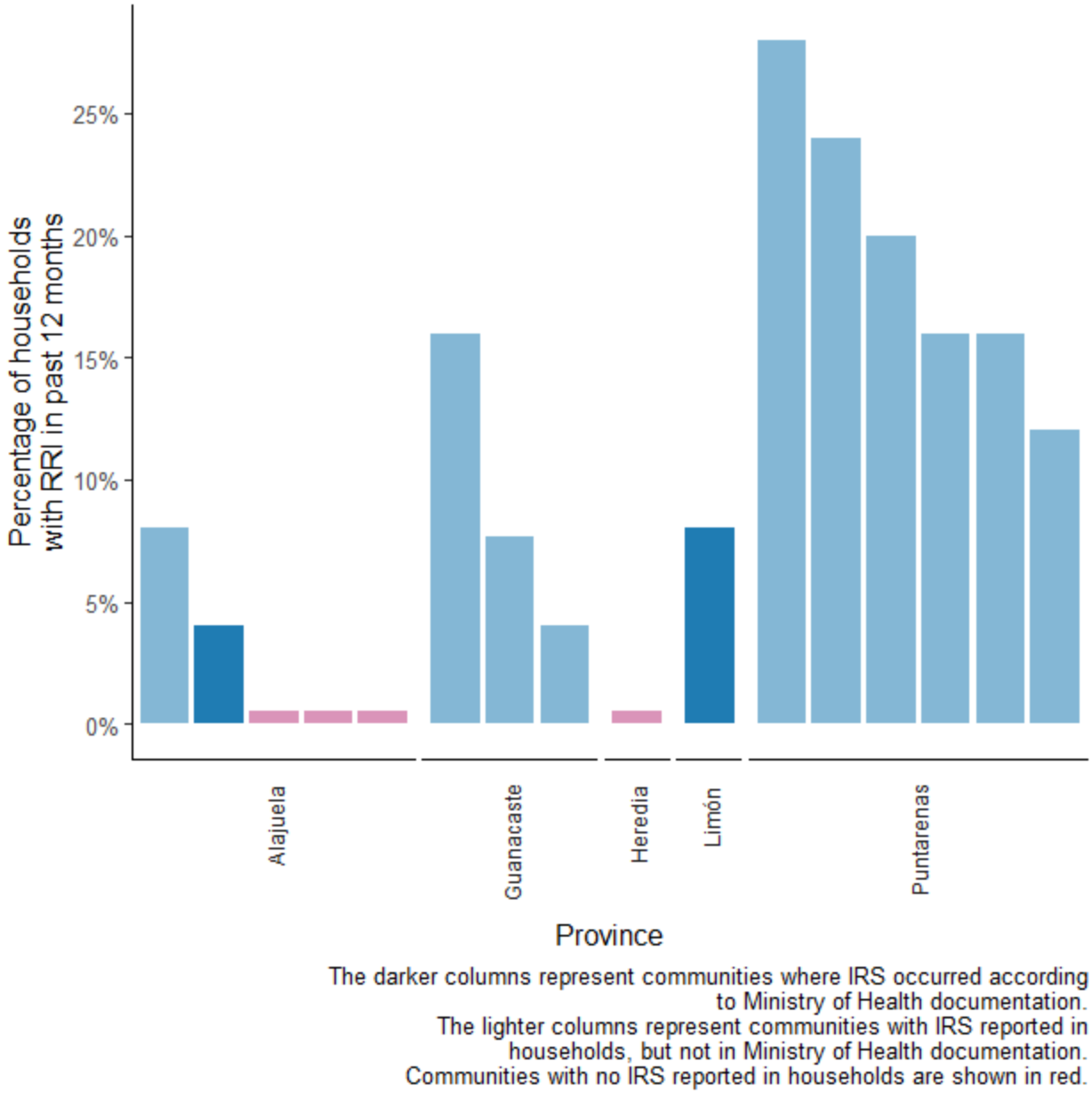
Households receiving IRS were asked whether they washed, painted, or plastered any walls since the most recent application (which diminishes the effectiveness of the insecticide), as shown in Table 4.11.

*Table 4.11: Post-spraying practices*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Walls painted since last IRS | 41 | 4 | 12.2 | (3 - 37) |
| Walls washed since last IRS | 41 | 9 | 29.7 | (10 - 61) |
| Walls plastered since last IRS | 41 | 2 | 6.1 | (2 - 20) |

Figure 4.5 shows by province the proportion of households that received IRS in each of the communities surveyed. The communities expected to receive the IRS intervention according to documentation provided by the ministry of health are highlighted in darker colors. The measured coverage of IRS is relatively high in some communities not expected to receive it, and below 10% in the communities that were expected to receive it. Respondents may have confused IRS with other insecticide interventions such as fogging, though application to interior walls was emphasized in the conduct of the survey.

*Figure 4.5: Indoor residual spraying by province 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 by the Ministry of Health 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 13.1% of individual

usual household members in target communities covered by one of the two interventions. The breakdown of the indicator by province is shown in Table 4.14.

*Table 4.12: Vector control received by reported intervention*

| Vector control reported | Communities | Used treated net | House sprayed |
|---|---|---|---|
| Spray | 2 | 6.1% | 7.3% |
| None | 14 | 0.7% | 11% |

*Table 4.13: Vector control indicator*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Usual household members in vector control communities who slept in house last night | 172 | 164 | 94.7 | (93 - 96) |
| Slept under insecticide treated net | 164 | 10 | 5.7 | (5 - 7) |
| House sprayed with mosquito treatment past 12 months | 164 | 12 | 7.5 | (7 - 8) |
| Omitted from household spraying calculations due to 'do not know' responses | 164 | 0 | 0 | ( - ) |
| Received either vector control to standard | 164 | 22 | 13.1 | (12 - 14) |

*Table 4.14: Vector control indicator: result by province*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Received either vector control to standard | | | | |
| Alajuela | 78 | 10 | 12.8 | (13 - 13) |
| Limón | 86 | 12 | 14 | (14 - 14) |
| Total | 164 | 22 | 13.1 | (12 - 14) |

# Chapter 5: Malaria Diagnostic Capacity

This chapter provides a descriptive summary of the health facilities surveyed for the RMEI-Costa Rica 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. Twenty-one of the surveyed facilities are *área de salud* clinics that provide primary level care, and 4 are hospitals that provide higher level care, though they may also provide primary attention as demanded. The remaining facilities in the sample are administrative units: *área rectora* offices that manage local malaria reporting and vector control programming. The measurement included the national malaria reference laboratory.

*Table 5.1: Health facility survey sample by facility type*

| Facility Type | # |
|---|---|
| Área de Salud clinic | 21 |
| Hospital | 4 |
| Área Rectora office | 4 |
| National Reference Laboratory | 1 |
| Total | 30 |

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

Most attention facilities in the sample provided services from Monday through Friday. A smaller number were open on the weekends (Table 5.3). Thirty-eight percent of *área de salud* clinics and 25% of hospitals had services open 24 hours (Table 5.4).

*Table 5.3: Workweek of facility*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Área de Salud Clinics: Days of the week service is provided | | | | |
| Monday | 21 | 21 | 100 | ( - ) |
| Tuesday | 21 | 21 | 100 | ( - ) |
| Wednesday | 21 | 20 | 95.2 | (70 - 99) |
| Thursday | 21 | 21 | 100 | ( - ) |
| Friday | 21 | 21 | 100 | ( - ) |
| Saturday | 21 | 13 | 61.9 | (39 - 81) |
| Sunday | 21 | 13 | 61.9 | (39 - 81) |
| Hospitals: Days of the week service is provided | | | | |
| Monday | 4 | 4 | 100 | ( - ) |
| Tuesday | 4 | 4 | 100 | ( - ) |
| Wednesday | 4 | 4 | 100 | ( - ) |
| Thursday | 4 | 4 | 100 | ( - ) |
| Friday | 4 | 4 | 100 | ( - ) |
| Saturday | 4 | 4 | 100 | ( - ) |
| Sunday | 4 | 4 | 100 | ( - ) |

*Table 5.4: Hours of operation*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Área de Salud Clinics: Hours of operation | | | | |
| Open less than 24 hours | 21 | 13 | 61.9 | (39 - 81) |
| Open 24 hours | 21 | 8 | 38.1 | (19 - 61) |
| Hospitals: Hours of operation | | | | |
| Open less than 24 hours | 4 | 1 | 25 | (3 - 79) |
| Open 24 hours | 4 | 3 | 75 | (21 - 97) |

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 100% of *área de salud* clinics and at all hospitals. In terms of laboratory diagnosis, microbiologists are employed at 71.4% and lab technicians at 81% of *área de salud* clinics. Only 52.4% of *área de salud* clinics employ epidemiology personnel, and 81% employ other statistics personnel, important functions for malaria notification and reporting.

*Table 5.5: Facility personnel*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Área de Salud Clinics | | | | |
| General physician | 21 | 21 | 100 | ( - ) |
| Pediatrician | 21 | 2 | 9.5 | (2 - 33) |
| Pharmacist | 21 | 21 | 100 | ( - ) |
| Auxiliary nurse | 21 | 21 | 100 | ( - ) |
| Practical nurse | 21 | 5 | 23.8 | (10 - 48) |
| Registered nurse | 21 | 19 | 90.5 | (67 - 98) |
| Social worker | 21 | 17 | 81 | (57 - 93) |
| Microbiologist (laboratory) | 21 | 15 | 71.4 | (48 - 87) |
| Lab technician | 21 | 17 | 81 | (57 - 93) |
| Dispenser at pharmacy | 21 | 17 | 81 | (57 - 93) |
| Epidemiology personnel | 21 | 11 | 52.4 | (31 - 73) |
| Other personnel specific for statistics and reporting | 21 | 17 | 81 | (57 - 93) |
| Hospitals | | | | |
| General physician | 3 | 3 | 100 | ( - ) |
| Pediatrician | 3 | 3 | 100 | ( - ) |
| Pharmacist | 3 | 3 | 100 | ( - ) |
| Auxiliary nurse | 3 | 3 | 100 | ( - ) |
| Practical nurse | 3 | 3 | 100 | ( - ) |
| Registered nurse | 3 | 3 | 100 | ( - ) |
| Social worker | 3 | 3 | 100 | ( - ) |
| Microbiologist (laboratory) | 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 | ( - ) |
| Área Rectora Offices | | | | |
| Epidemiology personnel | 4 | 4 | 100 | ( - ) |
| Other personnel specific for statistics and reporting | 4 | 2 | 50 | (11 - 89) |

## 5.2 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 in some areas, may be prepared by community health workers such as community malaria leaders. 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. Due to requests by the Ministry of Health and CCSS, all questions regarding use of RDTs for diagnosis were removed from the survey instruments and were not captured in the Costa Rica baseline measurement.

### 5.2.1 Microscopic diagnosis practices

In Costa Rica, all facilities in the sample are expected to have the capacity to prepare TBF slides. In the health facility interview and observation, 71.4% of *área de salud* clinics were found to take TBF samples. *Área rectora* offices often have this capacity as well, when the unit has vector control technicians affiliated (50%, as in Table 5.6). The health facility survey (interview and observation) determined microscopic diagnostic capacity at 71.4% of *área de salud* clinics, 100% of hospitals, and 0% of *área rectora* offices.

*Table 5.6: Microscopy and thick blood film sampling according to interview + observation*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Área de Salud Clinics | | | | |
| Unit takes thick blood film samples | 21 | 15 | 71.4 | (48 - 87) |
| Unit has microscopy capacity | 21 | 15 | 71.4 | (48 - 87) |
| Hospitals | | | | |
| Unit takes thick blood film samples | 4 | 4 | 100 | ( - ) |
| Unit has microscopy capacity | 4 | 4 | 100 | ( - ) |
| Área Rectora Offices | | | | |
| Unit takes thick blood film samples | 4 | 2 | 50 | (11 - 89) |
| Unit has microscopy capacity | 4 | 0 | 0 | ( - ) |

According to the interview alone and as seen in Table 5.7, 71.4% of all *área de salud* clinics have personnel that take TBF samples in-facility, and 14.3% have personnel that take TBF samples in the community. Hospital personnel do not take TBF samples in the community, but most *área rectora* offices do have personnel who take TBF samples in the community (75%). There were some discrepancies between what was observed in the facility and what was reported by the questionnaire respondent, as seen in Table 5.6 and Table 5.7, indicating that facility authorities may not be aware of malaria testing capabilities.

The breakdown of *área de salud* clinics that were reported to have personnel taking TBF samples in the community is shown in Table 5.8 by stratification.

*Table 5.7: Thick blood film sampling according to interview*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Área de Salud Clinics | | | | |
| Health personnel in this facility take thick blood film samples in-facility | 21 | 15 | 71.4 | (48 - 87) |
| Health personnel take thick blood film samples in the community | 21 | 3 | 14.3 | (4 - 38) |
| Hospitals | | | | |
| Health personnel in this facility take thick blood film samples in-facility | 4 | 3 | 75 | (21 - 97) |

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Health personnel take thick blood film samples in the community | 4 | 0 | 0 | ( - ) |
| Área Rectora Offices | | | | |
| Health personnel in this facility take thick blood film samples in-facility | 4 | 2 | 50 | (11 - 89) |
| Health personnel take thick blood film samples in the community | 4 | 3 | 75 | (21 - 97) |

*Table 5.8: Thick blood film sampling in the community by área de salud clinics, according to interview: stratum*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Área de salud clinics taking TBF samples in the community | | | | |
| Stratum 3 | 3 | 1 | 33.3 | (4 - 86) |
| Stratum 4 | 3 | 2 | 66.7 | (14 - 96) |

As shown in Table 5.9 and regardless of facility type, 85% of facilities conduct initial diagnosis of malaria according to the interview. Facilities that do not conduct initial diagnosis either do not have microscopic diagnostic capacity, or they exclusively examine already-diagnosed slides for quality control (such as the national laboratory). Of those 17 facilities that report conducting initial diagnosis, 0% also examine samples taken by volunteer collaborators or community malaria leaders, and 50% sometimes send slides elsewhere for initial diagnosis (for example, when the sole laboratorist is on leave). Among the 3 facilities that do not conduct initial diagnosis, 100% send samples to another facility for initial diagnosis.

Among all 11 facilities that send samples to another facility (sometimes or always), 18.2% report sending them to another health care facility, while 81.8% report sending them directly to the national laboratory for initial diagnosis (Table 5.10).

*Table 5.9: Microscopy capacity in facility according to interview*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Thick blood film samples examined for initial diagnosis of malaria in-facility | 20 | 17 | 85 | (61 - 95) |
| Thick blood film samples taken by community health workers (malaria leaders/ volunteer collaborators) examined for malaria in-facility | 17 | 0 | 0 | ( - ) |
| Samples sometimes sent elsewhere for initial diagnosis of malaria, among facilities with capacity | 16 | 8 | 50 | (26 - 74) |
| Samples sent elsewhere for initial diagnosis of malaria, among facilities without capacity | 3 | 3 | 100 | ( - ) |

*Table 5.10: Samples sent elsewhere: location*

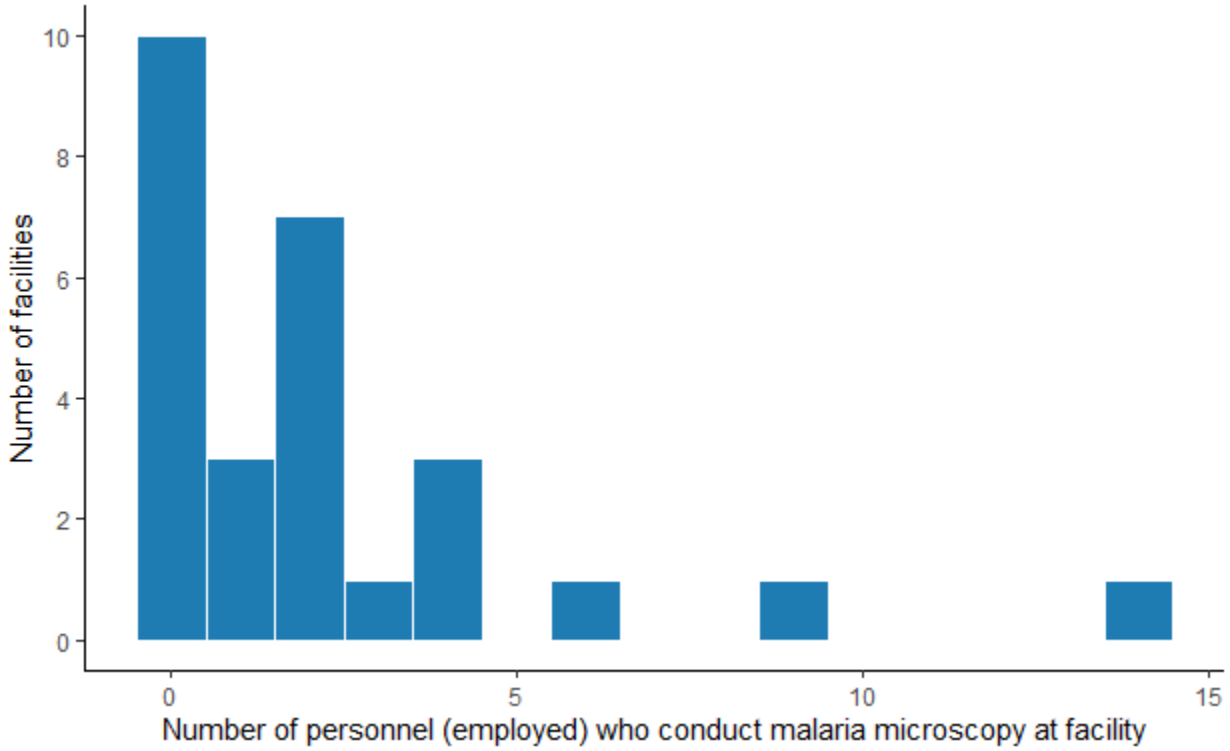
| | N | n | % | 95% CI |
|---|---|---|---|---|
| Location of initial diagnosis | | | | |
| National laboratory | 11 | 9 | 81.8 | (47 - 96) |
| Another health facility | 11 | 2 | 18.2 | (4 - 53) |

Facilities that reported conducting initial diagnosis (regardless of facility type) were asked about the personnel responsible for examining slides, and respondents could indicate more than one type. In 35.3% of facilities there is at least one malaria microscopist, 94.1% of facilities have at least one microbiologist who conducts malaria diagnosis, and 35.3% have other lab personnel that read malaria slides (Table 5.11). Figure 5.1 shows the number of employed personnel of all personnel types who conduct malaria diagnosis at each facility in the sample.

*Table 5.11: Personnel responsible for malaria microscopy testing*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Personnel responsible for TBF examination | | | | |
| Microbiologist (laboratory) | 17 | 16 | 94.1 | (65 - 99) |
| Malaria microscopist | 17 | 6 | 35.3 | (16 - 61) |
| Other lab technician/ bioanalyst | 17 | 6 | 35.3 | (16 - 61) |

*Figure 5.1: Diagnostic personnel employed by facilities*




The health facility survey also asked about any affiliated personnel (employed by another institution rather than by the facility directly) who conduct malaria diagnosis. None of the facilities had affiliated personnel involved in diagnosis.

### 5.2.2 Indicator 7.01: Supplies and equipment for malaria testing and treatment

In order to be able to detect and treat malaria, facilities must have certain basic supplies and equipment on hand. The indicator negotiated for RMEI considers whether these required basic inputs were observed at the facilities in the sample. The requirements vary by facility type, as detailed in Table 5.13.

*Table 5.13: Indicator P7.01: Required components by facility type*

| Component | Área de Salud Clinic (21) | Hospital (4) | Área Rectora office (4) | National Laboratory (1) |
|---|---|---|---|---|
| Medications (basic) | All | All | | |
| Medications (severe malaria) | | All | | |
| Medications (CQ resistant) | | All | | |
| Sampling equipment | All | All | | |
| Forms for sending samples | All | All | | |
| Microscopy equipment | If microscopy reported | | | Yes |
| Staining and sample reading equipment | If microscopy reported | | | Yes |
| Staining reagents | If microscopy reported | | | Yes |

The indicator results are shown in Table 5.14. Only 15.4% of all the facilities in the sample had all of the inputs required for the corresponding facility type. Table 5.15 shows, for comparison, the results by facility type in malaria stratum 4 versus malaria stratum 3.

*Table 5.14: Indicator P7.01: Equipment and medications*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Antimalarial medications | 25 | 5 | 20 | (8 - 41) |
| Medications for basic treatment: Chloroquine | 25 | 14 | 56 | (36 - 75) |
| Medications for basic treatment: Primaquine (5 or 15 mg tablets) | 25 | 10 | 40 | (22 - 61) |
| Medication for treatment of severe malaria: Quinine / Artesunate | 4 | 0 | 0 | ( - ) |
| Medication for treatment of chloroquine-resistant malaria: Artemisinin derivatives (artemeter + lumefantrine) | 4 | 3 | 75 | (21 - 97) |
| No stockout of chloroquine or primaquine in past 3 months | 25 | 9 | 36 | (19 - 57) |
| Sampling and biosafety equipment* | 19 | 15 | 78.9 | (54 - 92) |
| Disposable gloves | 19 | 18 | 94.7 | (68 - 99) |
| Lancets | 19 | 15 | 78.9 | (54 - 92) |
| Microscope slides (frosted or non-frosted) | 19 | 18 | 94.7 | (68 - 99) |
| Sample submission forms | 20 | 18 | 90 | (66 - 98) |
| Microscopy equipment | 20 | 20 | 100 | ( - ) |
| Binocular microscope (with 100x retractable lens) | 20 | 20 | 100 | ( - ) |
| Cell counter (manual or automatic) | 20 | 20 | 100 | ( - ) |
| Equipment for staining and testing | 20 | 18 | 90 | (66 - 98) |
| Immersion oil | 20 | 20 | 100 | ( - ) |
| Staining tray/ container | 20 | 19 | 95 | (69 - 99) |
| Laboratory stopwatch | 20 | 20 | 100 | ( - ) |
| Container for mixing dye/ stain | 20 | 20 | 100 | ( - ) |
| Pipettes/ droppers/ syringes | 20 | 18 | 90 | (66 - 98) |
| Reagents for staining | 20 | 16 | 80 | (56 - 93) |
| GIEMSA solution (or alternative: Methylene blue + Solution A + Solution B + Methanol) | 20 | 19 | 95 | (69 - 99) |

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Buffer solution or buffered water | 20 | 19 | 95 | (69 - 99) |
| No stockout of reagents in past 3 months | 20 | 16 | 80 | (56 - 93) |
| Units with all required equipment and medications | 26 | 4 | 15.4 | (6 - 36) |

*One facility excluded due to survey error.

*Table 5.15: Indicator P7.01 Comparison: result by facility stratification*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Área de salud clinics | | | | |
| Stratum 3 | 16 | 2 | 12.5 | (3 - 41) |
| Stratum 4 | 5 | 1 | 20 | (2 - 72) |
| Hospitals | | | | |
| Stratum 3 | 4 | 0 | 0 | ( - ) |
| National Laboratory | 1 | 1 | 100 | ( - ) |

### 5.2.3 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 5.16 and Table 5.17 show the proportion of facilities where each item for sample-taking and microscopy, respectively, was observed on the day of the survey. Some supplies for sample-taking (Alcohol swabs, Cotton-wool swabs, Acetone or Acetone alcohol (antiseptic), Needles, Vacutainer-type needles, Capillary tubes) were sought for observation only in facilities with a microscopy post or laboratory.

*Table 5.16: Sample-taking supplies observed*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Disposable gloves | 22 | 21 | 95.5 | (71 - 99) |
| Alcohol swabs | 22 | 10 | 45.5 | (25 - 67) |
| Cotton-wool swabs | 22 | 16 | 72.7 | (50 - 88) |
| Acetone or Acetone alcohol (antiseptic) | 22 | 21 | 95.5 | (71 - 99) |
| Lancets | 22 | 17 | 77.3 | (54 - 91) |
| Syringes (for taking blood) | 22 | 8 | 36.4 | (19 - 59) |
| Needles | 22 | 16 | 72.7 | (50 - 88) |
| Vacutainer-type needles | 22 | 18 | 81.8 | (59 - 93) |
| Capillary tubes | 22 | 11 | 50 | (29 - 71) |
| Sharps box | 22 | 19 | 86.4 | (63 - 96) |
| Microscope slides (not frosted) | 22 | 18 | 81.8 | (59 - 93) |
| Frosted microscope slides | 22 | 21 | 95.5 | (71 - 99) |

*Table 5.17: Microscopy equipment and supplies observed*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Lens-cleaning tissues | 20 | 17 | 85 | (61 - 95) |
| Spare bulbs (for microscopes) | 20 | 11 | 55 | (32 - 76) |
| Spare fuses (for microscopes) | 20 | 4 | 20 | (7 - 44) |
| Immersion oil | 20 | 20 | 100 | ( - ) |
| Oil immersion lens-cleaning solution | 20 | 16 | 80 | (56 - 93) |
| Staining rack | 20 | 19 | 95 | (69 - 99) |
| Drying rack (or sheet) | 20 | 19 | 95 | (69 - 99) |

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Measuring cylinder/disposable graduated cylinder | 20 | 15 | 75 | (51 - 90) |
| Glass or plastic bottles with a lid, that do not allow the passage of light | 20 | 13 | 65 | (41 - 83) |
| Filter paper (or other input to act as filter paper) | 20 | 20 | 100 | ( - ) |
| Slide holders or wooden dowels | 20 | 13 | 65 | (41 - 83) |
| Containers for mixing dye or stain | 20 | 18 | 90 | (66 - 98) |
| Concave staining surface | 20 | 6 | 30 | (13 - 54) |
| Staining tray/sheet/container | 20 | 16 | 80 | (56 - 93) |
| Glass petri dish | 20 | 5 | 25 | (10 - 49) |
| Plastic petri dish | 19 | 18 | 94.7 | (68 - 99) |
| Syringes | 20 | 11 | 55 | (32 - 76) |
| Disposable droppers | 20 | 16 | 80 | (56 - 93) |
| Test tubes with screw caps | 20 | 12 | 60 | (37 - 79) |
| Test tubes without caps (glass or plastic)* | 7 | 7 | 100 | ( - ) |
| Safety glasses (including the over-spectacle type) | 20 | 10 | 50 | (28 - 72) |
| Gowns | 20 | 19 | 95 | (69 - 99) |
| Markers | 20 | 19 | 95 | (69 - 99) |
| Detergents | 20 | 19 | 95 | (69 - 99) |
| Timer in laboratory | 20 | 18 | 90 | (66 - 98) |

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

Each microscope present at facilities in the sample was observed separately for characteristics. The number of microscopes at each facility is detailed in Figure 5.2. The observed characteristics, by microscope, are shown in Table 5.19.

*Figure 5.2: Functional microscopes per facility*

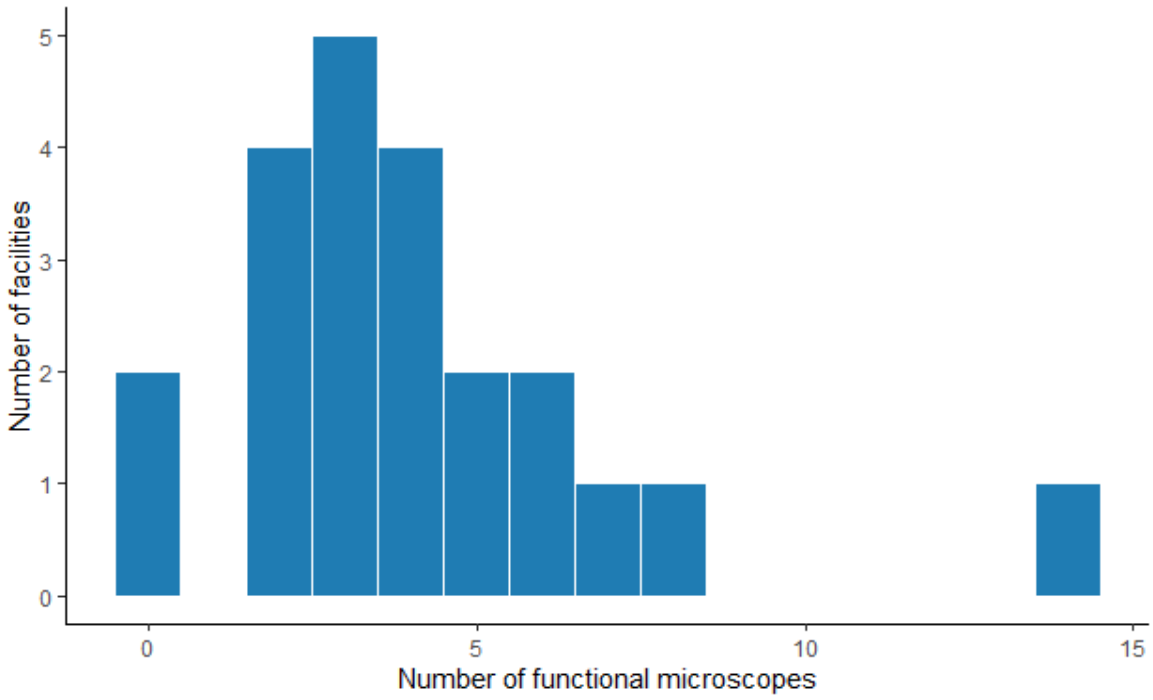


*Table 5.19: Microscope characteristics among all observed microscopes*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Is this a binocular microscope? | 91 | 90 | 98.9 | (92 - 100) |
| Is this a light microscope? | 91 | 90 | 98.9 | (92 - 100) |
| Is this a fluorescence microscope? | 91 | 14 | 15.4 | (9 - 25) |
| Is this a dark field microscope? | 91 | 14 | 15.4 | (9 - 25) |
| Is this a solar power microscope? | 91 | 1 | 1.1 | (0 - 8) |
| Lens observed: 4x | 91 | 81 | 89 | (81 - 94) |
| Lens observed: 10x | 91 | 86 | 94.5 | (87 - 98) |
| Lens observed: 20x | 91 | 64 | 70.3 | (60 - 79) |
| Lens observed: 40x | 91 | 86 | 94.5 | (87 - 98) |
| Lens observed: 100x | 91 | 90 | 98.9 | (92 - 100) |
| Lens observed: 1000x | 91 | 0 | 0 | ( - ) |
| Does the binocular microscope have an oil immersion lens? | 90 | 87 | 96.7 | (90 - 99) |

# Chapter 6: Malaria Case Detection and Diagnosis

Crucial to any malaria elimination program is quick detection of new malaria cases. Quickly administering treatment to the patient and enacting reactive activities in the community to search for additional cases and to monitor and control vector populations can interrupt the chain of transmission. In Costa Rica, active case detection is carried out by vector control personnel both through planned activities and in response to malaria cases confirmed. 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 Costa Rica, clinical and community health personnel are trained to suspect and test for malaria in patients with high fever in zones with local transmission or among patients who have traveled to those zones. Other signs that suggest malaria are history of recent fever, chills, and sweating, particularly in an alternating pattern. In addition, zones with ongoing or recent transmission may have volunteer collaborators (*colaboradores voluntarios*, or “col-vols”) or community malaria leaders based in localities with difficult access to health facilities. Community members experiencing fever or other malaria symptoms can seek out the col-vol, who will take a blood sample if he or she suspects the patient may have malaria.

## 6.1 Active case detection and outreach

As shown in Table 6.1, 50% of *área de salud* clinics and 100% of *área rectora* offices reported that facility personnel participate in active searches for malaria. All *área rectora* offices also reported storing mosquito nets for distribution (100%) and some reported employing personnel involved with indoor residual spraying (75%). Educational campaigns about malaria were conducted by 100% of *área rectora* offices.

*Table 6.1: Active case detection and community activities*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Área de Salud Clinics | | | | |
| Conducts active search for malaria cases | 20 | 10 | 50 | (28 - 72) |
| Stores insecticide-treated mosquito nets for distribution in the community | 19 | 7 | 36.8 | (18 - 61) |
| Performs indoor residual spraying | 20 | 0 | 0 | ( - ) |
| Conducts educational campaigns about malaria in the community | 19 | 11 | 57.9 | (34 - 78) |
| Other malaria outreach activities | 19 | 5 | 26.3 | (11 - 51) |
| Hospitals | | | | |
| Conducts active search for malaria cases | 3 | 1 | 33.3 | (4 - 86) |
| Stores insecticide-treated mosquito nets for distribution in the community | 3 | 1 | 33.3 | (4 - 86) |
| Performs indoor residual spraying | 3 | 0 | 0 | ( - ) |
| Conducts educational campaigns about malaria in the community | 2 | 1 | 50 | (5 - 95) |
| Other malaria outreach activities | 3 | 1 | 33.3 | (4 - 86) |
| Área Rectora Offices | | | | |
| Conducts active search for malaria cases | 4 | 4 | 100 | ( - ) |
| Stores insecticide-treated mosquito nets for distribution in the community | 4 | 4 | 100 | ( - ) |
| Performs indoor residual spraying | 4 | 3 | 75 | (21 - 97) |
| Conducts educational campaigns about malaria in the community | 3 | 3 | 100 | ( - ) |
| Other malaria outreach activities | 4 | 3 | 75 | (21 - 97) |

Facilities that reported participation in active search for malaria cases were asked about how active case detection activities are planned in the community. As shown in Table 6.2, many facilities (regardless of facility type) reported they do active case detection after there is a case of malaria in the catchment area (40% of facilities). Among the 6.7% of facilities that reported doing active search according to direction from health authorities, 100% said the active search was decided at this facility (Table 6.3).

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

*Table 6.2: Determinants of active case detection*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| When do you search for suspected malaria cases in your catchment area? | | | | |
| After there is a case of malaria in the catchment area | 15 | 6 | 40 | (18 - 67) |
| On a scheduled periodic basis | 15 | 5 | 33.3 | (14 - 61) |
| When events (market, celebrations, vacations) are happening in the community | 15 | 4 | 26.7 | (10 - 55) |
| Daily | 15 | 2 | 13.3 | (3 - 43) |
| Based on seasonality | 15 | 2 | 13.3 | (3 - 43) |
| When directed from health authorities | 15 | 1 | 6.7 | (1 - 38) |
| Other | 15 | 2 | 13.3 | (3 - 43) |

*Table 6.3: Active case detection direction from health authorities*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Agency/level that orders the active search | | | | |
| Decided at this facility | 1 | 1 | 100 | ( - ) |

*Figure 6.3: Active case detection completed after there is a case of malaria in the catchment area of the health facility, by province*

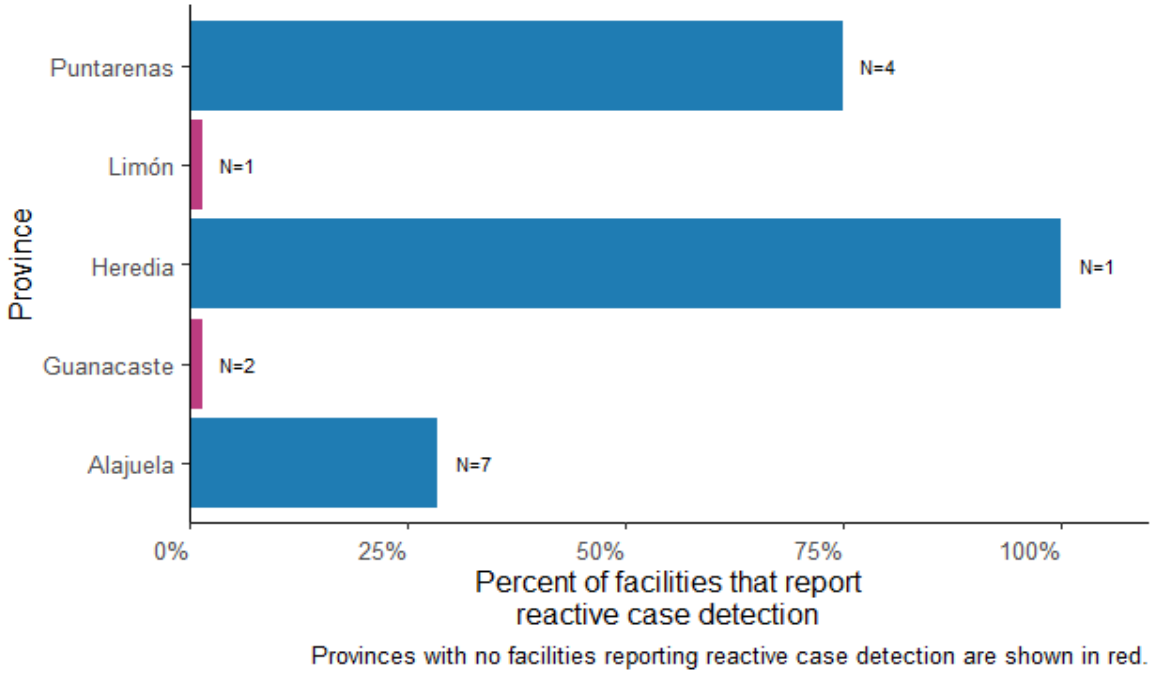
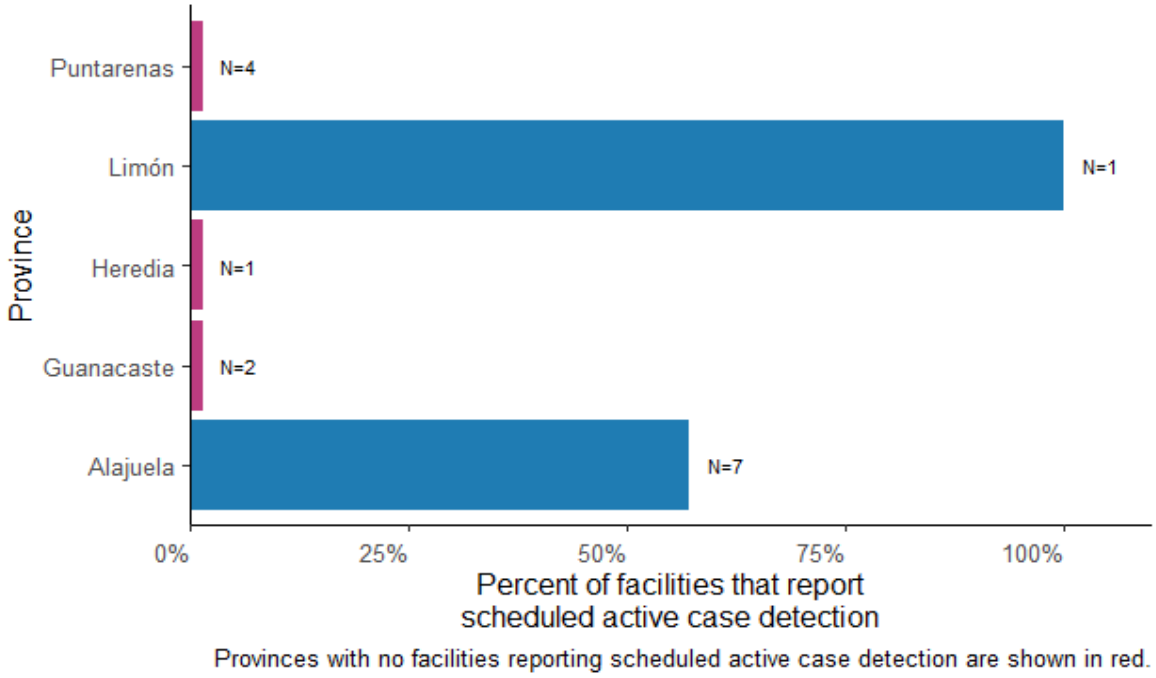


*Figure 6.4: Active case detection scheduled on a periodic basis, by province*




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. Responses for "other" show that pregnant women visiting the facility for antenatal appointments are provided nets.

*Table 6.4: Community net distribution*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Mode of treated net distribution | | | | |
| Routinely offered to patients visiting the health facility | 12 | 6 | 50 | (23 - 77) |
| Personnel from this health facility distributes the nets in the community | 12 | 3 | 25 | (8 - 57) |
| Vector control personnel distributes the nets in the community | 12 | 1 | 8.3 | (1 - 44) |
| Other | 12 | 4 | 33.3 | (12 - 64) |

Respondents were also asked a series of questions about malaria detection activities in the community and referrals from community malaria leaders or col-vols. Among facilities that administer malaria treatment, 9.5% of *área de salud* clinics and 25% of hospitals received referrals from col-vols or other community health workers to treat malaria. Diagnosis activities were common, with 4.8% of *área de salud* clinics receiving referrals for malaria testing and 14.3% of *área de salud* clinics taking TBF samples in the community.

*Table 6.5: Community malaria activities - questionnaire*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Área de Salud Clinics | | | | |
| Do you receive referred patients from volunteer collaborators or community malaria leaders for malaria testing? | 21 | 1 | 4.8 | (1 - 30) |
| Do you receive referred patients from volunteer collaborators or community malaria leaders for malaria treatment? | 21 | 2 | 9.5 | (2 - 33) |
| Do health personnel take thick blood film samples in the community? | 21 | 3 | 14.3 | (4 - 38) |
| Hospitals | | | | |
| Do you receive referred patients from volunteer collaborators or community malaria leaders for malaria testing? | 3 | 1 | 33.3 | (4 - 86) |
| Do you receive referred patients from volunteer collaborators or community malaria leaders for malaria treatment? | 4 | 1 | 25 | (3 - 79) |
| Do health personnel take thick blood film samples in the community? | 4 | 0 | 0 | ( - ) |
| Área Rectora Offices | | | | |
| Do you receive referred patients from volunteer collaborators or community malaria leaders for malaria testing? | 4 | 0 | 0 | ( - ) |
| Do health personnel take thick blood film samples in the community? | 4 | 3 | 75 | (21 - 97) |

## 6.2 Passive case detection practices (health facility questionnaire)

Personnel in health facilities are trained to suspect and test for malaria in patients who present with fever or other symptoms to the facility, known as passive case detection. Patients presenting with clinical signs that meet the definition of a suspected malaria case will have a sample taken, usually of capillary blood, to prepare a TBF slide. If the *Plasmodium* parasite is detected via microscopy, treatment with the first-line regimen corresponding to the parasite species begins and the case is notified electronically to the Ministry of Health. If the health facility the patient visits does not have microscopic diagnostic capacity, the patient may be referred to a facility with a laboratory or a TBF slide may be prepared and sent to a nearby laboratory for testing. The slide is tested by the laboratory, and in the case that malaria is confirmed, the patient's EBAIS is notified so that health personnel 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 100% of *área de salud* clinics and 100% of hospitals, and nurses order the test or take the sample at triage in 6.7% of *área de salud* clinics. A text response entered for "other" in *área de salud* clinics shows ATAP can decide whether a patient should receive a malaria test.

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

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Área de Salud Clinics: Who decides whether a patient presenting at this facility will receive a malaria test? | | | | |
| Nurse at triage or pre-clinic | 15 | 1 | 6.7 | (1 - 38) |
| Doctor during consult | 15 | 15 | 100 | ( - ) |
| Lab staff or microscopy staff | 15 | 2 | 13.3 | (3 - 43) |
| Other | 15 | 1 | 6.7 | (1 - 38) |
| Hospitals: Who decides whether a patient presenting at this facility will receive a malaria test? | | | | |

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Nurse at triage or pre-clinic | 3 | 0 | 0 | ( - ) |
| Doctor during consult | 3 | 3 | 100 | ( - ) |
| Lab staff or microscopy staff | 3 | 0 | 0 | ( - ) |
| Other | 3 | 0 | 0 | ( - ) |

Next, respondents were asked to mention what criteria are used to determine whether a patient gets a malaria test (Table 6.7). The respondent answered with the criteria they use at the facility and the interviewer marked the corresponding options in the survey without reading them aloud. High fever was an important criterion that determined testing (93.3%) and chills was also frequently mentioned (in 46.7% of facilities at consult). percent of respondents mentioned travel history as a determining factor for malaria testing. Text entries for “other” show headache and non-specific responses regarding patient meeting criteria for a suspected malaria case.

*Table 6.7: Malaria testing criteria at consultation*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| What criteria must a patient meet in order for the doctor to order a malaria test during the consultation? | | | | |
| High fever | 15 | 14 | 93.3 | (62 - 99) |
| General malaise | 15 | 8 | 53.3 | (28 - 77) |
| Chills | 15 | 7 | 46.7 | (23 - 72) |
| History of recent travel to areas with endemic malaria | 15 | 7 | 46.7 | (23 - 72) |
| History of recent fever | 15 | 4 | 26.7 | (10 - 55) |
| Sweating | 15 | 4 | 26.7 | (10 - 55) |
| Prior history of malaria | 15 | 3 | 20 | (6 - 49) |
| Other | 15 | 3 | 20 | (6 - 49) |

## 6.3 Fever cases with blood test (LQAS)

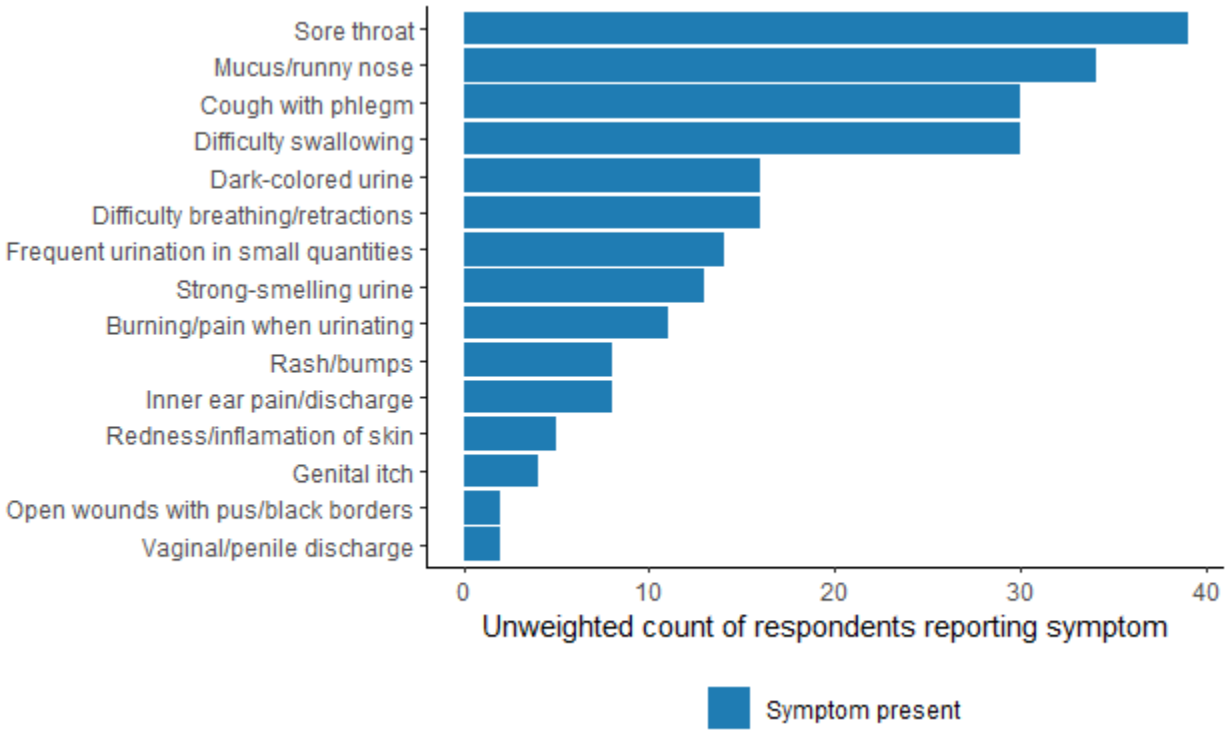
In the community survey (LQAS), interviews with households included questions about history of fever during the two weeks prior to the survey for all usual members of the household. The estimates from the LQAS survey reported in this section are not weighted due to the very small size of the sub-sample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

If the primary interview respondent reported that a household member had a recent fever, the interviewer asked to speak to the person who had the fever, or in the case that a child or adolescent had a fever, with the child’s primary caregiver. If the person with the fever was not available and the primary respondent knew the details of their recent fever, that person was permitted to respond on behalf of the fever patient. The respondent answered questions about other symptoms suffered during the febrile illness and whether and where they sought medical attention. As seen in Table 6.8, 4% 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 52 respondents who reported experiencing fever, the majority experienced other symptoms that suggested a condition other than malaria. Only 2 people, or 3.8% of the individuals reporting fever, were free of other symptoms excluding them from having to receive a malaria test. The simultaneous symptoms reported by respondents who experienced a recent fever are detailed in Figure 6.5.

*Table 6.8: Eligible fever cases reported in LQAS household survey*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| LQAS respondents | 1340 | 1340 | 100 | ( - ) |
| Fever cases in the last two weeks | 1306 | 52 | 4 | (2 - 6) |
| Fever without exclusion symptoms | 52 | 2 | 3.8 | (1 - 16) |

*Figure 6.5: Exclusion symptoms experienced by respondents reporting fever*




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

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

All respondents reporting fever without exclusion symptoms were asked whether, during the illness, a blood sample was taken from their finger, heel, earlobe, or vein. As shown in Table 6.9, 50% of respondents with an eligible fever (with no exclusion symptoms) had a blood sample taken.

*Table 6.9: Indicator 2.02: Fevers with blood sample*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Fever cases in past two weeks | 1306 | 52 | 4 | (2 - 6) |
| Fevers with no exclusion symptoms | 52 | 2 | 3.8 | (1 - 16) |
| Fevers with any blood sample | 2 | 1 | 50 | (5 - 95) |
| Capillary blood test | 2 | 0 | 0 | ( - ) |
| Venal blood test | 2 | 1 | 50 | (5 - 95) |

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 6.10, 0% of respondents with a blood sample reported a malaria test.

*Table 6.10: Result of blood tests, LQAS fevers*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Blood tested for malaria | 1 | 0 | 0 | ( - ) |

Care-seeking behavior among respondents with fever was also collected. The one respondent with fever who reported receiving a blood test reported seeking care at a public facility, and the one respondent with fever who did not receive a blood test did not seek advice or treatment for the illness.

The calculation for Indicator 2.02 is presented in Table 6.11 both excluding cases with symptoms suggesting an illness other than malaria (50%) and including all fever cases reported from the past two weeks (31.4%).

*Table 6.11: Indicator 2.02: Fevers with blood sample, with and without exclusion symptoms*

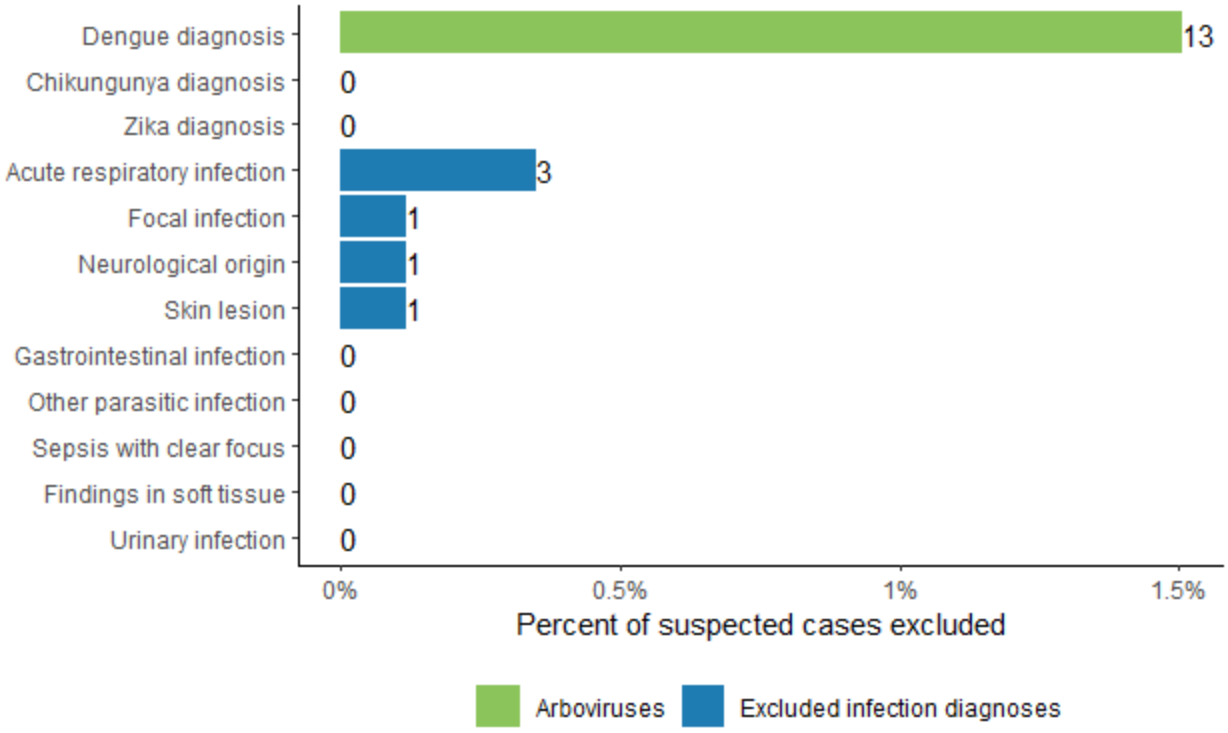
| | N | n | % | 95% CI |
|---|---|---|---|---|
| Fevers (with no exclusion symptoms) with any blood sample | 2 | 1 | 50 | (5 - 95) |
| All fevers with any blood sample | 51 | 16 | 31.4 | (22 - 43) |

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

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

Some of the sampled records were eligible to be selected based on information on the diagnosis database, 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.

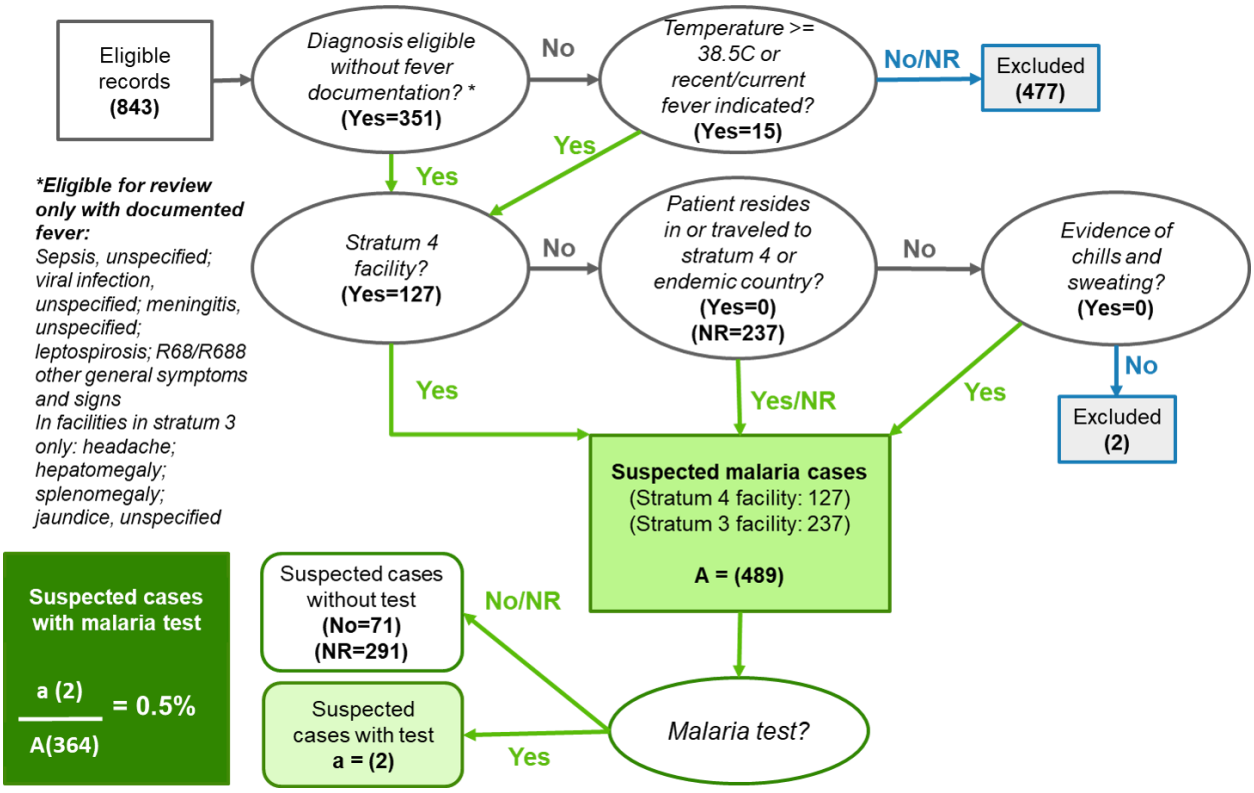
*Figure 6.6: Exclusion diagnoses for review of suspected malaria cases*




### 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 stratum 3, where patients presenting with fever do not require a test to rule out malaria unless they traveled to an endemic area or show other malaria symptoms like chills and sweating. Additionally, certain inclusion diagnoses only meet the suspected case definition (that is, malaria should be ruled out before making a clinical diagnosis of another condition) if the patient presented with fever or had a history of recent fever. Thus, additional ineligible records were identified and excluded from the indicator during the eligibility review.

*Figure 6.7: Eligibility of suspected cases reviewed for Indicator 2.01*




In total in Costa Rica, 364 of the 843 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. As shown in Table 6.13, 0.5% of patients with suspected malaria had evidence that a malaria test was received, which is also separated by stratum.

*Table 6.13: Indicator 2.01: Suspected cases with malaria test, result by facility stratification*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Suspected cases with malaria test | | | | |
| Stratum 3 | 237 | 0 | 0 | ( - ) |
| Stratum 4 | 127 | 2 | 1.6 | (0 - 6) |
| Total | 364 | 2 | 0.5 | (0 - 2) |

## 6.5 Malaria diagnosis (medical record review)

Early diagnosis of malaria is essential to interrupt transmission in a timely manner and to ensure the patient receives treatment before illness becomes more severe or complicated. The health facility survey included a record review of confirmed malaria cases. At *área rectora* offices selected to the sample (four offices with autochthonous cases in the health area during 2018), field personnel reviewed all paper records of confirmed malaria cases from the year 2018 stored at those units as described in Chapter 2. All case records that were stored at the *área rectora* offices were sought out and considered for the review, including case notification forms, case investigation forms, and any patient charts, laboratory records, or treatment forms filed at the *área rectora* offices. Figure 6.8 shows that the majority of confirmed malaria case reviews used both the VE-01 case notification form and the malaria case

investigation form. Examples of these forms are shown in Figure 6.9 for reference of the content included from these data sources.

*Figure 6.8: Sources of confirmed case medical record review*

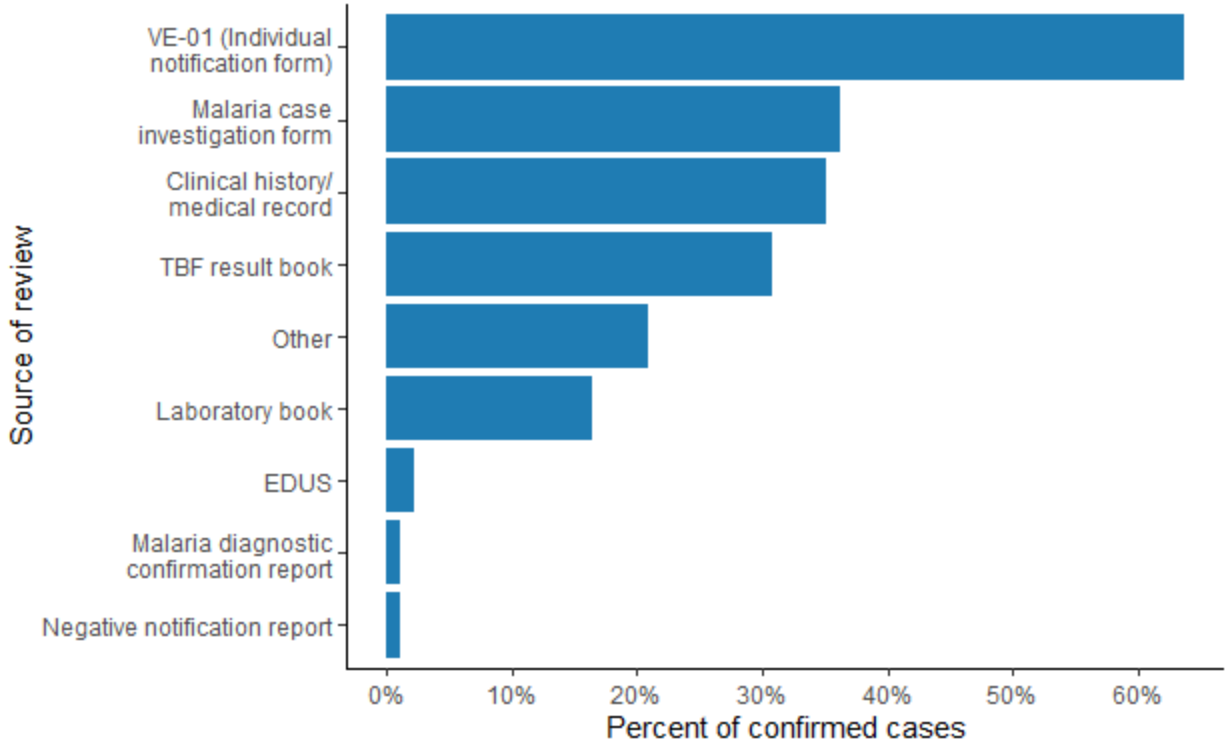
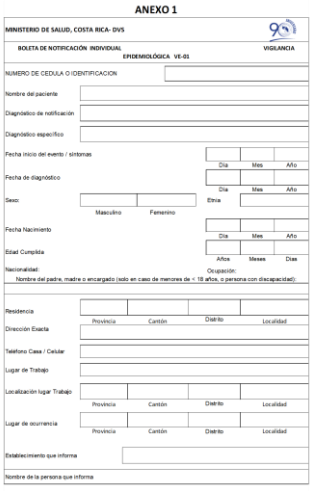
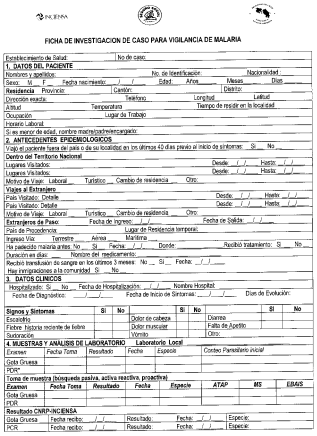


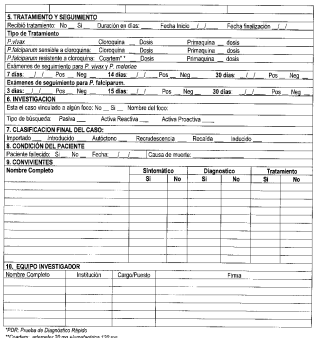

*Figure 6.9: VE-01 blank case notification form and blank case investigation form*


ANEXO 1

MINISTERIO DE SALUD, COSTA RICA- DVS

BOLETA DE NOTIFICACIÓN INDIVIDUAL — VIGILANCIA EPIDEMIOLÓGICA VE-01

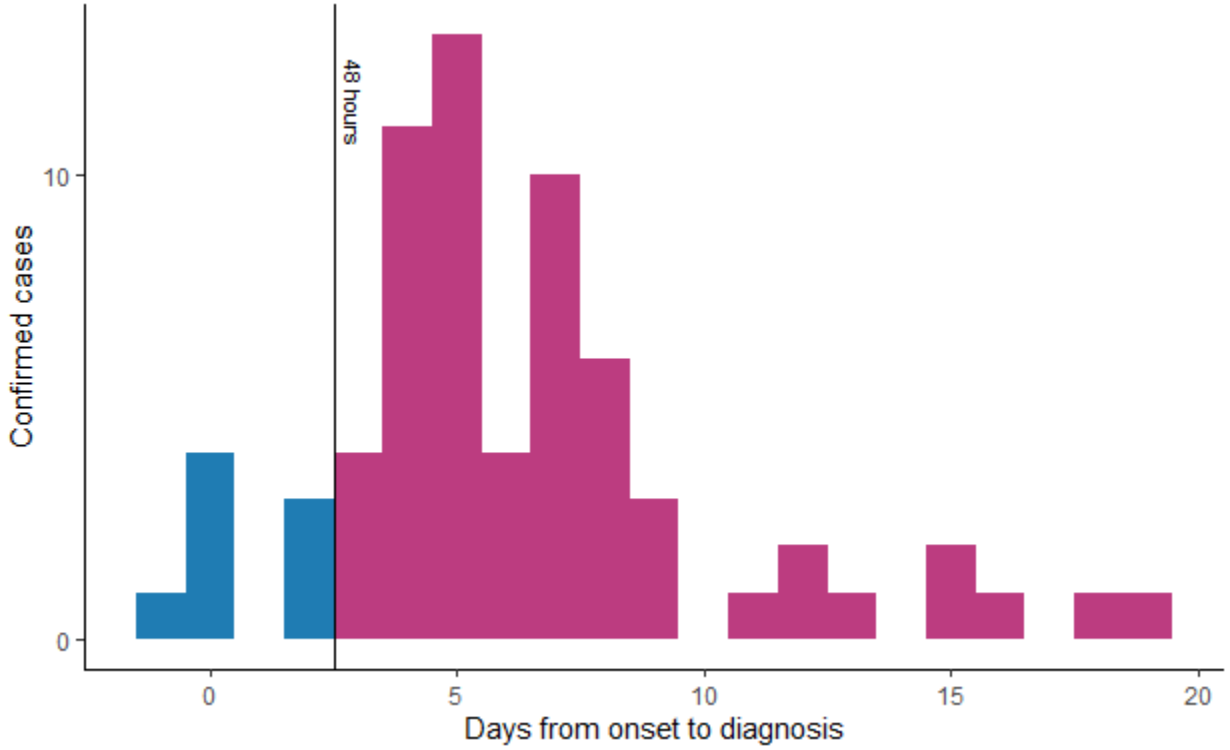

FICHA DE INVESTIGACION DE CASO PARA VIGILANCIA DE MALARIA



As a part of each record review module, field staff recorded the date of symptom onset, date of fever onset, and date of diagnosis from the VE-01 and malaria case investigation forms. Figure 6.10 shows the number of days from fever onset (or onset of other malaria symptoms, if date of fever onset was not recorded) to the date of diagnosis. If diagnosis was recorded more than seven days before or more than 30 days after fever onset, the case is excluded from the indicator because of the suspicion of recording

error (on the investigation form or in the survey module). This suspected error affected 1 case which is excluded from the figure. In 1 additional case, diagnosis was recorded before symptom onset which is a plausible scenario for cases tested through active case detection or for other reasons where testing was recommended before symptoms presented.

*Figure 6.10: Time from symptom onset to diagnosis*




The personnel who performed the diagnosis of these confirmed malaria cases by TBF are reported in Table 6.14. Many reports did not have the personnel recorded (17.1%). The personnel most commonly recorded as preparing TBFs were microscopists (70.7%) and *área rectora* or vector control staff (11%).

*Table 6.14: Personnel who performed diagnosis of confirmed cases, TBF*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Thick blood film sample taken by: | | | | |
| Microscopist | 82 | 58 | 70.7 | (60 - 80) |
| Not registered | 82 | 14 | 17.1 | (10 - 27) |
| Área Rectora / Vector Control staff (VC) | 82 | 9 | 11 | (6 - 20) |
| Lab tech/ microbiologist | 82 | 1 | 1.2 | (0 - 8) |

### 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 6.15, 75.6% of confirmed case records in Costa Rica had both fever/symptom onset and diagnosis dates registered. Only 8.9% were diagnosed within 48 hours of fever/symptom onset, and 20% were diagnosed more than a week after fever/symptom onset.

*Table 6.15: Indicator 4.02: Fever/symptom onset to diagnosis within 48 hours*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Total confirmed malaria cases | 91 | 91 | 100 | ( - ) |
| Excluded due to suspected inscription/data entry error (<-7 day or >30 day window) | 91 | 1 | 1.1 | (0 - 8) |
| Denominator: Confirmed cases with valid dates | 90 | 90 | 100 | ( - ) |
| Fever/symptom onset date registered | 90 | 87 | 96.7 | (90 - 99) |
| Diagnosis date registered | 90 | 71 | 78.9 | (69 - 86) |
| Both dates registered | 90 | 68 | 75.6 | (65 - 83) |
| Diagnosis before onset (presumptive) | 90 | 1 | 1.1 | (0 - 8) |
| Cases diagnosed within 48 hours of onset | 90 | 8 | 8.9 | (4 - 17) |
| 3 days | 90 | 4 | 4.4 | (2 - 11) |
| 4-5 days | 90 | 24 | 26.7 | (18 - 37) |
| 6-7 days | 90 | 14 | 15.6 | (9 - 25) |
| Over 7 days | 90 | 18 | 20 | (13 - 30) |
| Indicator result: Cases diagnosed within 48 hours of onset | 90 | 8 | 8.9 | (4 - 17) |

Figure 6.11 shows the same indicator results in a graphic format.

*Figure 6.11: Indicator 4.02: Cases categorized*

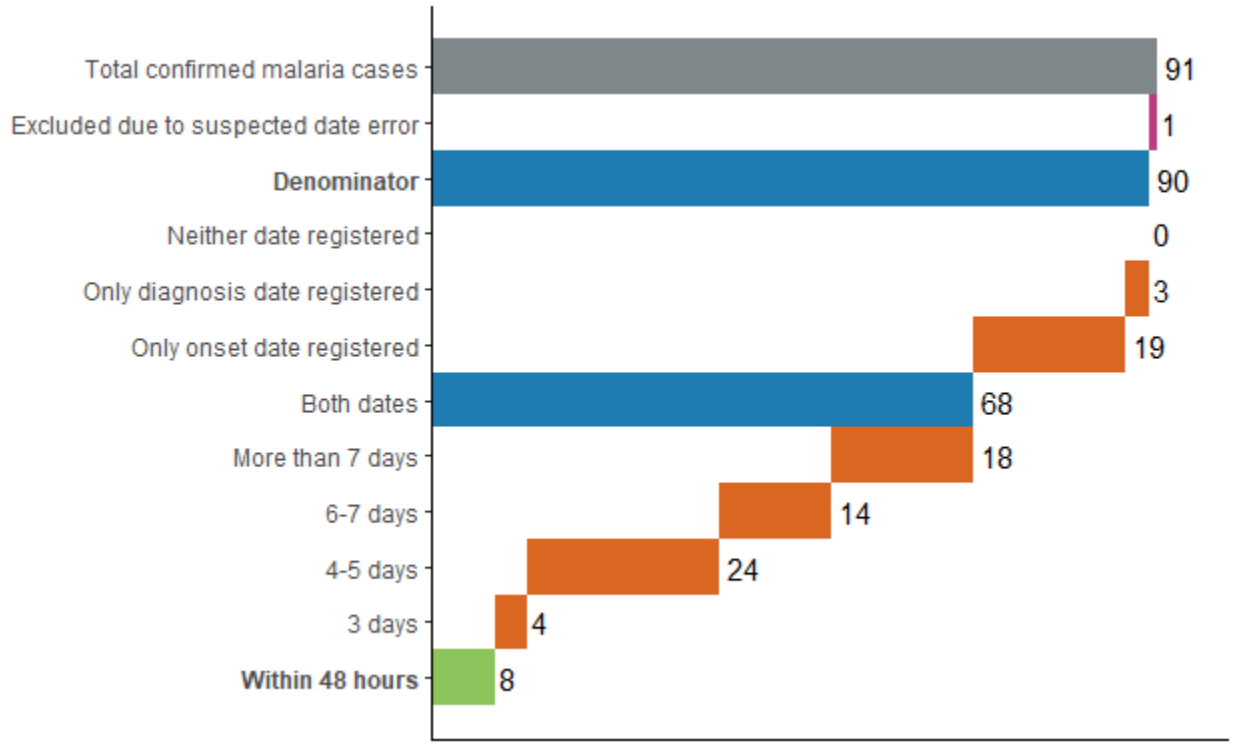



Table 6.16 shows indicator 4.02 by province.

*Table 6.16: Comparison: result by facility province*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Diagnosis within 48 hours of symptom onset | | | | |
| Alajuela | 89 | 7 | 7.9 | (4 - 16) |
| Puntarenas | 1 | 1 | 100 | ( - ) |
| Total | 90 | 8 | 8.9 | (4 - 17) |

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

Notification within 24 hours of diagnosis was negotiated as an indicator for RMEI. All confirmed cases of malaria were expected to have a notification report, but as shown in Figure 6.12 not all collected cases had a reviewed notification form and not all notification forms had a date recorded for when notification occurred. Cases without notification date registered were not considered to have been notified within 24 hours. As shown in Table 6.18, 65.9% of confirmed case records in Costa Rica had both diagnosis and notification dates registered. Only 52.8% were notified within 24 hours of diagnosis.

*Figure 6.12: Confirmed cases: source of notification information*

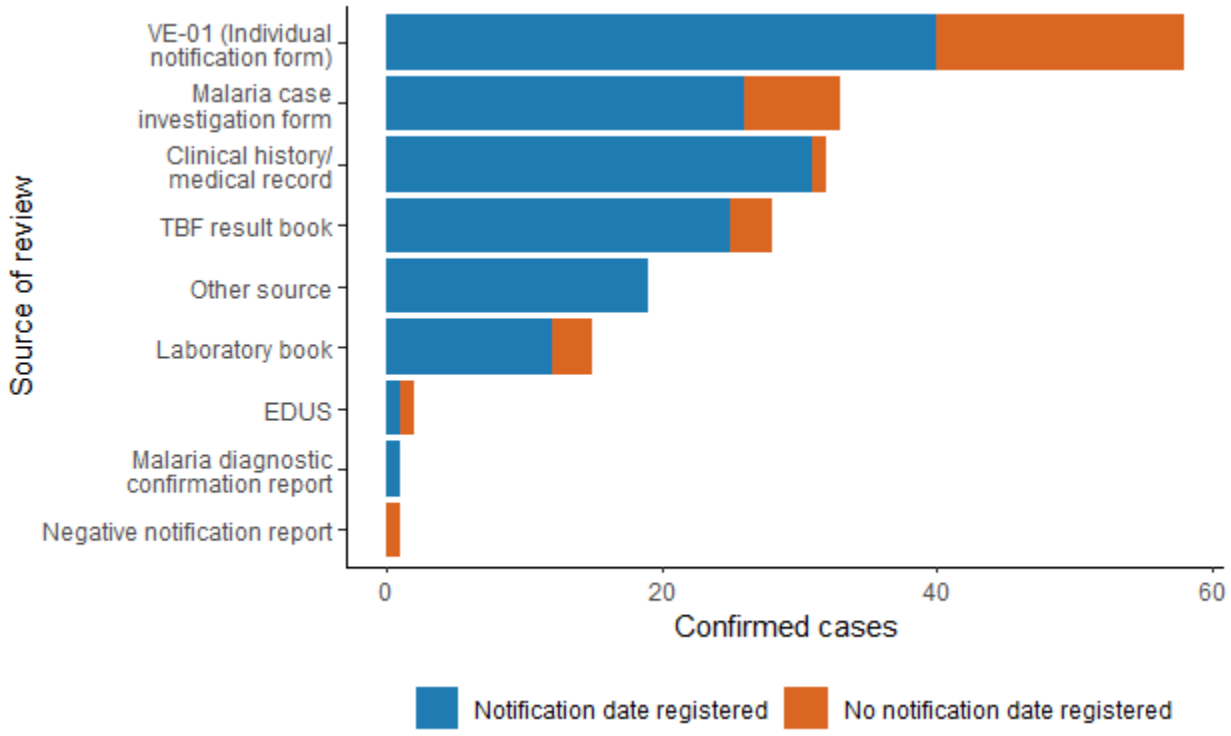



*Table 6.18: Indicator E2.04: Notification within 24 hours of diagnosis*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Diagnosis date registered | 91 | 72 | 79.1 | (69 - 86) |
| Notification date registered | 91 | 72 | 79.1 | (69 - 86) |
| Both dates registered | 91 | 60 | 65.9 | (55 - 75) |
| Excluded due to suspected inscription/data entry error (<-7 day or >30 day window) | 91 | 2 | 2.2 | (1 - 9) |
| Notification within 24 hours of diagnosis | 89 | 47 | 52.8 | (42 - 63) |

# Chapter 7: Malaria treatment

In Costa Rica, routine malaria treatment is managed by the CCSS through the patient's *área de salud* clinic. Supervision of ingestion of all doses is the norm in most areas of Costa Rica in order to ensure each patient completes the radical cure. Patients may visit the *área de salud* clinic or the local EBAIS facility to recieve each dose of treatment, or ATAP may deliver and supervise the doses at the patient's home. To treat severe malaria or chloroquine-resistant *P. falciparum*, the patient may be admitted to the hospital. The survey results in the following sections align to some extent with these expectations, though they suggest substantial variation in administration and supervision practices by facilities (or at least in knowledge of standard practices by personnel in health facilities that may diagnose malaria cases infrequently).

## 7.1 Treatment administration practices

The health facility interview includes questions about malaria service provision (in all health facilities and *área rectora* offices). Respondents listened to the list of activities shown in Table 7.1 and were asked to indicate whether personnel at the facility provide each service (yes or no). Many facilities reported that they supervise treatment at the facility (33.3% of *área de salud* clinics) and supervise treatment in the community (42.9% of *área de salud* clinics). *Área de salud* clinics and hospitals that reported "none of the above" have treatment prescribed and supervised by vector control personnel. Text entries for "other" options show that treatment is rarely provided or supervised in the facility because CCSS staff, such as ATAP, provide supervised treatment in the community.

*Table 7.1: Services provided by facilities for malaria treatment*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Área de Salud Clinics: Services provided for malaria treatment | | | | |
| Prescribe treatment to pharmacy at this facility | 21 | 17 | 81 | (57 - 93) |
| Provide prescription to external pharmacy | 21 | 1 | 4.8 | (1 - 30) |
| Give medication to take at home (unsupervised) | 21 | 1 | 4.8 | (1 - 30) |
| Supervise ingestion (in the facility) | 21 | 7 | 33.3 | (16 - 57) |
| Supervise ingestion (in the community) | 21 | 9 | 42.9 | (23 - 65) |
| Call or visit the home to ask if treatment was taken (without supervising ingestion) | 21 | 1 | 4.8 | (1 - 30) |
| None of the above | 21 | 2 | 9.5 | (2 - 33) |
| Other | 21 | 2 | 9.5 | (2 - 33) |
| Don't know | 21 | 1 | 4.8 | (1 - 30) |
| Hospitals: Services provided for malaria treatment | | | | |
| Prescribe treatment to pharmacy at this facility | 4 | 4 | 100 | ( - ) |
| Supervise ingestion (in the facility) | 4 | 1 | 25 | (3 - 79) |
| Área Rectora Offices: Services provided for malaria treatment | | | | |
| Call or visit the home to ask if treatment was taken (without supervising ingestion) | 4 | 1 | 25 | (3 - 79) |
| None of the above | 4 | 1 | 25 | (3 - 79) |
| Other | 4 | 1 | 25 | (3 - 79) |
| Don't know | 4 | 1 | 25 | (3 - 79) |

If the respondent reported that personnel supervise ingestion in-facility, the interviewer asked how many doses are supervised at the facility. At 75% of facilities that supervise treatment regardless of type, all doses are supervised at the facility, and at 12.5% of these facilities only the first dose is supervised in-facility (Table 7.2). Respondents at facilities that supervise some but not all doses in-facility were asked

who is responsible for administering the remaining doses (treatment was administered by CHW in the patient's home in 50% of cases).

*Table 7.2: Doses supervised in-facility*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Doses supervised in-facility | | | | |
| Only the first dose | 8 | 1 | 12.5 | (2 - 57) |
| Only some doses | 8 | 1 | 12.5 | (2 - 57) |
| All doses | 8 | 6 | 75 | (35 - 94) |

*Table 7.3: Personnel responsible for subsequent administrations*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Administration of subsequent doses | | | | |
| Patient was prescribed medication to take at home | 2 | 1 | 50 | (5 - 95) |
| Treatment is administered by community health workers or volunteer collaborators at the patient's home | 2 | 1 | 50 | (5 - 95) |

All facilities that provide malaria care were asked if personnel ever administer malaria treatment before a positive test result, and only 7.1% of *área de salud* clinics and 50% of *área rectora* offices replied that they do. Respondents reported that community personnel administer presumptive treatment in only 33.3% of *área de salud* clinics.

*Table 7.4: Presumptive treatment*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Área de Salud Clinics | | | | |
| Do clinical staff in this facility ever give antimalarial treatment for suspected malaria without waiting for a positive malaria test result? (Among facilities that provide treatment services on-site) | 14 | 1 | 7.1 | (1 - 40) |
| Do col-vols, community malaria leaders, ATAP or vector control personnel associated with this facility ever treat suspected malaria without waiting for a positive malaria test result? (Among all facilities that reported taking TBF samples in the community) | 3 | 1 | 33.3 | (4 - 86) |
| Hospitals | | | | |
| Do clinical staff in this facility ever give antimalarial treatment for suspected malaria without waiting for a positive malaria test result? (Among facilities that provide treatment services on-site) | 3 | 0 | 0 | ( - ) |
| Área Rectora Offices | | | | |
| Do clinical staff in this facility ever give antimalarial treatment for suspected malaria without waiting for a positive malaria test result? (Among facilities that provide treatment services on-site) | 2 | 1 | 50 | (5 - 95) |
| Do col-vols, community malaria leaders, ATAP or vector control personnel associated with this facility ever treat suspected malaria without waiting for a positive malaria test result? (Among all facilities that reported taking TBF samples in the community) | 3 | 0 | 0 | ( - ) |

## 7.2 Storage and stock of antimalarial medications

The health facility survey included an observation of antimalarial medications in stock on the day of the survey and of stock records for the three months prior (in all *área de salud* clinics and hospitals). First, the respondent (typically the pharmacist or pharmacy technician) was asked if the facility routinely stocks any antimalarial medications. As shown in Table 7.5, 61.9% of *área de salud* clinics and 100% of hospitals reported stock of antimalarials.

*Table 7.5: Facility types reporting stock of antimalarials*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Facilities reporting antimalarial stock in past 3 months | | | | |
| Área de Salud Clinics | 21 | 13 | 61.9 | (39 - 81) |
| Hospitals | 4 | 4 | 100 | ( - ) |

Next, the respondent was asked to respond whether or not the facility stocks each of a list of antimalarial medications including those shown in Table 7.6. Among the facilities that reported stocking any antimalarials, most *área de salud* clinics and all hospitals reported that they stocked chloroquine and primaquine. Any drugs that were reported to be stocked were then sought for observation by survey personnel. The drug presentation was registered and the surveyor checked the expiration date to see if at least one dose of the medication was valid on the day of the survey. As seen in Table 7.7, no doses or only expired doses of primaquine were observed in 16.7% of *área de salud* clinics and hospitals that stock primaquine, suggesting maintaining supply or replacing expired stock of first-line malarial medications is not a major challenge in Costa Rica.

*Table 7.6: Reported stock of antimalarials*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Área de Salud Clinics | | | | |
| Has this facility stocked any antimalarials for at least one day over the past three months? | 21 | 13 | 61.9 | (39 - 81) |
| Chloroquine | 13 | 10 | 76.9 | (46 - 93) |
| Primaquine | 13 | 8 | 61.5 | (33 - 84) |
| Pyrimethamine | 13 | 1 | 7.7 | (1 - 42) |
| Quinine Dihydrochloride | 13 | 1 | 7.7 | (1 - 42) |
| Hospitals | | | | |
| Has this facility stocked any antimalarials for at least one day over the past three months? | 4 | 4 | 100 | ( - ) |
| Chloroquine | 4 | 4 | 100 | ( - ) |
| Primaquine | 4 | 4 | 100 | ( - ) |
| Artemisinin (Artemether + Lumefantrine tablets (ex. Coartem)) | 4 | 3 | 75 | (21 - 97) |
| Pyrimethamine | 4 | 1 | 25 | (3 - 79) |

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

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Chloroquine tablets observed | | | | |
| At least one observed and valid | 14 | 14 | 100 | ( - ) |
| Primaquine tablets observed | | | | |
| At least one observed and valid | 12 | 10 | 83.3 | (50 - 96) |
| Not observed | 12 | 2 | 16.7 | (4 - 50) |

The health facility interview also asked about antimalarial medication stock and administration. Table 7.8 shows some discrepancies with Table 7.5 - facility directors more often reported antimalarial medications

in stock than could be confirmed with pharmacy staff, indicating that facility authorities may not be aware of pharmaceutical stock-outs or of changing strategies for treatment storage as malaria transmission decreases. One hospital director reported he “did not know” whether antimalarial medications were stocked, which is reported as “no” in Table 7.8.

*Table 7.8: Antimalarials medications stored, questionnaire*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Questionnaire: Does this facility store medications to treat malaria? | | | | |
| Área de Salud Clinics | 21 | 15 | 71.4 | (48 - 87) |
| Hospitals | 4 | 3 | 75 | (21 - 97) |

Because most health facilities do not store medications to treat chloroquine-resistant *P. falciparum* and severe malaria, the interview asked how a patient with severe or drug-resistant malaria receives treatment (Table 7.9). Most facilities (of those that reported storing antimalarial medications - *área de salud* clinics and hospitals) informed that the treatment is delivered to this health facility by vector control or malaria program staff (área rectora) (50% of facilities) when they need a type of medication not available in the surveyed facility. Respondents could indicate more than one answer to this question.

*Table 7.9: Antimalarial delivery for severe or chloroquine-resistant cases*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| If a case of severe or drug-resistant malaria is detected in this facility, how does the patient get special antimalarial medication that is not stored here (among área de salud clinics and hospitals that store antimalarial medications)? | | | | |
| Treatment is delivered to this health facility by vector control or malaria program staff (Área Rectora) | 18 | 9 | 50 | (27 - 73) |
| Patient is referred to a location that stores medication | 18 | 7 | 38.9 | (18 - 64) |
| Treatment is delivered to the patient's home by CCSS personnel (ATAP) | 18 | 2 | 11.1 | (2 - 39) |
| Treatment is delivered to the patient's home by vector control or malaria program staff (Área Rectora) | 18 | 0 | 0 | ( - ) |
| Other | 18 | 1 | 5.6 | (1 - 35) |

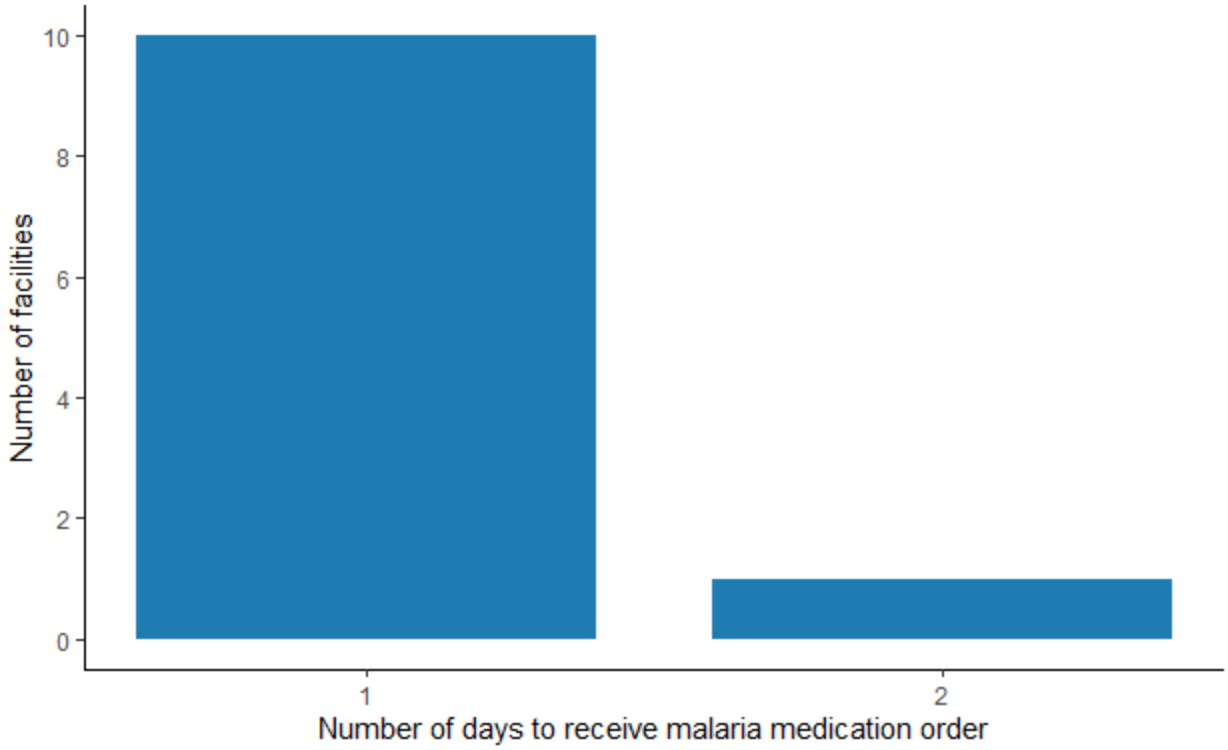
The interview also asked about how antimalarial supplies are managed. As seen in Table 7.10, all *área de salud* clinics and hospitals order their own antimalarials.

*Table 7.10: Determination of malaria medication needs*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Área de Salud Clinics: How is the quantity of malaria medication needed by this facility determined? | | | | |
| Facility determines quantity and orders | 15 | 15 | 100 | ( - ) |
| Hospitals: How is the quantity of malaria medication needed by this facility determined? | | | | |
| Facility determines quantity and orders | 3 | 3 | 100 | ( - ) |

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

*Figure 7.1: Days to receive ordered malaria medication*




The interview also asked about recent shortages of antimalarial medication and how they are handled. Most facilities that stock antimalarials reported that they always or almost always receive the expected quantities of antimalarial medications (Table 7.11). As seen in Table 7.12, if there is a shortage, many facilities reported that they make a special order (66.7% of *área de salud* clinics that stock antimalarials). Respondents could indicate more than one answer to this question.

*Table 7.11: Medication order reliability*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Área de Salud Clinics: 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 | 15 | 8 | 53.3 | (28 - 77) |
| Almost always | 15 | 5 | 33.3 | (14 - 61) |
| Don't know | 15 | 2 | 13.3 | (3 - 43) |
| 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 | 3 | 3 | 100 | ( - ) |
| Almost always | 3 | 0 | 0 | ( - ) |

*Table 7.12: Malaria medication shortages*

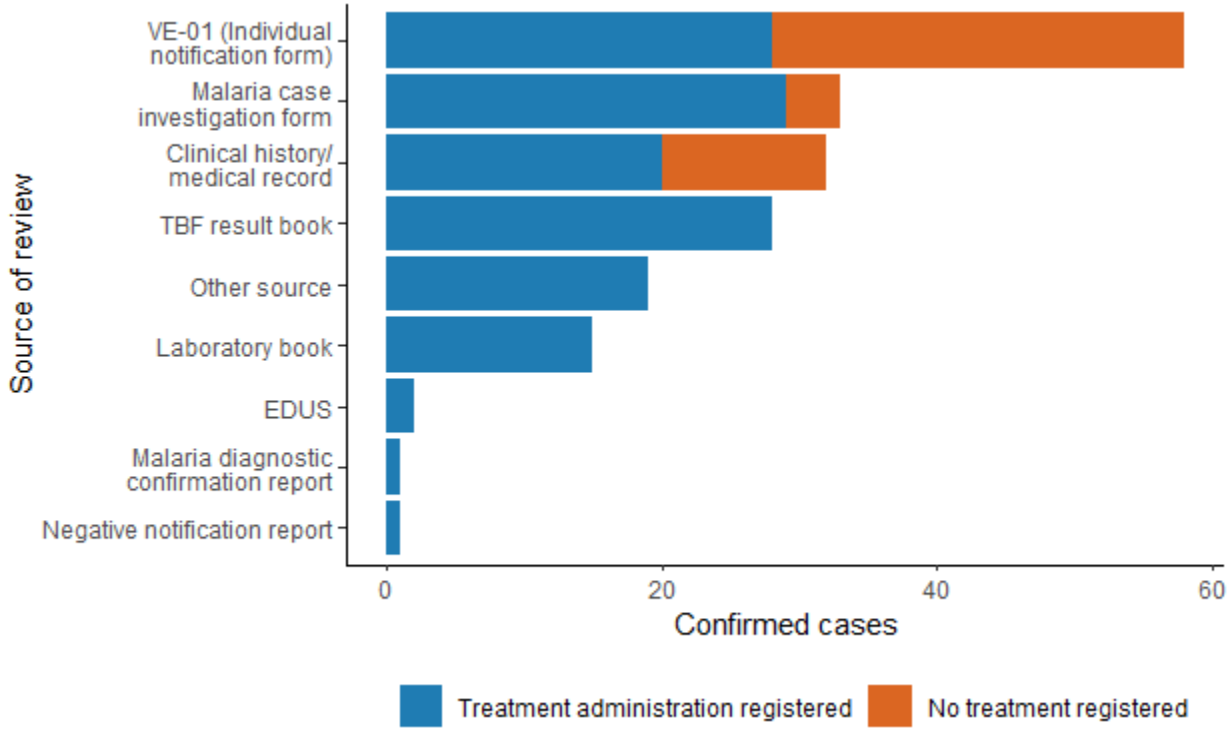
| | N | n | % | 95% CI |
|---|---|---|---|---|
| Área de Salud Clinics: If there is a shortage of a specific malaria medication between routine orders, what is the most commonly used procedure in this facility? | | | | |
| Special order | 15 | 10 | 66.7 | (39 - 86) |
| Borrow from another health facility | 15 | 5 | 33.3 | (14 - 61) |

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Hospitals: If there is a shortage of a specific malaria medication between routine orders, what is the most commonly used procedure in this facility? | | | | |
| Special order | 3 | 2 | 66.7 | (14 - 96) |
| Borrow from another health facility | 3 | 2 | 66.7 | (14 - 96) |

## 7.3 Confirmed cases: Time to treatment initiation

According to the targets of malaria elimination programs, the first dose of antimalarial treatment should be administered to the patient no later than 24 hours after diagnosis in order to interrupt community transmission as rapidly as possible. The review of confirmed malaria cases captured the dates of diagnosis and of treatment initiation and completion, as well as the medications administered, dosage, and the number of doses provided. Figure 7.2 shows that the malaria specific individual case notification forms and malaria case investigation forms were observed in most confirmed case reviews completed, and the majority of the forms had some treatment information registered. All the forms have space to register diagnosis date, but only the investigation form has space to enter treatment initiation date. Where dates are registered for both a rapid diagnostic test and a microscopic diagnosis, the earlier date is considered. Other source options include the facility specific electronic medical record systems and forms completed when a malaria case is fully treated.

*Figure 7.2: Confirmed cases: source of treatment information*




Antimalarial treatment is prescribed according to the test result. In Costa Rica, first-line regimens of chloroquine and primaquine are used for both *Plasmodium vivax* malaria and *Plasmodium falciparum* malaria without chloroquine resistance (including all locally transmitted *P. falciparum* cases in the Central American region). For imported *P. falciparum* or mixed infection cases from countries with chloroquine resistance, an artemisinin-based regimen is used. As seen in Table 7.13, 55.9% of the reviewed *P. vivax* cases had the correct regimen registered and 42.9% of the reviewed *P. falciparum* had the correct regimen registered. Nine of the cases reviewed did not have parasite species registered on any of the

forms reviewed, and thus the corresponding regimen could not be identified. These cases are not considered to have had the correct treatment regimen administered, because of the failure to register the species.

*Table 7.13: Confirmed cases: Appropriate treatment by parasite species*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Total cases with adequate treatment for species | 91 | 44 | 48.4 | (38 - 59) |
| P. vivax with adequate treatment for species | 68 | 38 | 55.9 | (44 - 67) |
| P. falciparum (non-resistant) with adequate treatment for species | 14 | 6 | 42.9 | (20 - 69) |
| Species not registered | 91 | 9 | 9.9 | (5 - 18) |

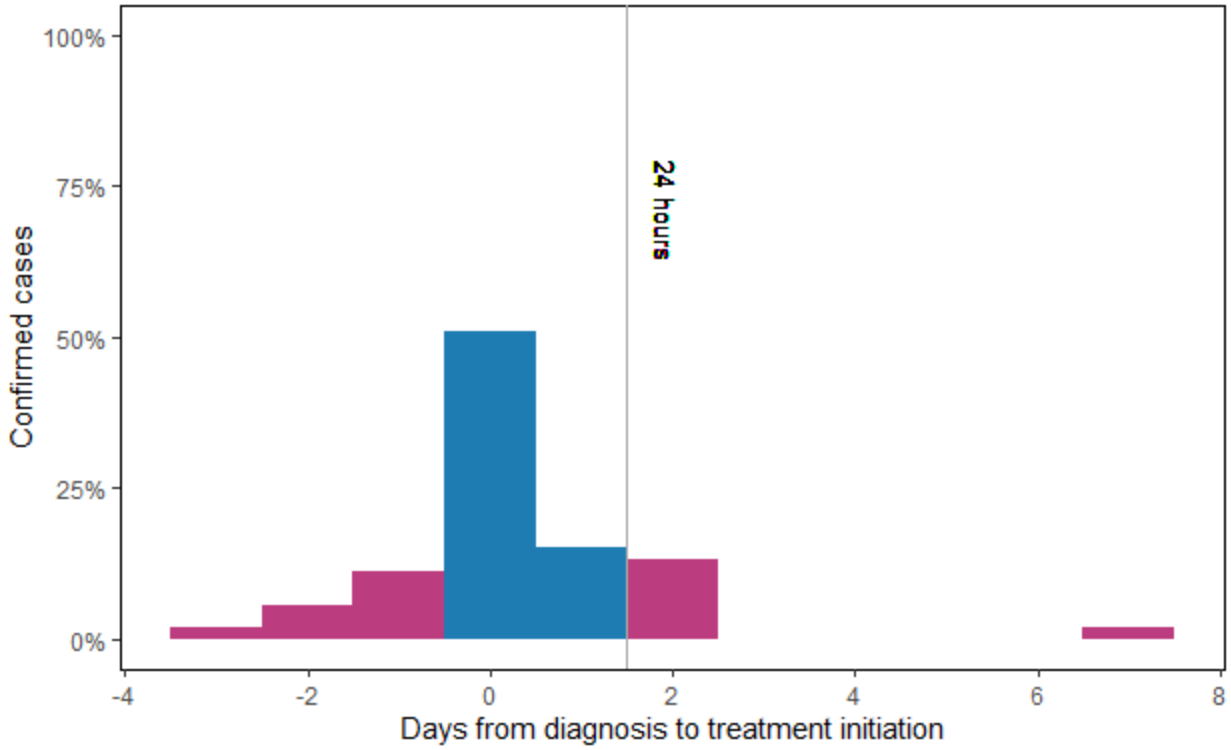
Table 7.14 shows the timing of administration of the first dose of antimalarial treatment. In 59.3% of the cases reviewed, both diagnosis and treatment date were registered. Evidence of any antimalarial treatment within one day of diagnosis was found in 38.5% of cases reviewed.

*Table 7.14: Confirmed cases: Treatment timeliness*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Diagnosis date registered | 91 | 72 | 79.1 | (69 - 86) |
| Treatment start date registered | 91 | 62 | 68.1 | (58 - 77) |
| Both dates registered | 91 | 54 | 59.3 | (49 - 69) |
| Any treatment within 24 hours of diagnosis | 91 | 35 | 38.5 | (29 - 49) |

Figure 7.3 shows the number of days from the date of diagnosis to the date of treatment initiation. Cases with treatment initiation on the same day of diagnosis or one day after are shown in blue. Cases with treatment initiation before diagnosis are not considered timely, because presumptive treatment is contrary to the norm in Costa Rica. If treatment initiation was recorded more than seven days before or more than 30 days after diagnosis, the case is excluded from the indicator because of the suspicion of recording error (on the notification form or in the survey module).

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




An indicator negotiated for RMEI measures the proportion of cases with the first dose of antimalarial treatment administered within one day of diagnosis, as shown in Table 7.15. Among the cases included in the indicator definition, 48.4% had the antimalarial treatment corresponding to the parasite species registered correctly on the forms. In 38.5% of the cases, the first dose of any treatment was registered as administered within one day (24 hours) of diagnosis, and in 33% of the cases, the first dose of the appropriate treatment was registered as administered within one day of diagnosis. For comparison, Table 7.16 shows the result by province.

*Table 7.15: Indicator 4.01: Timely treatment initiation*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Total malaria cases in the sample | 91 | 91 | 100 | ( - ) |
| Correct treatment administered for species | 91 | 44 | 48.4 | (38 - 59) |
| Diagnosis and treatment dates registered | 91 | 54 | 59.3 | (49 - 69) |
| First dose treatment within 24 hours of diagnosis | 91 | 35 | 38.5 | (29 - 49) |
| Correct treatment administered within 24 hours of diagnosis | 91 | 30 | 33 | (24 - 43) |

*Table 7.16: Comparison: result by province*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Timely treatment initiation | | | | |
| Alajuela | 90 | 30 | 33.3 | (24 - 44) |
| Puntarenas | 1 | 0 | 0 | ( - ) |
| Total | 91 | 30 | 33 | (24 - 43) |

## 7.4 Confirmed cases: Adequate and complete treatment

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

- For *P. vivax* cases: 3 days of chloroquine and 7 or 14 days of primaquine
- For *P. falciparum* cases without documented resistance to chloroquine: 3 days of chloroquine and 1 day 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 1 day primaquine
- For severe malaria cases: If IV treatment with artesunate started, when completed: 3 days of artemisinin-based treatment (artemether + lumefantrine)

### 7.4.1 Completion of malaria treatment

The Costa Rica malaria case investigation form includes space to register length of treatment, treatment type, and number of doses of each medication administered based on species. For length of treatment, the duration of treatment in days, as well as the initiation and completion dates are registered.

Table 7.18 shows treatment completion by parasite species as registered on the forms observed during baseline data collection. Nine of the cases reviewed did not have the parasite species registered, so the corresponding treatment scheme could not be identified and thus treatment is considered incomplete. *P. vivax* cases had evidence of complete treatment in 47.1% of cases, and 28.6% of the *P. falciparum* cases had evidence of complete treatment. Considering the cases with incomplete treatment registration because of the failure to record species, 39.6% of all reviewed cases had recorded evidence of adequate and complete treatment.

*Table 7.18: Confirmed cases: Complete treatment by malaria species*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Total cases with adequate treatment complete | 91 | 36 | 39.6 | (30 - 50) |
| P. vivax cases with adequate treatment complete | 68 | 32 | 47.1 | (35 - 59) |
| P. falciparum (non-resistant) with adequate treatment complete | 14 | 4 | 28.6 | (11 - 57) |
| Species not registered | 91 | 9 | 9.9 | (5 - 18) |

Adequate and complete antimalarial treatment with supervision was negotiated as an indicator for RMEI. Cases with evidence of at least one dose of antimalarial treatment supervised are considered to have treatment supervision. In Costa Rica, treatment supervision is the country standard practice, but none of the official forms have space to register this information. Only 39.6% of cases had evidence of complete and adequate treatment, and only 50.5% had evidence of any supervision. This evidence could be a note on the case investigation form that one or more doses were supervised, or a separate form included in the patient's record. Overall, 39.6% of cases had evidence that treatment was adequate, complete, and supervised.

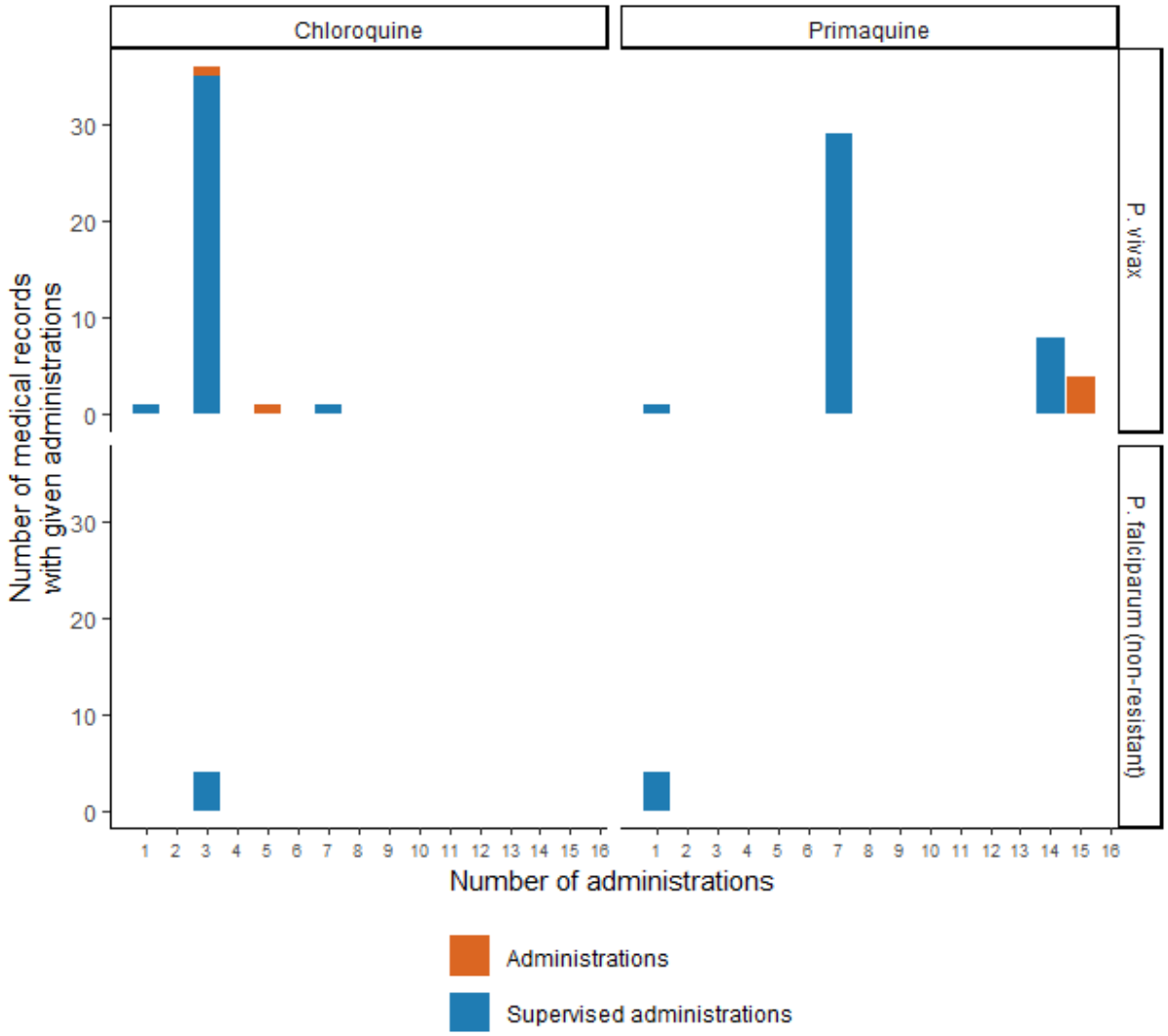
*Table 7.20: Indicator 4.03: Complete treatment with supervision*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Denominator: Total malaria cases | 91 | 91 | 100 | ( - ) |
| Adequate treatment and number of doses administered | 91 | 36 | 39.6 | (30 - 50) |
| Evidence of at least one supervised dose | 91 | 46 | 50.5 | (40 - 61) |
| Indicator Result: Complete treatment with supervision | 91 | 36 | 39.6 | (30 - 50) |

### 7.4.2 Supervision of malaria treatment

Figure 7.4 shows the number of doses with evidence of administration and supervision by species. The treatment form contains spaces to enter the number of doses supervised and which days treatment was administered. Many cases with evidence of treatment also had evidence of supervision of each administration. For *P. vivax*, a 7-day treatment scheme is most frequent in Costa Rica.

*Figure 7.4: Confirmed cases: Evidence of one supervised dose*



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

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

## 8.1 Case investigation

### 8.1.1 Case investigation practices

In Costa Rica, the malaria case investigation is completed jointly by CCSS staff at the local *área de salud* clinic and vector control or epidemiology personnel based at the *área rectora* office. It includes an interview with the patient and an analysis of the information provided in order to classify the malaria case, which is completed within three days of diagnosis at the local *área de salud* clinic before it is sent to the *área rectora* office for environmental investigation and case response. The investigation form is filled with the responses of the interview, as well as health care information such as the date, place, and results of malaria tests (obtained from the provider or laboratory), and tracking of treatment administration and follow-up tests. A copy of the case investigation is filed at the *área rectora* office and copies are sent by email to the regional offices of the Ministry of Health and CCSS as well as to the central surveillance unit.

### 8.1.2 Case detection source and classification

During the confirmed case medical record review, field personnel reviewed 91 cases, of which 14 were detected passively, 10 did not have the source of case detection registered, and the remainder were detected through active searches (Table 8.1).

According to the case investigation forms, 68.1% of malaria cases reviewed were autochthonous to Costa Rica (Table 8.2).

*Table 8.1: Source of confirmed case detection*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Case detection source: | | | | |
| Active search - Proactive | 91 | 53 | 58.2 | (48 - 68) |
| Passive search | 91 | 14 | 15.4 | (9 - 25) |
| Not registered | 91 | 10 | 11 | (6 - 19) |
| Active search - Reactive | 91 | 8 | 8.8 | (4 - 17) |
| Active search | 91 | 6 | 6.6 | (3 - 14) |

*Table 8.2: Classification of confirmed malaria cases*

| Classification | # | % |
|---|---|---|
| Autochthonous/indigenous/local | 62 | 68.1% |
| Imported | 20 | 22% |
| Introduced | 8 | 8.8% |
| Not registered | 1 | 1.1% |
| Total cases | 91 | |

## 8.2 Case management

### 8.2.1 Patient follow-up testing: health facility interview

According to the health facility interview and as shown in Table 8.3, 76.9% of respondents said that malaria patients receive at least one follow-up test in order to ensure the malaria infection has gone away.

*Table 8.3: Follow-up testing after malaria treatment: facility interview*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| After a patient begins treatment for malaria, do they ever receive a follow-up test for malaria? | 26 | 20 | 76.9 | (56 - 90) |

The interview also asked how many follow-up tests are routinely administered according to facility practices (Figure 8.1), and when the first and last samples are taken from the patient for follow-up testing (Figure 8.2). Most health facilities reported that follow-up tests are conducted for approximately one month after diagnosis.

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

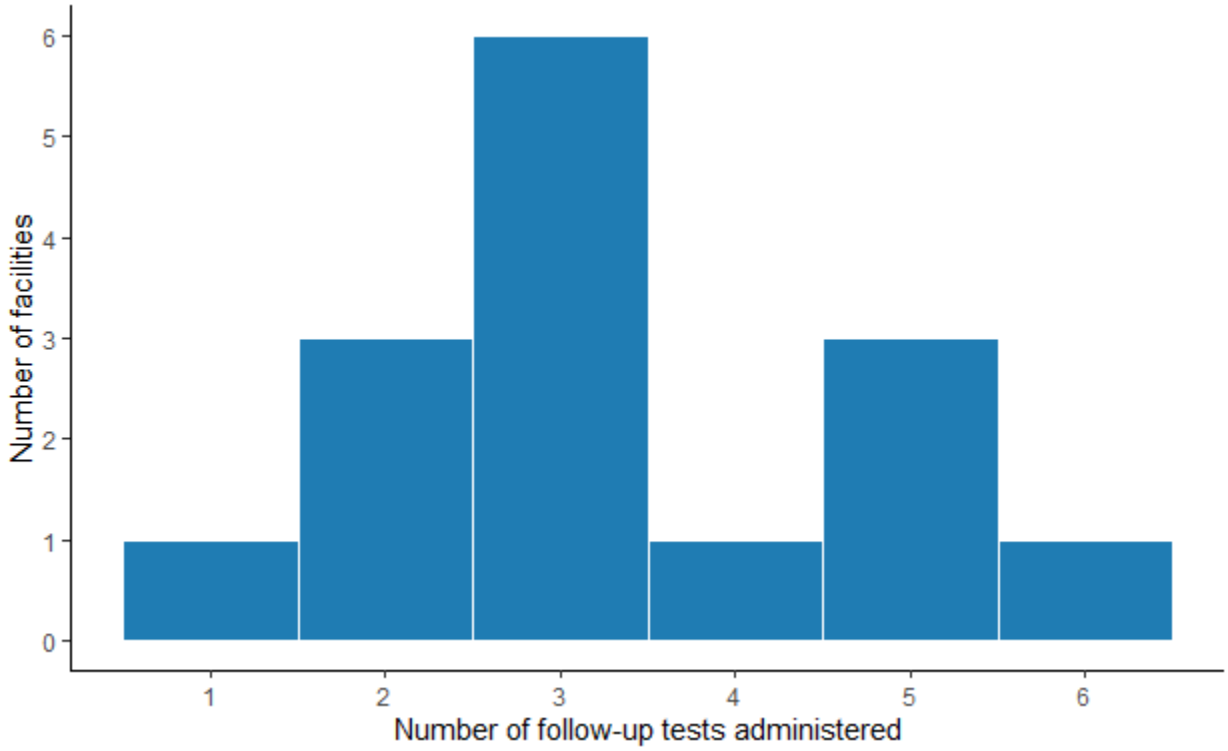
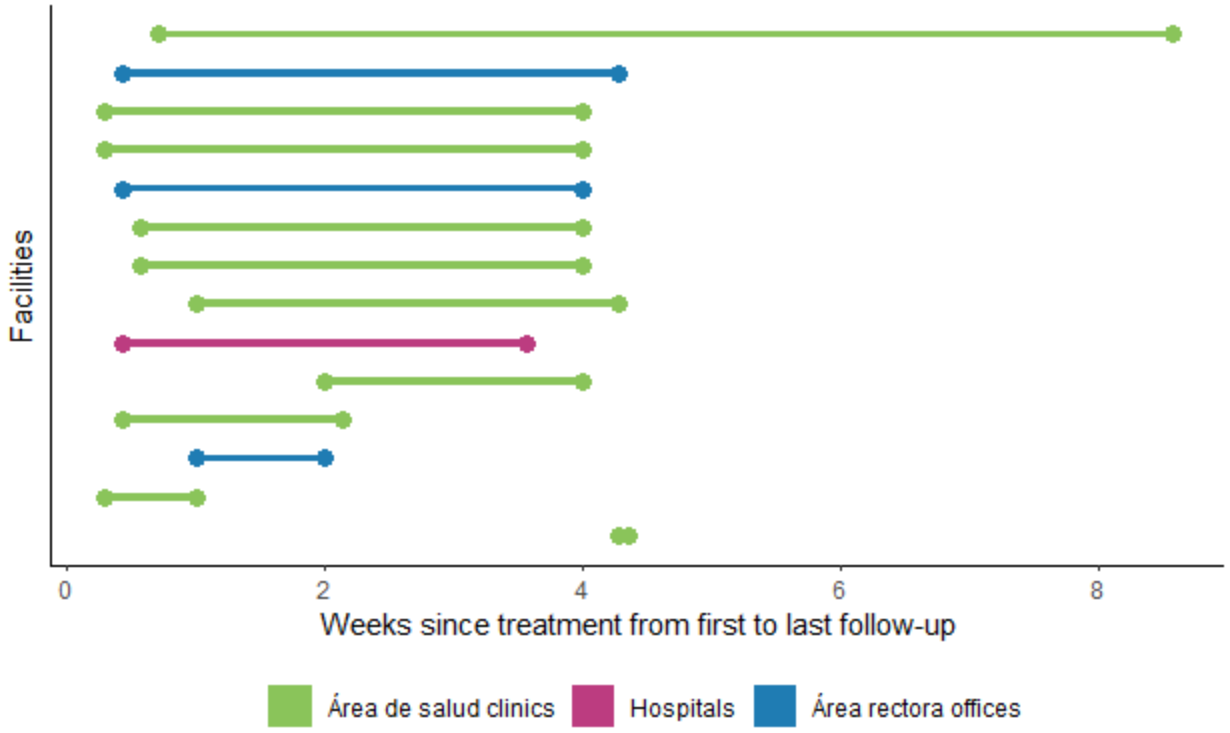


*Figure 8.2: Timing from first to last follow-up test*




### 8.2.2 Patient follow-up testing: medical record review

The case investigation form has space to track treatment administration and follow-up malaria testing, though in practice these activities may be tracked on separate, locally-developed forms or tracked only in the EDUS electronic medical record and never updated on the case investigation form after it is sent to the *área rectora* office. Chapter 7 covers treatment administration practices in detail.

There was evidence of at least one follow-up test for 63.2% of confirmed cases reviewed (Table 8.5). The number of follow-up tests recorded on the forms used for case review is shown in Figure 8.3 - most frequently there is only evidence of one follow-up test. Considering the discrepancy with the information reported in the health facility interview, it is possible that patients receive more than one test, but the dates and results for subsequent tests are not recorded on the case investigation form filed at the *área rectora* office. The first follow-up test was most often conducted at seven days (Figure 8.4).

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

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Received at least one follow-up test for malaria? | 68 | 43 | 63.2 | (51 - 74) |

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

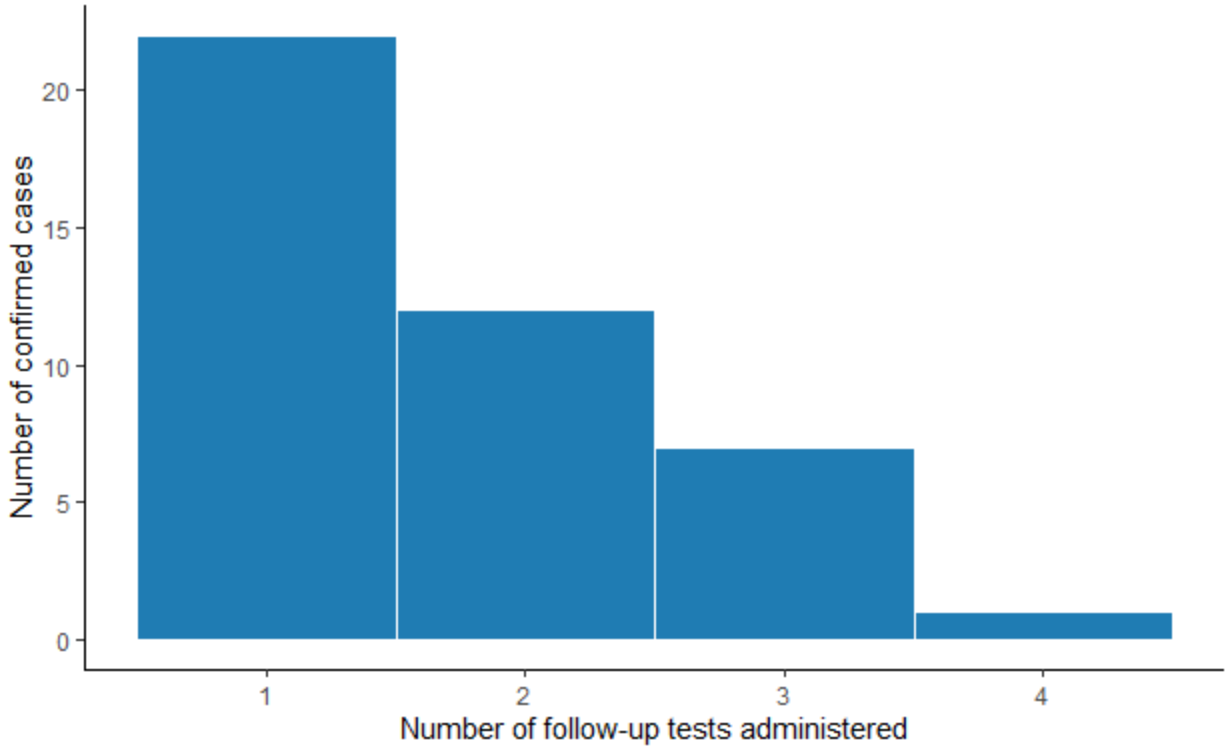
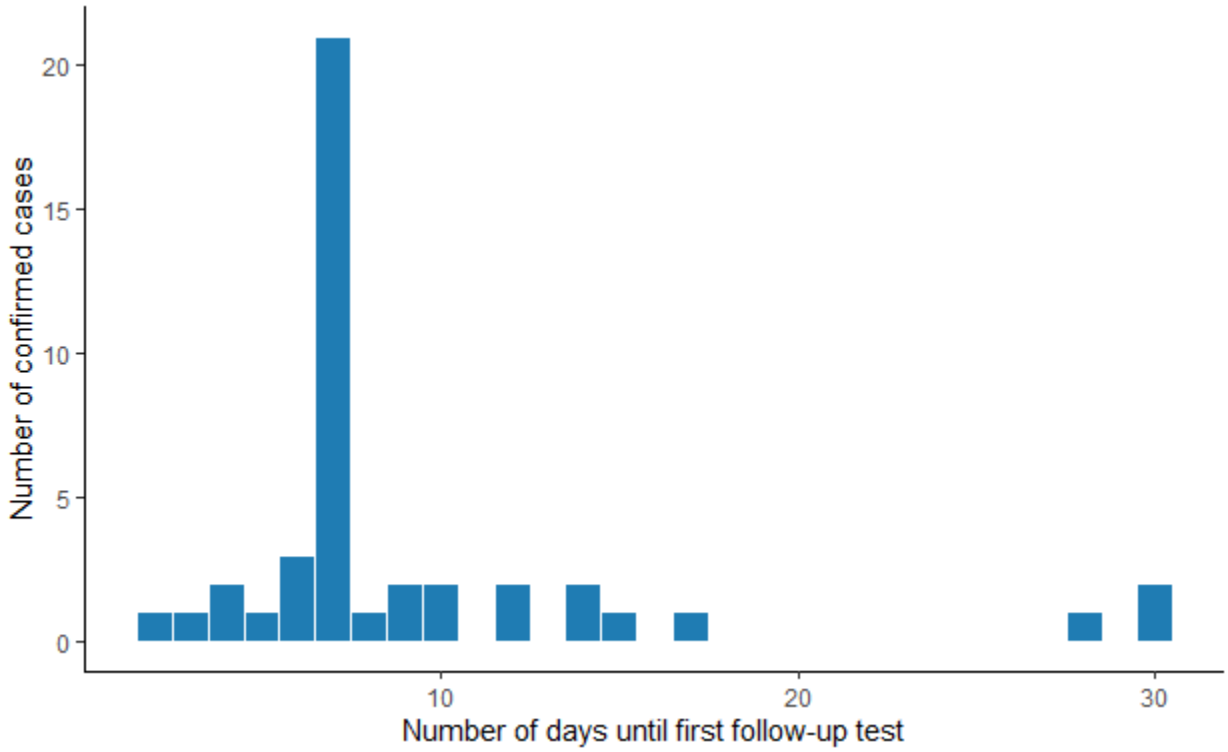



*Figure 8.4: Days to first follow-up test: medical record review*



## 8.3 Case response

Information extracted from the case investigation also allows vector control programs to plan community activities in response to a confirmed malaria case. Some of these activities are registered on the case investigation forms reviewed during the confirmed case review. Among the 91 cases reviewed, 57 had information about the environmental investigation and case response recorded. Table 8.6 shows the results of the environmental investigation, among the 57 cases with information. Table 8.7 shows whether repellents and chemoprophylaxis were used by the patients with confirmed malaria.

*Table 8.6: Medical record review case response*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Is there information about dwelling/environmental investigation and case response in the file? | 91 | 57 | 62.6 | (52 - 72) |
| Mosquito nets in house | 57 | 4 | 7 | (3 - 18) |
| Patient used/slept under net | 57 | 2 | 3.5 | (1 - 13) |
| House had been sprayed with insecticide | 57 | 42 | 73.7 | (61 - 84) |
| Anopheles vector present | 57 | 35 | 61.4 | (48 - 73) |
| Breeding areas observed around the home | 57 | 43 | 75.4 | (62 - 85) |
| Household members tested for malaria | 57 | 40 | 70.2 | (57 - 81) |
| Other contacts tested for malaria | 57 | 3 | 5.3 | (2 - 15) |

*Table 8.7: Repellents and chemoprophylaxis use*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Did the patient use repellents or chemoprophylaxis against malaria? | | | | |
| Not registered | 57 | 30 | 52.6 | (40 - 65) |
| Chemoprophylaxis | 57 | 26 | 45.6 | (33 - 59) |
| Repellents | 57 | 9 | 15.8 | (8 - 28) |

The case investigation form also specifies details about active case detection in a radius of the case, as well as insecticide application in the neighborhood. The results observed during the medical record review are shown in Table 8.8. Only two medical records reported number of households that were visited during active case detection, varying from 27 to 203 households covered. Also, only two medical records reported the number of households that received spraying, which ranged from 28 to 32 households.

*Table 8.8: Evidence of active case detection in medical records*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Was active case detection done? | 57 | 53 | 93 | (82 - 97) |
| Were houses sprayed? | 57 | 55 | 96.5 | (87 - 99) |
| Were houses fogged? | 57 | 28 | 49.1 | (36 - 62) |

# Chapter 9: Surveillance, Notification, and Reporting

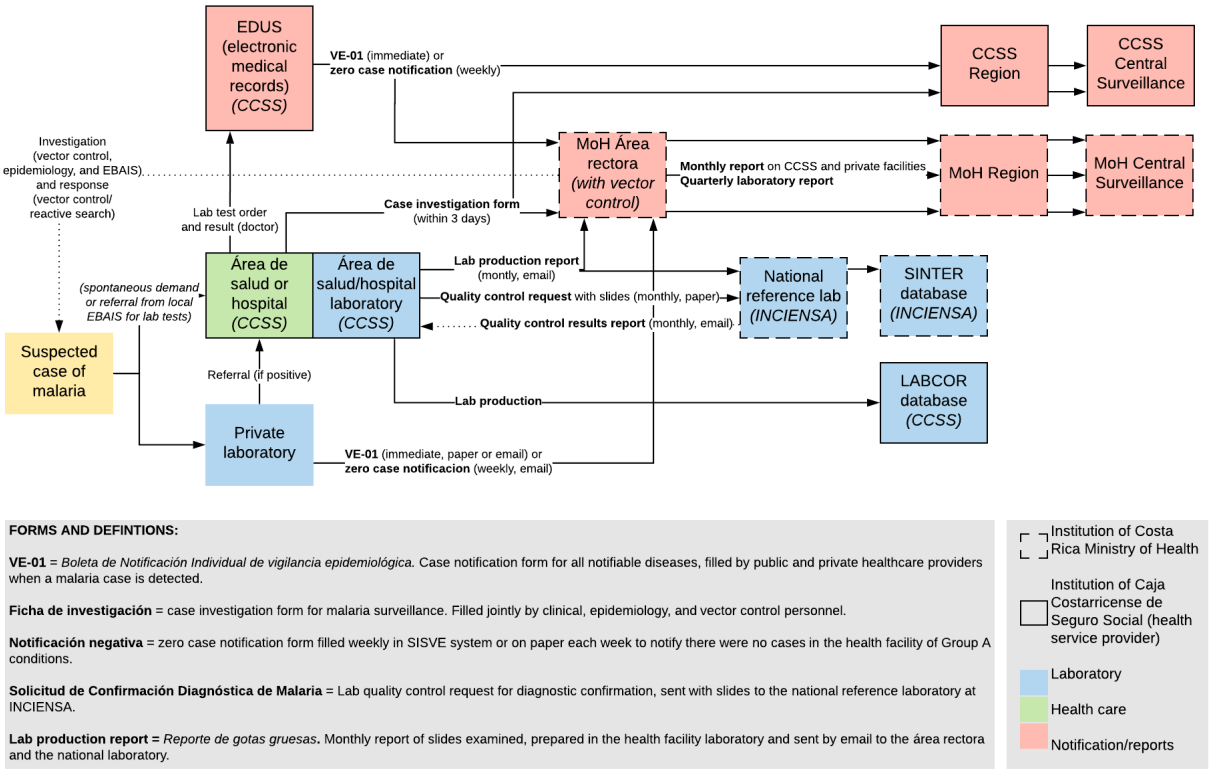
This chapter provides an overview of the malaria surveillance system in Costa Rica based on the fact-finding visit and health facility surveys, and summarizes results related to case reporting and laboratory reporting and quality control indicators.

## 9.1 Background

The fact-finding trip in 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 9.1 shows the information flows beginning with a patient with malaria symptoms. The left side of the diagram shows sample-taking and examination practices, already discussed in Chapters 5 and 6. Once a slide has been examined, the patient must be informed of the test result. Additionally, the laboratory is obligated to inform the regional CCSS and *área rectora* office of malaria test results. Negative results are informed in aggregate, once weekly or once monthly. Positive results must be entered to the SISVE system (*Sistema de Vigilancia Epidemiológica*, electronic surveillance system of the CCSS) immediately by clinical or statistics personnel in the facility conducting the diagnosis, which constitutes an automated notification to the CCSS system at all levels. Confirmed cases must also be notified to the corresponding *área rectora* office immediately by phone with a copy of the VE-01 form sent by email or on paper. Any positive results will also be included in aggregate monthly or weekly laboratory reporting. Facilities with capacity to diagnose malaria are obligated to prepare weekly negative notification reports for Group A notifiable diseases (malaria alongside other illnesses with obligatory notification), and to send these reports to the *área rectora* office through the SISVE electronic system, by email, or on paper. Malaria was not added to the list of diseases with obligatory notification until 2018, so in many health areas, negative notification reports did not include malaria for part or all of 2018. Aggregate weekly reporting of confirmed malaria cases varies by health region in Costa Rica and is not practiced in all regions.

*Figure 9.1: Costa Rica surveillance system flow diagram*




## 9.2 Notification of malaria test results

### 9.2.1 Notification to patient among facilities that send slides elsewhere for diagnosis

The health facility interview included questions about notification of malaria test results. As described in Chapter 5, health facilities that do not have microscopic diagnostic capacity in-facility (or have it in-facility only at certain days or hours) may send thick blood film slides to another health facility or laboratory for initial diagnosis. Table 9.1 and Table 9.2 show the method by which a patient is notified of a negative test result among the 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 50% of facilities). Among the three facilities where facility personnel are responsible to notify at least some patients of the test result, the notification is often in person (in 100% of facilities).

*Table 9.1: Notification to patient of negative test results (among facilities that send slides elsewhere for examination): personnel*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Who notifies the patient of a negative test result? | | | | |
| Health personnel from this facility | 6 | 3 | 50 | (15 - 85) |
| ATAP | 6 | 1 | 16.7 | (2 - 66) |
| The laboratory that tested the sample | 6 | 1 | 16.7 | (2 - 66) |
| The patient is not notified | 6 | 1 | 16.7 | (2 - 66) |
| Other | 6 | 3 | 50 | (15 - 85) |

*Table 9.2: Notification to patient of negative test results (among facilities that send slides elsewhere for examination): method*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| How is the patient notified of a negative test result? (among those notified by facility personnel) | | | | |
| In person | 3 | 3 | 100 | ( - ) |

In the case of a positive test result, eight facilities that send slides elsewhere for examination reported they receive positive test results for the slides they send. Among these facilities, 50% are sometimes or always responsible to notify the patient of the positive test result by their own personnel (Table 9.3). Among these four facilities, the most common modality for notification of a positive test result is in person (Table 9.4). 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 9.3: Notification to patient of positive test results (among facilities that send slides elsewhere for examination): personnel*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Who notifies the patient of a positive test result? | | | | |
| Health personnel from this facility | 8 | 4 | 50 | (19 - 81) |
| ATAP | 8 | 1 | 12.5 | (2 - 57) |
| The laboratory that tested the sample | 8 | 1 | 12.5 | (2 - 57) |
| Other | 8 | 5 | 62.5 | (27 - 88) |

*Table 9.4: Notification to patient of positive test results (among facilities that send slides elsewhere for examination): method*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| How is the patient notified of a positive test result? (among those notified by facility personnel) | | | | |
| In person | 4 | 3 | 75 | (21 - 97) |
| Don't know | 4 | 1 | 25 | (3 - 79) |

### 9.2.2 Notification to patient among facilities that examine slides for malaria

Other health facilities reported their own microscopic diagnosis capacity in-house. In these 17 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 35.3% of facilities (Table 9.5). In the case that a positive test result is detected in the facility, 29.4% 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 *área rectora* or hospital notify the patient of the test result.

*Table 9.5: Notification to patient of negative test results (among facilities that examine slides): personnel*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Who notifies the patient of a negative test result? | | | | |
| Health personnel from this facility | 17 | 6 | 35.3 | (16 - 61) |
| The patient is not notified | 17 | 1 | 5.9 | (1 - 35) |
| Other | 17 | 9 | 52.9 | (29 - 76) |
| Don't know | 17 | 1 | 5.9 | (1 - 35) |

*Table 9.6: Notification to patient of positive test results (among facilities that examine slides): personnel*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Who notifies the patient of a positive test result? | | | | |
| Health personnel from this facility | 17 | 5 | 29.4 | (12 - 56) |
| Other | 17 | 11 | 64.7 | (39 - 84) |
| Don't know | 17 | 1 | 5.9 | (1 - 35) |

### 9.2.3 Notification to health authorities among facilities that examine slides for malaria

When a case of malaria is confirmed in Costa Rica, notification must be sent to health authorities. Among all facilities that either examine TBF slides, 64.7% notify the *área rectora* and 58.8% notify the regional ministry of health (Table 9.7).

*Table 9.7: Notification to health authorities of positive test results*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Who is notified when a confirmed case of malaria is detected? | | | | |
| Área Rectora | 17 | 11 | 64.7 | (39 - 84) |
| Regional Ministry of Health | 17 | 10 | 58.8 | (34 - 80) |
| Regional Social Security Agency (CCSS) | 17 | 8 | 47.1 | (24 - 71) |
| Epidemiological surveillance program (National Ministry of Health) | 17 | 7 | 41.2 | (20 - 66) |
| National laboratory | 17 | 3 | 17.6 | (5 - 45) |
| Other | 17 | 1 | 5.9 | (1 - 35) |
| Don't know | 17 | 1 | 5.9 | (1 - 35) |

## 9.3 Malaria surveillance data and reporting

All health facilities in the sample were asked if they have access to an electronic health information system as shown in Table 9.8. One-hundred percent of *área de salud* clinics, 100% of hospitals, and 80% of *área rectora* offices and the national laboratory 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 33.3% of hospitals and 50% of administrative units (*área rectora* offices and the national laboratory) reported access to a system used for malaria information.

*Table 9.8: Access to electronic information systems*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Área de Salud Clinics | | | | |
| Access to an electronic health information system for capturing and/or consulting health statistics | 21 | 21 | 100 | ( - ) |
| Access to an electronic health information system for entering malaria-specific information | 19 | 9 | 47.4 | (26 - 70) |
| Hospitals | | | | |
| Access to an electronic health information system for capturing and/or consulting health statistics | 4 | 4 | 100 | ( - ) |
| Access to an electronic health information system for entering malaria-specific information | 3 | 1 | 33.3 | (4 - 86) |
| Área Rectora Offices & National Laboratory | | | | |
| Access to an electronic health information system for capturing and/or consulting health statistics | 5 | 4 | 80 | (28 - 98) |
| Access to an electronic health information system for entering malaria-specific information | 4 | 2 | 50 | (11 - 89) |

### 9.3.1 Indicator 2.03: Malaria case reporting

RMEI indicator 2.03 has two parts: case reporting and laboratory reporting. According to the negotiated definition for case reporting, health units in Costa Rica that conduct malaria diagnosis must send weekly

reports to the *área rectora* office 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 seven calendar days of the close of each week and have the date sent from the facility recorded on the report. The report can be specific to malaria or combined with other notifiable diseases, so long as the exact number of malaria cases can be determined from the report.

The fact-finding visit revealed substantial variation from one health region to the next in terms of the format and frequency of malaria case reporting, and this finding was confirmed during health facility surveys. Weekly zero case reporting is now required for malaria, but the requirement was introduced during 2018 so some negative notification reports from that year did not list malaria. Some health regions prepare monthly aggregate reports of confirmed cases instead of weekly. Many health areas did not routinely produce aggregate reports during the year 2018 at all, but rather completed the required immediate individual notification form (VE-01) and relied on the SISVE electronic system to produce a report as needed. The format of the reports observed during the survey at the facilities responsible to send case reports to health authorities (*área de salud* clinics and hospitals with diagnostic capacity) where at least one report was observed is shown in Table 9.9.

*Table 9.9: Format of case notification reports observed*

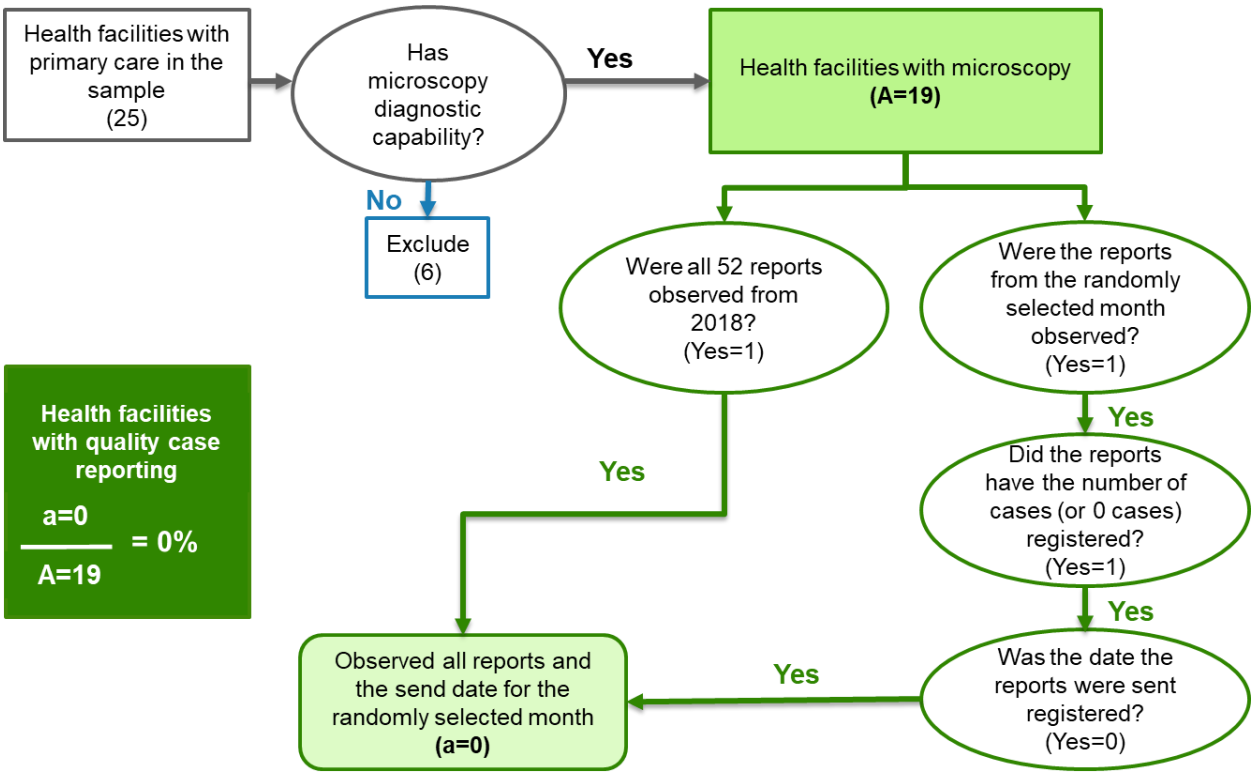
| | N | n | % | 95% CI |
|---|---|---|---|---|
| Aggregate negative case reporting | 17 | 2 | 11.8 | (3 - 39) |
| No aggregate case reporting, used aggregate reports from laboratory to determine number of cases | 17 | 10 | 58.8 | (34 - 80) |
| No aggregate case reporting, used individual case reports to determine number of cases (notfication or investigation) | 17 | 5 | 29.4 | (12 - 56) |

Field personnel conducted an audit of all malaria case reports from 2018 stored at *áreas de salud* clinics 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 9.2.

Table 9.11 shows the results of the case reporting component of the indicator, which requires the following:

- that the reports be in a weekly format
- that all 52 reports be observed for the year 2018
- that all four weekly reports be observed for the selected month with send date
- that all four send dates are verified to be within the first seven calendar days of the close of the selected week

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




Electronic reports were acceptable provided evidence of the date of submission was observed. The survey included questions about the ability to electronically generate reports of confirmed cases of malaria by epidemiological week where evidence of an archived report was not observed, but the ability to generate a report did not substitute for a report submitted on time and archived on paper or electronically because a report generated on the day of the survey does not meet the requirement for evidence of timely submission of the report to the health authority during 2018. Of the 11 health facilities that did not have case notification reports available, 27.3% were able to generate a report electronically at the time of the interview (Table 9.10).

*Table 9.10: Case notification report generated electronically, among health facilities without a report*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Could a report be generated electronically? | | | | |
| No, not able to generate reports electronically | 11 | 8 | 72.7 | (39 - 92) |
| Yes, electronic reports generated | 11 | 3 | 27.3 | (8 - 61) |

Nineteen facilities that provide attention to patients are eligible for consideration in the indicator. The results are shown in Table 9.11 and zero units met all the requirements of the indicator.

*Table 9.11: Indicator 2.03: Case reporting*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Indicator: Attention units | | | | |
| Relevant units | 25 | 25 | 100 | ( - ) |
| Units with diagnostic capacity | 25 | 19 | 76 | (54 - 89) |
| Units indicating reporting of malaria cases | 19 | 19 | 100 | ( - ) |
| At least one weekly report from 2018 observed | 19 | 1 | 5.3 | (1 - 32) |

| | N | n | % | 95% CI |
|---|---|---|---|---|
| All 52 weekly reports from 2018 observed | 19 | 1 | 5.3 | (1 - 32) |
| Four weekly reports for randomly selected month observed* | 19 | 1 | 5.3 | (1 - 32) |
| Number of cases (or zero) recorded for all reports of randomly selected month | 19 | 1 | 5.3 | (1 - 32) |
| Dates for reports of randomly selected month observed | 19 | 1 | 5.3 | (1 - 32) |
| Dates for reports of randomly selected month are valid | 19 | 0 | 0 | ( - ) |
| Result: Malaria case reporting to standard | 19 | 0 | 0 | ( - ) |

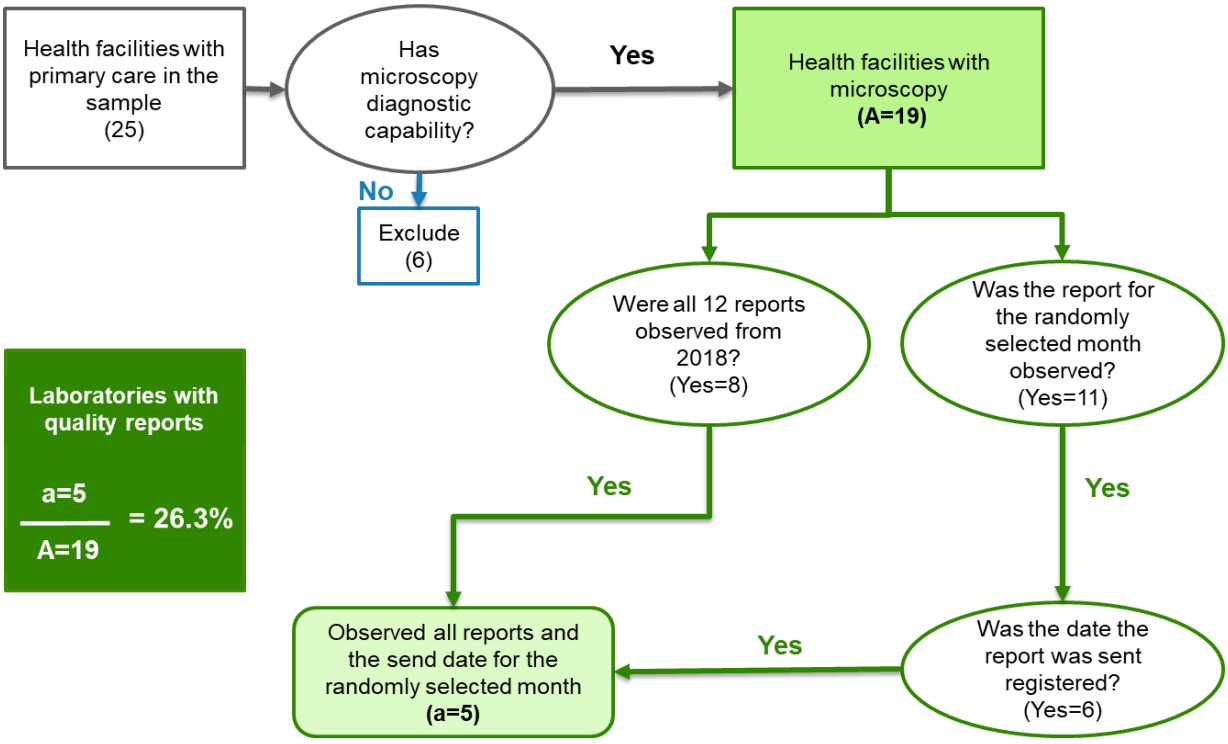
*13 attention units had monthly reports available, for 8 of which all 12 were observed

### 9.3.2 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 via the LABCOR database to the CCSS and via email or on paper to the national laboratory within the first 10 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 9.3. 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 10 days of the following month

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



Nineteen facilities that provide attention to patients are eligible for consideration in the indicator. The results are shown in Table 9.12 and five units met all the requirements of the indicator. The breakdown of the case reporting component of the indicator is shown in Table 9.13.

*Table 9.12: Indicator 2.03: Lab reporting*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Relevant units | 25 | 25 | 100 | ( - ) |
| Units with diagnostic capacity | 25 | 19 | 76 | (54 - 89) |
| At least one monthly report from 2018 observed | 19 | 13 | 68.4 | (44 - 86) |
| All 12 monthly reports from 2018 observed | 19 | 8 | 42.1 | (22 - 66) |
| Report for randomly selected month observed | 19 | 11 | 57.9 | (34 - 78) |
| Date for report of randomly selected month observed | 19 | 8 | 42.1 | (22 - 66) |
| Date for report of randomly selected month is valid | 19 | 6 | 31.6 | (14 - 56) |
| Result: Laboratory production reporting to standard | 19 | 5 | 26.3 | (11 - 51) |

*Table 9.13: Comparison: result by stratum*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Laboratory reporting to standard | | | | |
| Stratum 3 | 16 | 4 | 25 | (9 - 53) |
| Stratum 4 | 3 | 1 | 33.3 | (4 - 86) |
| Total | 19 | 5 | 26.3 | (11 - 51) |

The destination where laboratory production reports are sent is shown in Table 9.14. Respondents could indicate more than one answer to this question.

*Table 9.14: Destination of lab production reports observed*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Where are laboratory production reports sent? | | | | |
| Área Rectora office | 26 | 11 | 42.3 | (24 - 63) |
| National Laboratory | 26 | 9 | 34.6 | (18 - 56) |
| Regional Ministry of Health | 26 | 5 | 19.2 | (8 - 40) |
| Do not send reports | 26 | 2 | 7.7 | (2 - 28) |
| Regional Social Security Agency (CCSS) | 26 | 1 | 3.8 | (0 - 25) |
| Epidemiological surveillance program (National Ministry of Health) | 26 | 1 | 3.8 | (0 - 25) |

## 9.4 Indicator 3.02: Laboratory quality control

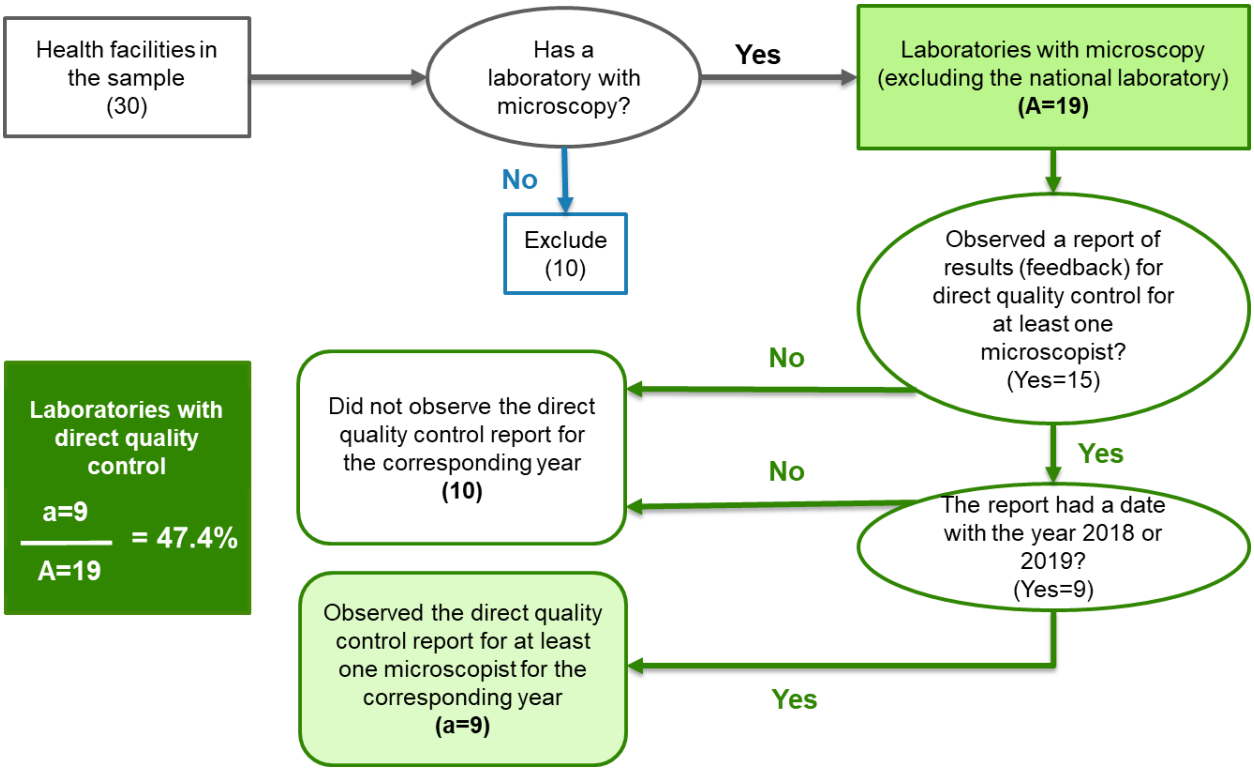
The RMEI indicators also require participation of the national reference laboratory for malaria in an external quality control certification with the Pan American Health Organization, which was observed at the Costa Rica national reference laboratory for the year 2018.

Additionally, all laboratories and microscopy posts that diagnose malaria through microscopy must participate in direct and indirect quality control exercises with the national reference laboratory. Thus, 19 laboratories at *área de salud* clinics 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. Health facility eligibility was determined according to a decision algorithm shown in Figure 9.4. According to Table 9.15, complete evidence of participation in direct quality control was observed at 47.4% of laboratories. The evidence required was a report of the results of the 2018 exam received back from the reference laboratory with feedback.

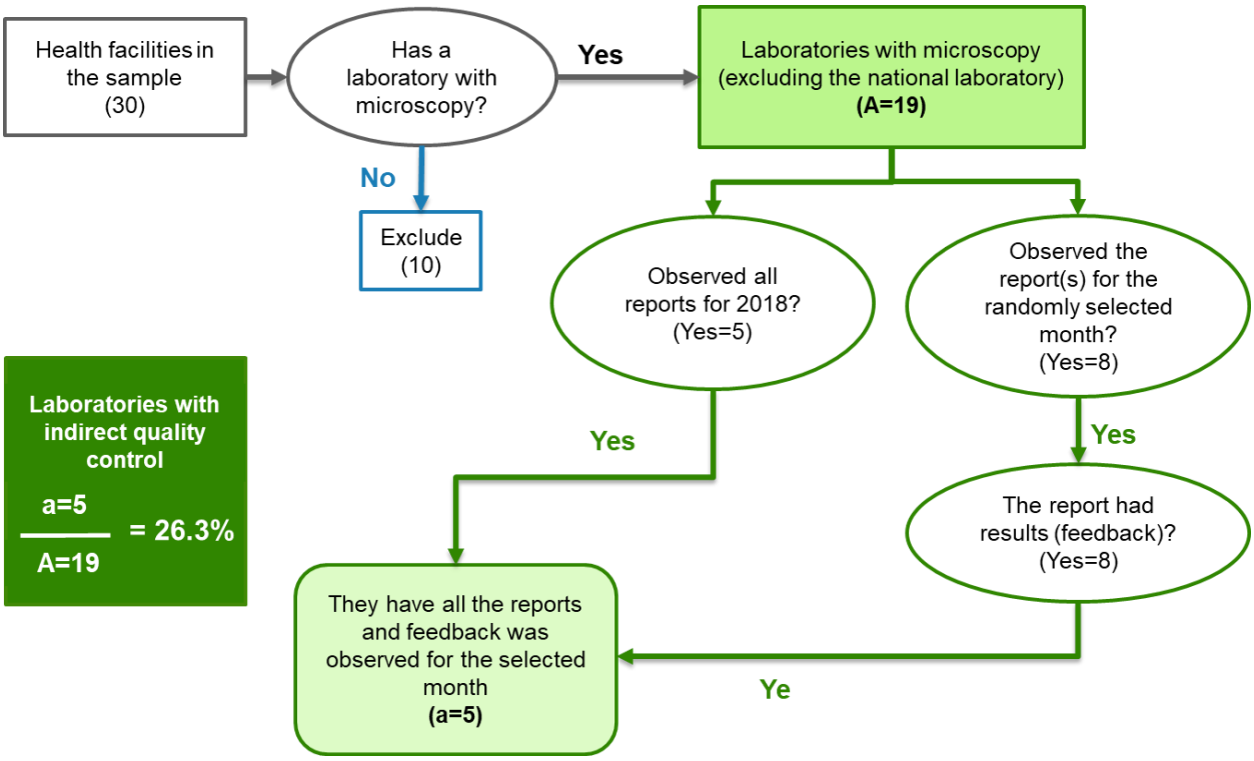
*Figure 9.4: Eligibility of health facilities for Indicator 3.02 (direct)*




The second exercise, indirect quality control, is a cross-check of a set proportion of the slides initially diagnosed by each local laboratory by a senior microscopist. In Costa Rica, local laboratories must send 10% of the slides with a negative test result for malaria and 100% of the slides with a positive test result to the national lab for cross-checking each month. 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 9.5. While 42.1% of laboratories reported participating in quality control, only 26.3% 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 9.5: Eligibility of health facilities for Indicator 3.02 (indirect)*




The detailed results of the indicator are shown in Table 9.16 and Table 9.17. A breakdown of the direct and indirect components of the indicator by stratum are shown in Table 9.18.

*Table 9.15: Indicator 3.02: Quality control*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| External quality control: 2018 National Lab Evaluation form observed | 1 | 1 | 100 | ( - ) |
| Direct | 19 | 9 | 47.4 | (26 - 70) |
| Indirect | 19 | 5 | 26.3 | (11 - 51) |

*Table 9.16: Indicator 3.02: Indirect and direct quality control*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Facilities with microscopy (excluding national lab) | 30 | 19 | 63.3 | (44 - 79) |
| Facilities passing direct quality control (DQC) component | 19 | 9 | 47.4 | (26 - 70) |
| Facilities that report participating in DQC | 19 | 17 | 89.5 | (64 - 98) |
| Feedback for at least one assessment in 2018 was observed | 19 | 15 | 78.9 | (54 - 92) |
| Feedback report with results was dated 2018 | 19 | 9 | 47.4 | (26 - 70) |
| Facilities passing indirect quality control (IDQC) component | 19 | 5 | 26.3 | (11 - 51) |
| Facilities that report participating in IDQC | 19 | 13 | 68.4 | (44 - 86) |
| Randomly selected month report was observed | 19 | 8 | 42.1 | (22 - 66) |
| Cross-checked results and feedback were observed on randomly selected report | 19 | 8 | 42.1 | (22 - 66) |
| All reports observed for 2018 | 19 | 5 | 26.3 | (11 - 51) |

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Facilities passing both direct and indirect quality control | 19 | 3 | 15.8 | (5 - 41) |

*Table 9.17: Indicator 3.02: Indirect quality control in detail*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Facilities who have microscopy (excluding national lab) | 30 | 19 | 63.3 | (44 - 79) |
| At least one report was observed for 2018 | 19 | 9 | 47.4 | (26 - 70) |
| Reports are monthly | 19 | 8 | 42.1 | (22 - 66) |
| 1-3 reports observed | 19 | 1 | 5.3 | (1 - 32) |
| 4-7 reports observed | 19 | 1 | 5.3 | (1 - 32) |
| 8-11 reports observed | 19 | 1 | 5.3 | (1 - 32) |
| 12 reports observed | 19 | 5 | 26.3 | (11 - 51) |
| Reports are weekly | 19 | 1 | 5.3 | (1 - 32) |
| 1-17 reports observed | 19 | 0 | 0 | ( - ) |
| 18-34 reports observed | 19 | 1 | 5.3 | (1 - 32) |
| 35-51 reports observed | 19 | 0 | 0 | ( - ) |
| 52 reports observed | 19 | 0 | 0 | ( - ) |
| All reports observed for 2018 | 19 | 5 | 26.3 | (11 - 51) |

*Table 9.18: Comparison: result by stratum*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Stratum 3 | | | | |
| Facilities passing direct quality control (DQC) component | 16 | 8 | 50 | (26 - 74) |
| Facilities passing indirect quality control (IDQC) component | 16 | 4 | 25 | (9 - 53) |
| Facilities passing both direct and indirect quality control | 16 | 3 | 18.8 | (6 - 47) |
| Stratum 4 | | | | |
| Facilities passing direct quality control (DQC) component | 3 | 1 | 33.3 | (4 - 86) |
| Facilities passing indirect quality control (IDQC) component | 3 | 1 | 33.3 | (4 - 86) |
| Facilities passing both direct and indirect quality control | 3 | 0 | 0 | ( - ) |

## 9.5 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 Costa Rica Ministry of Health and CCSS 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 Costa Rica, 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. For the purposes of this indicator, if a local laboratory diagnosed at least one negative slide, then at least one negative slide should have been sent to the reference laboratory for quality control. Only 21.1% of the eligible health facilities with diagnostic capabilities met the standards of the indicator based on the reporting observation. The evidence required was:

- the report sent from the local laboratory with original diagnosis be 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 be observed
- the results or feedback from the reference laboratory indicated 100% of positive and 10% of negative slides were cross-checked.

The detailed results of the indicator are shown in Table 9.19. It is important to note that positive and negative slides are sent to the reference lab at different intervals. When a positive slides is diagnosed, it is sent to the lab immediately for quality control, whereas 10% of negative slides are sent to the lab at monthly intervals. The results and feedback for positive and negative slides are stored in separate documents at the reference laboratory.

*Table 9.19: Indicator 3.01: Quality control results*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Facilities with microscopy (excluding national laboratory) | 19 | 19 | 100 | ( - ) |
| Original 'Quality control request' report observed for selected time period | 19 | 4 | 21.1 | (8 - 46) |
| Results or feedback report observed for selected time period* | 19 | 5 | 26.3 | (11 - 51) |
| Both original diagnosis report and feedback report observed for selected time period | 19 | 4 | 21.1 | (8 - 46) |
| Results show 10% of negative slides sent for cross-check | 4 | 4 | 100 | ( - ) |
| Results show 100% of positive slides sent for cross-check | 1 | 1 | 100 | ( - ) |
| Facility received indirect quality control results or feedback from the reference lab for selected time period | 19 | 4 | 21.1 | (8 - 46) |

*Reports observed for 5 additional facilities, but they did not correspond to the randomly selected month

# Chapter 10: Challenges, Conclusions, and Recommendations

## 10.1 Challenges and limitations

### 10.1.1 Challenges for health facility data collection

In Costa Rica, field personnel were generally able to gain authorization to interview in selected health facilities and to observe relevant service areas. However, it was challenging to access laboratories and to observe laboratory forms in the few cases where the laboratorist was on leave or otherwise not available during the week of the visit. Interviewers were able to conduct revisits within the span of a few days if key personnel were not available at the initial visit, but did encounter some extended laboratory closures. Even if the facility director was able to unlock the laboratory and allow interviewers to observe equipment, other facility personnel were often not equipped to find laboratory supplies, records of stock, and reporting files.

Rapid diagnostic tests for malaria were introduced in Costa Rica in 2019, first in the vector control program and subsequently in CCSS facilities. However, information on stock and use of rapid diagnostic tests was not collected in the health facility survey at the request of Ministry of Health and CCSS representatives.

Early in data collection, there were refusals from the directors of two health facilities to participate in the Initiative. The facility directors had not received information regarding the Initiative from central CCSS, so they did not allow the field team access to the facility to complete the questionnaires. After these refusals, the Ministry of Health and CCSS were contacted and new notifications were sent to all health facilities approving the Initiative and informing directors that survey teams may be arriving to complete questionnaires.

### 10.1.2 Challenges for suspected case review

A key challenge for the review of suspected malaria cases was technical issues with the statistics and record control function (CUBOS) within the EDUS electronic medical record system. At some locations, the system took a long time to load eligible cases and for a week there was a national system failure of the CUBOS function that prevented sampling of suspected medical records. The field team returned to two *área de salud* clinics multiple times to complete suspected case review during the time CUBOS was not functioning, but were unable to complete medical record review at these locations.

Some *área de salud* clinics in the sample had not yet adopted the EDUS system in 2018. Sample selection and record review was conducted from paper registries and records in these clinics.

### 10.1.3 Challenges for confirmed case review

In Costa Rica, malaria case notification (VE-01) and investigation forms were generally found for most confirmed cases of malaria and could be reviewed at the *área rectora* offices. The information found on these forms was sufficient to measure most indicators, with two exceptions. Sometimes the species of the parasite was not registered on the forms, making it impossible to determine what treatment scheme should have been followed. Additionally, treatment records were often not sufficiently complete to measure complete and continuous treatment, and evidence of treatment supervision was not always found. While complete treatment may be administered and supervised in practice, the records at the *área rectora* office are not always updated to reflect treatment completion.

### 10.1.4 Challenges for case and lab reporting review

In Costa Rica, there is no national standard for aggregate reporting of malaria cases, and malaria was not added to the zero case notification report until 2018. Due to this change, some case reporting forms for 2018 did not include reporting of zero cases. Confirmed malaria cases are reported individually when they are diagnosed and this information is entered into the SISVE electronic surveillance system from the VE-

01 individual case notification forms. Through SISVE, aggregate information is available for extraction by regional and central level surveillance units of the CCSS. Information observed for aggregate case reporting was commonly rendered at the time of the interview through the SISVE system. The malaria laboratory reporting form, in contrast, is nationally standard.

Copies of the forms are filed at the sending health facility and the receiving *área rectora* office or the national laboratory. 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 lab or statistics personnel since 2018.

#### 10.1.5 Challenges for household data collection

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

## 10.2 Key findings and recommendations

Though Costa Rica has made notable advances in updating reporting formats (zero-case reporting for malaria) and introducing electronic medical record and surveillance systems on a national scale, the pipeline from recording on paper in the field to the final electronic databases should be reviewed and improved to ensure the highest data quality, and to ensure the inclusion of information on case management captured after malaria diagnosis (treatment administration and supervision and follow-up parasitological tests). The emphasis must be on ensuring complete and precise data at the lowest levels of information, and in enabling effective data storage, processing, quality control, and analysis for decision-making at the regional and central levels.

Because malaria and other infectious disease programs have been managed for decades as parallel, vertically integrated systems, some disconnects between service provision in health facilities and through the vector control program persist. Different groups manage different activities for case detection, case management, and vector control, and there is not always a clear coordination plan. Vector control teams in the field must inform to the Ministry of Health surveillance program, while patients visit health facilities that are part of the CCSS reporting chain. Furthermore, the Ministry of Health and CCSS maintain separate and redundant health information and surveillance systems, which requires more staff time to fulfill the reporting requirements of both systems at the clinical level and to maintain the systems, coordinate and carry out surveillance functions at the regional and central levels. To reach malaria elimination, stakeholders will have to work to bridge gaps and reduce fragmentation in service provision.

Some practices and procedures are not standardized in Costa Rica, in particular adherence to aggregate notification requirements, and in terms of detection and record-keeping protocols for patients with fever presenting at a health facility (suspected malaria cases). Although the number of confirmed cases of malaria each year is low in Costa Rica, clinical staff must stay vigilant and order malaria testing for patients who meet the case definition in order to avoid reintroducing local transmission. 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) | 364 | 0.5 | (0 - 2) |
| P2.03 | Case reporting with quality | 19 | 0 | ( - ) |
| | Lab production reporting | 19 | 26.3 | (11 - 51) |
| P3.02 | Quality control (external) | 1 | 100 | ( - ) |
| P3.01* | Slide results cross-checked at a reference laboratory | 19 | 21.1 | (8 - 46) |
| P3.02 | Quality control (direct) | 19 | 47.4 | (26 - 70) |
| | Quality control (indirect) | 19 | 26.3 | (11 - 51) |
| P4.01 | Treatment within 24 hours | 91 | 33 | (24 - 43) |
| P6.01 | Vector control coverage | 164 | 13.1 | (12 - 14) |
| P7.01 | Equipment and instruments for diagnosis and treatment | 26 | 15.4 | (6 - 36) |

*Definition updated considering data collected in the field. Pending discussion with Ministry of Health and CCSS to update the indicator manual and finalize definition.

## A.2 Monitoring indicator matrix

| # | Indicator | N | % | CI |
|---|---|---|---|---|
| M2.02 | Fever cases with blood sample | 2 | 50 | (5 - 95) |
| E2.04 | Notified within 24 hours of detection | 89 | 52.8 | (42 - 63) |
| E3.03 | Equipment and instruments for sampling and diagnosis | 21 | 57.1 | (35 - 77) |
| M4.02 | Diagnosis within 48 hours | 90 | 8.9 | (4 - 17) |
| M4.03 | Treatment complete and supervised | 91 | 39.6 | (30 - 50) |
| E4.05 | Health facilities without stockouts of first-line treatments | 25 | 36 | (19 - 57) |
| E6.03 | Population protected by IRS | 1150 | 9.4 | (8 - 11) |
| E6.05 | Population protected by ITNs | 1159 | 1.3 | (1 - 2) |

| # | Indicator | N | Median | CI |
|---|---|---|---|---|
| E4.03 | Median time between onset of symptoms and start of treatment (days): active surveillance - Proactive | 52 | 6 | ( - ) |
| | Median time between onset of symptoms and start of treatment (days): passive surveillance | 14 | 6 | ( - ) |
| | Median time between onset of symptoms and start of treatment (days): surveillance type not registered | 10 | 7 | ( - ) |
| | Median time between onset of symptoms and start of treatment (days): active surveillance - Reactive | 8 | 5 | ( - ) |
| | Median time between onset of symptoms and start of treatment (days): active surveillance - Undefined | 5 | 7 | ( - ) |

# 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*

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

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

*Sampling by presumptive or final diagnosis - diagnoses eligible for review*

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

*Sampling by principal complaint - motives eligible for review*

- Fever
- Malaria
- Dengue
- Chikungunya

**Numerator:** Cases with evidence a malaria test was ordered

**Exclusions:**

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

2. Diagnoses ineligible without a documented fever:

*All health facilities:*

*Sampling by ICD code*

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

- A27.9 Leptospirosis, unspecified

*Sampling by presumptive or final diagnosis*

- Leptospirosis
- Viral infection, unspecified
- Meningitis

*Only health facilities in stratum 3:*

*Sampling by ICD code*

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

*Sampling by presumptive or final diagnosis*

- Hepatomegaly
- Splenomegaly

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

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

## M2.02: Fever cases with blood sample

**Source:** Household survey

**Denominator:** People in stratum 3 and 4 communities who reported fever during the two weeks prior to the survey

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

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

## P2.03a: Malaria case reports with quality standards

**Source:** Health facility observation

**Denominator:** Health facilities with self-reported diagnostic capacity

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

- Reports list the aggregate number of malaria cases or report of zero cases
- Reports observed for all 52 weeks of the year 2018
- Reports in randomly selected month list sending date
- All observed dates within first 7 calendar days of the following week

**Exclusions:** *Área rectora* offices, 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 (or weekly) laboratory production reports observed (paper or electronic reports acceptable)

- Reports list the malaria samples taken
- Reports observed for all 12 months or 52 weeks of the year 2018
- Reports in randomly selected month list sending date
- All observed dates within first 10 business days of the following month

**Exclusions:** *Área rectora* offices, 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 from the reference laboratory with 100% positive and 10% negative slides sent for cross-check verification, 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)

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

**Exclusions:** 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

- *P. vivax* or *P. falciparum* from areas without chloroquine resistance: chloroquine + primaquine
- Imported *P. falciparum* cases from areas with documented resistance to chloroquine: artemisinin-based treatment (artemether + lumefantrine) + primaquine
- Severe malaria cases: artesunate or quinine or artemether (or others according to the norm)

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

## 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

- For *P. vivax* 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 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)

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

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

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

**Source:** Health facility observation

**Denominator:** Points of care and laboratories

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

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

- All *área de salud* clinics and hospitals

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

- All hospitals

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

- All hospitals

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

- All *área de salud* clinics and hospitals

*Forms for sending slide samples*

- All *área de salud* clinics and hospitals

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

- All health facilities 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

- All health facilities 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]

- All health facilities that reported microscopic diagnostic capacity, including national laboratory

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

- One eligible establishment where this information was not captured due to an error in the survey logic are excluded from this component of the indicator.

# Appendix C: Sample design and methods

## C.1 Sample size

The size of the sample of health facilities for Costa Rica 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 Costa Rica, 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*

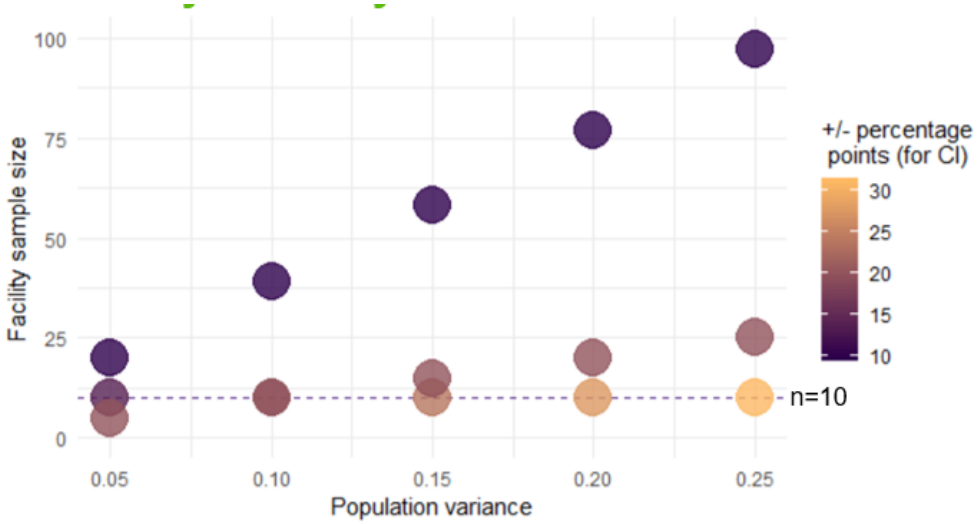



**Figure 1. Facility sample sizes and corresponding margins of error across different levels of population variance.** Potentially acceptable margins of error range from +/-10 ppts (ideal) to +/-30 ppts (considered high) on either side of the point estimate.

## 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 *área de salud* clinics that provide care or services to localities in malaria strata 3 and 4 based on referral networks and facility lists provided by the Costa Rica Ministry of Health and CCSS. *Área de salud* clinics were listed according to whether vector control activities (IRS or ITN distribution) were carried out within the catchment area during 2019, as noted in intervention activity lists that the Ministry of Health and CCSS provided to IHME. *Área de salud* clinics were sorted by a random variable and a sample was drawn in two strata: malaria stratum 4 and malaria stratum 3. Based on the fact-finding visit and information provided by the Ministry of Health, the measurement was planned with the expectation that all *área de salud* clinics had malaria microscopy capacity, so the sample was not stratified according to microscopy capacity.

The five *área de salud* clinics with localities in malaria stratum 4 or with localities with vector control measures (IRS) implemented were selected with certainty. The remainder of the sample was selected at random among *área de salud* clinics with at least one locality in malaria stratum 3 until the full sample size was reached. The *área de salud* clinics that were not selected for the sample were 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 *área rectora* offices and referral hospitals according to the referral network, including each health area with the *área de salud* clinic already selected to the sample. In Costa Rica, the four *área rectora* offices with autochthonous malaria cases during 2018 and the four hospitals that provide care for severe or complicated malaria were included with certainty and no other *área rectora* offices nor hospitals were eligible for selection. 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 Costa Rica, the method used for sampling at most *área de salud* clinics and hospitals is the EDUS electronic diagnosis database. The time window for the baseline measurement was the calendar year 2018.

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

### C.2.3 Selecting communities

IHME used information about vector control interventions and referral networks received from the Ministry of Health and CCSS to select one community in the catchment area of each of 16 *área de salud* clinics for the household survey. *Área de salud* clinics with ITN or IRS interventions since the start of 2018

reported in the catchment area and those in malaria stratum 4 were selected with certainty. The remaining facilities were selected at random among the *área de salud* clinics remaining in the health facility sample. Within the selected catchment area, a community that had received ITN or IRS interventions since the start of 2018 was selected at random among all communities with vector control interventions. If no communities received vector control interventions or intervention status was unknown, a community was selected at random among all communities in the catchment area. A second community from the catchment area was selected as backup in the event that the first community could not be surveyed due to security concerns, logistical challenges, or community refusal of the study.

### C.2.4 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. In the sample, IHME provided a random integer between 1 and 9 and a randomly selected cardinal direction to use as a starting point, and a skip interval calculated by dividing the total number of households in the community in order to achieve a sample of 25 households completed. If the calculated interval was greater than 9, an interval of 9 was given such that only a single sector of larger communities was surveyed to facilitate field operations. The field team started at the recognized center of the community (such as a plaza, church, or market) and began sample selection in the random direction provided by the sampling module, counting dwellings first to the random start point and subsequently according to the skip interval, along the right hand side of the street. Each selected household was approached to explain the study and request participation. Upon reaching a dead end or reaching the border of the community, field workers made a turn to the right (or turned around) and continued the systematic selection along the right hand side. If a selected dwelling contained more than one household, each of those households was eligible for the survey and counted toward the quota of 25 households per community. If a selected household could not be interviewed due to absence or refusal, it was replaced with the household in the dwelling next door on the right side.

Informed consent was sought from each respondent to the household questionnaire. Occasionally, a survey was refused in course, resulting in a partially complete household result. Because multiple interviewers worked the sample simultaneously, in a handful of instances more than 25 surveys were completed. In the baseline, counts of complete households by community range from 25 to 26 households. Counts of absent households range from 2 to 32 households. Counts of refused households range from 0 to 57 households. Communities with high refusal rates were in urban locations with large immigrant communities with many residents who did not want to provide personal information, especially to a project associated with a government agency.

## 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) Costa Rica 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, MPH
Data Analyst, IHME

Erin Palmisano, MPH
Senior Research Manager, IHME

Max Thom, BS
Data Specialist, IHME

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