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# Regional Malaria Elimination Initiative Panama

# Baseline Measurement (2019-20)

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## Acronyms

**BMGF** - Bill & Melinda Gates Foundation
**CAPI** - Computer-assisted personal interview
**CC** - *Colaborador comunitario* (community collaborator)
**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
**CSS** - *Caja de Seguro Social* (Social Security Agency)
**DTI-R** - Detection, Diagnosis, Treatment, Investigation, and Response
**ICD** - International Classification of Diseases
**IDB** - Inter-American Development Bank
**IHME** - Institute for Health Metrics and Evaluation
**IRS** - Indoor residual spraying
**ITN** - Long-lasting insecticide-treated nets
**LQAS** - Lot Quality Assurance Sampling
**MINSA** - *Ministerio de Salud* (Ministry of Health)
**MRR** - Medical record review
**PAHO** - Pan American Health Organization
**RBA** - Results-based aid
**RDT** - Rapid diagnostic test
**RMEI** - Regional Malaria Elimination Initiative
**SEIS** - *Sistema Electrónico de Información de Salud*
**SIVE** - *Sistema Nacional 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 Panama, with input from the Ministry of Health. The measurement included a health facility survey consisting of interview, observation, and records review components and a Lot Quality Assurance Sampled (LQAS) household survey in the catchment area of selected health facilities. The health facility survey sample was selected among eligible primary care facilities in malaria focus areas of Panama. Secondary care facilities (*"CAPSI," "CAPPS,", "ULAPS"* and hospitals) and *corregimiento*-level vector control units associated with selected primary care facilities in the public health service network were included in the sample to capture inter-facility pipelines for patient care (e.g., referrals), malaria diagnosis (e.g., thick blood film slides sent away for diagnosis by facilities without a laboratory), and notification and surveillance.

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

*Table E1: Panama data collection summary*

| Point of data collection | Number completed | Measurement completed |
|---|---|---|
| Primary care health facilities with/without malaria microscopy | 43 | Health facility questionnaire and observation |
| | | Medical record review of suspected cases of malaria |
| | | Treatment stock |
| | | Laboratory supplies/reports |
| | | Household measurement in catchment area |
| Secondary care health facilities | 8 | Health facility questionnaire and observation |
| | | Medical record review of suspected cases of malaria |
| | | Treatment stock |
| | | Laboratory supplies/reports |
| *Suspected malaria cases reviewed* | *579* | |
| Corregimiento-level vector control units | 8 | Record review of confirmed cases of malaria |
| | | Stock of treatment and diagnostic supplies |

| Point of data collection | Number completed | Measurement completed |
|---|---|---|
| *Confirmed malaria cases reviewed* | *95* | |
| 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* | *407* | |

# Summary of results

### Malaria prevention

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

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

| Vector control reported | Communities | Used treated net | House sprayed |
|---|---|---|---|
| Nets | 1 | 75% | 95.2% |
| Spray | 4 | 30.6% | 67.3% |
| Both | 9 | 23.3% | 37% |
| None | 2 | 30.1% | 3.2% |

### 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 | 31 | 11 | 35.5 | (21 - 54) |
| Sampling and biosafety equipment | 33 | 27 | 81.8 | (64 - 92) |
| Sample submission forms | 3 | 3 | 100 | ( - ) |
| Rapid diagnostic tests (RDTs) for onsite testing | 51 | 18 | 35.3 | (23 - 50) |
| Microscopy equipment | 9 | 9 | 100 | ( - ) |

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Equipment for staining and testing | 9 | 8 | 88.9 | (48 - 99) |
| Reagents for staining | 9 | 3 | 33.3 | (11 - 68) |
| **Units with all required equipment and medications** | **51** | **9** | **17.6** | **(9 - 31)** |

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

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

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

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

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Fevers with any blood sample (LQAS survey) | 16 | 9 | 56.2 | (22 - 85) |
| Suspected case with malaria test (medical record review) | 555 | 52 | 9.4 | (7 - 12) |

### 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 *corregimiento*-level vector control units. Only one confirmed case report was found at a *corregimiento*-level vector control unit in the sample, so the review captured all cases from 2018 with records found at *corregimiento*-level vector control units, central-level vector control, and primary and secondary care health facilities. Significantly fewer confirmed cases were collected than expected based on Panama Ministry of Health surveillance data from 2018, so the confirmed case measurements take the expected number of confirmed cases as the denominator, as opposed to the number of records actually collected. The indicator for timely diagnosis of malaria compares the date of initiation of fever or other symptoms with the date of diagnosis (if the patient received both an RDT and a TBF, the indicator is calculated using earlier diagnosis date) as shown in Table E5. Cases with diagnosis two days or less after symptom initiation are considered to have timely diagnosis. Cases with fever/symptom initiation date or diagnosis date not registered are not considered to have timely treatment initiation.

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

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Cases diagnosed within 48 hours of onset | 559 | 50 | 8.9 | (7 - 12) |
| 3 days | 559 | 5 | 0.9 | (0 - 2) |
| 4-5 days | 559 | 11 | 2 | (1 - 4) |
| 6-7 days | 559 | 4 | 0.7 | (0 - 2) |
| Over 7 days | 559 | 10 | 1.8 | (1 - 3) |
| Indicator result: Cases diagnosed within 48 hours of onset* | 559 | 50 | 8.9 | (7 - 12) |

*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 (if the patient received both an RDT and a TBF, the indicator is calculated using the earlier diagnosis date) with the date of treatment initiation (Table E6). Cases for which the first dose of the appropriate treatment was given one day or less after diagnosis are considered to have timely treatment initiation. Cases with diagnosis date, treatment initiation date, or *Plasmodium* species not registered are not considered to have timely treatment initiation.

*Table E6: Treatment within one day, Confirmed case review*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Correct treatment administered for species | 562 | 49 | 8.7 | (7 - 11) |
| First dose treatment within 24 hours of diagnosis* | 559 | 67 | 12 | (10 - 15) |
| Correct treatment administered within 24 hours of diagnosis* | 559 | 31 | 5.5 | (4 - 8) |

*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 | 562 | 40 | 7.1 | (5 - 10) |
| Evidence of at least one supervised dose | 562 | 61 | 10.9 | (9 - 14) |
| Indicator Result: Complete treatment with supervision | 562 | 37 | 6.6 | (5 - 9) |

**Malaria reporting and surveillance**

The RMEI health facility survey included a review of malaria case and laboratory production reports and laboratory quality control reports from the year 2018 to measure adherence of each facility to reporting and quality control standards as defined through the Initiative. Field personnel conducted an audit of all malaria case reports from 2018 stored at primary and secondary level facilities in the sample. They then sought to observe all 12 monthly reports or all 52 weekly reports for the year 2018. Next, surveyors sought to find the reports corresponding to a randomly selected month (or 4 weeks), and captured detailed information from this report, such as the number of malaria cases reported (or whether zero cases were reported) and the date sent or received as listed on the report (or as listed in a logbook of official correspondence sent and received in facilities that use such a book). An analogous process was completed for laboratory production reports and reports of the indirect quality control (slide cross-

checking) exercise in facilities with microscopic diagnostic capacity. A report of the 2018 annual direct quality control (slide panel) exercise with feedback from the reference laboratory was also sought in each facility with malaria microscopy, and a report of external microscopy certification from the Pan American Health Organization was sought in the national reference laboratory.

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

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

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Malaria case reporting to standard | 19 | 3 | 15.8 | (5 - 40) |
| Laboratory production reporting to standard | 15 | 3 | 20 | (6 - 48) |
| External quality control: 2018 National Lab Evaluation form observed | 1 | 1 | 100 | ( - ) |
| Facilities passing direct quality control (DQC) component | 9 | 4 | 44.4 | (17 - 76) |
| Facilities passing indirect quality control (IDQC) component | 9 | 0 | 0 | ( - ) |

## Key findings

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

The measurement found evidence of local and regional variation in practices for malaria detection and notification. While different strategies may be necessary in zones with different levels of malaria transmission or risk, it is important to ensure a shared understanding of goals and adherence to standard at the local level when such standards have been established. Furthermore, this understanding of the strategy and the role of each contributor must extend beyond the malaria and vector control programs and diagnosis networks to include primary health care providers who play an increasingly important role in detection and management of cases as Panama 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 Panama, and harness partnerships with PAHO, CHAI, and the Global Fund. RMEI's approach seeks to eliminate malaria in humans, the main reservoir of the parasite, through surveillance and "Detection, Diagnosis, Treatment, Investigation, and Response (DTI-R)" interventions. A hallmark intervention of the Initiative, as many countries in the region enter the elimination phase of their malaria programs, was to carry out micro-stratification of geographic areas vulnerable and receptive to malaria transmission. In Panama, active, residual, and inactive foci were defined, each *corregimiento* was assigned to a stratum 1 through 4, and the province of Panama Este and *Comarcas* of Guna Yala, Darien, and Ngöbe-Buglé were broken down further and stratum was defined by locality. In provinces stratified at the *corregimiento* level, each locality was assigned the stratum of its *corregimiento*. The number of localities in each stratum and their definitions are 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. Stratum classifications may be updated at subsequent points in the Initiative as their level of importation risk and number of autochthonous cases evolves. The malaria program in Panama 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: Panama malaria stratification: Definition and distribution of strata*

| Stratum | Number of localities | Definition |
|---|---|---|
| 1 | 42 | Non-receptive |
| 2 | 1621 | Receptive, no autochthonous cases, no risk of importation |
| 3 | 283 | Receptive, risk of importation, no autochthonous cases |
| 4 | 193 | Receptive, presence of autochthonous cases |

In Panama, malaria burden has dropped in recent years, though transmission persists in some coastal communities and in certain zones east of the canal. In 2018, the reference year for the baseline measurement, Panama had 699 confirmed cases of malaria according to national public health surveillance data provided by the Ministry of Health. Panama has historically depended on a vertically integrated malaria program that operates in close coordination with programs for other vector-transmitted diseases, and receives grant support from the Global Fund. Panama has an established network of community health volunteers called *"colaboradores voluntarios"* ("col-vol", volunteer collaborator) or *"colaboradores comunitarios"* (CC, community collaborators) who collaborate in case detection in communities with active malaria transmission and with limited access to health services. In the malaria elimination phase, Panama will transition malaria detection and case management to be more closely

horizontally integrated within the public primary care system, increasingly relying on passive detection of cases at health facilities and eventually shifting responsibility to primary care providers to administer treatment and follow-up care.

## 1.2 Components of the RMEI baseline measurement

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

The facility survey, observation, and record review 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 Panama from a randomly selected group of households in each surveyed community. Respondents are asked questions about their background, dwelling conditions, knowledge and use of behaviors to prevent malaria, illness and care-seeking history, and other questions that will be helpful to policy makers and administrators in controlling and seeking to eliminate malaria. Community data collection permits the observation of health status, knowledge of malaria, access to health care, and uptake of interventions and practices that prevent malaria infection.

## 1.3 Fact-finding and data collection scope

In order to refine the survey instruments and prepare for sample selection and data collection, IHME and IDB conducted a joint multi-day fact-finding visit in two regions of Panama in May 2019. During the exploratory visit, the team visited a range of health facilities and vector control units in Darién and Guna Yala. 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 Panama, the sample includes primary care facilities (*Puesto de salud, Sub Centro de Salud,* and *Centro de Salud*), secondary care facilities (*"CAPSI," "CAPPS,", "ULAPS"* and hospitals), *corregimiento*-level vector control offices, and the national reference laboratory. Households within the catchment area of primary care facilities selected to the sample were interviewed for the community survey. Table 1.2 shows the information collected at each point.

*Table 1.2: Points of data collection for baseline measurement*

| Type of health unit | Information collected |
|---|---|
| Primary care health facilities without malaria microscopy | Health facility questionnaire and observation |
| | Medical record review of suspected cases of malaria |
| | Treatment stock |
| | Household measurement in catchment area |
| Primary care health facilities with malaria microscopy | Health facility questionnaire and observation |
| | Medical record review of suspected cases of malaria |
| | Treatment stock |
| | Laboratory supplies/reports |
| | Household measurement in catchment area |
| Secondary care health facilities | Health facility questionnaire and observation |
| | Medical record review of suspected cases of malaria |
| | Treatment stock |
| | Laboratory supplies/reports |
| Corregimiento-level vector control units | Record review of confirmed cases of malaria |
| | Stock of treatment and diagnostic supplies |
| 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 |

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

records to be reviewed for a patient with malaria detected by a col-vol/CC, or with treatment supervised by a col-vol/CC, will be filed at a health facility or vector control office rather than at the col-vol's/CC's home and these records are captured within the existing sampling frame. Further, col-vol/CC posts are costly to reach because they are intended to serve communities without an easily accessible health facility, and col-vols/CCs may not keep regular hours since they are volunteers and not health system employees. Confirmed cases of malaria detected by a col-vol/CC were included in the sample for review of medical records, as paperwork for cases detected at any service point should always be filed at the *corregimiento*-level vector control unit, where review was planned, in Panama.

# Chapter 2: Survey Methodology

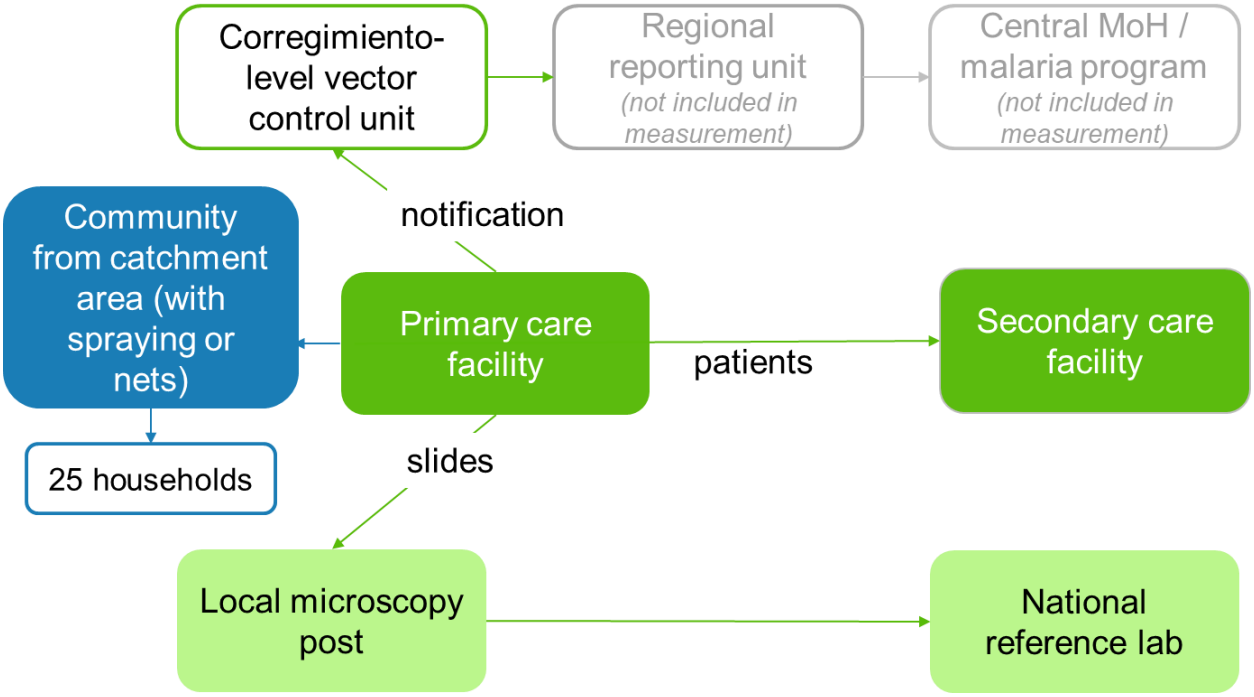
## 2.1 Sample selection and description

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

The set of indicators defined and negotiated for the baseline measurement necessitates data collection at several distinct points of the health system. To draw the sample, we selected a primary care facility (*"puestos de salud," "sub-centros de salud"* and *"centros de salud"*) at random as the primary sampling unit, and then selected the other health services linked with it in malaria service provision, such as secondary care units (*"CAPSI," "CAPPS,", "ULAPS"* and hospitals), the national reference laboratory, and *corregimiento*-level vector control units responsible for notification and reporting, as depicted in Figure 2.1. The communities we selected for the household survey are within the catchment areas of the selected primary care facilities.

Public health facilities in Panama are either managed by the Panama Ministry of Health (MINSA) or by the Panama Social Security Agency (*Caja de Seguro Social*, CSS). All MINSA and CSS facilities were combined in the datasets provided by the Panama Ministry of Health and were sampled together for the baseline measurement by service level. MINSA facilities include facilities we selected as primary care facilities (*"puestos de salud," "sub-centros de salud"* and *"centros de salud"*), secondary care facilities (*"CAPSI"* and hospitals), and *corregimiento*-level vector control units. CSS facilities include facilities we selected as secondary care facilities (*"CAPPS", "ULAPS", "policlínicas"* and hospitals). All of these facility types will be referred to as "public health facilities" throughout this report.

*Figure 2.1: RMEI-Panama baseline health system structure*




### 2.1.1 Health facility sample selection

In Panama, malaria stratification was completed at the locality level in areas with recent local transmission, and at *corregimiento* level in other areas. Primary care facilities in localities classified as malaria stratum 3 or malaria stratum 4 were eligible to enter the sampling frame, with priority to facilities serving communities with malaria cases in their catchment area during 2018. Because patients with fever may seek care at any health facility, but only a fraction of these facilities has microscopy capacity, the sample of primary care facilities was drawn separately for facilities with and without microscopy. This ensured a sufficient denominator to measure indicators for laboratory inputs, equipment, and reporting. The sample was thus selected in four sampling strata: with and without microscopy capacity in malaria stratum 4, and with and without microscopy capacity in malaria stratum 3.

The sampling frame was built based on referral networks and facility lists provided by the Panama Ministry of Health. Each health facility eligible to be selected for the sample was assigned to a malaria stratum 1 through 4 based on its *corregimiento.* We assigned each *corregimiento*-level vector control unit to the maximum stratum found in its service area (units serving any localities in stratum 4 are therefore assigned to stratum 4).

The initial sampling frame for the health facility survey is the list of facilities that provide primary care services for malaria. In order to ensure necessary information is captured for all indicators, for each selected facility we included the ancillary units from the reporting chain (*corregimiento*-level vector control offices and referral health facilities, and reference laboratory) associated with a selected primary care facility for measurement, up to a fixed sample size defined to balance budget considerations with statistical power for analysis. For example, once a local-level ambulatory facility was selected at random, several related units were identified for inclusion (or for random selection, if more than one qualifies). These include the secondary health facility to which it refers severe malaria cases (CAPSI, CAPPS, ULAPS, and hospitals), the reference laboratory responsible for its microscopy quality control, and the vector control unit where confirmed malaria cases from the facility are investigated and filed. More detail on sample selection procedures and sample size considerations is in Appendix C.

This sample selection strategy minimizes the need for sample stratification while maximizing the opportunity to track care and surveillance activities from the point of service to the central level, and thus to identify gaps in malaria service provision and surveillance. Additionally, the selection strategy allows for a random sample of facilities to be included in the measurement for supplies and equipment, testing of suspected cases, and reporting sent from the local level, but remains cost-effective by concentrating visits to vector control offices to review confirmed cases of malaria and household measurement in the zones with the most autochthonous transmission.

### 2.1.2 Substitutions within the sample

We kept all remaining units in the sampling frame after the initial selection as backup facilities in case sampled facilities cannot be interviewed due to security or logistic concerns. When replacement was required, we replaced with a facility of the same level, with the same diagnostic capacity, and within the same *corregimiento* or a neighboring *corregimiento* when possible. If substitutes were not available in the same corregimiento, we replaced with a randomly selected facility from the same malaria stratum. In the Panama baseline, five primary care facilities and two secondary care facilities were replaced during data collection. Where replaced units were planned for the community survey, the community survey was carried out in a locality associated with the replacement facility rather than the original facility.

After the sample was selected, it was determined that five units that were actually temporary units or permanently closed had been selected to the sample. Since these units were not in operation, they were replaced with substitutes before the start of data collection and the community survey was completed at the replacement health facilities for the four facilities that had been selected to complete the community survey.

After this discovery, four primary care facilities and two secondary care facilities were replaced due to a long-term interruption in service provision at the facility - it was not open or staffed during the data collection team's visit. Another primary care facility was replaced because there was concern for the safety of the data collection team. For two of the primary care facilities with associated community surveys, the community survey was carried out in the catchment areas of the replacement facilities, rather than the originally selected facilities.

One replacement facility is reported as stratum 2 due to a replacement situation for a stratum 3 facility that was being renovated at the time. The staff from the stratum 3 facility relocated to a nearby stratum 2 facility and all patients from the original facility were referred there for treatment.

### 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 of the primary care facilities selected to the facility sample in malaria stratum 4. Within the selected catchment area, a community that had received ITN or IRS interventions since the start of 2018 was selected at random among all communities with vector control interventions, as determined by the facility staff and community selection module during data collection. If no communities received vector control interventions or intervention status was unknown, a community was selected at random among all communities in the catchment area. Field staff used an automated survey module to enter information about eligible communities in the catchment area, usually provided by health facility staff. Often in Panama, selected health posts served a single community, which was surveyed accordingly. The module automated the selection of one eligible community and provided the random and calculated inputs (random starting point, calculated skip interval) for field random selection of households.

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

completed the day of the survey was replaced with an alternate. The visit results among selected and replacement households are shown in Table 2.1.

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

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Status of selected and replacement households | | | | |
| Complete | 417 | 407 | 97.6 | (96 - 99) |
| Members absent | 417 | 9 | 2.2 | (1 - 4) |
| Refused | 417 | 1 | 0.2 | (0 - 2) |

### 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 *corregimiento*-level vector control units. Field staff collected information from all documents available at the *corregimiento*-level vector control unit, including case notification and investigation forms, lab records, and treatment follow-up forms. Table 2.2 shows the number of cases expected at each *corregimiento*-level vector control unit in the sample (based on counts of cases by *corregimiento* in the microstratification data provided to IHME), and the number of case reviews completed during data collection, though these were not all collected through *corregimiento*-level vector control units; all but one of these records was collected at other level units, including primary and secondary facilities.

Based on the fact-finding trip and the surveillance reporting process, it was expected that all paper copies of malaria confirmed case reports from the *corregimiento* would be stored at the *corregimiento*-level vector control unit. The field team visited *corregimiento*-level and regional vector control offices, but were only able to find one confirmed case report at all the units visited. When available, the field team collected confirmed case reports from primary and secondary level facilities. At the end of data collection, the central-level vector control office in Panama City was visited and 39 confirmed cases for the comarca of Guna Yala were collected. Due to lack of storage of the paper reports, significantly fewer confirmed cases were collected during the baseline evaluation than expected. All confirmed cases collected at primary and secondary care units were compared with cases collected at vector control units to evaluate whether any of the cases collected were duplicates. No identifying information was collected, so key variables were used to determine that there was one duplicate case captured from Guna Yala. The version of this confirmed case collected at central-level vector control is not used in this report.

*Table 2.2: Confirmed case collection*

| Province/ Comarca | Confirmed cases according to stratification documentation | Confirmed cases captured during collection |
|---|---|---|
| Darién | 76 | 1 |
| Guna Yala | 276 | 56 |
| Ngöbe-Buglé | 73 | 0 |
| Panamá | 137 | 39* |
| **Total** | **562** | **96*** |

*One case collected at central-level vector control was determined to be a duplicate and was not included in report calculations.

### 2.1.5 Suspected case medical record review sample selection

For suspected cases of malaria (fever and other complaints and diagnoses meeting the case definition), a random sample of eligible attentions from 2018 was selected for medical record review (MRR). The total budgeted quota of record reviews was divided equally among the primary care facilities and secondary care facilities selected to the sample, excluding *puestos de salud* which did not store medical records. Eligible attentions were identified in-facility using attention registries or diagnosis databases. The sample was selected for full review using a systematic manual sampling technique as detailed in Appendix C. Field staff collected information from all documents available at the health facility, including daily attention

registries, medical records or attention forms, and lab records. Table 2.3 shows the total number of suspected cases reviewed (566), the number of cases selected based on diagnosis or principal complaint but found to be ineligible based on final diagnosis (72), and the cases selected and requested at facilities for which no paperwork could be located for review (7).

The quota of suspected cases was increased during data collection when it was observed that many health facilities were not meeting the set quota of cases or did not have capacity for suspected case review. Despite this increase, the anticipated quota of 1200 suspected medical records was not met in Panama.

*Table 2.3: Suspected case collection*

| | # |
|---|---|
| Total suspected cases selected for review | 645 |
| Suspected cases selected but could not be located for review | 7 |
| All suspected cases screened for eligibility | 638 |
| Ineligible suspected cases discarded | 72 |
| Eligible suspected cases collected | 566 |

In many facilities in Panama, all eligible cases from the entire year 2018 were selected for review, because there were relatively few attentions with eligible diagnoses recorded. Many facilities did not have any suspected medical records reviewed due to lack of sampling documents, no medical records were stored at the unit, or medical records from 2018 were destroyed (Table 2.4).

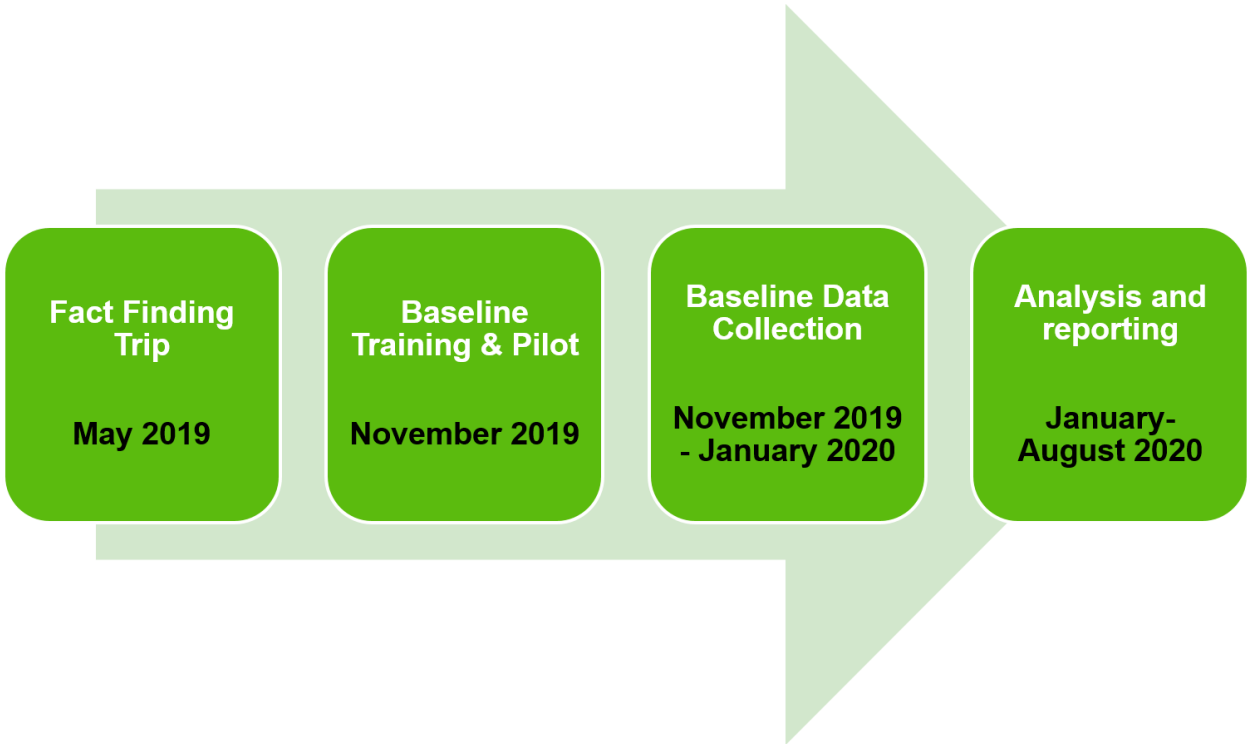
*Table 2.4: Health facilities with suspected case collection*

| | # |
|---|---|
| Original Sample: Heath facilities planned to complete MRR for suspected cases of malaria | 34 |
| With replacements: Heath facilities planned to complete MRR for suspected cases of malaria | 31 |
| Records reviewed: Quota met | 10 |
| Records reviewed: Quota not met | 8 |
| No records reviewed | 13 |

## 2.2 Survey implementation

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

*Figure 2.2: RMEI-Panama baseline timeline*




### 2.2.1 Data collection instruments

Questionnaires were initially developed in English, and then translated to Spanish. To best reflect the issues most relevant to the region under study and the local language, we revised the Spanish-language questionnaires following input from key stakeholders and at the conclusion of the pilot studies (described below). Study areas included a substantial proportion of indigenous populations, many of them also Spanish speakers. In order to allow the participation of non-Spanish speakers in the survey, the data collection team was prepared to contract local interpreters proficient in Buglere, Emberá (Norte), Emberá-Catío, Epena, Guna Yala, Ngäbere/ Ngöbe-Buglé (Guaymí), Inglés criollo, Francés criollo, Teribe, Wounaan, Woun Meu, Chino Hakka, and Chino Yue as required.

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

### 2.2.2 Survey content

The health facility survey includes several modules. An interview with the facility director records information about facility characteristics, services provided, and personnel employed by the facility. Observation modules are organized by room or category to facilitate visits to the rooms where care is provided to patients, the pharmacy, the laboratory, and other areas. An additional module is used to capture information about the catchment area of the facility and to select the community to be enumerated in the household survey.

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

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

### 2.2.3 Training and supervision of data collectors

IHME led training sessions and pilot surveys in health facilities and households in Panama between November 11 and November 16, 2019. The local agency contracted for data collection in Panama, Grupo iDIES, Fundación Universidad del Valle/ Consult Exp S.A, hired three doctors, three nurses, and three field supervisors who we trained to conduct surveys in households and health facilities and to review medical records. The training included content of each survey, proper conduct of the survey, in-depth review of the instrument, and hands-on training on the CAPI software, as well as interview practice among participants. Surveyors participated in a 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 Panama Ministry of Health provided oversight during pilot exercises. IHME and Grupo iDIES, Fundación Universidad del Valle/ Consult Exp S.A held debriefing and re-training sessions with surveyors post-pilot and provided continued training during the first week of data collection in communities and health facilities. Grupo iDIES, Fundación Universidad del Valle/ Consult Exp S.A continued providing retraining throughout data collection to maintain homogeneity and quality standards of the data collection teams over time. During a supervisory trip from November 18-22, 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 Panama. 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 Panama Ministry of Health.

### 2.2.5 Ethical considerations

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

were collected and managed by Grupo iDIES, Fundación Universidad del Valle/ Consult Exp S.A, the in-country data collection partner, and this information was not transmitted to IHME for privacy reasons

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

This chapter provides a descriptive summary of basic demographic, socioeconomic, and environmental characteristics, as well as knowledge and behaviors for malaria prevention, of the households interviewed for the RMEI-Panama Baseline LQAS Survey in households. As noted in Chapter 2, the household measurement in Panama was conducted entirely in malaria stratum 4. 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.

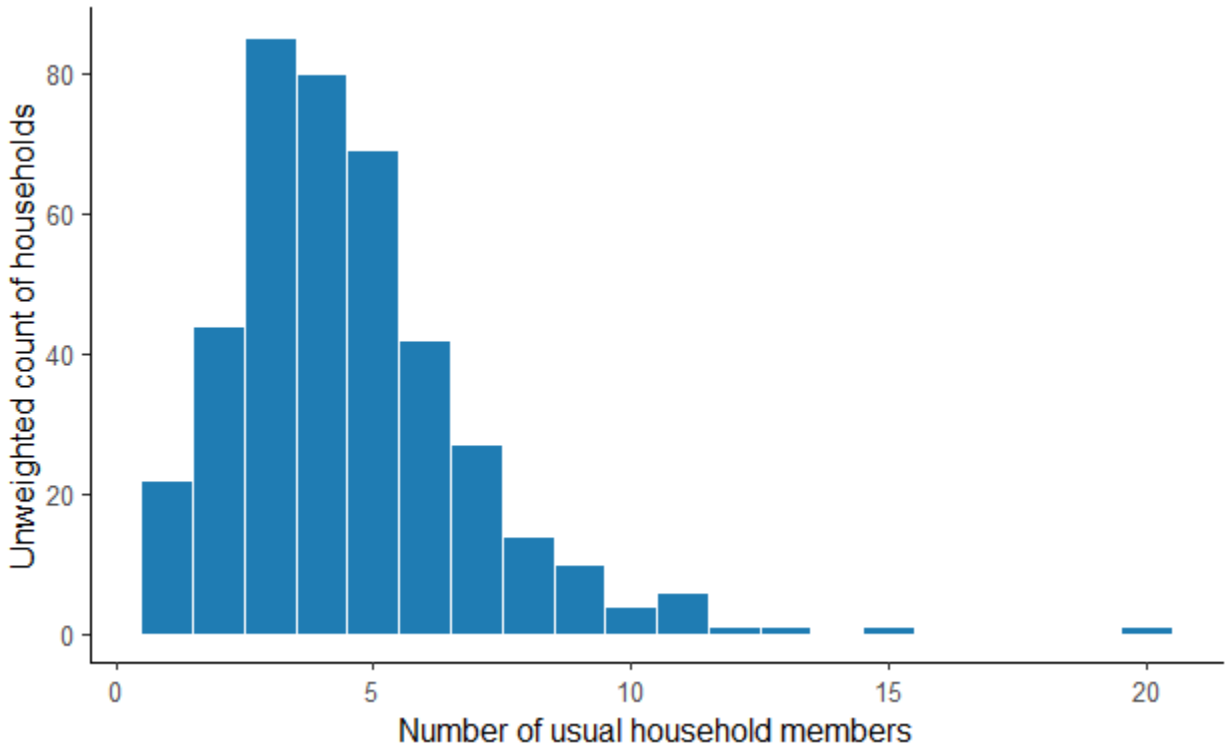
## 3.1 Characteristics of participating households

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 407 households in the Panama 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 Panama has a median household size of 4 and an unweighted average household size of 4.5.

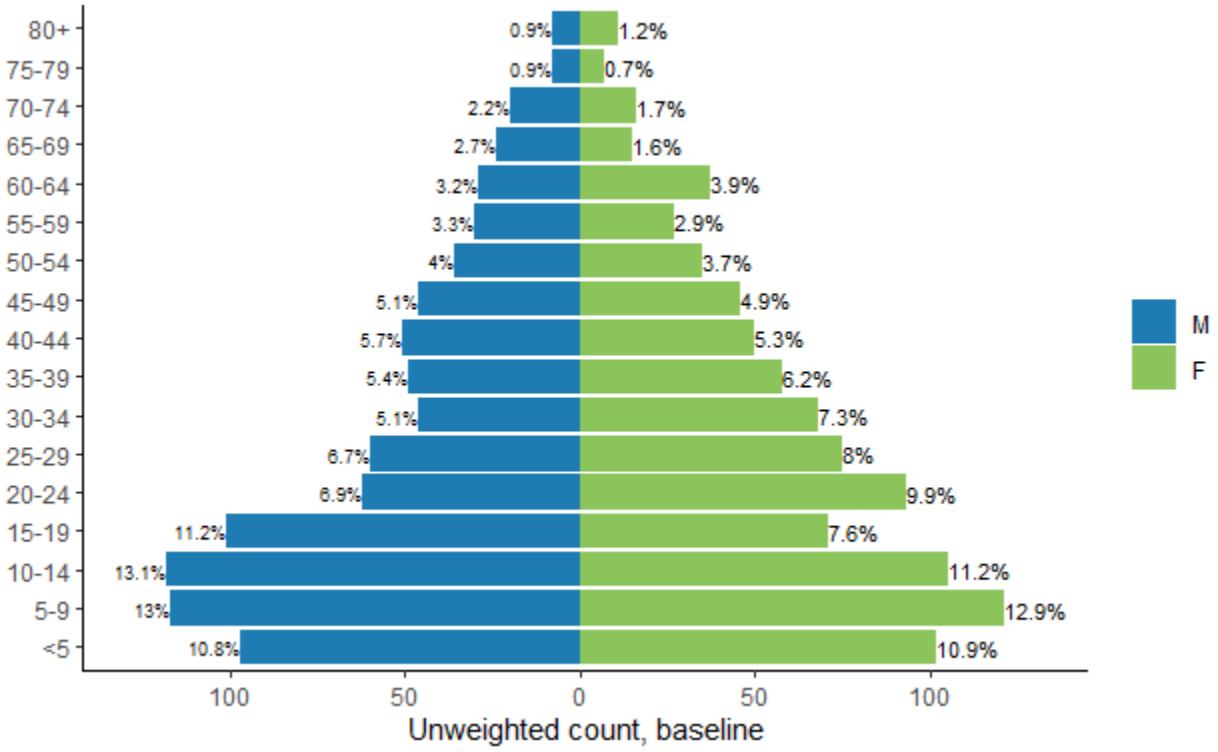
*Figure 3.1: Household size, unweighted percent distribution*




The unweighted distribution of the de facto household population in the surveyed households in Panama by five-year age groups and by sex is shown in Figure 3.2. Panama has a larger proportion of its population in the younger age groups than in the older age groups. Figure 3.2 indicates that in the baseline, 36% of the population in the baseline is under age 15 years, more than half (58%) of the

population is in the economically productive age range (15-64), and the remaining 6% is age 65 and above.

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




The respondent was asked to indicate education level, languages spoken, and ethnic identity for all usual household members aged 15 or older. Respondents could indicate multiple languages spoken or ethnic identities. The results are shown in Table 3.1, Table 3.2, and Table 3.3 respectively. In Panama, 18.8% of household members had no formal schooling, and 43.8% completed only primary education. Seventy-six percent speak Spanish and 46.6% speak Guna Yala. Forty-one percent identify as ethnically Guna.

*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 | 1179 | 207 | 18.8 | (14 - 25) |
| Primary | 1179 | 545 | 43.8 | (39 - 49) |
| Pre-middle school education | 1179 | 226 | 19.5 | (16 - 24) |
| Middle school education | 1179 | 153 | 13.6 | (11 - 17) |
| University | 1179 | 33 | 3.1 | (2 - 5) |
| Specialty | 1179 | 1 | 0.1 | (0 - 1) |
| Don't know | 1179 | 14 | 1.1 | (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 | 1179 | 918 | 76.3 | (56 - 89) |
| Guna Yala | 1179 | 555 | 46.6 | (25 - 70) |
| Emberá (Norte) | 1179 | 150 | 20.1 | (6 - 50) |
| Ngäbere / Ngöbe-Buglé (Guaymí) | 1179 | 150 | 10.4 | (3 - 33) |
| English | 1179 | 5 | 0.4 | (0 - 1) |
| Emberá-Catío | 1179 | 1 | 0.1 | (0 - 1) |
| Other | 1179 | 1 | 0.1 | (0 - 1) |

*Table 3.3: Indigeneity of household members age 15 and older*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Indigenous group affiliation of household members age 15 and older | | | | |
| Guna | 1178 | 485 | 40.7 | (21 - 63) |
| None | 1178 | 383 | 28.1 | (15 - 46) |
| Embera | 1178 | 151 | 20.2 | (6 - 50) |
| Ngöbe | 1178 | 155 | 10.6 | (3 - 34) |
| Buglé | 1178 | 1 | 0 | ( - ) |
| Other | 1178 | 3 | 0.2 | (0 - 1) |

### 3.1.2 Dwelling characteristics

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

*Table 3.4: Exterior wall material as observed*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Main material of exterior walls of dwelling | | | | |
| Plywood | 407 | 196 | 46 | (29 - 64) |
| Cement block | 407 | 129 | 32.7 | (18 - 51) |
| Cane/palm/trunks | 407 | 61 | 16.4 | (6 - 37) |
| Palm/bamboo | 407 | 12 | 2.2 | (1 - 6) |
| "Bahareque"/wattle-and-daub (mud plaster and cane) | 407 | 2 | 0.6 | (0 - 3) |
| No walls | 407 | 2 | 0.5 | (0 - 3) |
| Cardboard/waste material | 407 | 1 | 0.4 | (0 - 0) |
| Stone with lime/cement | 407 | 1 | 0.4 | (0 - 0) |
| Other | 407 | 3 | 0.9 | (0 - 3) |

*Table 3.5: Roofing material as observed*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Main material of roof of dwelling | | | | |
| Sheet metal (zinc/Alucin) | 407 | 223 | 57 | (42 - 71) |
| Thatch/palm leaf/cane | 407 | 176 | 40.7 | (27 - 56) |
| Concrete | 407 | 4 | 1.4 | (1 - 2) |
| Wood planks | 407 | 2 | 0.4 | (0 - 2) |

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Cement fiber/asbestos sheet | 407 | 1 | 0.1 | (0 - 1) |
| Other | 407 | 1 | 0.3 | (0 - 2) |

*Table 3.6: Flooring material as observed*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Main material of floor of dwelling | | | | |
| Cement sheet/board | 407 | 143 | 37.1 | (23 - 54) |
| Earth/sand | 407 | 146 | 35.2 | (20 - 54) |
| Wood planks | 407 | 87 | 20.1 | (10 - 37) |
| Cement brick or tile | 407 | 26 | 6.3 | (3 - 12) |
| Mud brick | 407 | 2 | 0.7 | (1 - 1) |
| Parquet or polished wood | 407 | 2 | 0.4 | (0 - 1) |
| Ceramic tiles | 407 | 1 | 0.1 | (0 - 1) |

Many houses (69.5%) have open roof eaves. Most have no glass in windows (61.5%), screens in windows (65.5%), nor screens in doors (91.2%).

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

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Open gap between wall and roof eave | 405 | 285 | 69.5 | (53 - 82) |

*Table 3.8: Glass in windows as observed*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Do windows have glass panes? | | | | |
| None | 407 | 263 | 61.5 | (46 - 75) |
| There are no windows in the house | 407 | 60 | 16.7 | (6 - 39) |
| Yes, in all windows | 407 | 54 | 14.6 | (8 - 26) |
| Yes, but only in some windows | 407 | 30 | 7.2 | (5 - 10) |

*Table 3.9: Screens in windows as observed*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Do windows have screens? | | | | |
| None | 407 | 281 | 65.5 | (49 - 79) |
| There are no windows in the house | 407 | 60 | 16.7 | (6 - 39) |
| Yes, in all windows | 407 | 37 | 10.7 | (5 - 21) |
| Yes, but only in some windows | 407 | 29 | 7.1 | (4 - 11) |

*Table 3.10: Screens in doors as observed*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Do doors have screens? | | | | |
| None | 407 | 377 | 91.2 | (87 - 94) |
| Yes, in all doors | 407 | 18 | 5.8 | (4 - 8) |
| Yes, but only in some doors | 407 | 12 | 3 | (2 - 6) |

*Aedes* mosquitoes, which spread arboviruses like dengue, zika, and chikungunya, breed in small deposits of water like puddles, flowerpots, and old tires. *Anopheles* mosquitoes, which spread malaria, breed in water bodies like lagoons, rivers, and canals. After the interview, field personnel observed the surroundings of each surveyed dwelling for potential breeding areas. Table 3.11 shows that while 74.6%

of homes had clean surroundings without standing water on the day of the survey, 8% 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 | 407 | 301 | 74.6 | (65 - 83) |
| Trash, tires, or other refuse present, but no standing water | 407 | 45 | 11.3 | (7 - 18) |
| Yes, puddles | 407 | 41 | 9.6 | (6 - 16) |
| Yes, pond or other natural water body | 407 | 29 | 8 | (5 - 13) |
| Yes, water collected in trash, tires, or other small containers | 407 | 16 | 3.5 | (2 - 7) |
| Other | 407 | 0 | 0 | ( - ) |

Table 3.12 shows the principal water source of the household as reported by the respondent; 62.8% of households have water piped to their house. The most common type of sanitation facility is a flush toilet (32.3% 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 | 407 | 254 | 62.8 | (42 - 80) |
| Protected dug well | 407 | 44 | 8.5 | (4 - 19) |
| Unprotected dug well | 407 | 34 | 7.6 | (2 - 21) |
| Surface water (river/dam/lake/pond/stream/canal/irrigation channel) | 407 | 20 | 7.2 | (1 - 32) |
| Public tap/standpipe | 407 | 20 | 5.7 | (1 - 23) |
| Piped to yard/plot | 407 | 17 | 3.7 | (1 - 13) |
| Tube well or borehole | 407 | 9 | 1.6 | (0 - 5) |
| Rainwater | 407 | 5 | 1.6 | (0 - 7) |
| Bottled water | 407 | 3 | 1.1 | (0 - 4) |
| Unprotected spring | 407 | 1 | 0.1 | (0 - 1) |

*Table 3.13: Type of sanitation facility used*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Type of toilet used | | | | |
| Flush toilet | 407 | 139 | 32.3 | (19 - 50) |
| No facility/bush/field | 407 | 91 | 20.1 | (8 - 42) |
| Dry latrine | 407 | 59 | 18.4 | (7 - 39) |
| Hanging latrine | 407 | 48 | 13.6 | (4 - 39) |
| Pit latrine | 407 | 52 | 11.5 | (5 - 26) |
| Pour flush toilet | 407 | 17 | 3.9 | (2 - 9) |
| Don't know | 407 | 1 | 0.1 | (0 - 1) |

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 | 407 | 241 | 62.4 | (46 - 76) |
| Wood | 407 | 221 | 52.4 | (36 - 68) |
| Electricity | 407 | 3 | 0.8 | (0 - 2) |
| Charcoal | 407 | 2 | 0.2 | (0 - 1) |

*Table 3.15: Cooking location*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Where cooking is done | | | | |
| In the house | 407 | 308 | 74.5 | (57 - 86) |
| In a separate building | 407 | 95 | 24.6 | (13 - 42) |
| Outdoors | 407 | 3 | 0.6 | (0 - 2) |
| Other | 407 | 1 | 0.3 | (0 - 2) |

### 3.1.3 Household wealth

Ownership of farmland and livestock, along with possession of durable consumer goods, indicate a household's socioeconomic status. Respondents were asked how many of each listed item the household (or household members) possessed. Table 3.16 and Table 3.17 show the proportion of households with at least one of each item. Many households (57.4%) have electricity. Of the 89 households that own livestock, most own poultry (85.5% 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 | 407 | 230 | 57.4 | (38 - 75) |
| Radio | 407 | 160 | 39.4 | (28 - 52) |
| Sound system | 407 | 57 | 14.2 | (9 - 21) |
| Television | 407 | 195 | 49.1 | (35 - 63) |
| Home telephone | 407 | 13 | 4.4 | (4 - 5) |
| Mobile phone | 407 | 253 | 64 | (50 - 76) |
| Refrigerator | 407 | 117 | 28.2 | (18 - 41) |
| Washing machine | 407 | 92 | 22.7 | (13 - 37) |
| Computer | 407 | 21 | 5 | (4 - 7) |
| Electric fan | 407 | 116 | 27.6 | (16 - 43) |
| Air conditioner | 407 | 16 | 4 | (2 - 7) |
| Watch | 407 | 207 | 50 | (40 - 60) |
| Guitar | 407 | 3 | 1.1 | (1 - 2) |
| Bike | 407 | 26 | 6 | (3 - 12) |
| Motorcycle or scooter | 407 | 7 | 1.6 | (1 - 3) |
| Animal-drawn cart | 407 | 7 | 2.1 | (1 - 5) |
| Car | 407 | 5 | 1.4 | (1 - 2) |
| Truck | 407 | 2 | 0.8 | (0 - 2) |
| Motor boat | 407 | 20 | 5.2 | (2 - 12) |
| Bank account | 404 | 34 | 8.4 | (5 - 13) |

*Table 3.17: Livestock ownership*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Cattle | 89 | 18 | 21.2 | (9 - 44) |
| Horses, donkeys or mules | 89 | 16 | 18.2 | (11 - 29) |
| Goats or sheep | 89 | 2 | 2.9 | (1 - 12) |
| Chickens or other poultry | 89 | 78 | 85.5 | (77 - 91) |
| Pigs | 89 | 22 | 22.4 | (13 - 36) |

*Table 3.18: Ownership of agricultural land*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Does any member of the household own, rent, or share agricultural land? | | | | |
| No | 407 | 369 | 90.7 | (82 - 96) |
| Yes, own | 407 | 32 | 7.7 | (3 - 16) |
| Yes, share | 407 | 1 | 0.4 | (0 - 2) |
| Yes, rent | 407 | 1 | 0.3 | (0 - 2) |
| Don't know | 407 | 4 | 0.9 | (0 - 3) |

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, United States Dollar (USD) | | | | |
| Less than 100 USD | 387 | 182 | 43 | (29 - 58) |
| 101 - 200 USD | 387 | 71 | 19.4 | (13 - 27) |
| 201 - 300 USD | 387 | 17 | 3.9 | (3 - 6) |
| 301 - 400 USD | 387 | 21 | 5.2 | (3 - 10) |
| 401 - 500 USD | 387 | 19 | 5.1 | (2 - 12) |
| 501 - 600 USD | 387 | 5 | 1.7 | (1 - 2) |
| 601 - 700 USD | 387 | 2 | 0.8 | (1 - 1) |
| 701 - 800 USD | 387 | 3 | 0.6 | (0 - 2) |
| 801 - 900 USD | 387 | 2 | 0.8 | (1 - 1) |
| 901 - 1000 USD | 387 | 1 | 0.1 | (0 - 1) |
| 1001 - 1100 USD | 387 | 1 | 0.1 | (0 - 1) |
| More than 1100 USD | 387 | 1 | 0.1 | (0 - 1) |
| Don't know | 387 | 62 | 19.1 | (8 - 38) |

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 Panama has an unweighted average distance of 0.6 kilometers and an unweighted average travel time of 1 minutes by usual mode of travel to the nearest health facility.

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

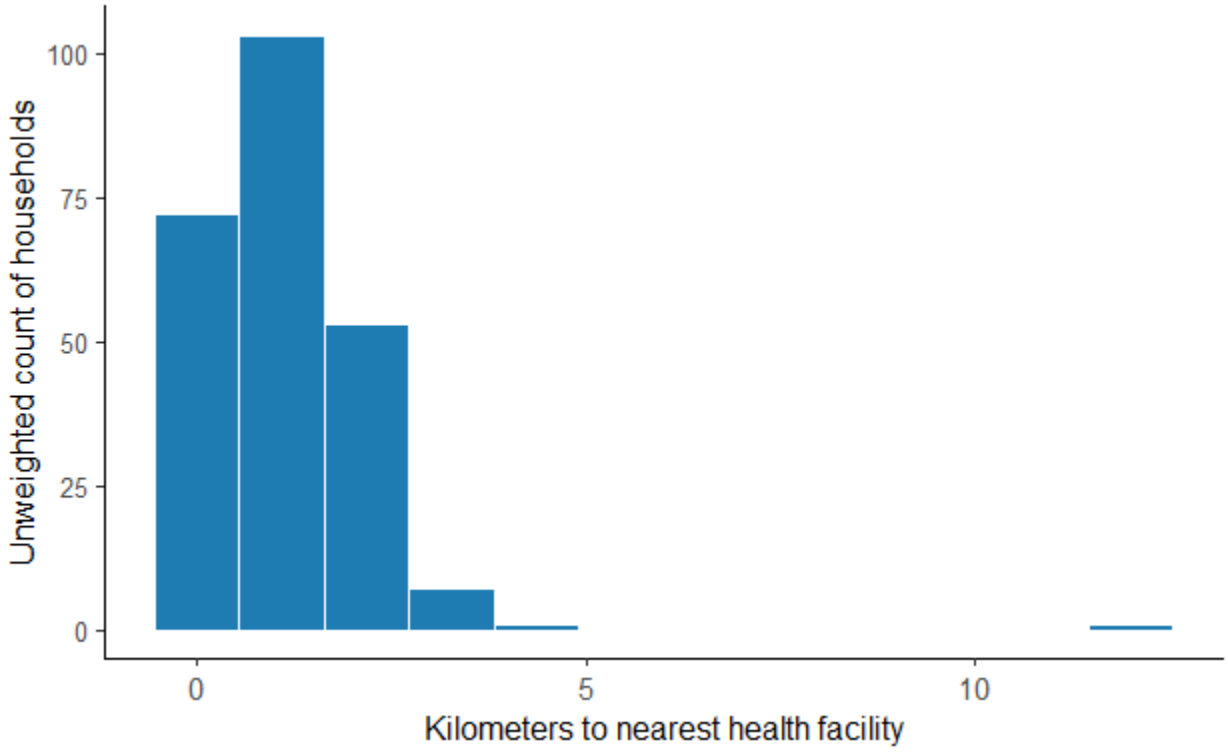
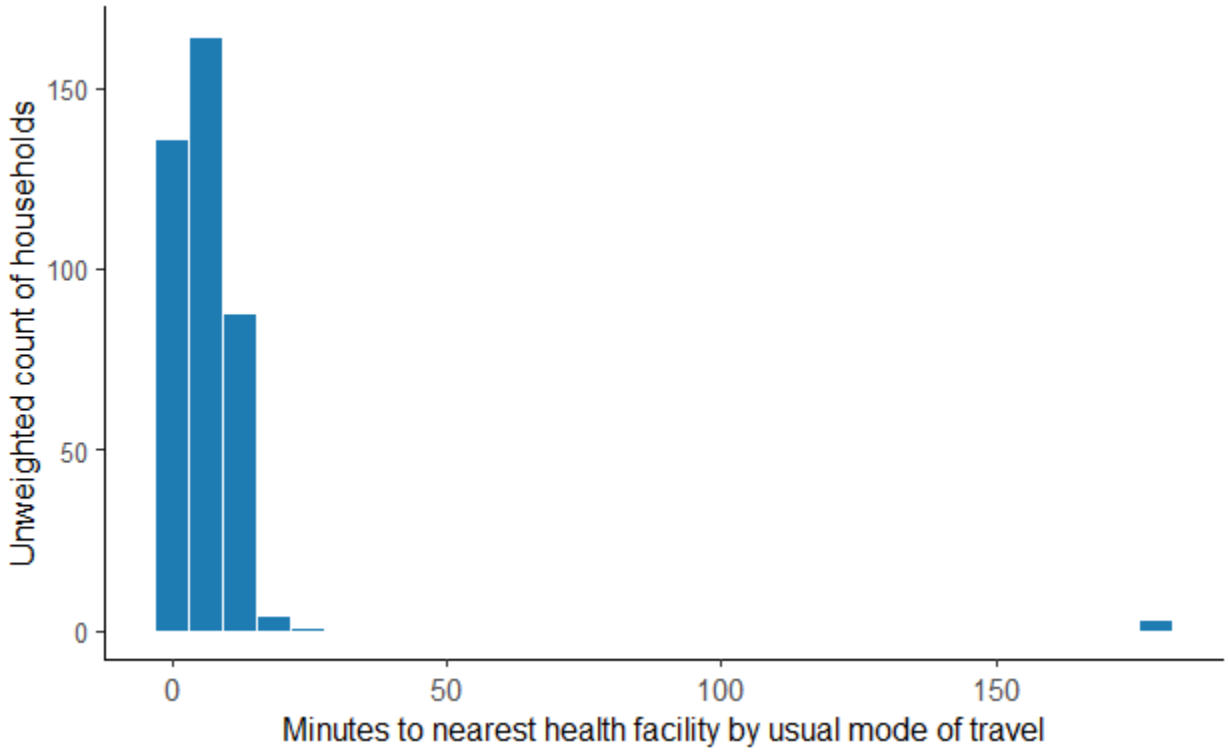



*Figure 3.4: Travel time to nearest health facility, unweighted percent distribution*



## 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 (66.8%). 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 | 405 | 258 | 66.8 | (56 - 76) |

*Table 3.22: Knowledge of cause of malaria*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| In your opinion, what causes malaria? | | | | |
| Mosquito bites | 258 | 201 | 78.5 | (70 - 85) |
| Stagnant water | 258 | 21 | 7.4 | (4 - 13) |
| Dirty surroundings | 258 | 13 | 5.2 | (3 - 9) |
| Anopheles mosquito bite | 258 | 8 | 3.5 | (2 - 6) |
| Working in the forest or the fields | 258 | 7 | 2.6 | (1 - 6) |
| Weedy surroundings | 258 | 6 | 2.4 | (1 - 6) |
| Eating dirty food/drinking dirty water | 258 | 5 | 2 | (1 - 5) |
| Contaminated air | 258 | 4 | 1.3 | (1 - 3) |
| Cold or changing weather | 258 | 2 | 0.5 | (0 - 2) |
| Malaria parasite (plasmodium) | 258 | 1 | 0.2 | (0 - 1) |
| Other | 258 | 2 | 0.7 | (0 - 2) |
| Don't know | 258 | 32 | 11.5 | (8 - 17) |
| Decline to respond | 258 | 1 | 0.3 | (0 - 2) |

*Table 3.23: Knowledge of malaria transmission*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| How is malaria transmitted? | | | | |
| By mosquitoes | 258 | 210 | 81.7 | (76 - 86) |
| Stagnant water | 258 | 13 | 5.9 | (2 - 16) |
| Poor personal hygiene | 258 | 4 | 2 | (1 - 4) |
| Passes from one person to another | 258 | 1 | 0.5 | (0 - 3) |
| Contaminated air | 258 | 1 | 0.2 | (0 - 1) |
| Other | 258 | 3 | 1.1 | (0 - 5) |
| Don't know | 258 | 35 | 12.8 | (8 - 19) |

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 | 258 | 212 | 83 | (75 - 89) |
| Headache | 258 | 117 | 45.7 | (36 - 55) |
| Chills | 258 | 88 | 34.9 | (26 - 45) |
| Nausea and vomiting | 258 | 63 | 23.2 | (17 - 30) |
| Body ache or joint pain | 258 | 38 | 14 | (9 - 21) |
| Diarrhea | 258 | 23 | 8.2 | (5 - 15) |
| Body weakness | 258 | 19 | 6.5 | (4 - 11) |
| Dizziness | 258 | 9 | 3.7 | (1 - 11) |
| Loss of appetite | 258 | 3 | 0.9 | (0 - 2) |
| Pale eyes or skin | 258 | 1 | 0.2 | (0 - 1) |
| Don't know | 258 | 31 | 11.1 | (7 - 17) |

*Table 3.25: Multiple common symptoms of malaria known*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Fever and chills | 258 | 79 | 30.6 | (25 - 37) |
| Fever and sweating | 258 | 0 | 0 | ( - ) |
| Fever, chills, and sweating | 258 | 0 | 0 | ( - ) |

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 | 258 | 135 | 52.7 | (35 - 70) |
| One person | 258 | 28 | 13.3 | (4 - 38) |
| 2-4 people | 258 | 10 | 3.6 | (2 - 7) |
| 5-10 people | 258 | 16 | 6.2 | (2 - 20) |
| 11-100 people | 258 | 35 | 11.9 | (4 - 28) |
| Don't know | 258 | 34 | 12.3 | (7 - 22) |

### 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, 64.2% had heard messages about malaria during the last year. Of those who had heard messages, the specific information heard is detailed in Table 3.27. Some of the responses indicate that people may confuse messages about preventing dengue or other arboviruses with malaria prevention messages. However, many had learned to seek medical attention for fevers and about using a mosquito net.

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

*Table 3.27: Malaria messages heard in last year*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Messages seen or heard in last year | | | | |
| If have fever go to health facility | 160 | 115 | 72.5 | (62 - 81) |
| Eliminate breeding sites/clean up trash | 160 | 30 | 20.2 | (12 - 33) |
| Sleep under a net every night to protect yourself against malaria | 160 | 21 | 11.5 | (8 - 16) |
| Nets are used to protect from mosquitoes | 160 | 19 | 11.1 | (5 - 24) |
| Sleep under an insecticide-treated mosquito net | 160 | 14 | 8.5 | (4 - 17) |
| Always test before treating malaria | 160 | 8 | 5 | (3 - 9) |
| Anopheles mosquitoes transmit malaria by biting people at night | 160 | 3 | 2.5 | (1 - 7) |
| Nets are being distributed free of charge | 160 | 3 | 2.2 | (1 - 4) |
| Don't wash nets more than 4 times per year | 160 | 1 | 0.8 | (0 - 4) |
| Other | 160 | 3 | 1.6 | (1 - 5) |
| Don't know | 160 | 3 | 2.1 | (1 - 7) |

*Table 3.28: Source of malaria messages*

| Source of messages, among those who heard them | N | n | % | 95% CI |
|---|---|---|---|---|
| On the radio | 159 | 28 | 14.8 | (7 - 28) |
| On TV | 160 | 41 | 22.8 | (13 - 37) |
| On a poster or billboard | 160 | 37 | 20.8 | (13 - 32) |
| From a community health worker | 160 | 73 | 44.5 | (26 - 65) |
| From personnel at a health facility | 160 | 96 | 62.1 | (47 - 75) |
| At a community event | 159 | 79 | 51.8 | (38 - 66) |
| At school | 159 | 25 | 15.4 | (8 - 28) |
| On the internet or social media | 159 | 9 | 5 | (1 - 16) |
| Somewhere else | 159 | 2 | 1.5 | (0 - 5) |

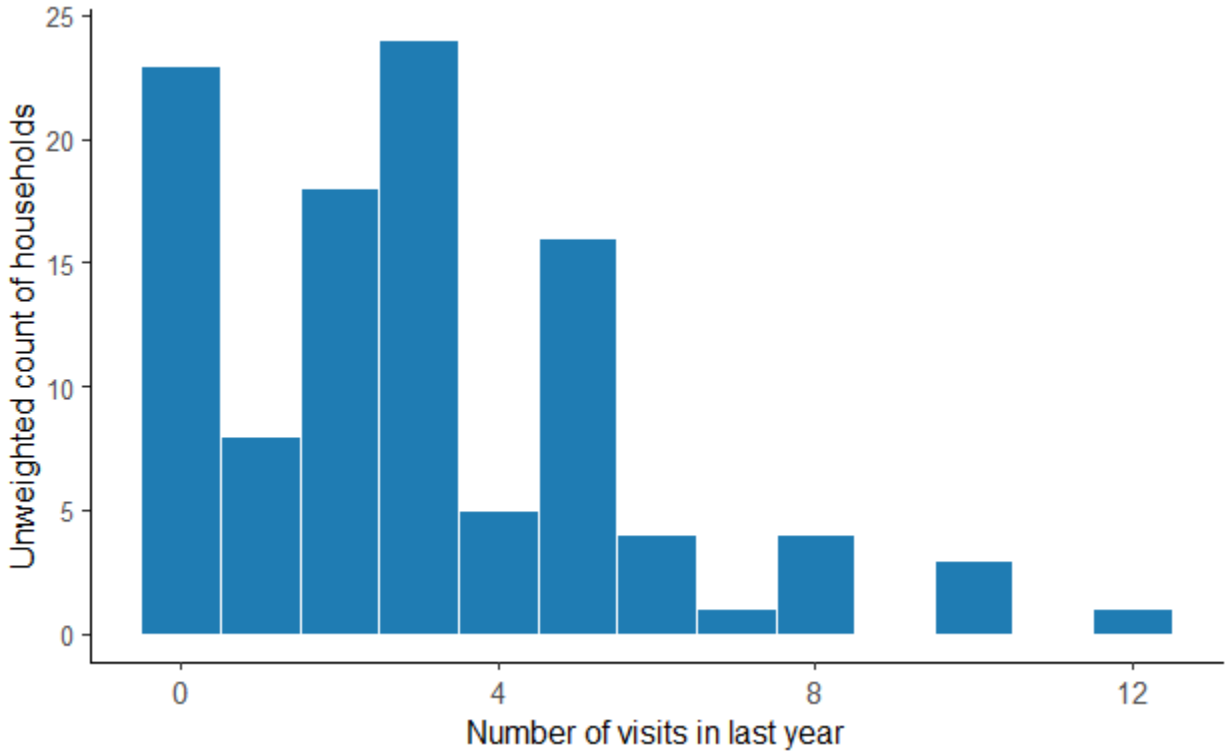
### 3.2.3 Knowledge of community resources

A key component of malaria detection in many regions in Panama is the volunteer collaborator program. Col-vols/CCs are community members who are trained to carry out malaria detection activities such as screening, taking blood samples for thick blood film or rapid tests, and referring patients to health facilities or to community-based vector control technicians. They also sometimes oversee malaria treatment after a malaria case has been confirmed. In the Panama baseline survey, 28.3% of households know of a col-vol in their community. Of those who knew of a col-vol, 73.6% 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 is shown in Figure 3.5.

*Table 3.29: Knowledge of col-vols*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Know of col-vol or CC in own community | 386 | 109 | 28.3 | (16 - 45) |
| Visited by col-vol or CC in last year | 108 | 85 | 73.6 | (56 - 86) |

*Figure 3.5: Number of visits from col-vols in last year*




Malaria testing and treatment is provided free of charge through the Ministry of Health in Panama, and 59.5% of respondents are aware of this benefit (Table 3.30). Because cost and knowledge of where services are available may be barriers to seeking care, the survey asked respondents where someone could access testing and treatment. Respondents could indicate multiple health facility types they knew provided the service, and interviewers classified them according to the options in the survey. A majority of households knew that they could seek malaria care at primary care facilities (Table 3.31, Table 3.32). Col-vol knowledge by province is shown in Table 3.33. The baseline measurement was not designed to produce representative estimates at the province/ comarca level, so results by province/ comarca 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 | 214 | 126 | 59.5 | (49 - 69) |

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

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Where can someone go to be tested for malaria? | | | | |
| Public Sector: Government primary level health center | 258 | 137 | 53.2 | (34 - 71) |
| Public Sector: Government hospital | 258 | 74 | 30.7 | (16 - 50) |
| Public Sector: Fieldworker/Community Health Worker | 258 | 40 | 13.7 | (8 - 22) |
| Other public sector | 258 | 4 | 1.8 | (0 - 8) |
| Public Sector: mobile clinic | 258 | 2 | 0.6 | (0 - 2) |
| Other private sector | 258 | 1 | 0.4 | (0 - 3) |

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Private medical sector: Private hospital/clinic | 258 | 1 | 0.2 | (0 - 1) |
| Private medical sector: Pharmacy | 258 | 0 | 0 | ( - ) |
| Private medical sector: Private doctor | 258 | 0 | 0 | ( - ) |
| Private medical sector: mobile clinic | 258 | 0 | 0 | ( - ) |
| Traditional healer | 258 | 0 | 0 | ( - ) |
| Other | 258 | 0 | 0 | ( - ) |
| Don't know | 258 | 10 | 2.5 | (1 - 5) |

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

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Where can someone receive treatment for malaria? | | | | |
| Public Sector: Government primary level health center | 249 | 135 | 54.5 | (35 - 73) |
| Public Sector: Government hospital | 249 | 81 | 34.8 | (19 - 54) |
| Public Sector: Fieldworker/Community Health Worker/Promoter | 249 | 42 | 14.1 | (8 - 23) |
| Other public sector | 249 | 5 | 2.3 | (1 - 8) |
| Public Sector: mobile clinic | 249 | 3 | 1.2 | (1 - 3) |
| Private medical sector: mobile clinic | 249 | 1 | 0.4 | (0 - 2) |
| Traditional healer | 249 | 1 | 0.4 | (0 - 3) |
| Private medical sector: Private hospital/clinic | 249 | 1 | 0.2 | (0 - 1) |
| Private medical sector: Pharmacy | 249 | 0 | 0 | ( - ) |
| Private medical sector: Private doctor | 249 | 0 | 0 | ( - ) |
| Other private sector | 249 | 0 | 0 | ( - ) |
| Other | 249 | 0 | 0 | ( - ) |
| Don't know | 249 | 4 | 1.2 | (0 - 3) |

*Table 3.33: Knowledge of col-vols by province/ comarca*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Colón (1 community) | | | | |
| Know of col-vol in own community | 25 | 0 | 0 | ( - ) |
| Visited by col-vol in last year | 0 | 0 | | - |
| Col-vols/CC/CHW conduct testing for malaria | 10 | 0 | 0 | ( - ) |
| Col-vols/CC/CHW provide treatment for malaria | 10 | 0 | 0 | ( - ) |
| Comarca Emberá (1 community) | | | | |
| Know of col-vol in own community | 25 | 0 | 0 | ( - ) |
| Visited by col-vol in last year | 0 | 0 | | - |
| Col-vols/CC/CHW conduct testing for malaria | 21 | 0 | 0 | ( - ) |
| Col-vols/CC/CHW provide treatment for malaria | 21 | 0 | 0 | ( - ) |
| Comarca Guna Yala (5 communities) | | | | |
| Know of col-vol in own community | 115 | 90 | 73.2 | (60 - 83) |
| Visited by col-vol in last year | 89 | 72 | 77 | (55 - 90) |
| Col-vols/CC/CHW conduct testing for malaria | 109 | 20 | 14.9 | (6 - 31) |
| Col-vols/CC/CHW provide treatment for malaria | 107 | 21 | 14.9 | (6 - 33) |

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Comarca Ngöbe-Buglé (2 communities) | | | | |
| Know of col-vol in own community | 48 | 0 | 0 | ( - ) |
| Visited by col-vol in last year | 0 | 0 | | - |
| Col-vols/CC/CHW conduct testing for malaria | 34 | 4 | 9.8 | (6 - 17) |
| Col-vols/CC/CHW provide treatment for malaria | 32 | 5 | 12.4 | (6 - 24) |
| Darién (2 communities) | | | | |
| Know of col-vol in own community | 50 | 9 | 26.5 | (13 - 48) |
| Visited by col-vol in last year | 9 | 8 | 88.9 | (89 - 89) |
| Col-vols/CC/CHW conduct testing for malaria | 13 | 5 | 38.5 | (38 - 38) |
| Col-vols/CC/CHW provide treatment for malaria | 13 | 5 | 38.5 | (38 - 38) |
| Panamá (5 communities) | | | | |
| Know of col-vol in own community | 123 | 10 | 8.4 | (5 - 13) |
| Visited by col-vol in last year | 10 | 5 | 27.9 | (10 - 57) |
| Col-vols/CC/CHW conduct testing for malaria | 71 | 11 | 13.8 | (7 - 24) |
| Col-vols/CC/CHW provide treatment for malaria | 66 | 11 | 14.4 | (8 - 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, 8.8% reported travel outside the community in the last two weeks (Table 3.35). According to respondents, most household members did not participate in any of the risk activities listed in Table 3.36 in the two months prior to the survey.

*Table 3.34: Temporal migration within surveyed households*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| At least one member migrates seasonally | 407 | 29 | 7 | (4 - 13) |
| At least one member migrates weekly | 406 | 18 | 4.4 | (3 - 7) |

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

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Individual traveled outside community in last 2 weeks | 1836 | 165 | 8.8 | (5 - 15) |

*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 | 1839 | 1195 | 64.9 | (59 - 71) |
| Cultivating crops or working in the fields | 1839 | 558 | 31.1 | (25 - 38) |
| Gathering firewood in the forest | 1839 | 223 | 11.7 | (7 - 19) |
| Collecting shellfish | 1839 | 109 | 5.8 | (3 - 12) |
| Sleeping outdoors overnight | 1839 | 26 | 1.4 | (1 - 3) |
| Working in timber/lumber industries in the forest | 1839 | 32 | 1.3 | (1 - 2) |

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Producing charcoal | 1839 | 2 | 0.1 | (0 - 0) |
| Working in a mine | 1839 | 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 some responses also referred to use of mosquito nets or other practices that protect against all mosquito vectors. None of the households that had heard of malaria 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) | 223 | 152 | 68.8 | (54 - 80) |
| Keep house surroundings clean | 223 | 50 | 22 | (14 - 34) |
| Sleep under a mosquito net | 223 | 31 | 13.2 | (8 - 21) |
| Cut the grass around the house | 223 | 25 | 12.6 | (8 - 19) |
| Fill in puddles (stagnant water) | 223 | 15 | 8.3 | (2 - 29) |
| Fumigate or spray house with insecticides | 223 | 7 | 3.6 | (1 - 12) |
| Avoid mosquito bites | 223 | 5 | 2.6 | (1 - 6) |
| Use insect repellent | 223 | 5 | 2.2 | (1 - 4) |
| Clean water storage tanks with bleach | 223 | 4 | 1.6 | (1 - 4) |
| Put mosquito screens on the windows | 223 | 2 | 1.2 | (1 - 3) |
| Can't be prevented | 223 | 2 | 0.7 | (0 - 3) |
| Add bleach temephos (Abate) to the water tank | 223 | 1 | 0.6 | (0 - 1) |
| Sleep under an insecticide-treated mosquito net | 223 | 1 | 0.6 | (0 - 3) |
| Take preventive medication | 223 | 1 | 0.2 | (0 - 1) |
| Use mosquito coils | 223 | 0 | 0 | ( - ) |
| Other | 223 | 2 | 0.4 | (0 - 3) |
| Don't know | 223 | 7 | 2.4 | (1 - 8) |

*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) | 223 | 140 | 68.1 | (58 - 76) |
| Keep house surroundings clean | 223 | 58 | 25.1 | (20 - 31) |
| Sleep under a mosquito net | 223 | 41 | 16.9 | (9 - 30) |
| Cut the grass around the house | 223 | 34 | 14.5 | (11 - 18) |
| Use insect repellent | 223 | 11 | 5.1 | (4 - 7) |
| Avoid mosquito bites | 223 | 9 | 4.7 | (3 - 8) |
| Fill in puddles (stagnant water) | 223 | 11 | 3.7 | (2 - 7) |
| Fumigate or spray house with insecticides | 223 | 8 | 3.6 | (2 - 6) |
| Clean water storage tanks with bleach | 223 | 7 | 3.3 | (2 - 6) |
| Sleep under an insecticide-treated mosquito net | 223 | 4 | 1.1 | (0 - 4) |

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Put mosquito screens on the windows | 223 | 2 | 0.7 | (0 - 3) |
| Organize community cleaning work days | 223 | 1 | 0.6 | (0 - 3) |
| Add bleach or temephos (Abate) to the water tank | 223 | 1 | 0.5 | (0 - 3) |
| Use mosquito coils | 223 | 1 | 0.2 | (0 - 1) |
| Take preventive medication | 223 | 0 | 0 | ( - ) |
| Does nothing to protect from malaria | 223 | 0 | 0 | ( - ) |
| Other | 223 | 1 | 0.5 | (0 - 3) |
| Don't know | 223 | 5 | 1.8 | (1 - 5) |

# Chapter 4: Vector control activities

This chapter provides a descriptive summary of vector control measures used in the households selected for the RMEI-Panama Baseline LQAS Survey. As noted in Chapter 2, the household measurement in Panama was conducted entirely in malaria stratum 4. 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 Panama households

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

In Panama, the community sample was designed to capture data from 16 communities 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. According to these data, 41 communities across four provinces/ comarcas should have received spraying, and 12 communities (in rural areas of comarca Guna Yala) should have received net distribution. However, because the intervention data are organized by locality and not by health facility, and because the health service network received from the Ministry of Health did not include the names of the localities served by each health facility, the pairing of the intervention data to corresponding health facilities in the service network had to rely on matches of locality name or mapping via name-based online searches. This was the best available method but known to be imperfect. Ten facilities in the sample were matched to communities with reported interventions.

According to data collected at the local-level health facilities via the Community Selection Module, 14 of 16 communities surveyed had vector control interventions carried out. There are a few feasible explanations for the discrepancy in the four communities with no record of recent interventions in the Ministry of Health documentation: the assumption about which facility served a given target community may have been incorrect, and the selected facility may have served communities with interventions; intervention activity may have been planned at the local level and not documented at the central level (for example, in response to a malaria case); or the local health facilities may have reported intervention activities that were planned but not yet carried out at the date of the survey. We expect that each of these scenarios explains a portion of the discrepancies, as some of the 14 communities had intervention measures observed at the household level, while others did not.

## 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.

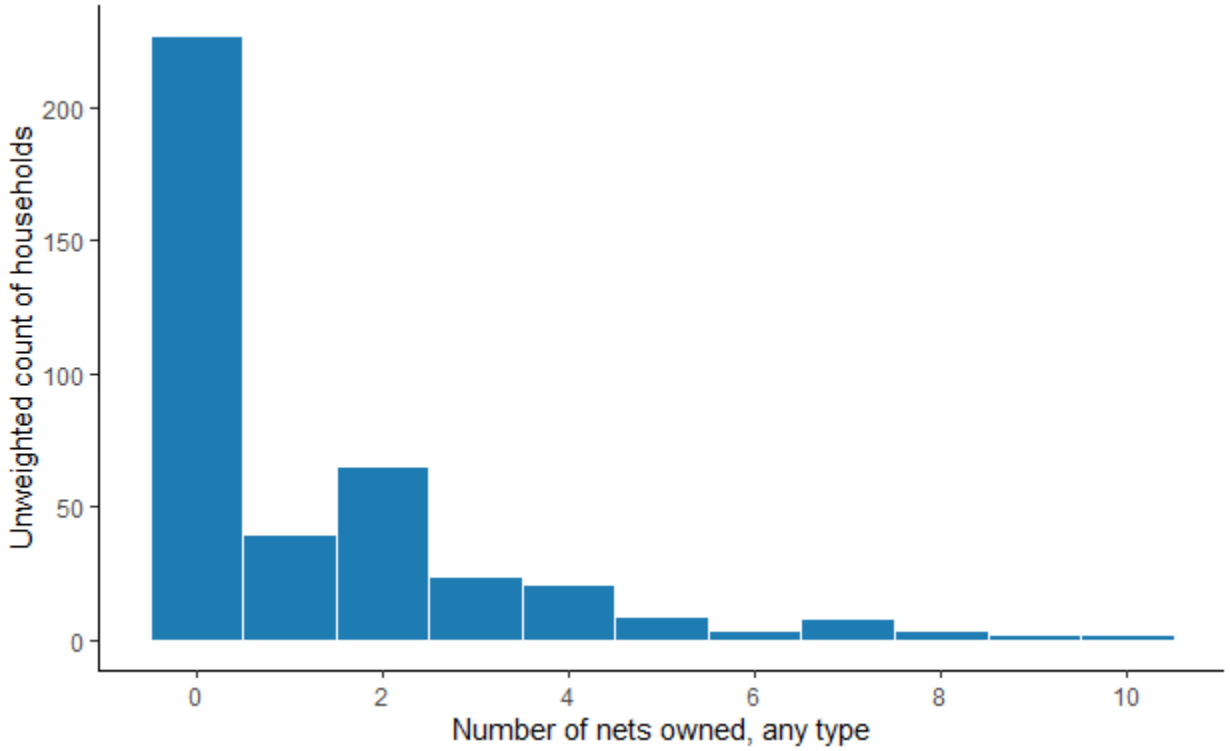
### 4.2.1 Ownership of nets by surveyed households

As Table 4.1 shows, 45.1% 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 | 406 | 180 | 45.1 | (30 - 61) |

*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 the vector control program. Most untreated nets were purchased in a store (81%, in Table 4.3).

*Table 4.2: Source of insecticide-treated nets*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Source of net | | | | |
| Vector control or malaria program | 402 | 364 | 90.5 | (87 - 93) |
| Government health facility | 402 | 24 | 6 | (4 - 9) |
| Community health worker or Col-Vol | 402 | 13 | 3.2 | (2 - 5) |
| Decline to respond | 402 | 1 | 0.2 | (0 - 2) |

*Table 4.3: Source of untreated nets*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Source of net | | | | |
| Shop/market | 126 | 102 | 81 | (73 - 87) |
| Pharmacy | 126 | 1 | 0.8 | (0 - 5) |
| Other | 126 | 14 | 11.1 | (7 - 18) |
| Don't know | 126 | 9 | 7.1 | (4 - 13) |

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 | 448 | 430 | 96 | (94 - 97) |
| Only thumb-sized holes | 448 | 17 | 3.8 | (2 - 6) |
| At least one fist or head-sized hole | 448 | 1 | 0.2 | (0 - 2) |

*Table 4.5: Reported condition of nets not observed*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Condition of mosquito net as reported | | | | |
| No holes | 79 | 34 | 43 | (33 - 54) |
| Only thumb-sized holes | 79 | 28 | 35.4 | (26 - 47) |
| At least one fist or head-sized hole | 79 | 3 | 3.8 | (1 - 11) |
| Net never used | 79 | 3 | 3.8 | (1 - 11) |
| Don't know | 79 | 11 | 13.9 | (8 - 23) |

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)*

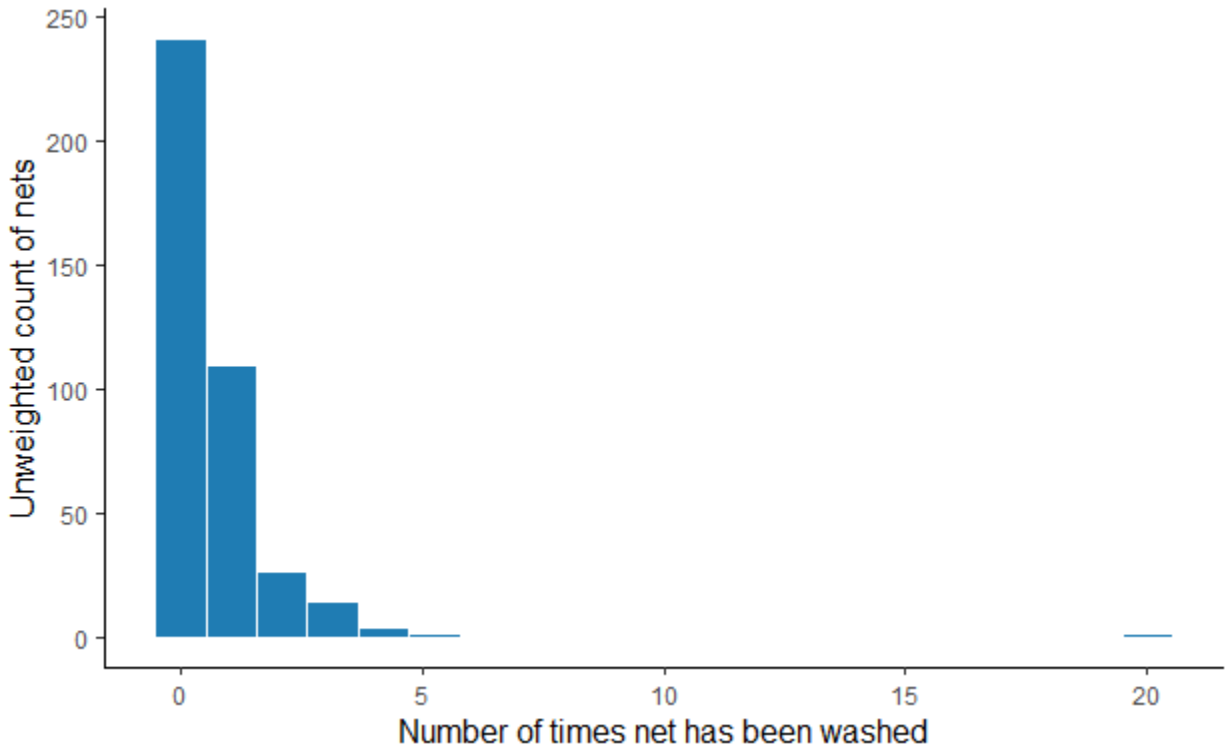


*Table 4.6: Care of insecticide-treated nets - drying*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Method of drying net | | | | |
| In the shade | 161 | 78 | 48.4 | (41 - 56) |
| Indoors | 161 | 53 | 32.9 | (26 - 41) |
| In the sun | 161 | 30 | 18.6 | (13 - 25) |

### 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, 28% 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, 36.8% 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 | 1809 | 515 | 28 | (13 - 51) |
| Slept under untreated net | 1809 | 224 | 13.8 | (7 - 27) |
| Under 5 | | | | |
| Slept under treated net | 199 | 73 | 36.8 | (16 - 64) |
| Slept under untreated net | 199 | 32 | 18.4 | (9 - 35) |
| Pregnant | | | | |
| Slept under treated net | 18 | 3 | 20.5 | (7 - 49) |
| Slept under untreated net | 18 | 3 | 14.4 | (4 - 44) |
| Reported usually sleeping under net during pregnancy | 16 | 6 | 32.4 | (12 - 63) |

When households had nets that were not used the previous night, or reported that not all household members slept under a net, they were asked why they do not sleep under a mosquito net. The reasons given are shown in Table 4.8. Most frequently, households reported they did not have enough mosquito nets for all members to use.

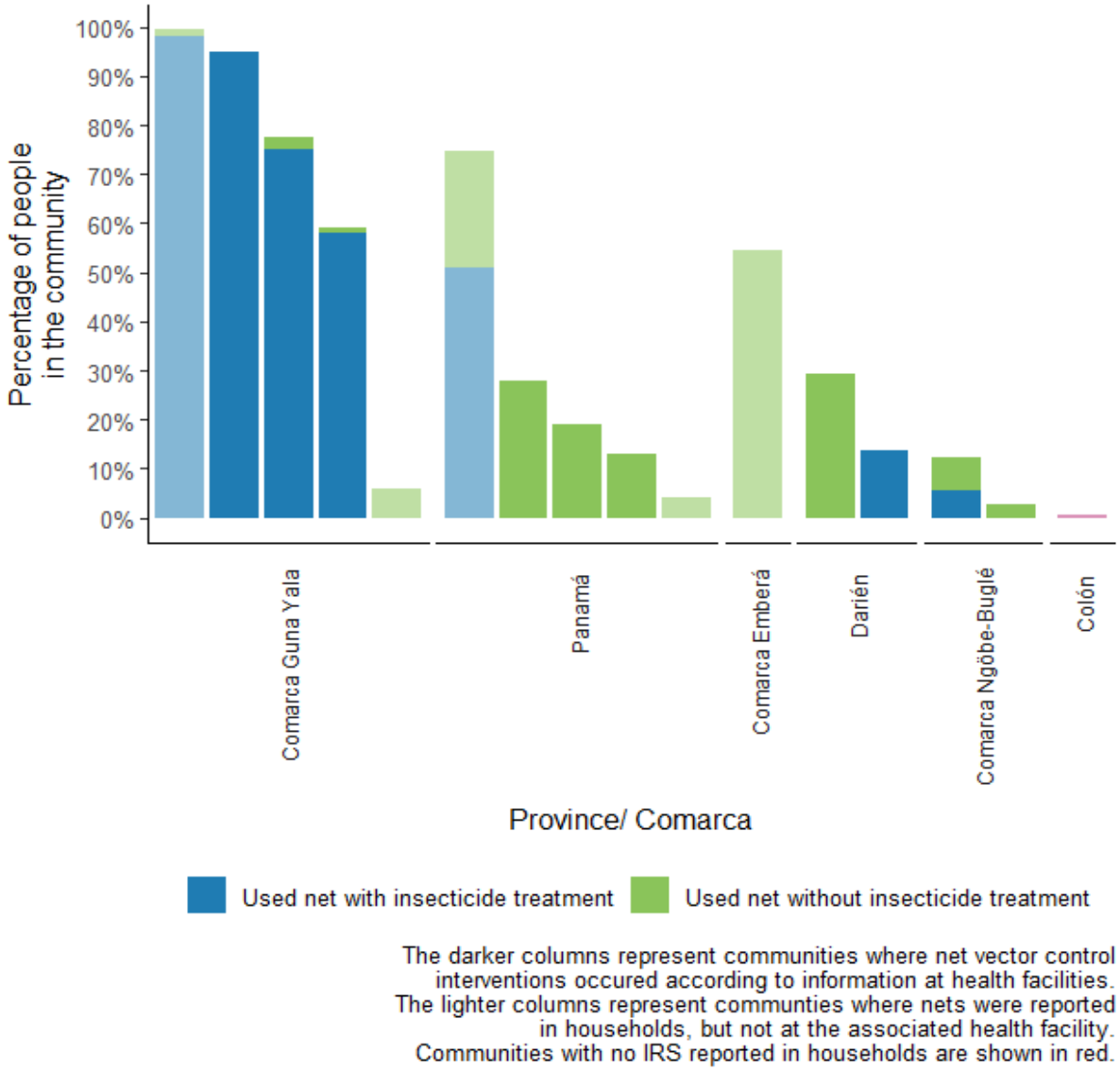
*Table 4.8: Reasons for not using net*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Reasons for not sleeping under mosquito net | | | | |
| Don't have enough nets | 70 | 39 | 60.1 | (39 - 78) |
| Extra net/more nets available than sleeping areas | 70 | 6 | 8.5 | (3 - 22) |
| No mosquitoes | 70 | 5 | 7.9 | (3 - 22) |
| Too hot | 70 | 8 | 7.4 | (3 - 16) |
| Usual user(s) did not sleep here last night | 70 | 2 | 3.3 | (1 - 10) |
| Net too expensive | 70 | 2 | 2.7 | (1 - 12) |
| Don't know where or how to get another net | 70 | 1 | 1.8 | (0 - 10) |
| No malaria now | 70 | 1 | 1.8 | (0 - 11) |
| Net not available last night/net being washed | 70 | 1 | 1.6 | (0 - 10) |
| It is bad for the skin, it causes irritation | 70 | 2 | 1.4 | (0 - 8) |
| Feel closed in/afraid | 70 | 1 | 1.3 | (0 - 7) |
| Other | 70 | 1 | 0.7 | (0 - 4) |

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Don't know | 70 | 3 | 3.3 | (1 - 11) |
| Decline to respond | 70 | 1 | 1.3 | (0 - 7) |

Figure 4.3 shows by province/ comarca the proportion of individuals who slept in the household the previous night using a mosquito net in each of the communities surveyed. The communities expected to receive the net intervention are highlighted in darker colors. In Panama, the communities that received the net intervention, according to *corregimiento*-level vector control staff at the corresponding health facility in the sample, had more insecticide-treated net use than the communities that did not receive the intervention. Untreated net use is notable in some communities. The baseline measurement was not designed to produce representative estimates at the province/ comarca level, so results by province/ comarca should be interpreted with discretion.

*Figure 4.3: Net use by province/ comarca and community*



## 4.3 Indoor Residual Spraying

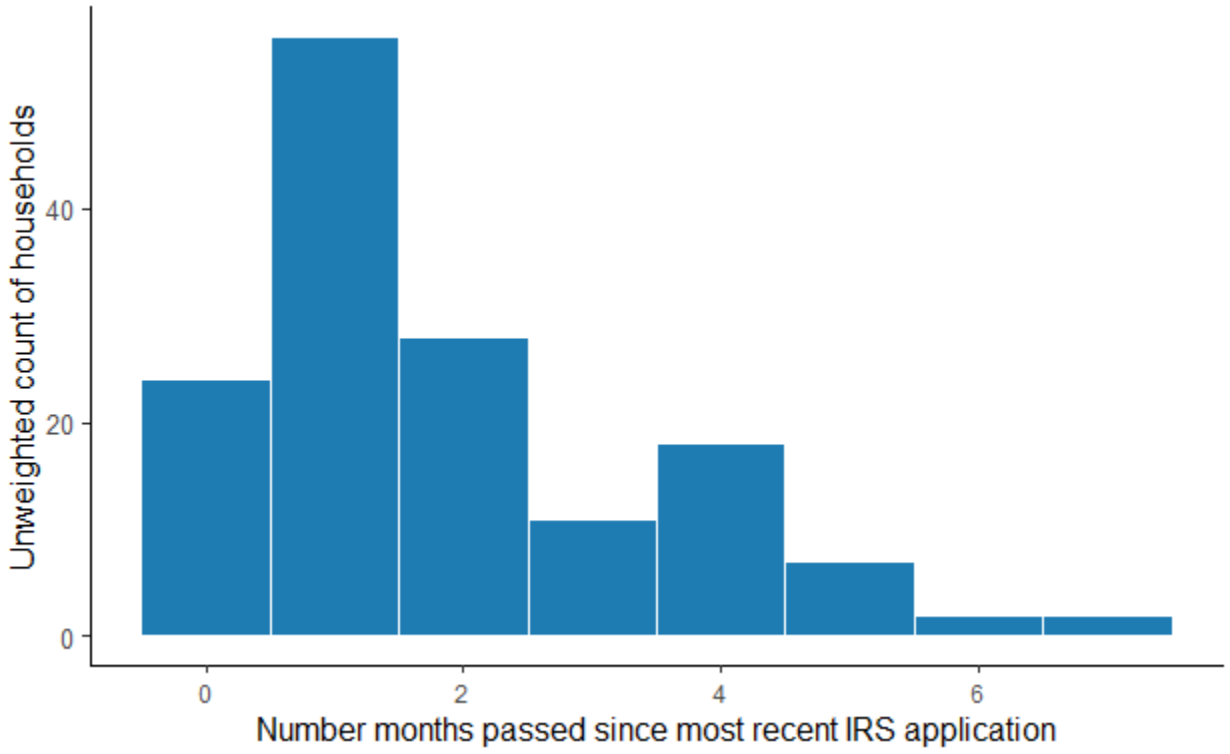
The other key vector control intervention of the Initiative is to offer to spray the interior walls of the dwelling against mosquitoes (usually with deltamethrin or a comparable insecticide). Insecticide application is usually carried out by staff or contractors of the vector control program every 4 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, 44.8% of households were offered IRS, and spraying was carried out in 96.9% 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 57% of households that received IRS. The response “don’t know” was given to the question about observing evidence of IRS completion in 15 households.

*Table 4.9: Households offered and accepting spraying*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Offered indoor residual spraying | 405 | 169 | 44.8 | (27 - 64) |
| Accepted indoor residual spraying | 167 | 160 | 96.9 | (94 - 98) |
| Evidence observed (card, sticker, mark) | 145 | 85 | 57 | (38 - 74) |

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

*Figure 4.4: Number of months since most recent spraying occurred*




Respondents who were offered IRS, but whose house was not sprayed, were asked why the spraying was not carried out, an uncommon circumstance. The results are shown in Table 4.10.

*Table 4.10: Reasons for not accepting spraying*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Reason house was not sprayed | | | | |
| No one was at home | 7 | 3 | 43.4 | (24 - 65) |
| Dangerous for children | 7 | 2 | 32.5 | (10 - 68) |
| Didn't have time/visit time was not convenient | 7 | 1 | 15.9 | (3 - 57) |
| Other | 7 | 1 | 8.3 | (1 - 35) |

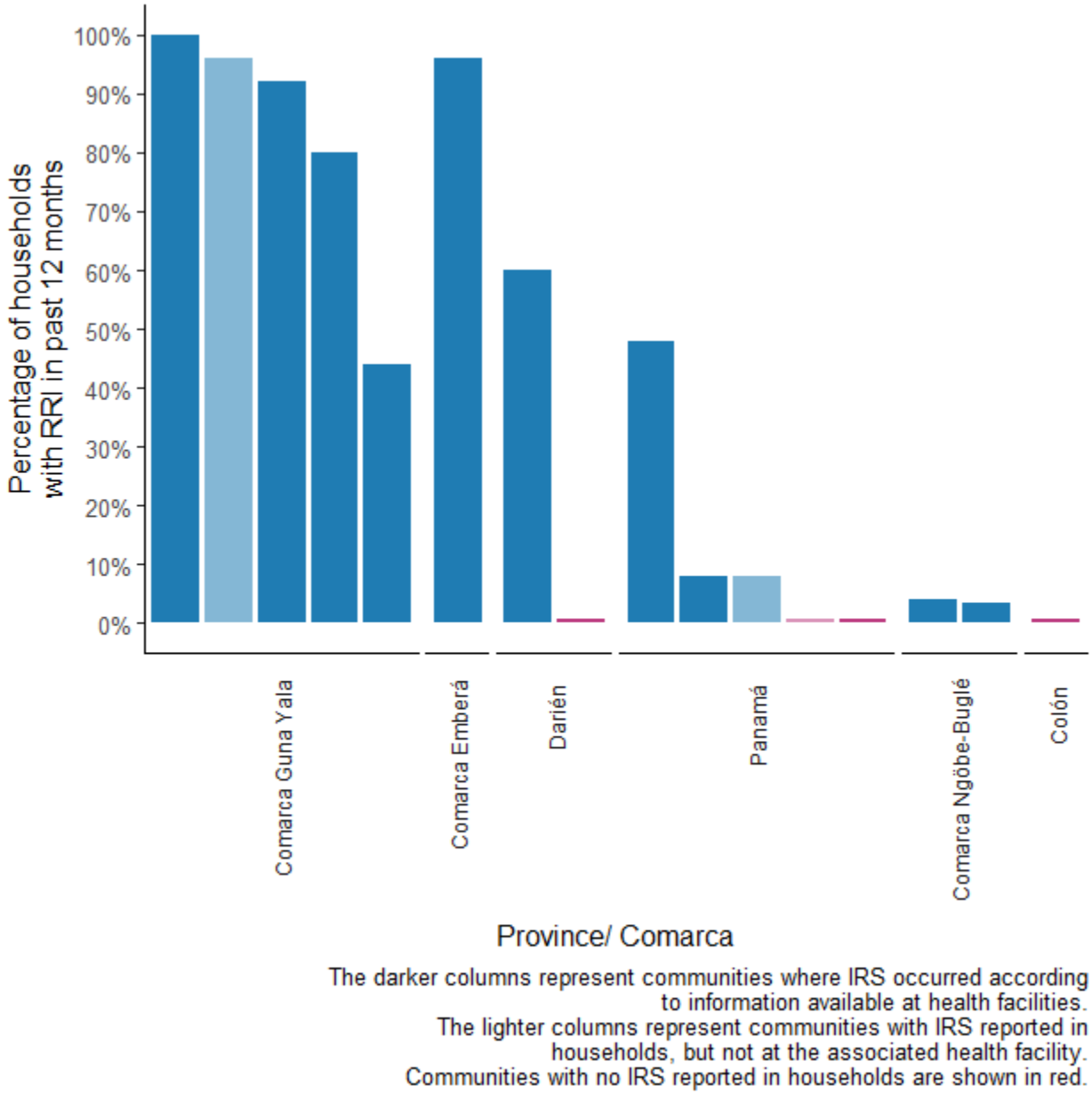
Households receiving IRS were asked whether they washed, painted, or plastered any walls since the most recent application (which diminishes the effectiveness of the insecticide), as shown in Table 4.11.

*Table 4.11: Post-spraying practices*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Walls painted since last IRS | 160 | 10 | 5.7 | (2 - 14) |
| Walls washed since last IRS | 159 | 9 | 5 | (2 - 12) |
| Walls plastered since last IRS | 160 | 6 | 3.3 | (1 - 7) |

Figure 4.5 shows by province/ comarca the proportion of households that received IRS in each of the communities surveyed. The communities expected to receive the IRS intervention according to vector control staff at the corresponding health facility are highlighted in darker colors. The measured coverage of IRS is below 50% in some communities that were expected to receive it. Several factors could contribute to this mismatch. First, personnel at the local health facility may not be informed about vector control activities planned and carried out from the regional or central level. Second, respondents may have confused IRS with other insecticide interventions such as fogging, though application to interior walls was emphasized in the conduct of the survey.

*Figure 4.5: Indoor residual spraying by province/ comarca and community*




## 4.4 Indicator 6.01: Vector control coverage

Individual-level coverage by one of the two interventions was negotiated as an indicator for RMEI. The indicator is measured on the subset of usual household members who slept in the house the night prior to the survey (because net use is measured for the night prior to the survey) in the communities identified at the local level as targeted for vector control interventions. Individuals are considered covered if they slept under an insecticide-treated net the previous night, or if their home had indoor residual spraying applied within the last 12 months, regardless of which intervention was planned for the community where they reside (there was evidence of both types of interventions in many target communities, as seen in Table 4.12). Table 4.13 shows the indicator results, with 56.3% of individual usual household members in target communities covered by one of the two interventions.

*Table 4.12: Vector control received by reported intervention*

| Vector control reported | Communities | Used treated net | House sprayed |
|---|---|---|---|
| Nets | 1 | 75% | 95.2% |
| Spray | 4 | 30.6% | 67.3% |
| Both | 9 | 23.3% | 37% |
| None | 2 | 30.1% | 3.2% |

*Table 4.13: Vector control indicator*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Usual household members in vector control communities who slept in house last night | 1657 | 1623 | 97.5 | (95 - 99) |
| Slept under insecticide treated net | 1623 | 459 | 28.1 | (11 - 55) |
| House sprayed with mosquito treatment past 12 months | 1614 | 800 | 54.8 | (34 - 74) |
| Omitted from household spraying calculations due to 'do not know' responses | 1623 | 9 | 0.4 | (0 - 1) |
| 'DK' responses included in indicator because they slept under treated net | 9 | 4 | 26.5 | (4 - 76) |
| Received either vector control to standard | 1618 | 837 | 56.3 | (35 - 76) |

# Chapter 5: Malaria Diagnostic Capacity

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

## 5.1 Characteristics of health facility sample

As previously described, the health facility sample included 60 facilities of various types as shown in Table 5.1. Forty-three of the surveyed facilities provide primary level care, and 8 are secondary level services, though they may also provide primary attention as demanded. The remaining facilities in the sample are *corregimiento*-level vector control units that manage local malaria reporting and vector control programming. The measurement included the national malaria reference lab.

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

| | Facility Type | # |
|---|---|---|
| Primary care | Puesto de salud | 20 |
| | Sub centro de salud | 3 |
| | Centro de salud | 20 |
| Secondary care | CAPSI | 2 |
| | CAPPS | 1 |
| | ULAPS | 1 |
| | Hospital | 4 |
| Vector control unit (Corregimiento)/ National Lab | Corregimiento-level vector control unit | 8 |
| | National reference laboratory | 1 |
| **Total** | | **60** |

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

Most attention facilities in the sample provided services from Monday through Friday. A smaller number were open on the weekends (Table 5.3). Twenty-one percent of primary care units and 62.5% of secondary care units had services open 24 hours (Table 5.4).

*Table 5.3: Workweek of facility*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Primary care units: Days of the week service is provided | | | | |
| Monday | 43 | 43 | 100 | ( - ) |
| Thursday | 43 | 42 | 97.7 | (84 - 100) |
| Friday | 43 | 42 | 97.7 | (84 - 100) |
| Tuesday | 43 | 41 | 95.3 | (83 - 99) |
| Wednesday | 43 | 41 | 95.3 | (83 - 99) |
| Saturday | 43 | 18 | 41.9 | (28 - 57) |
| Sunday | 43 | 18 | 41.9 | (28 - 57) |
| Secondary care units: Days of the week service is provided | | | | |
| Monday | 8 | 8 | 100 | ( - ) |
| Tuesday | 8 | 8 | 100 | ( - ) |

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Wednesday | 8 | 8 | 100 | ( - ) |
| Thursday | 8 | 8 | 100 | ( - ) |
| Friday | 8 | 8 | 100 | ( - ) |
| Saturday | 8 | 5 | 62.5 | (28 - 88) |
| Sunday | 8 | 5 | 62.5 | (28 - 88) |

*Table 5.4: Hours of operation*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Primary care units: Hours of operation | | | | |
| Open less than 24 hours | 43 | 34 | 79.1 | (64 - 89) |
| Open 24 hours | 43 | 9 | 20.9 | (11 - 36) |
| Secondary care units: Hours of operation | | | | |
| Open 24 hours | 8 | 5 | 62.5 | (28 - 88) |
| Open less than 24 hours | 8 | 3 | 37.5 | (12 - 72) |

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 65.9% of primary level facilities and at all secondary level facilities. In terms of laboratory diagnosis, microbiologists are employed at 4.5% and lab technicians at 34.1% of primary care units. Only 11.4% of primary level units employ epidemiology personnel, and 56.8% employ other statistics personnel, important functions for malaria notification and reporting.

*Table 5.5: Facility personnel*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Primary care units | | | | |
| General physician | 44 | 29 | 65.9 | (50 - 79) |
| Pediatrician | 44 | 9 | 20.5 | (11 - 35) |
| Nutritionist /dietician | 44 | 6 | 13.6 | (6 - 28) |
| Pharmacist | 44 | 15 | 34.1 | (21 - 50) |
| Auxiliary nurse | 44 | 37 | 84.1 | (70 - 92) |
| Practical nurse | 44 | 2 | 4.5 | (1 - 17) |
| Registered nurse | 44 | 26 | 59.1 | (44 - 73) |
| Professional midwife | 44 | 3 | 6.8 | (2 - 20) |
| Social worker | 44 | 9 | 20.5 | (11 - 35) |
| Microbiologist (laboratory) | 44 | 2 | 4.5 | (1 - 17) |
| Lab technician | 44 | 15 | 34.1 | (21 - 50) |
| Dispenser at pharmacy | 44 | 22 | 50 | (35 - 65) |
| Epidemiology personnel | 44 | 5 | 11.4 | (5 - 25) |
| Other personnel specific for statistics and reporting | 44 | 25 | 56.8 | (42 - 71) |
| Secondary care units | | | | |
| General physician | 7 | 7 | 100 | ( - ) |
| Pediatrician | 7 | 3 | 42.9 | (14 - 78) |
| Nutritionist /dietician | 7 | 5 | 71.4 | (32 - 93) |
| Pharmacist | 7 | 6 | 85.7 | (40 - 98) |
| Auxiliary nurse | 7 | 7 | 100 | ( - ) |
| Practical nurse | 7 | 1 | 14.3 | (2 - 60) |
| Registered nurse | 7 | 7 | 100 | ( - ) |

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Professional midwife | 7 | 1 | 14.3 | (2 - 60) |
| Social worker | 7 | 6 | 85.7 | (40 - 98) |
| Microbiologist (laboratory) | 7 | 1 | 14.3 | (2 - 60) |
| Lab technician | 7 | 5 | 71.4 | (32 - 93) |
| Dispenser at pharmacy | 7 | 6 | 85.7 | (40 - 98) |
| Epidemiology personnel | 7 | 4 | 57.1 | (22 - 86) |
| Other personnel specific for statistics and reporting | 7 | 7 | 100 | ( - ) |
| Vector control units (Corregimiento) | | | | |
| Microbiologist (laboratory) | 8 | 1 | 12.5 | (2 - 55) |
| Epidemiology personnel | 8 | 1 | 12.5 | (2 - 55) |
| Other personnel specific for statistics and reporting | 8 | 1 | 12.5 | (2 - 55) |

## 5.2 Rapid diagnostic tests

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

### 5.2.1 Rapid diagnostic test practices

In Panama, 36.4% of primary care facilities store RDTs, and 34.1% provide testing with RDTs (Table 5.6). In 36.4% of primary care facilities, personnel test with RDTs inside the facility, and personnel conduct testing in the community in 25% of facilities (Table 5.7). Testing in the community is most often conducted daily (40.9% of facilities that conduct testing in the community), as shown in Table 5.8.

*Table 5.6: Rapid diagnostic testing according to interview and observation*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Primary care units | | | | |
| Unit stores RDTs | 44 | 16 | 36.4 | (23 - 52) |
| Unit conducts RDT testing | 44 | 15 | 34.1 | (21 - 50) |
| Secondary care units | | | | |
| Unit stores RDTs | 7 | 2 | 28.6 | (7 - 68) |
| Unit conducts RDT testing | 7 | 4 | 57.1 | (22 - 86) |
| Vector control units (Corregimiento) | | | | |
| Unit stores RDTs | 8 | 6 | 75 | (37 - 94) |
| Unit conducts RDT testing | 8 | 8 | 100 | ( - ) |

*Table 5.7: Rapid diagnostic testing practices (interview)*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Primary care units | | | | |
| Do health personnel perform rapid diagnostic testing for malaria in this facility? | 44 | 16 | 36.4 | (23 - 52) |
| Do health personnel in this facility perform rapid diagnostic testing for malaria in the community? | 44 | 11 | 25 | (14 - 40) |
| Secondary care units | | | | |
| Do health personnel perform rapid diagnostic testing for malaria in this facility? | 7 | 4 | 57.1 | (22 - 86) |
| Do health personnel in this facility perform rapid diagnostic testing for malaria in the community? | 7 | 3 | 42.9 | (14 - 78) |
| Vector control units (Corregimiento) | | | | |
| Do health personnel perform rapid diagnostic testing for malaria in this facility? | 8 | 8 | 100 | ( - ) |
| Do health personnel in this facility perform rapid diagnostic testing for malaria in the community? | 8 | 8 | 100 | ( - ) |

*Table 5.8: Community rapid diagnostic testing frequency*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Frequency of rapid diagnostic testing in the community | | | | |
| Daily | 22 | 9 | 40.9 | (22 - 62) |
| Only in reaction to a positive malaria case | 22 | 6 | 27.3 | (12 - 50) |
| At least once per week | 22 | 3 | 13.6 | (4 - 36) |
| At least once per month | 22 | 3 | 13.6 | (4 - 36) |
| At least once per quarter | 22 | 1 | 4.5 | (1 - 27) |

Respondents at facilities that reported using both RDTs and microscopic diagnosis methods were asked which of the two methods are more commonly used. While 78.6% of facilities reported using both RDT and microscopy routinely for the same patient, 14.3% reported taking only a RDT routinely (Table 5.9).

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

| | N | n | % | 95% CI |
|---|---|---|---|---|
| For malaria diagnosis, is it most common to take a thick blood film only, use an RDT only, or take both samples (thick blood film and RDT) for diagnosis? | | | | |
| Both RDT and thick blood film: Samples are routinely taken for both tests at the same time | 28 | 22 | 78.6 | (59 - 90) |
| Only RDT used more commonly | 28 | 4 | 14.3 | (5 - 33) |
| Only thick blood film used more commonly | 28 | 2 | 7.1 | (2 - 25) |

Respondents at facilities that reported using both RDTs and microscopic diagnosis methods were asked if they must wait for confirmation with microscopic diagnosis before beginning malaria treatment. According to the norm, treatment can be initiated with a positive RDT diagnosis. However, 31.3% of primary care facilities that used RDTs reported that they require confirmation by TBF examination in order to start treatment (Table 5.10).

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

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Do you require a positive thick blood film test as confirmation after a positive RDT to start malaria treatment? | | | | |
| Primary care units | 16 | 5 | 31.3 | (13 - 57) |
| Secondary care units | 4 | 0 | 0 | ( - ) |

### 5.2.2 Rapid diagnostic testing as measured in medical record review

The health facility survey included a record review of confirmed cases of malaria to evaluate diagnosis and case management practices, and a review of suspected cases of malaria (patients presenting with fever). Chapters 6 and 7 discuss the results in detail. The review captured whether each case from the year 2018 included in the sample received a rapid diagnostic test based on case notification, treatment, and investigation paperwork stored at the *corregimiento*-level vector control units (for confirmed cases) and based on patient charts, attention registries, and lab records at selected health facilities (for suspected cases). As seen in Table 5.11, 86.3% of confirmed cases reviewed had evidence of an RDT, and 7.8% of suspected cases reviewed had evidence of receiving an RDT.

*Table 5.11: Rapid diagnostic testing observed in medical record review*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| RDT observed in record | | | | |
| Confirmed cases | 95 | 82 | 86.3 | (78 - 92) |
| Suspected cases | 566 | 44 | 7.8 | (6 - 10) |

### 5.2.3 Stock of rapid diagnostic testing inputs

The health facility survey included an observation by field personnel of inputs and equipment for malaria diagnosis. The recommended *P. falciparum* + *P. vivax* card test was observed in 31.8% of primary care facilities. No rapid tests were observed the day of the survey in 63.6% of primary care facilities (Table 5.12).

*Table 5.12: Rapid diagnostic test supply observed*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Primary care units | | | | |
| P. falciparum rapid detection card equipment observed | 44 | 7 | 15.9 | (8 - 30) |
| P. falciparum + P. vivax rapid detection card equipment observed | 44 | 14 | 31.8 | (20 - 47) |
| None of these rapid detection cards observed | 44 | 28 | 63.6 | (48 - 77) |
| Secondary care units | | | | |
| P. falciparum + P. vivax rapid detection card equipment observed | 7 | 2 | 28.6 | (7 - 68) |
| None of these rapid detection cards observed | 7 | 5 | 71.4 | (32 - 93) |
| Vector control units (Corregimiento) | | | | |
| P. falciparum rapid detection card equipment observed | 8 | 3 | 37.5 | (12 - 72) |
| P. falciparum + P. vivax rapid detection card equipment observed | 8 | 6 | 75 | (37 - 94) |
| None of these rapid detection cards observed | 8 | 2 | 25 | (6 - 63) |

As shown in Table 5.13, 31.8% of primary care facilities, 57.1% of secondary care facilities, and 87.5% of *corregimiento*-level vector control units routinely store RDTs.

*Table 5.13: Rapid diagnostic test routine storage (questionnaire)*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Primary care units: Does this facility routinely store any malaria rapid diagnostic tests (RDTs)? | | | | |
| No, picked up from another facility | 44 | 5 | 11.4 | (5 - 25) |
| Yes, stores malaria rapid diagnostic tests (RDTs) | 44 | 14 | 31.8 | (20 - 47) |
| None of the above | 44 | 23 | 52.3 | (37 - 67) |
| Don't know | 44 | 2 | 4.5 | (1 - 17) |
| Secondary care units: Does this facility routinely store any malaria rapid diagnostic tests (RDTs)? | | | | |
| No, picked up from another facility | 7 | 0 | 0 | ( - ) |
| Yes, stores malaria rapid diagnostic tests (RDTs) | 7 | 4 | 57.1 | (22 - 86) |
| None of the above | 7 | 2 | 28.6 | (7 - 68) |
| Don't know | 7 | 1 | 14.3 | (2 - 60) |
| Vector control units (Corregimiento): Does this facility routinely store any malaria rapid diagnostic tests (RDTs)? | | | | |
| No, picked up from another facility | 8 | 1 | 12.5 | (2 - 55) |
| Yes, stores malaria rapid diagnostic tests (RDTs) | 8 | 7 | 87.5 | (45 - 98) |
| None of the above | 8 | 0 | 0 | ( - ) |

## 5.3 Malaria microscopy

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

### 5.3.1 Microscopic diagnosis practices

In Panama, all facilities providing primary care to patients are expected to have the capacity to prepare TBF slides. In the health facility interview and observation, 52.3% of primary care facilities were found to take TBF samples. *corregimiento*-level vector control units often have this capacity as well (87.5% of *corregimiento*-level vector control units, as in Table 5.14). The health facility survey (interview and observation) determined microscopic diagnostic capacity at 11.4% of primary care facilities, 57.1% of secondary care facilities, and 0% of *corregimiento*-level vector control units.

*Table 5.14: Microscopy and thick blood film sampling according to interview + observation*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Primary care units | | | | |
| Unit takes thick blood film samples | 44 | 23 | 52.3 | (37 - 67) |
| Unit has microscopy capacity | 44 | 5 | 11.4 | (5 - 25) |
| Secondary care units | | | | |
| Unit takes thick blood film samples | 7 | 4 | 57.1 | (22 - 86) |
| Unit has microscopy capacity | 7 | 4 | 57.1 | (22 - 86) |
| Vector control units (Corregimiento) | | | | |
| Unit takes thick blood film samples | 8 | 7 | 87.5 | (45 - 98) |
| Unit has microscopy capacity | 8 | 0 | 0 | ( - ) |

According to the interview alone and as seen in Table 5.15, 61% of all facilities (regardless of type) have personnel that take TBF samples in-facility, and 42.4% have personnel that take TBF samples in the community.

*Table 5.15: Thick blood film sampling according to interview*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Health personnel in this facility take thick blood film samples in-facility | 59 | 36 | 61 | (48 - 73) |
| Health personnel take thick blood film samples in the community | 59 | 25 | 42.4 | (30 - 56) |

As shown in Table 5.16 and regardless of facility type, 37.1% 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 13 facilities that report conducting initial diagnosis, 45.5% also examine samples taken by community health workers or volunteer/community collaborators, and 75% sometimes send slides elsewhere for initial diagnosis (for example, when the sole laboratorist is on leave). Among the 22 facilities that do not conduct initial diagnosis, 100% send samples to another facility for initial diagnosis.

Among all 31 facilities that send samples to another facility (sometimes or always), 45.2% report sending them to the regional laboratory, while 22.6% report sending them directly to the national laboratory for initial diagnosis (Table 5.17). The “other” option includes sending samples to the regional vector control office.

*Table 5.16: Microscopy capacity in facility according to interview*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Thick blood film samples examined for initial diagnosis of malaria in-facility | 35 | 13 | 37.1 | (23 - 54) |
| Thick blood film samples taken by community health workers (health promotors/volunteer collaborators) examined for malaria in-facility | 11 | 5 | 45.5 | (20 - 74) |
| Samples sometimes sent elsewhere for initial diagnosis of malaria, among facilities with capacity | 12 | 9 | 75 | (44 - 92) |
| Samples sent elsewhere for initial diagnosis of malaria, among facilities without capacity | 22 | 22 | 100 | ( - ) |

*Table 5.17: Samples sent elsewhere: location*

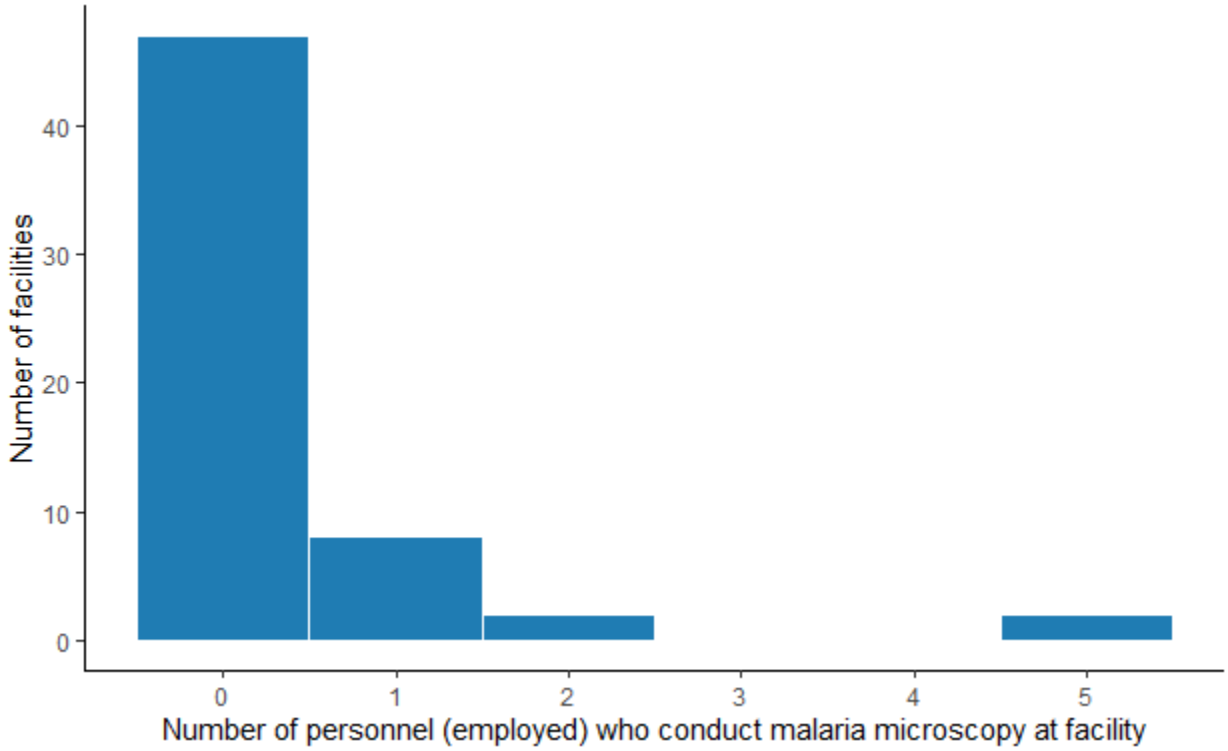
| | N | n | % | 95% CI |
|---|---|---|---|---|
| Location of initial diagnosis | | | | |
| Regional laboratory | 31 | 14 | 45.2 | (28 - 63) |
| National laboratory | 31 | 7 | 22.6 | (11 - 41) |
| Another health facility | 31 | 7 | 22.6 | (11 - 41) |
| Other | 31 | 3 | 9.7 | (3 - 27) |

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 53.8% of facilities there is at least one malaria microscopist, 23.1% of facilities have at least one microbiologist who conducts malaria diagnosis, and 23.1% have other lab personnel that read malaria slides (Table 5.18). The “other” option shows that vector control personnel located at the health facility performed TBF examinations. Figure 5.2 shows the number of employed personnel of all personnel types who conduct malaria diagnosis at each facility in the sample.

*Table 5.18: Personnel responsible for malaria microscopy testing*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Personnel responsible for TBF examination | | | | |
| Malaria microscopist | 13 | 7 | 53.8 | (28 - 78) |
| Microbiologist (laboratory) | 13 | 3 | 23.1 | (7 - 53) |
| Other lab technician/ bioanalyst | 13 | 3 | 23.1 | (7 - 53) |
| Other | 13 | 2 | 15.4 | (4 - 46) |

*Figure 5.2: Diagnostic personnel employed by facilities*

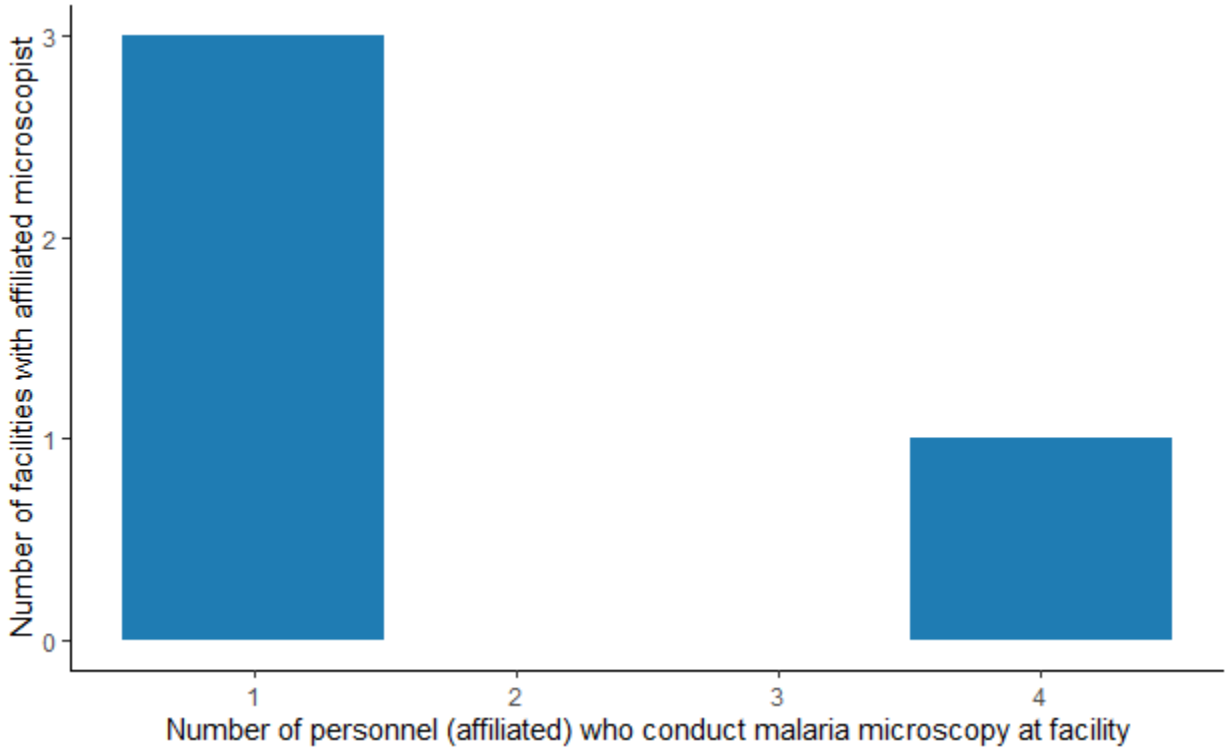



The health facility survey also asked about any affiliated personnel (employed by another institution rather than by the facility directly) who conduct malaria diagnosis. Only 6.7% of facilities had affiliated personnel involved in diagnosis (Table 5.19). Figure 5.3 shows the number of affiliated diagnostic personnel at each of the four facilities reporting affiliates.

*Table 5.19: Diagnostic personnel not employed but working in facility*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Affiliated microscopists work at but are not employed by facility | 60 | 4 | 6.7 | (2 - 17) |

*Figure 5.3: Diagnostic personnel affiliated to facilities*




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

In order to be able to detect and treat malaria, facilities must have certain basic supplies and equipment on hand. The indicator negotiated for RMEI considers whether these required basic inputs were observed at the facilities in the sample. The requirements vary by facility type, as detailed in Table 5.20.

*Table 5.20: Indicator P7.01: Required components by facility type*

| Component | Puesto de salud (20) | Sub centro de salud (3) | Centro de salud (20) | CAPSI (2) | CAPPS (1) | ULAPS (1) | Hospital (4) |
|---|---|---|---|---|---|---|---|
| Medications (basic) | | All | All | All | All | All | All |
| Sampling equipment | All | All | All | All | All | All | All |
| Forms for sending samples | All | | | | | | |
| Equipment for on-site diagnosis (RDT) | All | All | All | All | All | All | All |
| Microscopy equipment | | Stratum 3+ if microscopy reported | | | | | |
| Staining and sample reading equipment | | Stratum 3+ if microscopy reported | | | | | |
| Staining reagents | | Stratum 3+ if microscopy reported | | | | | |

The indicator results are shown in Table 5.21. Only 17.6% of all the facilities in the sample had all of the inputs required for the corresponding facility type. Table 5.22 shows, for comparison, the results in malaria stratum 4 versus malaria stratum 2 and 3. One facility is reported as stratum 2 due to a replacement situation for a stratum 3 facility that was being renovated at the time.

*Table 5.21: Indicator P7.01: Equipment and medications*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Antimalarial medications | 31 | 11 | 35.5 | (21 - 54) |
| Medications for basic treatment: Chloroquine | 31 | 11 | 35.5 | (21 - 54) |
| Medications for basic treatment: Primaquine (5 or 15 mg tablets) | 31 | 11 | 35.5 | (21 - 54) |
| No stockout of chloroquine or primaquine in past 3 months | 31 | 11 | 35.5 | (21 - 54) |
| Sampling and biosafety equipment | 33 | 27 | 81.8 | (64 - 92) |
| Disposable gloves | 33 | 33 | 100 | ( - ) |
| Lancets | 33 | 29 | 87.9 | (71 - 96) |
| Microscope slides (frosted or non-frosted) | 33 | 28 | 84.8 | (68 - 94) |
| Sample submission forms | 3 | 3 | 100 | ( - ) |
| RDTs for onsite testing | 51 | 18 | 35.3 | (23 - 50) |
| Microscopy equipment | 9 | 9 | 100 | ( - ) |
| Binocular microscope (with 100x retractable lens) | 9 | 9 | 100 | ( - ) |
| Cell counter (manual or automatic) | 9 | 9 | 100 | ( - ) |
| Equipment for staining and testing | 9 | 8 | 88.9 | (48 - 99) |
| Immersion oil | 9 | 8 | 88.9 | (48 - 99) |
| Staining tray/ container | 9 | 9 | 100 | ( - ) |
| Laboratory stopwatch | 9 | 9 | 100 | ( - ) |
| Container for mixing dye/ stain | 9 | 9 | 100 | ( - ) |
| Pipettes/ droppers/ syringes | 9 | 9 | 100 | ( - ) |
| Reagents for staining | 9 | 3 | 33.3 | (11 - 68) |
| GIEMSA solution (or alternative: Methylene blue + Solution A + Solution B + Methanol) | 9 | 8 | 88.9 | (48 - 99) |
| Buffer solution or buffered water | 9 | 5 | 55.6 | (24 - 83) |
| No stockout of reagents in past 3 months | 9 | 3 | 33.3 | (11 - 68) |
| Units with all required equipment and medications | 51 | 9 | 17.6 | (9 - 31) |

*Table 5.22: Comparison: result by facility stratification*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| P7.01 Equipment Indicator | | | | |
| Stratum 2 and 3 | 19 | 1 | 5.3 | (1 - 31) |
| Stratum 4 | 32 | 8 | 25 | (13 - 43) |
| Total | 51 | 9 | 17.6 | (9 - 31) |

### 5.3.3 Stock of microscopy inputs and equipment

The observation module of the health facility survey checked stock of sample-taking and microscopy supplies and equipment. Each item in the observation list had to be observed by the surveyor, checked for functionality, in the case of equipment, and recorded to the electronic module. Table 5.23 and Table 5.24 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 5.23: Sample-taking supplies observed*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Disposable gloves | 42 | 40 | 95.2 | (82 - 99) |
| Alcohol swabs | 42 | 29 | 69 | (53 - 81) |
| Cotton-wool swabs | 42 | 30 | 71.4 | (56 - 83) |
| Acetone or Acetone alcohol (antiseptic) | 42 | 24 | 57.1 | (42 - 71) |
| Lancets | 42 | 35 | 83.3 | (68 - 92) |
| Syringes (for taking blood) | 42 | 36 | 85.7 | (71 - 94) |
| Needles | 42 | 34 | 81 | (66 - 90) |
| Vacutainer-type needles | 42 | 17 | 40.5 | (27 - 56) |
| Capillary tubes | 42 | 15 | 35.7 | (22 - 52) |
| Sharps box | 42 | 39 | 92.9 | (80 - 98) |
| Microscope slides (not frosted) | 42 | 28 | 66.7 | (51 - 79) |
| Frosted microscope slides | 42 | 23 | 54.8 | (39 - 69) |

*Table 5.24: Microscopy equipment and supplies observed, among all facilities reporting microscopy capacity*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Lens-cleaning tissues | 10 | 10 | 100 | ( - ) |
| Spare bulbs (for microscopes) | 10 | 9 | 90 | (52 - 99) |
| Spare fuses (for microscopes) | 10 | 7 | 70 | (37 - 90) |
| Immersion oil | 10 | 9 | 90 | (52 - 99) |
| Oil immersion lens-cleaning solution | 10 | 5 | 50 | (22 - 78) |
| Staining rack | 10 | 9 | 90 | (52 - 99) |
| Drying rack (or sheet) | 10 | 9 | 90 | (52 - 99) |
| Measuring cylinder/disposable graduated cylinder | 10 | 8 | 80 | (45 - 95) |
| Glass or plastic bottles with a lid, that do not allow the passage of light | 10 | 7 | 70 | (37 - 90) |
| Filter paper (or other input to act as filter paper) | 10 | 8 | 80 | (45 - 95) |
| Slide holders or wooden dowels | 10 | 9 | 90 | (52 - 99) |
| Containers for mixing dye or stain | 10 | 7 | 70 | (37 - 90) |
| Concave staining surface | 10 | 5 | 50 | (22 - 78) |
| Staining tray/sheet/container | 10 | 6 | 60 | (29 - 85) |
| Glass petri dish | 10 | 3 | 30 | (10 - 63) |
| Plastic petri dish | 10 | 1 | 10 | (1 - 48) |
| Syringes | 10 | 6 | 60 | (29 - 85) |
| Disposable droppers | 10 | 8 | 80 | (45 - 95) |
| Test tubes with screw caps | 10 | 8 | 80 | (45 - 95) |
| Test tubes without caps (glass or plastic)* | 2 | 1 | 50 | (5 - 95) |
| Safety glasses (including the over-spectacle type) | 10 | 8 | 80 | (45 - 95) |
| Gowns | 10 | 10 | 100 | ( - ) |
| Markers | 10 | 10 | 100 | ( - ) |
| Detergents | 10 | 10 | 100 | ( - ) |
| Timer in laboratory | 10 | 8 | 80 | (45 - 95) |

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

Each microscope present at facilities in the sample was observed separately for characteristics. The number of microscopes at each facility is detailed in Figure 5.4. The observed characteristics, by microscope, are shown in Table 5.26.

*Figure 5.4: Functional microscopes per facility*

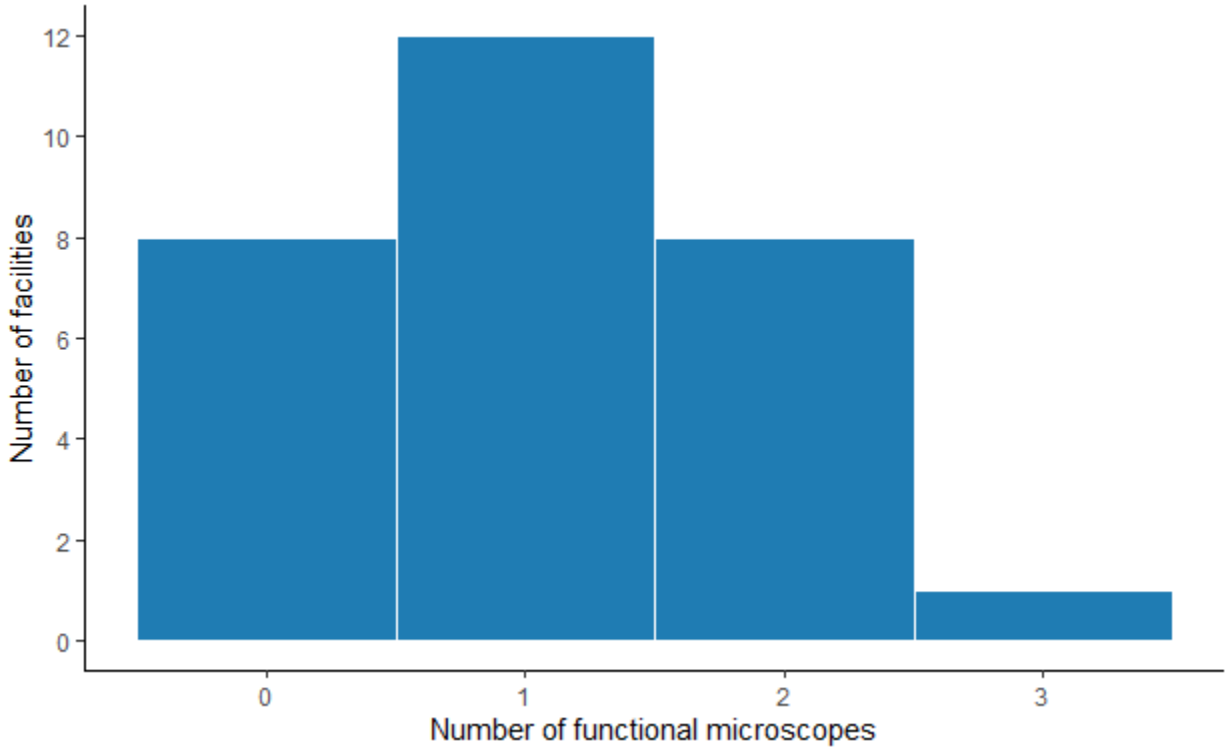



*Table 5.26: Microscope characteristics among all observed microscopes*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Is this a binocular microscope? | 31 | 29 | 93.5 | (77 - 98) |
| Is this a light microscope? | 31 | 30 | 96.8 | (80 - 100) |
| Is this a fluorescence microscope? | 31 | 10 | 32.3 | (18 - 50) |
| Is this a dark field microscope? | 31 | 10 | 32.3 | (18 - 50) |
| Is this a solar power microscope? | 31 | 4 | 12.9 | (5 - 30) |
| Lens observed: 4x | 31 | 11 | 35.5 | (21 - 54) |
| Lens observed: 10x | 31 | 28 | 90.3 | (74 - 97) |
| Lens observed: 20x | 31 | 21 | 67.7 | (50 - 82) |
| Lens observed: 40x | 31 | 28 | 90.3 | (74 - 97) |
| Lens observed: 100x | 31 | 25 | 80.6 | (63 - 91) |
| Lens observed: 1000x | 31 | 7 | 22.6 | (11 - 41) |
| Does the binocular microscope have an oil immersion lens? | 29 | 26 | 89.7 | (72 - 97) |

# 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 Panama, active case detection is carried out by vector control personnel both through planned activities and in response to malaria cases confirmed in areas without ongoing transmission. Passive case detection relies on health facilities to suspect and test for malaria in patients who present with fever or other malaria symptoms, and is a key component of malaria program strategy in the elimination phase.

In Panama, 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 collaborators (*colaboradores comunitarios*, CCs) based in localities with difficult access to health facilities. Community members experiencing fever or other malaria symptoms can seek out the col-vol/CC, who will take a blood sample if he or she suspects the patient may have malaria.

## 6.1 Active case detection and outreach

As a part of the health facility interview, respondents were asked about community health workers affiliated with the facility. Many primary care facilities had at least one community health worker affiliated, most of whom were involved in malaria service provision. Volunteer collaborators were sometimes affiliated to vector control offices (Table 6.1).

*Table 6.1: Affiliated malaria personnel*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Primary care units | | | | |
| Community health workers/volunteer collaborators | 44 | 21 | 47.7 | (33 - 63) |
| Community health workers/volunteer collaborators involved in malaria activities (such as vector control, diagnosis, case detection, or treatment) | 21 | 14 | 66.7 | (44 - 84) |
| Other personnel involved in malaria diagnosis or treatment | 44 | 9 | 20.5 | (11 - 35) |
| Secondary care units | | | | |
| Community health workers/volunteer collaborators | 7 | 2 | 28.6 | (7 - 68) |
| Community health workers/volunteer collaborators involved in malaria activities (such as vector control, diagnosis, case detection, or treatment) | 2 | 2 | 100 | ( - ) |
| Other personnel involved in malaria diagnosis or treatment | 7 | 2 | 28.6 | (7 - 68) |
| Vector control units (Corregimiento) | | | | |
| Community health workers/volunteer collaborators | 8 | 4 | 50 | (19 - 81) |
| Other personnel involved in malaria diagnosis or treatment | 8 | 4 | 50 | (19 - 81) |

As shown in Table 6.2, 52.4% of primary care facilities, 57.1% of secondary care facilities and 100% of *corregimiento*-level vector control units reported that facility personnel participate in active searches for malaria. Some *corregimiento*-level vector control units also reported storing mosquito nets for distribution

(25%) and employing personnel involved with indoor residual spraying (87.5%). Educational campaigns about malaria were conducted by 100% of *corregimiento*-level vector control units.

*Table 6.2: Active case detection and community activities*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Primary care units | | | | |
| Conducts active search for malaria cases | 42 | 22 | 52.4 | (37 - 67) |
| Stores insecticide-treated mosquito nets for distribution in the community | 44 | 2 | 4.5 | (1 - 17) |
| Performs indoor residual spraying | 43 | 13 | 30.2 | (18 - 46) |
| Conducts educational campaigns about malaria in the community | 44 | 33 | 75 | (60 - 86) |
| Other malaria outreach activities | 44 | 8 | 18.2 | (9 - 33) |
| Secondary care units | | | | |
| Conducts active search for malaria cases | 7 | 4 | 57.1 | (22 - 86) |
| Stores insecticide-treated mosquito nets for distribution in the community | 7 | 0 | 0 | ( - ) |
| Performs indoor residual spraying | 7 | 2 | 28.6 | (7 - 68) |
| Conducts educational campaigns about malaria in the community | 7 | 4 | 57.1 | (22 - 86) |
| Other malaria outreach activities | 6 | 1 | 16.7 | (2 - 65) |
| Vector control units (Corregimiento) | | | | |
| Conducts active search for malaria cases | 8 | 8 | 100 | ( - ) |
| Stores insecticide-treated mosquito nets for distribution in the community | 8 | 2 | 25 | (6 - 63) |
| Performs indoor residual spraying | 8 | 7 | 87.5 | (45 - 98) |
| Conducts educational campaigns about malaria in the community | 8 | 8 | 100 | ( - ) |
| Other malaria outreach activities | 8 | 3 | 37.5 | (12 - 72) |

Facilities that reported participation in active search for malaria cases were asked about how active case detection activities are planned in the community. As shown in Table 6.3, many facilities (regardless of facility type) reported they do active case detection after there is a case of malaria in the catchment area (41.2% of facilities). Among the 17.6% of facilities that reported doing active search according to direction from health authorities, 83.3% said the direction came from the local malaria management team (Table 6.4).

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

*Table 6.3: Determinants of active case detection*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| When do you search for suspected malaria cases in your catchment area? | | | | |
| After there is a case of malaria in the catchment area | 34 | 14 | 41.2 | (26 - 59) |
| On a scheduled periodic basis | 34 | 13 | 38.2 | (23 - 56) |
| Daily | 34 | 6 | 17.6 | (8 - 35) |
| When directed from health authorities | 34 | 6 | 17.6 | (8 - 35) |
| When events (market, celebrations, vacations) are happening in the community | 34 | 5 | 14.7 | (6 - 31) |

*Table 6.4: Active case detection direction from health authorities*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Agency/level that orders the active search | | | | |
| Local malaria management team | 6 | 5 | 83.3 | (35 - 98) |
| Decided at this facility | 6 | 3 | 50 | (16 - 84) |
| Regional level | 6 | 1 | 16.7 | (2 - 65) |

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

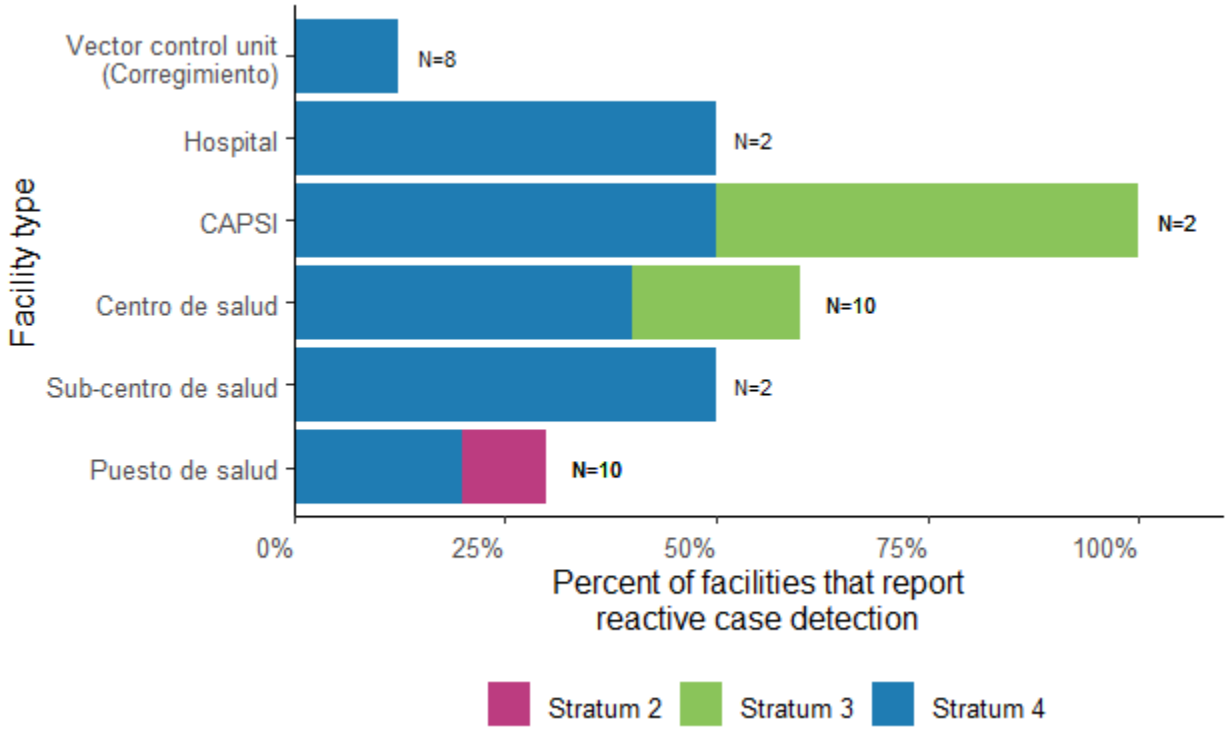
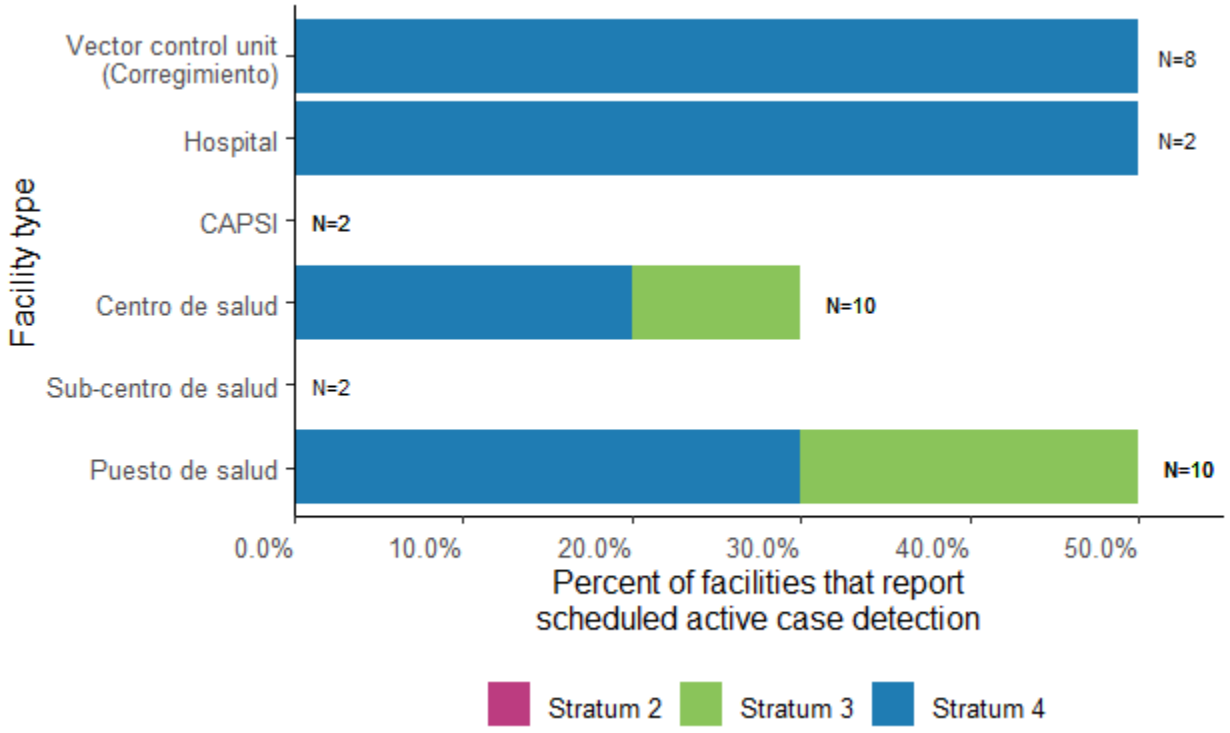


*Figure 6.2: Active case detection scheduled on a periodic basis, by facility type and stratification*




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

*Table 6.5: Community net distribution*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Mode of treated net distribution | | | | |
| Vector control personnel distributes the nets in the community | 4 | 3 | 75 | (23 - 97) |
| Personnel from this health facility distributes the nets in the community | 4 | 1 | 25 | (3 - 77) |
| Don't know | 4 | 1 | 25 | (3 - 77) |

Respondents were also asked a series of questions about malaria detection activities in the community and referrals from community health workers. Among facilities that administer malaria treatment, 14.3% of primary care units and 14.3% of secondary care units received referrals from col-vols/CCs or other community health workers to treat malaria. Diagnosis activities were common, with 25% of primary care facilities receiving referrals for malaria testing, 34.1% of primary care units taking TBF samples in the community, and 25% of primary care units taking RDTs in the community.

*Table 6.6: Community malaria activities - questionnaire*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Primary care units | | | | |
| Do you receive referred patients from community health workers or volunteer collaborators for malaria testing? | 44 | 11 | 25 | (14 - 40) |
| Do you receive referred patients from community health workers or volunteer collaborators for malaria treatment? | 42 | 6 | 14.3 | (6 - 29) |
| Do health personnel take thick blood film samples in the community? | 44 | 15 | 34.1 | (21 - 50) |
| Do health personnel in this facility perform rapid diagnostic testing for malaria in the community? | 44 | 11 | 25 | (14 - 40) |
| Do community health workers or volunteer collaborators receive malaria rapid tests from this facility for use in the community? | 42 | 7 | 16.7 | (8 - 32) |
| Secondary care units | | | | |
| Do you receive referred patients from community health workers or volunteer collaborators for malaria testing? | 7 | 1 | 14.3 | (2 - 60) |
| Do you receive referred patients from community health workers or volunteer collaborators for malaria treatment? | 7 | 1 | 14.3 | (2 - 60) |
| Do health personnel take thick blood film samples in the community? | 7 | 3 | 42.9 | (14 - 78) |
| Do health personnel in this facility perform rapid diagnostic testing for malaria in the community? | 7 | 3 | 42.9 | (14 - 78) |
| Do community health workers or volunteer collaborators receive malaria rapid tests from this facility for use in the community? | 7 | 1 | 14.3 | (2 - 60) |
| Vector control units (Corregimiento) | | | | |
| Do you receive referred patients from community health workers or volunteer collaborators for malaria testing? | 8 | 3 | 37.5 | (12 - 72) |
| Do health personnel take thick blood film samples in the community? | 8 | 7 | 87.5 | (45 - 98) |
| Do health personnel in this facility perform rapid diagnostic testing for malaria in the community? | 8 | 8 | 100 | ( - ) |
| Do community health workers or volunteer collaborators receive malaria rapid tests from this facility for use in the community? | 8 | 4 | 50 | (19 - 81) |

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

Personnel in health facilities are trained to suspect and test for malaria in patients who present with fever or other symptoms to the facility, known as passive case detection. Patients presenting with clinical signs that meet the definition of a suspected malaria case will have a sample taken, usually of capillary blood, to prepare a TBF slide and sometimes to perform a rapid diagnostic test as well. If the *Plasmodium* parasite is detected via rapid test or microscopy, treatment with the first-line regimen corresponding to the parasite species begins and the case is notified to *corregimiento*-level vector control personnel and to the regional health authority. If the health facility the patient visits does not have microscopic diagnostic capacity, or if the patient visits a col-vol/CC for testing, the TBF slide is sent, along with a suspected case notification form filled by the provider who took the sample, to a nearby lab for testing, transported by vector control technicians who either visit on a regular basis (usually at least weekly) for pickup or who

are notified by phone that a slide is ready for testing. The slide is tested by the lab, and in the case that malaria is confirmed, vector control personnel are notified so that they can locate the patient and begin to administer treatment.

During the health facility interview, respondents in facilities that reported conducting malaria tests were asked who decides whether a patient will receive a diagnostic test for malaria, and could indicate more than one personnel type. Table 6.7 shows that doctors order the test in 78.3% of primary care facilities and 100% of secondary care facilities, and nurses order the test or take the sample at triage in 13% of primary care facilities. Text responses entered for "other" in primary care units include health assistant, col-vol, and vector control personnel.

*Table 6.7: Malaria testing by facility personnel among facilities conducting testing*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Primary care units: Who decides whether a patient presenting at this facility will receive a malaria test? | | | | |
| Nurse at triage or pre-clinic | 23 | 3 | 13 | (4 - 34) |
| Doctor during consult | 23 | 18 | 78.3 | (56 - 91) |
| Lab staff or microscopy staff | 23 | 2 | 8.7 | (2 - 30) |
| Other | 23 | 5 | 21.7 | (9 - 44) |
| Secondary care units: Who decides whether a patient presenting at this facility will receive a malaria test? | | | | |
| Nurse at triage or pre-clinic | 5 | 0 | 0 | ( - ) |
| Doctor during consult | 5 | 5 | 100 | ( - ) |
| Lab staff or microscopy staff | 5 | 0 | 0 | ( - ) |
| Other | 5 | 0 | 0 | ( - ) |

Next, respondents were asked to mention what criteria are used to determine whether a patient gets a malaria test, at triage (Table 6.8) and at consult (Table 6.9). The respondent answered with the criteria they use at the facility and the interviewer marked the corresponding options in the survey without reading them aloud. In both triage and consult, high fever was an important criterion that determined testing (100% and 82.6% respectively) and chills was also frequently mentioned (in 66.7% of facilities at triage). Few respondents mentioned travel history as a determining factor for malaria testing.

*Table 6.8: Malaria testing criteria at triage*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| What criteria must a patient meet in order to get a blood sample taken for malaria test during triage or pre-clinic? | | | | |
| High fever | 3 | 3 | 100 | ( - ) |
| Fever for more than 3 days | 3 | 2 | 66.7 | (14 - 96) |
| Chills | 3 | 2 | 66.7 | (14 - 96) |
| General malaise | 3 | 2 | 66.7 | (14 - 96) |
| History of recent fever | 3 | 1 | 33.3 | (4 - 86) |
| History of recent travel to areas with endemic malaria | 3 | 1 | 33.3 | (4 - 86) |

*Table 6.9: Malaria testing criteria at consultation*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| What criteria must a patient meet in order for the doctor to order a malaria test during the consultation? | | | | |
| High fever | 23 | 19 | 82.6 | (61 - 94) |
| Chills | 23 | 9 | 39.1 | (21 - 60) |
| General malaise | 23 | 6 | 26.1 | (12 - 48) |
| History of recent travel to areas with endemic malaria | 23 | 6 | 26.1 | (12 - 48) |
| History of recent fever | 23 | 5 | 21.7 | (9 - 44) |
| Sweating | 23 | 5 | 21.7 | (9 - 44) |

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Fever without respiratory symptoms | 23 | 3 | 13 | (4 - 34) |
| Prior history of malaria | 23 | 1 | 4.3 | (1 - 26) |
| Other | 23 | 1 | 4.3 | (1 - 26) |

## 6.3 Fever cases with blood test (LQAS survey)

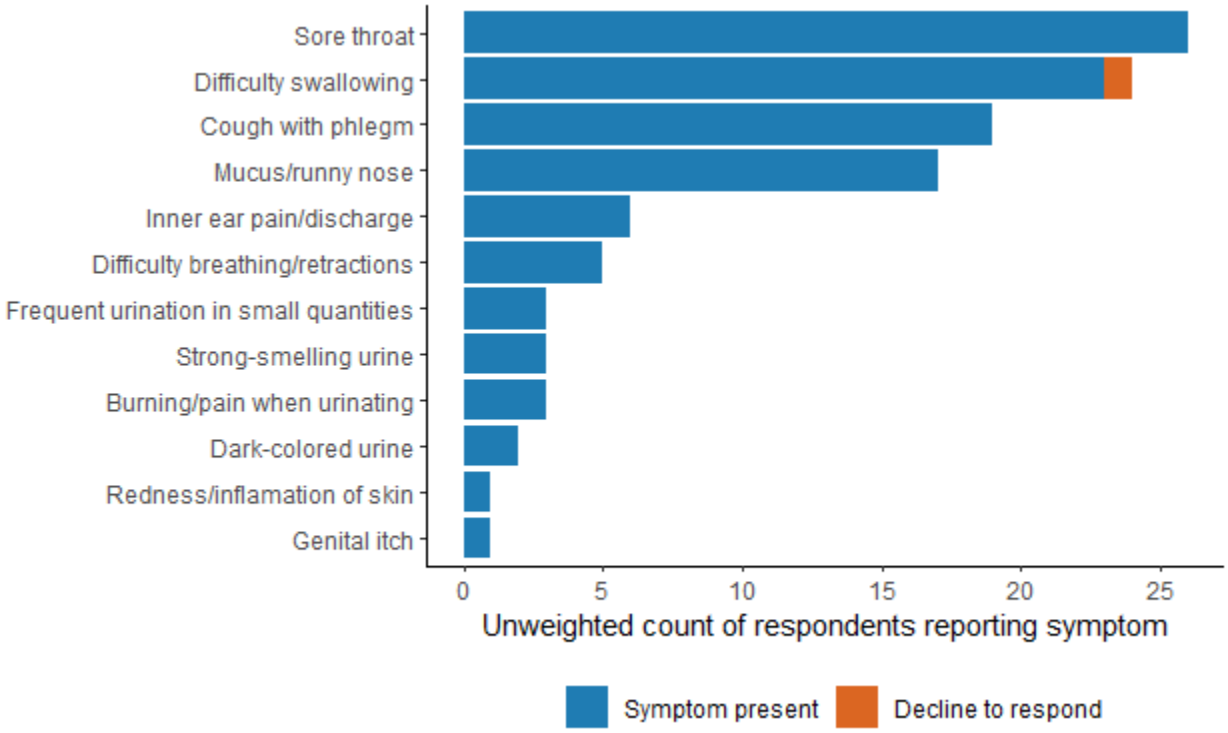
In the community survey (LQAS), interviews with households included questions about history of fever during the two weeks prior to the survey for all usual members of the household. The estimates from the LQAS survey reported in this section are not weighted due to the very small size of the sub-sample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

If the primary interview respondent reported that a household member had a recent fever, the interviewer asked to speak to the person who had the fever, or in the case that a child or adolescent had a fever, with the child's primary caregiver. If the person with the fever was not available and the primary respondent knew the details of their recent fever, that person was permitted to respond on behalf of the fever patient. The respondent answered questions about other symptoms suffered during the febrile illness and whether and where they sought medical attention. As seen in Table 6.10, 2.9% of the individuals whose households were selected for the LQAS survey experienced a fever during the two weeks prior to the date of the survey. However, not all patients with fever need to be tested for malaria according to suspected case definitions: patients with respiratory symptoms, urinary symptoms, or skin symptoms suggesting an infection unrelated to malaria will receive a clinical diagnosis and treatment without needing to test to rule out malaria. Of the 54 respondents who reported experiencing fever, the majority experienced other symptoms that suggested a condition other than malaria. Only 16 people, or 29.6% of the individuals reporting fever, were free of other symptoms excluding them from having to receive a malaria test. The simultaneous symptoms reported by respondents who experienced a recent fever are detailed in Figure 6.3.

*Table 6.10: Eligible fever cases reported in LQAS household survey*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| LQAS respondents | 1843 | 1843 | 100 | ( - ) |
| Fever cases in the last two weeks | 1835 | 54 | 2.9 | (2 - 5) |
| Fever without exclusion symptoms | 54 | 16 | 29.6 | (17 - 47) |

*Figure 6.3: Exclusion symptoms experienced by respondents reporting fever*




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

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

All respondents reporting fever without exclusion symptoms were asked whether, during the illness, a blood sample was taken from their finger, heel, earlobe, or vein. As shown in Table 6.11, 56.2% of respondents with an eligible fever (with no exclusion symptoms) had a blood sample taken.

*Table 6.11: Indicator 2.02: Fevers with blood sample*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Fever cases in past two weeks | 1835 | 54 | 2.9 | (2 - 5) |
| Fevers with no exclusion symptoms | 54 | 16 | 29.6 | (17 - 47) |
| Omitted due to 'do not know' responses | 16 | 0 | 0 | ( - ) |
| Fevers with any blood sample | 16 | 9 | 56.2 | (22 - 85) |
| Capillary blood test | 16 | 9 | 56.2 | (22 - 85) |
| Venal blood test | 16 | 3 | 18.8 | (7 - 40) |

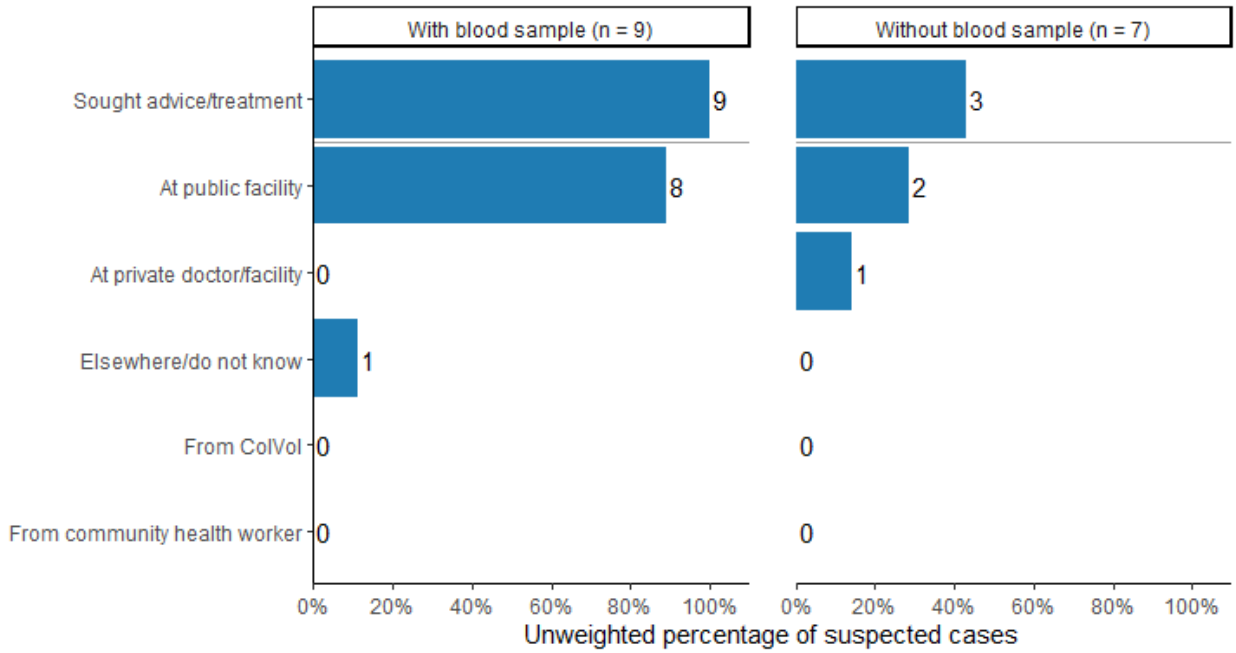
Respondents who reported a blood sample draw were asked whether their blood was tested for malaria, and if so, the result of the test. As seen in Table 6.13, 88.9% of respondents with a blood sample reported a malaria test, and 87.5% of those who had the malaria test reported a negative result.

*Table 6.13: Result of blood tests, LQAS fevers*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Blood tested for malaria | 9 | 8 | 88.9 | (85 - 92) |
| Result of malaria test | | | | |
| Negative malaria | 8 | 7 | 87.5 | (83 - 91) |
| Positive malaria | 8 | 1 | 12.5 | (9 - 17) |

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

*Figure 6.4: Treatment sought by respondents with fever cases*




The calculation for Indicator 2.02 is presented in Table 6.14 both excluding cases with symptoms suggesting an illness other than malaria (56.2%) and including all fever cases reported from the past two weeks (48.1%).

*Table 6.14: Indicator 2.02: Fevers with blood sample, with and without exclusion symptoms*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Fevers (with no exclusion symptoms) with any blood sample | 16 | 9 | 56.2 | (22 - 85) |
| All fevers with any blood sample | 54 | 26 | 48.1 | (31 - 65) |

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

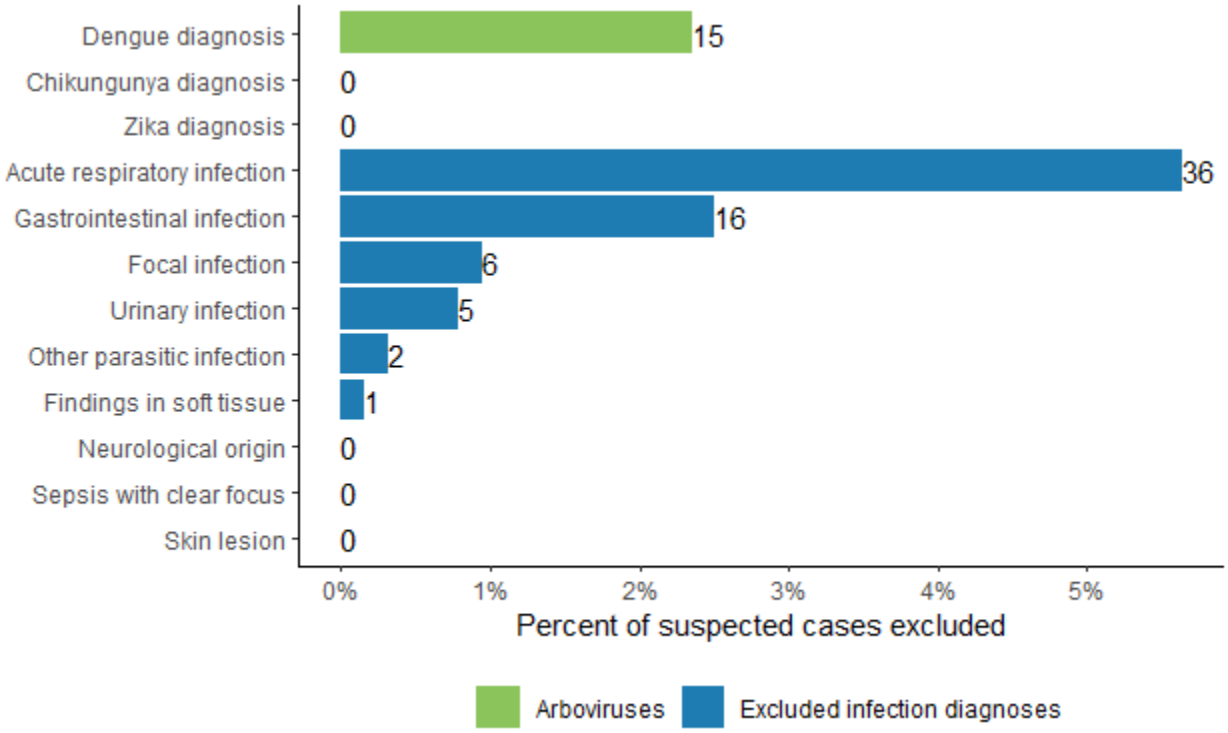
For a clinical comparison to the indicator measured in the LQAS survey, the health facility survey included a review of medical records of patients with fever or other malaria symptoms (suspected cases of malaria). In each facility that provided care to patients, field personnel selected eligible patient visits based on attention registries or diagnosis databases according to the process described in Chapter 2 and Appendix C. The eligible time window for review was the calendar year 2018. Suspected cases with an eligible diagnosis or principal complaint (details in Appendix B, Indicator 2.01) were selected at random,

and all relevant records of the patient's visit were sought out for completion of a chart review module. For each case, field staff reviewed attention registries, laboratory records, and patient medical records as available and entered information related to the diagnosis, symptoms, and lab tests to the electronic survey module. No information that could identify the patients was collected.

Many health facilities were not able to meet the quota of medical records that meet the criteria to be reviewed for suspected malaria cases. Only 10 facilities were able to meet the assigned quota and eight facilities had medical records and the field team reviewed all eligible medical records from 2018, but did not meet the quota. Suspected case medical record review was not able to be completed at the 13 remaining health facilities and no medical records were reviewed.

Some of the sampled records were eligible to be selected based on information on the attention registry, such as a primary or initial diagnosis from the inclusion list, but upon review of the full chart, were found to be ineligible due to a diagnosis of another identified infection with clear cause or a diagnosis of arbovirus with a positive viral test result documented. The frequency of diagnoses of exclusion among cases ruled ineligible after sample selection is shown in Figure 6.5. Each of these ineligible records was replaced with an alternate record selected to a back-up sample in order to ensure completion of the total quota for medical record reviews in each facility. In some primary care facilities, field personnel found an inadequate number of eligible attentions from the year 2018 to meet the quota, and all eligible cases from 2018 were reviewed.

*Figure 6.5: Exclusion diagnoses for review of suspected malaria cases*

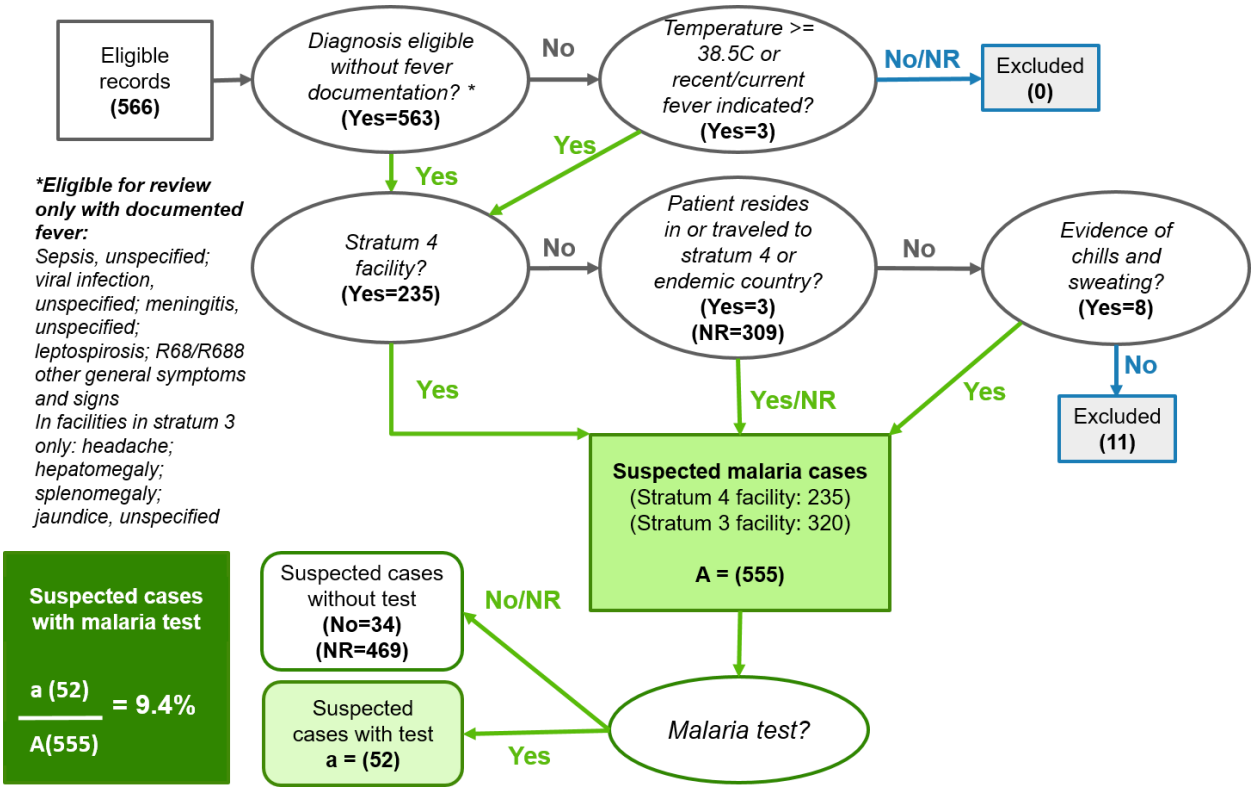



### 6.4.1 Indicator 2.01: Suspected malaria cases with parasitological test (medical record review)

IHME conducted a second eligibility review of the data collected from medical records in order to identify the cases eligible for inclusion in indicator 2.01 (suspected cases with malaria test) according to a decision algorithm shown in Figure 6.6. Facilities in malaria stratum 4 are subject to a different suspected malaria case definition than facilities in malaria stratum 3, where patients presenting with fever do not require a test to rule out malaria unless they traveled to an endemic area or show other malaria

symptoms like chills and sweating. Additionally, certain inclusion diagnoses only meet the suspected case definition (that is, malaria should be ruled out before making a clinical diagnosis of another condition) if the patient presented with fever or had a history of recent fever. Thus, additional ineligible records were identified and excluded from the indicator during the eligibility review.

*Figure 6.6: Eligibility of suspected cases reviewed for Indicator 2.01*




In total in Panama, 555 of the 566 suspected cases reviewed were eligible for consideration in indicator 2.01.

For the purposes of the indicator, cases with evidence that a malaria test was ordered or that a sample was taken, as well as cases with a malaria test result registered, were considered to have had a parasitological test. The test could be a rapid diagnostic test or thick blood film, and some patients had evidence of both tests in the record. As shown in Table 6.16, 9.4% of patients with suspected malaria had evidence that a malaria test was received. Of these 52 patients with evidence of a test, 82.7% received an RDT and 36.5% a TBF. For comparison, Table 6.17 shows the results by malaria stratum and Figure 6.7 shows the results by province/ comarca. The baseline measurement was not designed to produce representative estimates at the province/ comarca level, so results by province/ comarca should be interpreted with discretion.

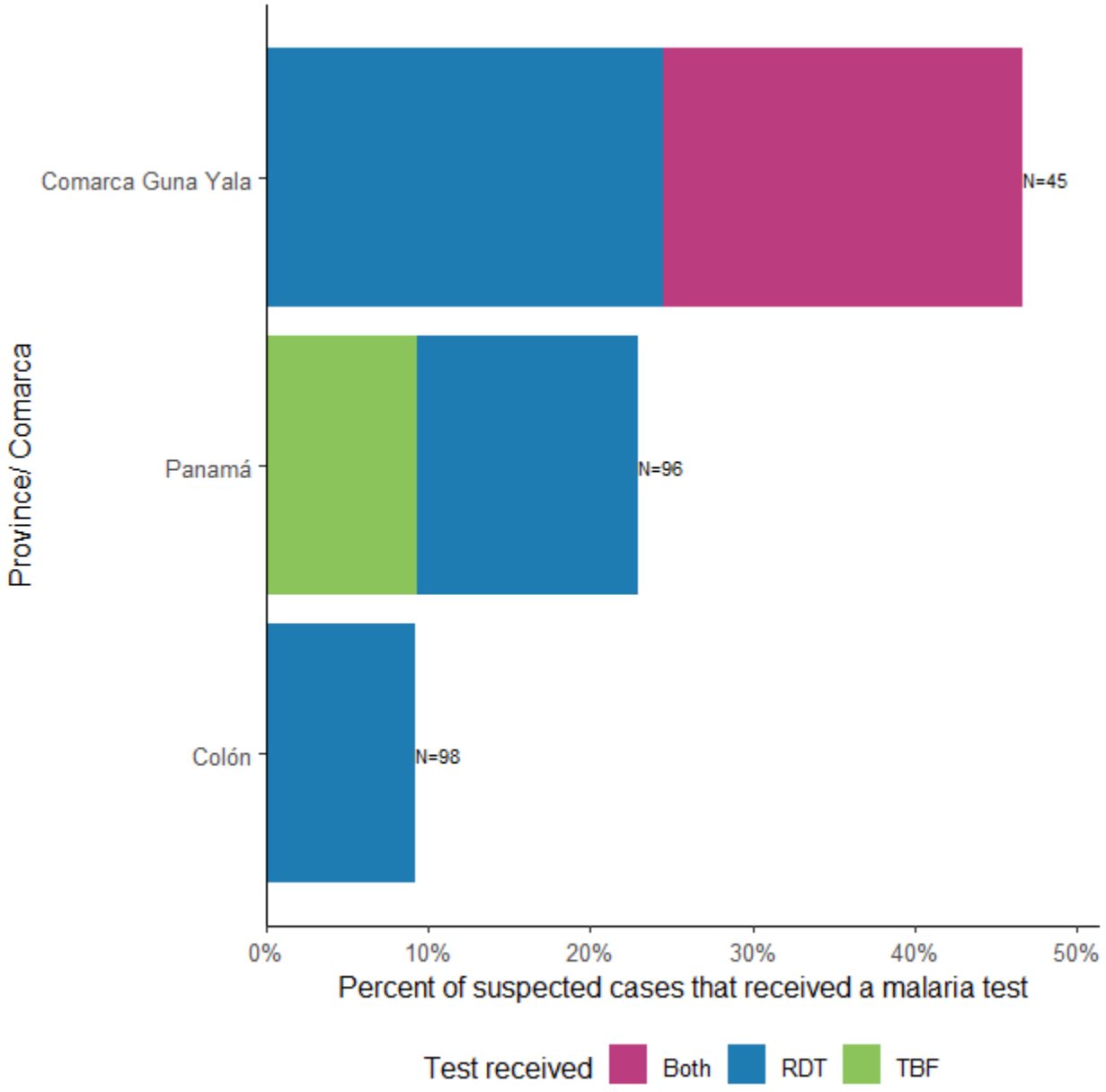
*Table 6.16: Indicator 2.01: Suspected cases with malaria test*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Suspected case with malaria test | 555 | 52 | 9.4 | (7 - 12) |
| Rapid diagnostic test | 52 | 43 | 82.7 | (70 - 91) |
| Thick blood film | 52 | 19 | 36.5 | (25 - 50) |

*Table 6.17: Comparison: result by facility stratification*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Suspected cases with malaria test | | | | |
| Stratum 3 | 320 | 9 | 2.8 | (1 - 5) |
| Stratum 4 | 235 | 43 | 18.3 | (14 - 24) |
| Total | 555 | 52 | 9.4 | (7 - 12) |

*Figure 6.7: Comparison: result by province/ comarca*




## 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 *corregimiento*-level vector control units selected to the sample, field personnel reviewed all paper records of confirmed malaria cases from the year 2018 stored at those units as described in Chapter 2. All case records that were stored at the *corregimiento*-level vector control units 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 *corregimiento*-level vector control unit.

Only one medical record was found and collected at *corregimiento*-level vector control units. The remaining confirmed case reports were found at primary and secondary care units that did the initial diagnosis of the case and at the vector control office for the comarca of Guna Yala, which was visited at the end of data collection.

Figure 6.8 shows that the majority of confirmed malaria case reviews used both the malaria specific individual 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. Other options include the generic communicable disease investigation form and the col-vol registry.

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

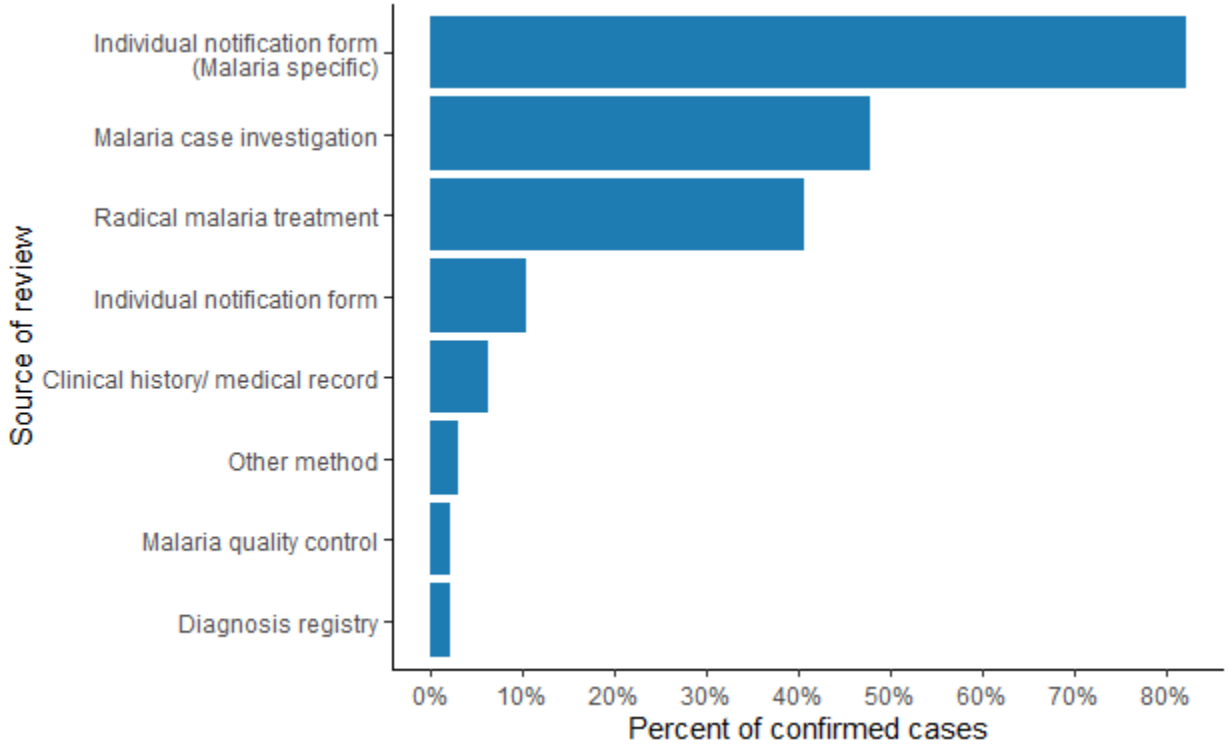
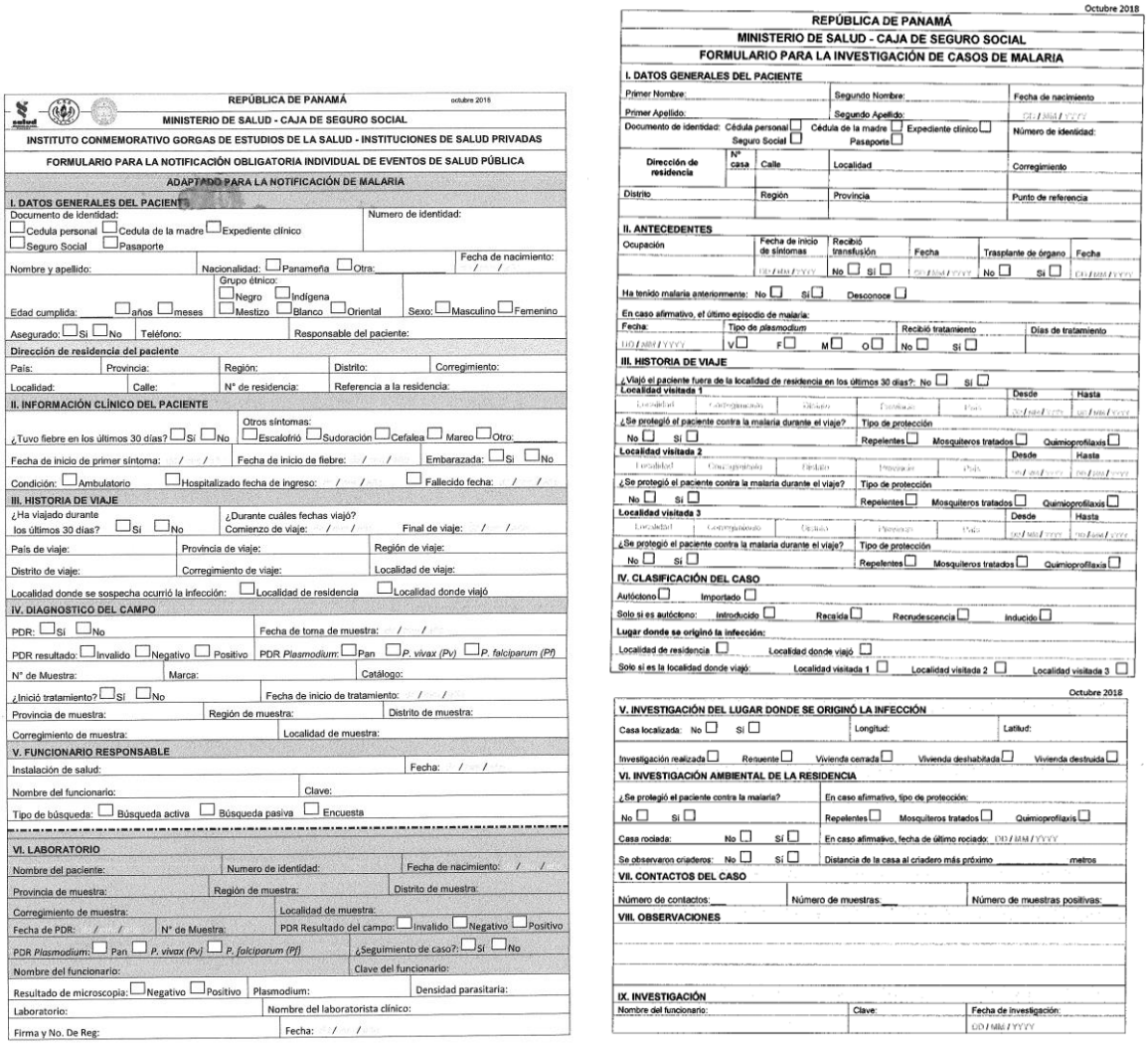


*Figure 6.9: Blank malaria specific individual case notification form and blank malaria case investigation forms*



REPÚBLICA DE PANAMÁ
octubre 2018
MINISTERIO DE SALUD - CAJA DE SEGURO SOCIAL
INSTITUTO CONMEMORATIVO GORGAS DE ESTUDIOS DE LA SALUD - INSTITUCIONES DE SALUD PRIVADAS
FORMULARIO PARA LA NOTIFICACIÓN OBLIGATORIA INDIVIDUAL DE EVENTOS DE SALUD PÚBLICA
ADAPTADO PARA LA NOTIFICACIÓN DE MALARIA

I. DATOS GENERALES DEL PACIENTE
Documento de Identidad: Cedula personal / Cedula de la madre / Expediente clínico / Seguro Social / Pasaporte
Numero de identidad:
Nombre y apellido:
Nacionalidad: Panameña / Otra:
Fecha de nacimiento:
Grupo étnico: Negro / Indígena / Mestizo / Blanco / Oriental
Edad cumplida: años / meses
Sexo: Masculino / Femenino
Asegurado: Si / No
Teléfono:
Responsable del paciente:
Dirección de residencia del paciente
País:
Provincia:
Región:
Distrito:
Corregimiento:
Localidad:
Calle:
N° de residencia:
Referencia a la residencia:

II. INFORMACIÓN CLÍNICO DEL PACIENTE
¿Tuvo fiebre en los últimos 30 días? Si / No
Otros síntomas: Escalofrió / Sudoración / Cefalea / Mareo / Otro:
Fecha de inicio de primer síntoma:
Fecha de inicio de fiebre:
Embarazada: Si / No
Condición: Ambulatorio / Hospitalizado fecha de ingreso: / Fallecido fecha:

III. HISTORIA DE VIAJE
¿Ha viajado durante los últimos 30 días? Si / No
¿Durante cuáles fechas viajó? Comienzo de viaje: Final de viaje:
País de viaje:
Provincia de viaje:
Región de viaje:
Distrito de viaje:
Corregimiento de viaje:
Localidad de viaje:
Localidad donde se sospecha ocurrió la infección: Localidad de residencia / Localidad donde viajó

IV. DIAGNOSTICO DEL CAMPO
PDR: Si / No
Fecha de toma de muestra:
PDR resultado: Invalido / Negativo / Positivo
PDR *Plasmodium*: Pan / *P. vivax (Pv)* / *P. falciparum (Pf)*
N° de Muestra:
Marca:
Catálogo:
¿Inició tratamiento? Si / No
Fecha de inicio de tratamiento:
Provincia de muestra:
Región de muestra:
Distrito de muestra:
Corregimiento de muestra:
Localidad de muestra:

V. FUNCIONARIO RESPONSABLE
Instalación de salud:
Fecha:
Nombre del funcionario:
Clave:
Tipo de búsqueda: Búsqueda activa / Búsqueda pasiva / Encuesta

VI. LABORATORIO
Nombre del paciente:
Numero de identidad:
Fecha de nacimiento:
Provincia de muestra:
Región de muestra:
Distrito de muestra:
Corregimiento de muestra:
Localidad de muestra:
Fecha de PDR:
N° de Muestra:
PDR Resultado del campo: Invalido / Negativo / Positivo
PDR *Plasmodium*: Pan / *P. vivax (Pv)* / *P. falciparum (Pf)*
¿Seguimiento de caso?: Si / No
Nombre del funcionario:
Clave del funcionario:
Resultado de microscopia: Negativo / Positivo
Plasmodium:
Densidad parasitaria:
Laboratorio:
Nombre del laboratorista clínico:
Firma y No. De Reg:
Fecha:

Octubre 2018
REPÚBLICA DE PANAMÁ
MINISTERIO DE SALUD - CAJA DE SEGURO SOCIAL
FORMULARIO PARA LA INVESTIGACIÓN DE CASOS DE MALARIA

I. DATOS GENERALES DEL PACIENTE
Primer Nombre:
Segundo Nombre:
Fecha de nacimiento
Primer Apellido:
Segundo Apellido:
Documento de identidad: Cédula personal / Cédula de la madre / Expediente clínico / Seguro Social / Pasaporte
Número de identidad:
Dirección de residencia
N° casa
Calle
Localidad
Corregimiento
Distrito
Región
Provincia
Punto de referencia

II. ANTECEDENTES
Ocupación
Fecha de inicio de síntomas
Recibió transfusión
Fecha
Trasplante de órgano
Fecha
Ha tenido malaria anteriormente: No / Si / Desconoce
En caso afirmativo, el último episodio de malaria:
Fecha:
Tipo de *plasmodium*: V / F / M / O
Recibió tratamiento: No / Si
Días de tratamiento

III. HISTORIA DE VIAJE
¿Viajó el paciente fuera de la localidad de residencia en los últimos 30 días?: No / Si
Localidad visitada 1
Desde
Hasta
¿Se protegió el paciente contra la malaria durante el viaje?
Tipo de protección
Repelentes / Mosquiteros tratados / Quimioprofilaxis
Localidad visitada 2
Desde
Hasta
¿Se protegió el paciente contra la malaria durante el viaje?
Tipo de protección
Repelentes / Mosquiteros tratados / Quimioprofilaxis
Localidad visitada 3
Desde
Hasta
¿Se protegió el paciente contra la malaria durante el viaje?
Tipo de protección
Repelentes / Mosquiteros tratados / Quimioprofilaxis

IV. CLASIFICACIÓN DEL CASO
Autóctono / Importado
Solo si es autóctono: Introducido / Recaída / Recrudescencia / Inducido
Lugar donde se originó la infección:
Localidad de residencia / Localidad donde viajó
Solo si es la localidad donde viajó: Localidad visitada 1 / Localidad visitada 2 / Localidad visitada 3

Octubre 2018
V. INVESTIGACIÓN DEL LUGAR DONDE SE ORIGINÓ LA INFECCIÓN
Casa localizada: No / Si
Longitud:
Latitud:
Investigación realizada / Renuente / Vivienda cerrada / Vivienda deshabitada / Vivienda destruida

VI. INVESTIGACIÓN AMBIENTAL DE LA RESIDENCIA
¿Se protegió el paciente contra la malaria?
En caso afirmativo, tipo de protección:
Repelentes / Mosquiteros tratados / Quimioprofilaxis
Casa rociada: No / Si
En caso afirmativo, fecha de último rociado:
Se observaron criaderos: No / Si
Distancia de la casa al criadero más próximo: metros

VII. CONTACTOS DEL CASO
Número de contactos:
Número de muestras:
Número de muestras positivas:

VIII. OBSERVACIONES

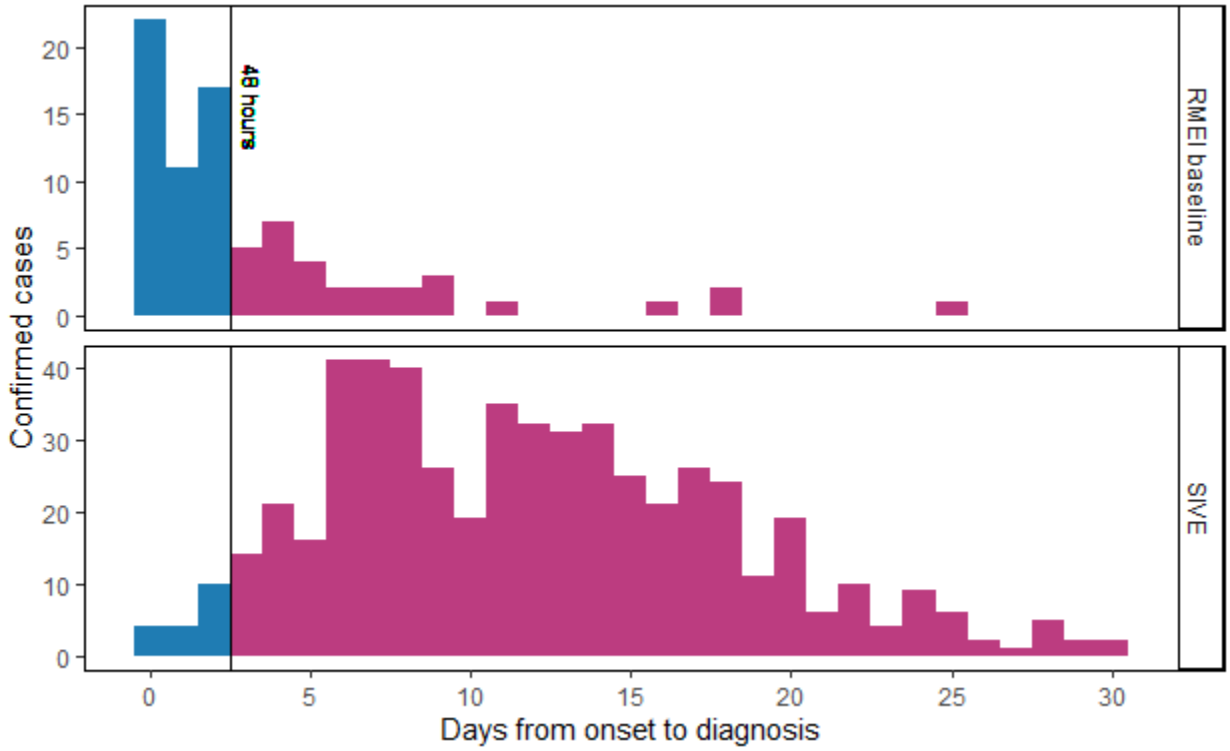
IX. INVESTIGACIÓN
Nombre del funcionario:
Clave:
Fecha de investigación:

All malaria case notification and malaria case investigation reports reviewed during baseline data collection were the original paper reports. These paper reports were completed while the patient was receiving care or while investigations were being conducted by vector control personnel and later the data were entered into the national surveillance database, SIVE (*Sistema Nacional de Vigilancia Epidemiológica*). All confirmed cases of malaria within Panama follow this process. IHME was provided the de-identified SIVE database for 2018 confirmed cases of malaria by the Panama Ministry of Health. When possible, the SIVE data are shown in comparison to the data collected by field staff during RMEI baseline data collection.

As a part of each record review module, field staff recorded the date of symptom onset, date of fever onset, and date of diagnosis from the malaria specific individual case notification and the malaria case investigation forms. Figure 6.11 shows the number of days from fever onset (or onset of other malaria symptoms, if date of fever onset was not recorded) to the date of diagnosis for paper records reviewed during the RMEI-baseline data collection and the SIVE database for all 2018 malaria cases. If diagnosis was recorded more than seven days before or more than 30 days after fever onset, the case is excluded from the indicator because of the suspicion of recording error (on the investigation form or in the survey

module). This suspected error affected 3 cases for RMEI-baseline data and 36 cases in the SIVE database, which are excluded from the figure. Data reviewed on paper records by the field team during the RMEI-baseline evaluation had a higher proportion of cases with a smaller time gap between symptom onset and diagnosis, compared to the SIVE surveillance system database.

*Figure 6.11: Time from symptom onset to diagnosis, RMEI baseline and surveillance database*




The personnel who performed the diagnosis of the reviewed confirmed malaria cases are reported in Table 6.18 (diagnosis by RDT) and Table 6.19 (diagnosis by TBF). Many reports did not have the personnel recorded (39% for records with RDT diagnosis and 14% for records with TBF diagnosis). The personnel most commonly recorded as collecting a RDT were laboratory technicians or microbiologists (18.3%) and vector control staff (13.4%). The personnel most commonly recorded as preparing TBFs were microscopists (54.4%) and doctors (12.3%). Other responses show that health promoters took RDTs.

*Table 6.18: Personnel who performed diagnosis of confirmed cases, RDT*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| RDT taken by: | | | | |
| Not registered | 82 | 32 | 39 | (29 - 50) |
| Lab tech/ microbiologist | 82 | 15 | 18.3 | (11 - 28) |
| Vector Control staff (VC) | 82 | 11 | 13.4 | (8 - 23) |
| Doctor | 82 | 10 | 12.2 | (7 - 21) |
| Community Health Worker (CHW) | 82 | 9 | 11 | (6 - 20) |
| Microscopist | 82 | 2 | 2.4 | (1 - 9) |
| Other | 82 | 3 | 3.7 | (1 - 11) |

*Table 6.19: Personnel who performed diagnosis of confirmed cases, TBF*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Thick blood film sample taken by: | | | | |
| Microscopist | 57 | 31 | 54.4 | (41 - 67) |
| Not registered | 57 | 8 | 14 | (7 - 26) |
| Doctor | 57 | 7 | 12.3 | (6 - 24) |
| Lab tech/ microbiologist | 57 | 6 | 10.5 | (5 - 22) |
| Vector Control staff (VC) | 57 | 4 | 7 | (3 - 18) |
| Community Health Worker (CHW) | 57 | 1 | 1.8 | (0 - 12) |

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

Due to the fact finding trip to Panama before data collection, it was expected the *corregimiento*-level vector control units would store investigation and notification forms for confirmed malaria cases. During data collection, the field team did not find any confirmed case forms at these units. Regional vector control units were visited to see if the paper forms were stored there, but they were not encountered there either. Paper forms were encountered at the central level vector control office for some confirmed malaria cases from Comarca Guna Yala, but not the number expected based on the information about confirmed cases provided by the Panama Ministry of Health. The denominator for performance indicator 4.02 is the number of confirmed cases of malaria in 2018 in the *corregimientos* visited for the Initiative during the baseline measurement. Because the additional cases could not be located nor reviewed, they are not considered to have dates registered and thus have inadequate time from symptom initiation to diagnosis.

Diagnosis within two days (48 hours) of symptom onset was negotiated as an indicator for RMEI. As shown in Table 6.20, 14.8% of confirmed case records in the Panama baseline measurement had both fever/symptom onset and diagnosis dates registered. Only 8.9% were diagnosed within 48 hours of fever/symptom onset, and 1.8% were diagnosed more than a week after fever/symptom onset.

*Table 6.20: Indicator 4.02: Fever/symptom onset to diagnosis within 48 hours*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Total confirmed malaria cases | 562 | 562 | 100 | ( - ) |
| Cases actually collected | 562 | 95 | 16.9 | (14 - 20) |
| Fever/symptom onset date registered | 562 | 87 | 15.5 | (13 - 19) |
| Diagnosis date registered | 562 | 87 | 15.5 | (13 - 19) |
| Both dates registered | 562 | 83 | 14.8 | (12 - 18) |
| Excluded due to suspected inscription/data entry error (<-7 day or >30 day window) | 562 | 3 | 0.5 | (0 - 2) |
| Diagnosis before onset (presumptive) | 559 | 0 | 0 | ( - ) |
| Cases diagnosed within 48 hours of onset | 559 | 50 | 8.9 | (7 - 12) |
| 3 days | 559 | 5 | 0.9 | (0 - 2) |
| 4-5 days | 559 | 11 | 2 | (1 - 4) |
| 6-7 days | 559 | 4 | 0.7 | (0 - 2) |
| Over 7 days | 559 | 10 | 1.8 | (1 - 3) |
| Indicator result: Cases diagnosed within 48 hours of onset | 559 | 50 | 8.9 | (7 - 12) |

Figure 6.13 shows the same indicator results in a graphic format, with both RMEI baseline data and SIVE data. The data provided from the SIVE database had more dates missing, a higher proportion of cases excluded due to suspected date error, and a notably lower proportion of cases were diagnosed within 48 hours of onset of symptoms.

*Figure 6.13: Indicator 4.02: Cases categorized, RMEI baseline measurement and surveillance database*

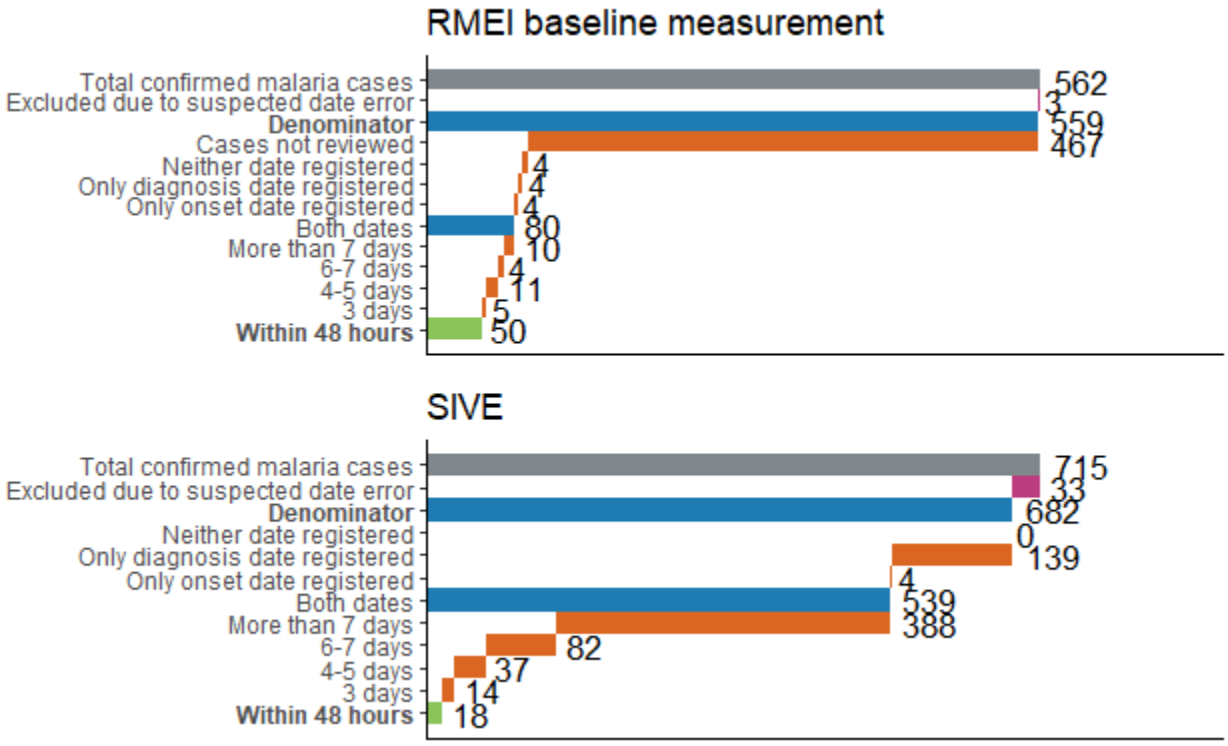



Table 6.22 shows the indicator by diagnosis type. Cases diagnosed by RDT (61.8%) were more likely to be diagnosed within 48 hours of symptom onset.

*Table 6.22: Comparison: result by diagnosis test*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Diagnosis within 48 hours of symptom onset | | | | |
| RDT | 76 | 47 | 61.8 | (50 - 72) |
| TBF | 8 | 3 | 37.5 | (12 - 72) |
| No test date registered | 8 | 0 | 0 | ( - ) |
| Total | 92 | 50 | 54.3 | (44 - 64) |

### 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 6.14 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 6.23, 85.3% of confirmed case records in Panama had both diagnosis and notification dates registered. Only 70.7% were notified within 24 hours of diagnosis. The indicator definition includes the confirmed cases that were expected to be reviewed, but were not found in the field (denominator 559).

*Figure 6.14: Confirmed cases: source of notification information*

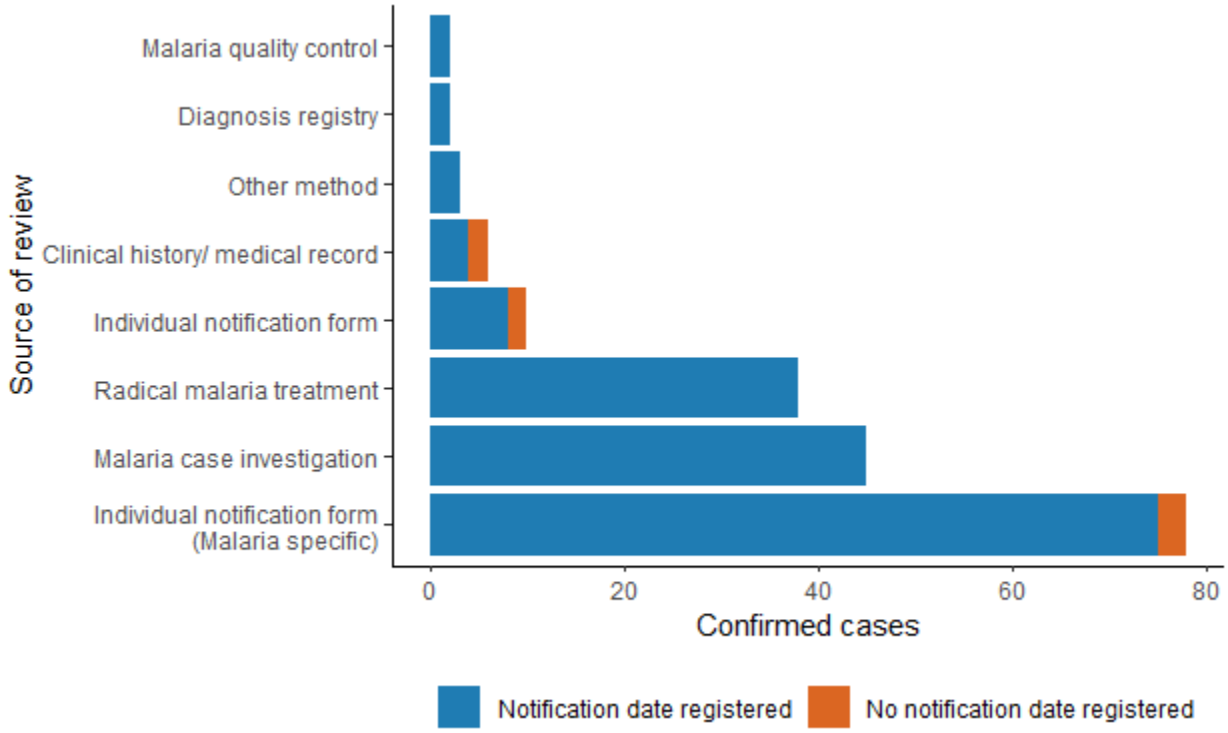



*Table 6.23: Indicator E2.04: Notification within 24 hours of diagnosis*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Diagnosis date registered | 95 | 87 | 91.6 | (84 - 96) |
| Notification date registered | 95 | 88 | 92.6 | (85 - 96) |
| Both dates registered | 95 | 81 | 85.3 | (77 - 91) |
| Excluded due to suspected inscription/data entry error (<-7 day or >30 day window) | 95 | 3 | 3.2 | (1 - 9) |
| Notification within 24 hours of diagnosis | 92 | 65 | 70.7 | (61 - 79) |
| Indicator calculation: Notification within 24 hours of diagnosis | 559 | 65 | 11.6 | (9 - 15) |

# Chapter 7: Malaria treatment

In Panama, routine malaria treatment is managed by the vector control program. At the fact-finding visit, IHME learned that primary and secondary care facilities rarely stock antimalarial medications, and if they do, they usually stock a small amount of chloroquine and primaquine in order to administer the first dose upon diagnosis of a new malaria case. Vector control personnel see to the remaining doses, usually delivering them to the patient's home. In some cases, col-vols/CCs may assist with delivery and supervision of some doses, for example on the weekend or in very remote areas without vector control personnel based in the locality. Occasionally the patient may be expected to visit a health facility in order to receive medication or follow-up malaria tests instead of receiving services through home visits, and to treat severe malaria, 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 *corregimiento*-level vector control units). Respondents listened to the list of activities shown in Table 7.1 and were asked to indicate whether personnel at the facility provide each service (yes or no). Many facilities reported that they supervise treatment at the facility (45.5% of primary care facilities) and supervise treatment in the community (50% of primary care facilities). Primary and secondary care facilities that reported "none of the above" have treatment prescribed and supervised by *corregimiento*-level vector control units.

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

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Primary care units: Services provided for malaria treatment | | | | |
| Prescribe treatment to pharmacy at this facility | 44 | 5 | 11.4 | (5 - 25) |
| Provide prescription to external pharmacy | 44 | 4 | 9.1 | (3 - 22) |
| Supervise ingestion (in the facility) | 44 | 20 | 45.5 | (31 - 61) |
| Supervise ingestion (in the community) | 44 | 22 | 50 | (35 - 65) |
| Call or visit the home to ask if treatment was taken (without supervising ingestion) | 44 | 2 | 4.5 | (1 - 17) |
| None of the above | 44 | 11 | 25 | (14 - 40) |
| Secondary care units: Services provided for malaria treatment | | | | |
| Supervise ingestion (in the facility) | 7 | 5 | 71.4 | (32 - 93) |
| Supervise ingestion (in the community) | 7 | 4 | 57.1 | (22 - 86) |
| None of the above | 7 | 2 | 28.6 | (7 - 68) |
| Vector control units (Corregimiento): Services provided for malaria treatment | | | | |
| Supervise ingestion (in the facility) | 8 | 4 | 50 | (19 - 81) |
| Supervise ingestion (in the community) | 8 | 8 | 100 | ( - ) |

If the respondent reported that personnel supervise ingestion in-facility, the interviewer asked how many doses are supervised at the facility. At 89.7% of facilities that supervise treatment regardless of type, all doses are supervised at the facility, and at 6.9% 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 vector control personnel in the patient's home in 100% of cases).

*Table 7.2: Doses supervised in-facility*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Doses supervised in-facility | | | | |
| Only the first dose | 29 | 2 | 6.9 | (2 - 25) |
| All doses | 29 | 26 | 89.7 | (72 - 97) |
| Don't know | 29 | 1 | 3.4 | (0 - 22) |

*Table 7.3: Personnel responsible for subsequent administrations*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Administration of subsequent doses | | | | |
| Treatment is administered by vector control personnel at the patient's home | 2 | 2 | 100 | ( - ) |
| 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 4.3% replied that they do. Respondents reported that community personnel administer presumptive treatment in only 1.8% of facilities.

*Table 7.4: Presumptive treatment*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Do clinical staff in this facility ever give antimalarial treatment for suspected malaria without waiting for a positive malaria test result? (Among facilities that provide treatment services on-site) | 47 | 2 | 4.3 | (1 - 16) |
| Do community health workers or vector control personnel associated with this facility ever treat suspected malaria without waiting for a positive malaria test result? (Among all facilities excluding national lab) | 55 | 1 | 1.8 | (0 - 12) |

## 7.2 Storage and stock of antimalarial medications

The health facility survey included an observation of antimalarial medications in stock on the day of the survey and of stock records for the three months prior (in all health facilities and *corregimiento*-level vector control units). First, the respondent (typically the pharmacist or pharmacy technician) was asked if the facility routinely stocks any antimalarial medications. As shown in Table 7.5, 25% of primary care facilities, 57.1% of secondary care facilities, and 100% of *corregimiento*-level vector control units reported stock of antimalarials. Observation of antimalarial medications was not completed in one *corregimiento*-level vector control unit, so that unit is not included in the following tables.

*Table 7.5: Facility types reporting stock of antimalarials*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Facilities reporting antimalarial stock in past 3 months | | | | |
| Primary care units | 44 | 11 | 25 | (14 - 40) |
| Secondary care units | 7 | 4 | 57.1 | (22 - 86) |
| Vector control units (Corregimiento) | 7 | 7 | 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, all primary and secondary care units and *corregimiento*-level vector control units 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 chloroquine were observed in 4.5% of primary care facilities that stock chloroquine and no doses or only expired doses of primaquine were observed in 9.1% of primary care facilities that stock primaquine, suggesting maintaining supply or replacing expired stock of first-line malarial medications is not a major challenge in Panama.

*Table 7.6: Reported stock of antimalarials*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Primary care units | | | | |
| Has this facility stocked any antimalarials for at least one day over the past three months? | 44 | 11 | 25 | (14 - 40) |
| Chloroquine | 11 | 11 | 100 | ( - ) |
| Primaquine | 11 | 11 | 100 | ( - ) |
| Secondary care units | | | | |
| Has this facility stocked any antimalarials for at least one day over the past three months? | 7 | 4 | 57.1 | (22 - 86) |
| Chloroquine | 4 | 4 | 100 | ( - ) |
| Primaquine | 4 | 4 | 100 | ( - ) |
| Pyrimethamine | 4 | 1 | 25 | (3 - 77) |
| Vector control units (Corregimiento) | | | | |
| Has this facility stocked any antimalarials for at least one day over the past three months? | 7 | 7 | 100 | ( - ) |
| Chloroquine | 7 | 7 | 100 | ( - ) |
| Primaquine | 7 | 7 | 100 | ( - ) |

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

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Chloroquine tablets observed | | | | |
| At least one observed and valid | 22 | 21 | 95.5 | (73 - 99) |
| Not observed | 22 | 1 | 4.5 | (1 - 27) |
| Primaquine tablets observed | | | | |
| At least one observed and valid | 22 | 20 | 90.9 | (69 - 98) |
| Not observed | 22 | 1 | 4.5 | (1 - 27) |
| At least one observed, but none valid | 22 | 1 | 4.5 | (1 - 27) |

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

*Table 7.8: Antimalarials medications stored, questionnaire*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Questionnaire: Does this facility store medications to treat malaria? | | | | |
| Primary care units | 41 | 14 | 34.1 | (21 - 50) |
| Secondary care units | 7 | 3 | 42.9 | (14 - 78) |
| Vector control units (Corregimiento) | 8 | 8 | 100 | ( - ) |

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 (regardless of type) informed that the treatment is delivered to this health facility by vector control or malaria program staff (56% 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? | | | | |
| Treatment is delivered to this health facility by vector control or malaria program staff | 25 | 14 | 56 | (35 - 75) |
| Patient is referred to a location that stores medication | 25 | 7 | 28 | (13 - 50) |
| Treatment is delivered to the patient's home by vector control or malaria program staff | 25 | 2 | 8 | (2 - 29) |
| Other | 25 | 2 | 8 | (2 - 29) |
| Don't know | 25 | 2 | 8 | (2 - 29) |

The interview also asked about how antimalarial supplies are managed. As seen in Table 7.10, 85.7% of primary care facilities generally order their own antimalarials. Among those primary care facilities that do not determine their own antimalarial supplies, most frequently the supply is determined by the local vector control or malaria program personnel (Table 7.11).

*Table 7.10: Determination of malaria medication needs*

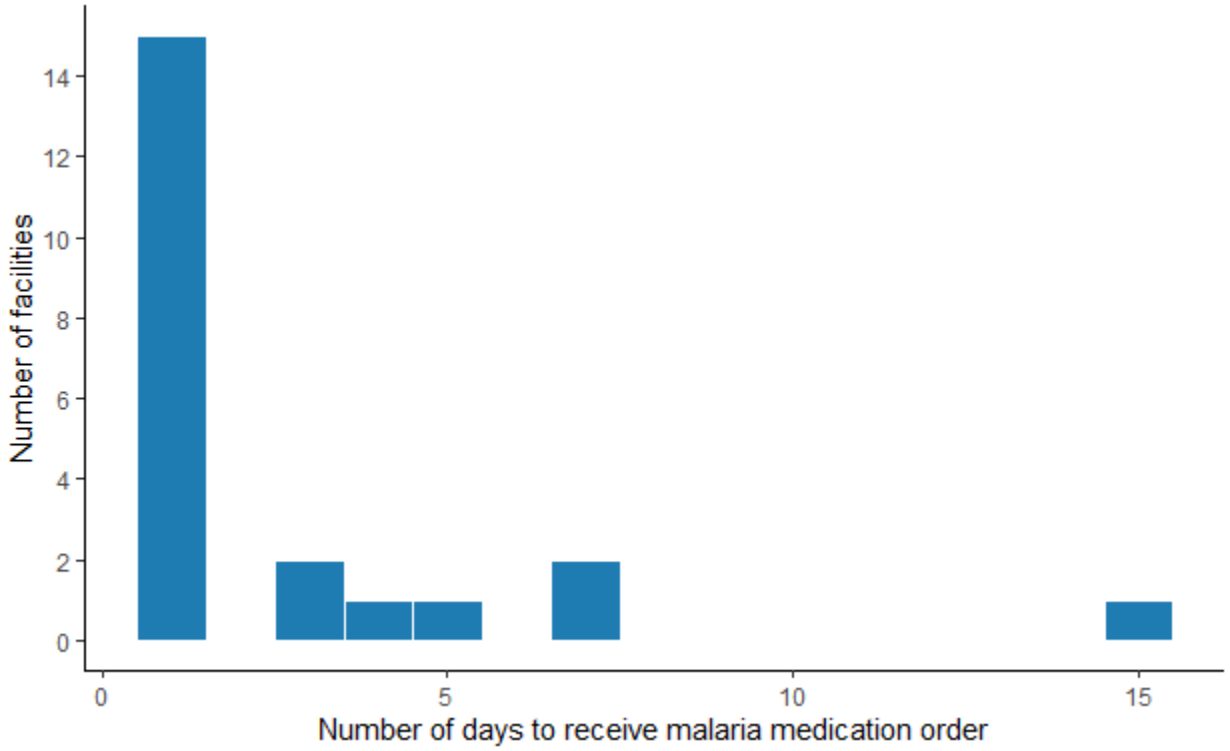
| | N | n | % | 95% CI |
|---|---|---|---|---|
| Primary care units: How is the quantity of malaria medication needed by this facility determined? | | | | |
| Facility determines quantity and orders | 14 | 12 | 85.7 | (56 - 97) |
| Quantity determined elsewhere | 14 | 2 | 14.3 | (3 - 44) |
| Secondary care units: How is the quantity of malaria medication needed by this facility determined? | | | | |
| Facility determines quantity and orders | 3 | 3 | 100 | ( - ) |
| Quantity determined elsewhere | 3 | 0 | 0 | ( - ) |
| Vector control units (Corregimiento): How is the quantity of malaria medication needed by this facility determined? | | | | |
| Facility determines quantity and orders | 8 | 8 | 100 | ( - ) |
| Quantity determined elsewhere | 8 | 0 | 0 | ( - ) |

*Table 7.11: Determination of malaria medication needs: authority*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Primary care units: Who determines the quantity of malaria medication that are given to this facility? | | | | |
| Local vector control or malaria program personnel | 2 | 2 | 100 | ( - ) |

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

*Figure 7.1: Days to receive ordered malaria medication*




The interview also asked about recent shortages of antimalarial medication and how they are handled. All facilities that stock antimalarials reported that they always or almost always receive the expected quantities of antimalarial medications (Table 7.12). As seen in Table 7.13, if there is a shortage, many facilities reported that they make a special order (85.7% of primary care facilities that stock antimalarials). Respondents could indicate more than one answer to this question.

*Table 7.12: Medication order reliability*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Primary care units: During the past 6 months, have you always, almost always, or almost never received the amount of each medicine that you ordered (or that you are supposed to routinely receive)? | | | | |
| Always | 14 | 10 | 71.4 | (43 - 89) |
| Almost always | 14 | 4 | 28.6 | (11 - 57) |
| Secondary care units: During the past 6 months, have you always, almost always, or almost never received the amount of each medicine that you ordered (or that you are supposed to routinely receive)? | | | | |
| Always | 3 | 3 | 100 | ( - ) |
| Almost always | 3 | 0 | 0 | ( - ) |
| Vector control units (Corregimiento): 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 | 8 | 7 | 87.5 | (45 - 98) |
| Almost always | 8 | 1 | 12.5 | (2 - 55) |

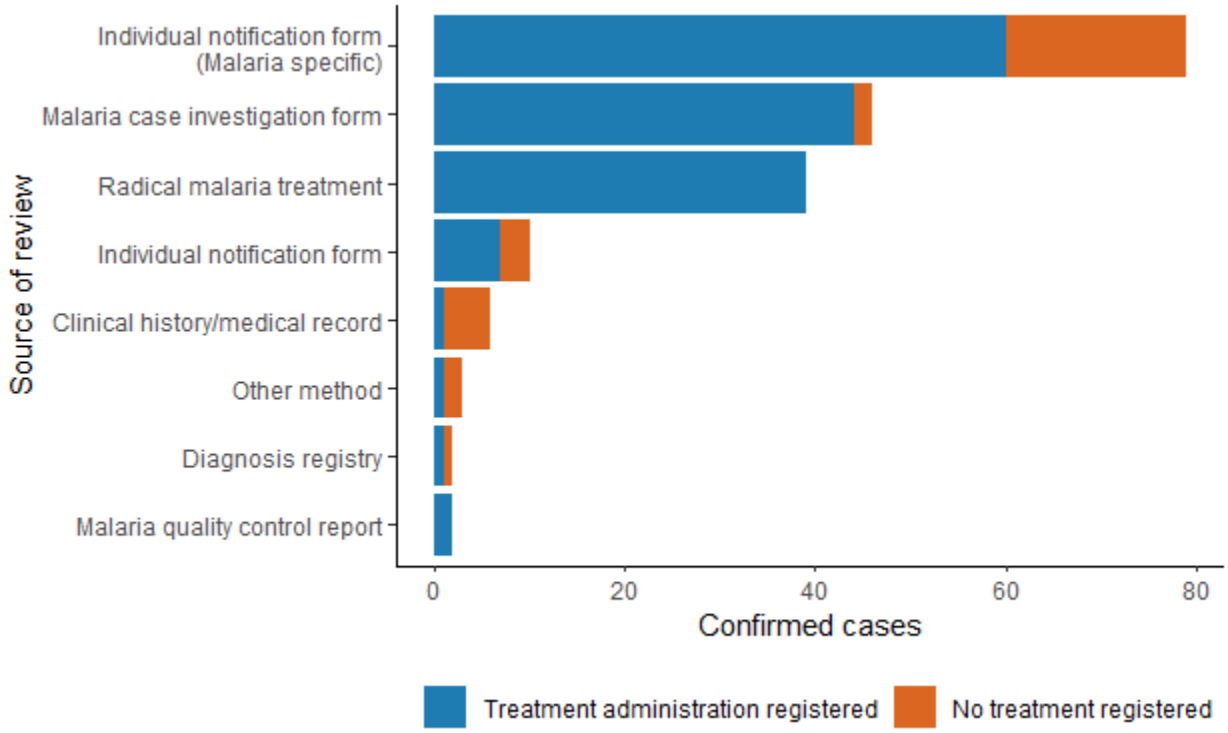
*Table 7.13: Malaria medication shortages*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Primary care units: If there is a shortage of a specific malaria medication between routine orders, what is the most commonly used procedure in this facility? | | | | |
| Special order | 14 | 12 | 85.7 | (56 - 97) |
| Borrow from another health facility | 14 | 4 | 28.6 | (11 - 57) |
| Secondary care units: If there is a shortage of a specific malaria medication between routine orders, what is the most commonly used procedure in this facility? | | | | |
| Special order | 3 | 2 | 66.7 | (14 - 96) |
| Borrow from another health facility | 3 | 1 | 33.3 | (4 - 86) |
| Vector control units (Corregimiento): 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 | 8 | 6 | 75 | (37 - 94) |
| Borrow from another health facility | 8 | 4 | 50 | (19 - 81) |
| Facility purchases | 8 | 1 | 12.5 | (2 - 55) |

## 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, malaria case investigation forms, and treatment control reports 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 and the investigation and treatment forms have 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 options include the generic communicable disease investigation form and the col-vol registry.

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




Antimalarial treatment is prescribed according to the test result. In Panama, first-line regimens are different for *Plasmodium vivax* malaria, *Plasmodium falciparum* malaria, and mixed cases of malaria due to the presence of chloroquine-resistant *P. falciparum* in the country. The first-line regimen for *P. vivax* malaria consists of chloroquine and primaquine and the regimens for *P. falciparum* and mixed cases requires primaquine and artemisinin-based medication. As seen in Table 7.14, 89.1% of the reviewed *P. vivax* cases had the correct regimen registered and none of the reviewed *P. falciparum* or mixed cases had the correct regimen registered. Thirty-four of the cases reviewed did not have parasite species registered on any of the forms reviewed, and thus the corresponding regimen could not be identified. These cases are not considered to have had the correct treatment regimen administered, because of the failure to register the species.

*Table 7.14: Confirmed cases: Appropriate treatment by parasite species*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Total cases with adequate treatment for species | 95 | 49 | 51.6 | (42 - 61) |
| P. vivax with adequate treatment for species | 55 | 49 | 89.1 | (78 - 95) |
| P. falciparum with adequate treatment for species | 5 | 0 | 0 | ( - ) |
| Mixed cases with adequate treatment | 1 | 0 | 0 | ( - ) |
| Species not registered | 95 | 34 | 35.8 | (27 - 46) |

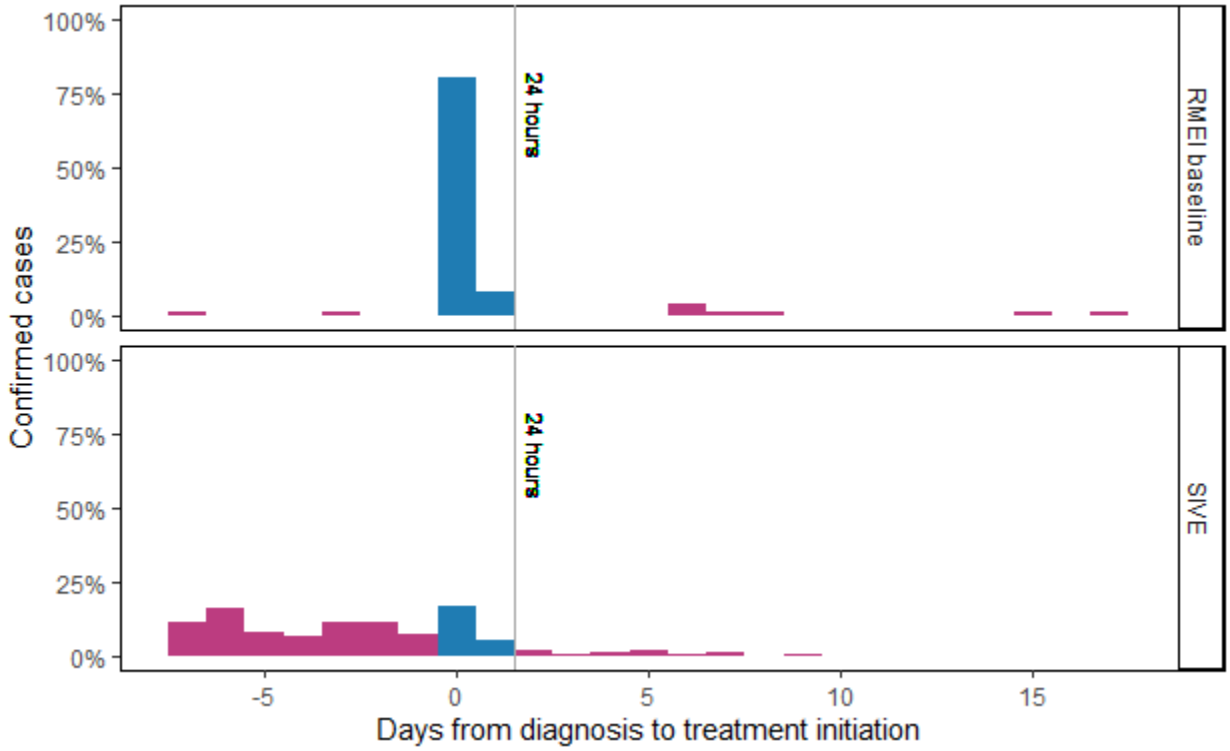
Table 7.15 shows the timing of administration of the first dose of antimalarial treatment for the RMEI baseline measurement data and data from the national malaria surveillance database (SIVE). In 83.2% of the cases reviewed, both diagnosis and treatment date were registered, compared to 69.5% in the SIVE data. This suggests that the cases maintained on paper may have higher-quality management and registration than the cases for which paperwork was destroyed or lost after entering to the SIVE system.

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

| | N | n | % | 95% CI |
|---|---|---|---|---|
| RMEI baseline | | | | |
| Diagnosis date registered | 95 | 87 | 91.6 | (84 - 96) |
| Treatment start date registered | 95 | 86 | 90.5 | (83 - 95) |
| Both dates registered | 95 | 79 | 83.2 | (74 - 89) |
| Excluded due to suspected inscription/data entry error (<-7 day or >30 day window) | 95 | 3 | 3.2 | (1 - 9) |
| Any treatment within 24 hours of diagnosis | 92 | 67 | 72.8 | (63 - 81) |
| SIVE | | | | |
| Diagnosis date registered | 715 | 711 | 99.4 | (99 - 100) |
| Treatment start date registered | 715 | 501 | 70.1 | (67 - 73) |
| Both dates registered | 715 | 497 | 69.5 | (66 - 73) |
| Excluded due to suspected inscription/data entry error (<-7 day or >30 day window) | 715 | 234 | 32.7 | (29 - 36) |
| Any treatment within 24 hours of diagnosis | 481 | 56 | 11.6 | (9 - 15) |

Evidence of any antimalarial treatment within one day of diagnosis was found in 72.8% of cases reviewed (Table 7.15). Figure 7.3 shows the number of days from the date of diagnosis to the date of treatment initiation. Cases with treatment initiation on the same day of diagnosis or one day after are shown in blue. Cases with treatment initiation before diagnosis (by RDT or microscopy) are not considered timely, because presumptive treatment is contrary to the norm in Panama. If treatment initiation was recorded more than seven days before or more than 30 days after diagnosis, the case is excluded from the indicator because of the suspicion of recording error (on the notification form or in the survey module). This suspected error affected 3 cases in the reviewed data, which are excluded from the figure.

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



An indicator negotiated for RMEI measures the proportion of cases with the first dose of antimalarial treatment administered within one day of diagnosis, as shown in Table 7.16. The denominator for this indicator represents the number of confirmed malaria cases that were expected to be reviewed in the *corregimientos* visited during the RMEI-Panama baseline evaluation, based on the surveillance data provided by the Panama Ministry of Health. The field team encountered significantly fewer records of confirmed cases in the field than expected (16.9%), so availability of confirmed case reports was added as a component in the indicator.

Among the cases included in the indicator definition, 8.7% had the antimalarial treatment corresponding to the parasite species registered correctly on the forms. In 12% of the cases, the first dose of any treatment was registered as administered within one day (24 hours) of diagnosis, and in 5.5% of the cases, the first dose of the appropriate treatment was registered as administered within one day of diagnosis. For comparison, Table 7.17 shows the result by province/ comarca and Table 7.18 shows the result by the diagnosis type.

*Table 7.16: Indicator 4.01: Timely treatment initiation*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Total malaria cases in the sample | 562 | 562 | 100 | ( - ) |
| Total malaria cases reviewed | 562 | 95 | 16.9 | (14 - 20) |
| Correct treatment administered for species | 562 | 49 | 8.7 | (7 - 11) |
| Diagnosis and treatment dates registered | 562 | 79 | 14.1 | (11 - 17) |
| Excluded due to suspected inscription/data entry error (<-7 day or >30 day window) | 562 | 3 | 0.5 | (0 - 2) |
| First dose treatment within 24 hours of diagnosis | 559 | 67 | 12 | (10 - 15) |
| Correct treatment administered within 24 hours of diagnosis | 559 | 31 | 5.5 | (4 - 8) |

*Table 7.19: Comparison: result by province/ comarca*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Timely treatment initiation | | | | |
| Comarca Emberá | 1 | 0 | 0 | ( - ) |
| Comarca Guna Yala | 53 | 28 | 52.8 | (39 - 66) |
| Panamá | 38 | 3 | 7.9 | (3 - 22) |
| Total | 92 | 31 | 33.7 | (25 - 44) |

*Table 7.20: Comparison: result by diagnosis type*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Timely treatment initiation | | | | |
| RDT | 76 | 26 | 34.2 | (24 - 46) |
| TBF | 8 | 5 | 62.5 | (28 - 88) |
| No test date registered | 8 | 0 | 0 | ( - ) |
| Total | 92 | 31 | 33.7 | (25 - 44) |

## 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 Panama, the national norm requires treatment according to parasite species, following these regimens:

- For *P. vivax* cases: 3 days of chloroquine and 7 or 14 days of primaquine

- For *P. falciparum* cases: 3 days of artemisinin-based treatment (artemether + lumefantrine) and 1 day primaquine
- For mixed infections cases: 3 days of artemisinin-based treatment (artemether + lumefantrine) and 7 or 14 days of primaquine
- For severe malaria cases: If IV treatment with artesunate started, when completed: 3 days of artemisinin-based treatment (artemether + lumefantrine) and one day of primaquine

### 7.4.1 Completion of malaria treatment

The Panama malaria case notification form includes space to register the treatment type and the date treatment was started. There is no space to enter the dosage prescribed, the number of doses administered for any medication selected, or whether the treatment was supervised by health facility personnel or community health workers. Specific malaria treatment forms contain this information, but were not available for all confirmed cases reviewed.

Table 7.21 shows treatment completion by parasite species as registered on the forms observed during baseline data collection. Thirty-four 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 72.7% of cases, and none of the *P. falciparum* or mixed cases had evidence of complete treatment. Considering the cases with incomplete treatment registration because of the failure to record species and the expected number of confirmed cases expected to be reviewed the *corregimientos* visited, 42.1% of all reviewed cases had recorded evidence of adequate and complete treatment.

*Table 7.21: Confirmed cases: Complete treatment by malaria species*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Total cases with adequate treatment complete | 95 | 40 | 42.1 | (33 - 52) |
| P. vivax cases with adequate treatment complete | 55 | 40 | 72.7 | (60 - 83) |
| P. falciparum with adequate treatment complete | 5 | 0 | 0 | ( - ) |
| Mixed cases with adequate treatment complete | 1 | 0 | 0 | ( - ) |
| Species not registered | 95 | 34 | 35.8 | (27 - 46) |

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 Panama, treatment supervision is the country standard practice, but only the treatment form has space to enter this information, and this form was not observed for all reviewed confirmed cases. Table 7.22 shows the indicator results with the denominator representing the number of confirmed cases expected to be found based on the Panama Ministry of Health documentation of 2018 confirmed cases from the *corregimientos* in the RMEI-Panama baseline sample. Only 16.9% of cases had evidence of complete and adequate treatment, and only 7.1% 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, 10.9% of cases had evidence that treatment was adequate, complete, and supervised.

The field team encountered significantly fewer records of confirmed cases in the field than expected, so the denominator for this indicator represents the number of confirmed malaria cases that were expected to be reviewed in the *corregimientos* visited during the RMEI-Panama baseline evaluation, based on the surveillance data provided by the Panama Ministry of Health.

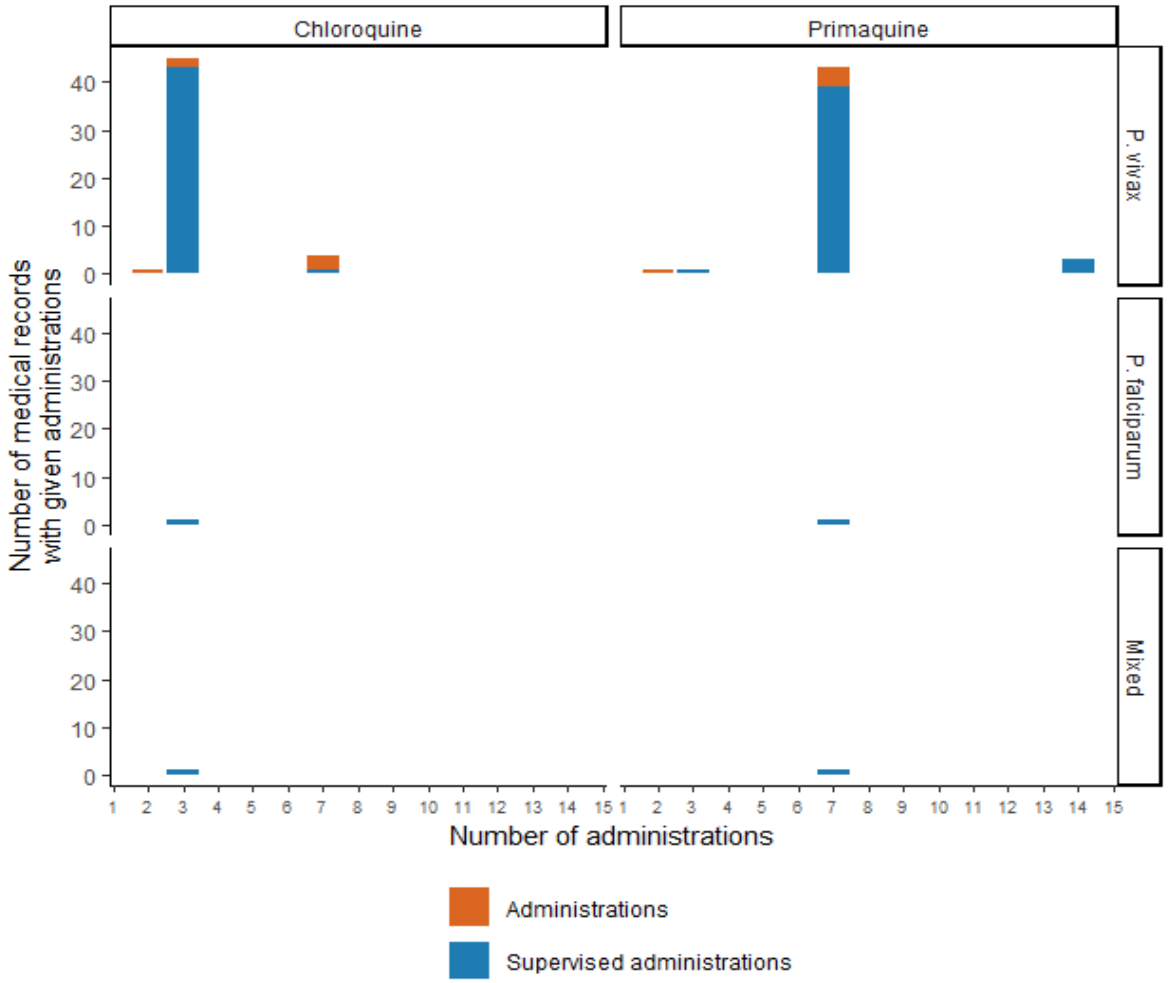
*Table 7.22: Indicator 4.03: Complete treatment with supervision*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Denominator: Total malaria cases | 562 | 562 | 100 | ( - ) |
| Total malaria cases reviewed | 562 | 95 | 16.9 | (14 - 20) |
| Adequate treatment and number of doses administered | 562 | 40 | 7.1 | (5 - 10) |
| Evidence of at least one supervised dose | 562 | 61 | 10.9 | (9 - 14) |
| Indicator Result: Complete treatment with supervision | 562 | 37 | 6.6 | (5 - 9) |

### 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. The number of malaria cases with evidence of all doses supervised was generally lower than the total number of doses registered. For *P. vivax*, a 7-day treatment scheme is most frequent in Panama.

*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 *corregimiento*-level vector control units, 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 Panama, the malaria case investigation is usually carried out by a vector control technician. It includes an interview with the patient and an analysis of the information provided in order to classify the malaria case. The malaria case investigation form is filled with the responses of the interview, including travel history, previous malaria case information, and interventions observed in the patient's household (use of bed nets and IRS). A copy of the case investigation is intended to be filed at the *corregimiento* and regional vector control levels, though copies of confirmed cases from 2018 were not found at these units during the data collection in the last quarter of 2019. The case information is entered to the "SIVE" information system (*Sistema Nacional de Vigilancia Epidemiológica*) at the regional vector control unit and transmitted to an electronic database accessible by local, regional, and central-level malaria personnel.

### 8.1.2 Case detection source and classification

During the confirmed case medical record review, field personnel reviewed 95 cases, of which 53 were detected passively, 33 were detected during active or reactive search in the community, and 9 did not have the source of the case registered (Table 8.1).

According to the case investigation forms, 74.7% of malaria cases were autochthonous to Panama (Table 8.2).

*Table 8.1: Source of confirmed case detection*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Case detection source: | | | | |
| Passive search | 95 | 53 | 55.8 | (46 - 66) |
| Active search | 95 | 33 | 34.7 | (26 - 45) |
| Not registered | 95 | 9 | 9.5 | (5 - 17) |

*Table 8.2: Classification of confirmed malaria cases*

| Classification | # | % |
|---|---|---|
| Autochthonous/indigenous/local | 71 | 74.7% |
| Imported | 13 | 13.7% |
| Relapse | 3 | 3.2% |
| Not registered | 8 | 8.4% |
| Total cases | 95 | |

## 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, 75% of respondents said that malaria patients receive at least one follow-up test in order to ensure the malaria infection has gone away. Table 8.4 shows that the thick blood film sample is most frequent for follow-up testing.

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

| | N | n | % | 95% CI |
|---|---|---|---|---|
| After a patient begins treatment for malaria, do they ever receive a follow-up test for malaria? | 56 | 42 | 75 | (62 - 85) |

*Table 8.4: Follow-up testing methods*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Is an RDT or thick blood film more commonly used for follow-up tests? | | | | |
| Only thick blood film used more commonly | 42 | 26 | 61.9 | (46 - 76) |
| Only RDT used more commonly | 42 | 10 | 23.8 | (13 - 39) |
| Both RDT and thick blood film: Samples are routinely taken for both tests at the same time | 42 | 6 | 14.3 | (6 - 29) |

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). Some *corregimiento*-level vector control units, where the vector control personnel responsible for malaria case management are typically based, report conducting follow-up testing from one or two weeks after diagnosis through six months after diagnosis. Many primary care facilities only conduct, or are only aware of, the first follow-up tests within two to four weeks of diagnosis.

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

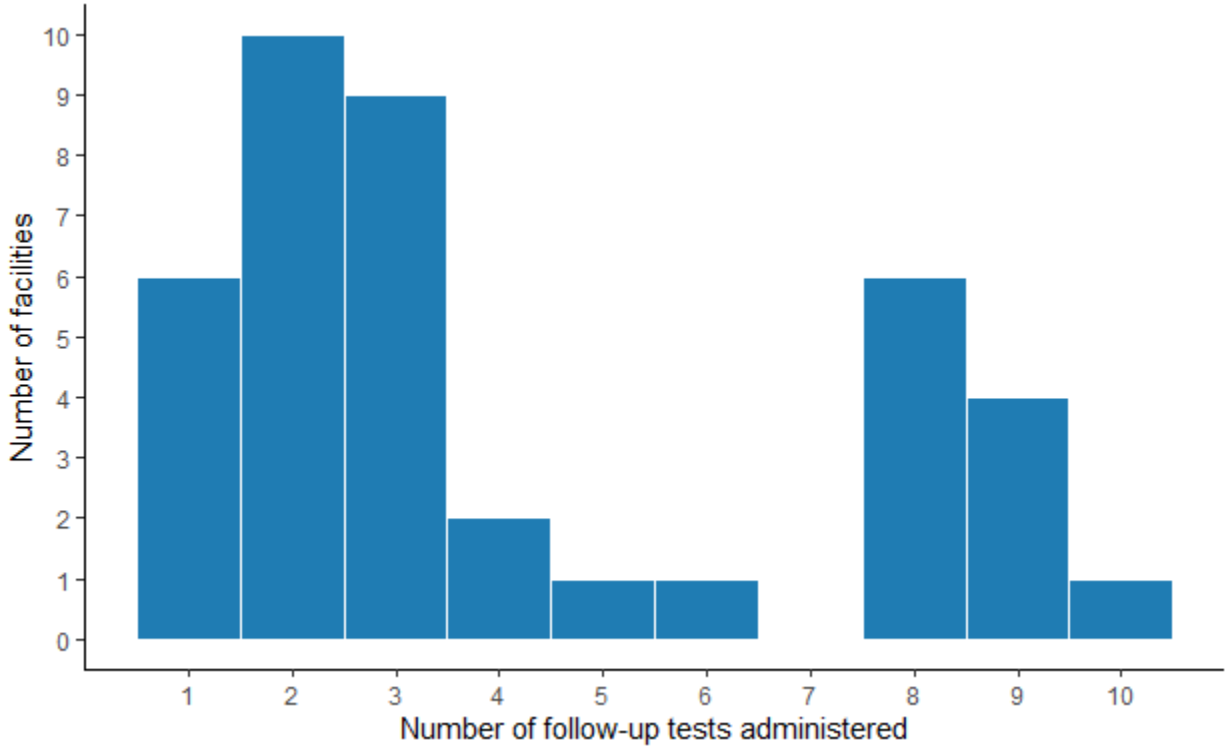
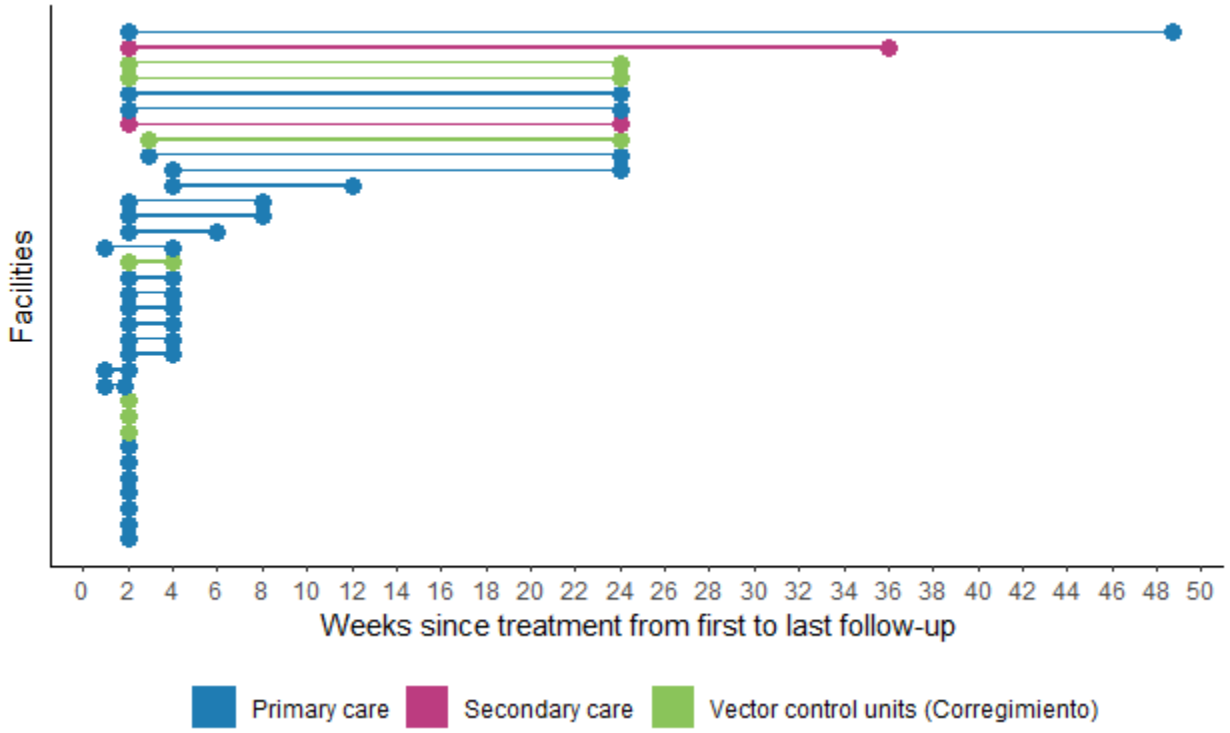


*Figure 8.2: Timing from first to last follow-up test*




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

Neither the case notification nor the case investigation forms have a space to track follow-up malaria testing. In practice, follow-up testing may be tracked on separate, locally-developed forms or in the patient medical record and never updated on the case investigation form after it is entered to the SIVE database and a copy sent to the regional vector control unit. Only one of the 95 reviewed confirmed cases had evidence of one follow-up test, which was completed one month after the positive diagnosis.

## 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 95 cases reviewed, 49 had information about the environmental investigation and case response recorded. Table 8.6 shows the results of the environmental investigation, among the 49 cases with information.

*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? | 95 | 49 | 51.6 | (41 - 62) |
| House located | 49 | 44 | 89.8 | (77 - 96) |
| Mosquito nets in house | 49 | 4 | 8.2 | (3 - 20) |
| Patient used/slept under net | 49 | 0 | 0 | ( - ) |
| House had been sprayed with insecticide | 49 | 17 | 34.7 | (23 - 49) |
| Anopheles vector present | 49 | 1 | 2 | (0 - 14) |
| Breeding areas observed around the home | 49 | 17 | 34.7 | (23 - 49) |

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Family members/other contacts tested for malaria | 49 | 10 | 20.4 | (11 - 34) |

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 8.7.

*Table 8.7: Evidence of active case detection in medical records*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Was active case detection done? | 49 | 49 | 100 | ( - ) |
| Were houses sprayed? | 49 | 43 | 87.8 | (75 - 94) |
| Were houses fogged? | 49 | 47 | 95.9 | (85 - 99) |

# Chapter 9: Surveillance, Notification, and Reporting

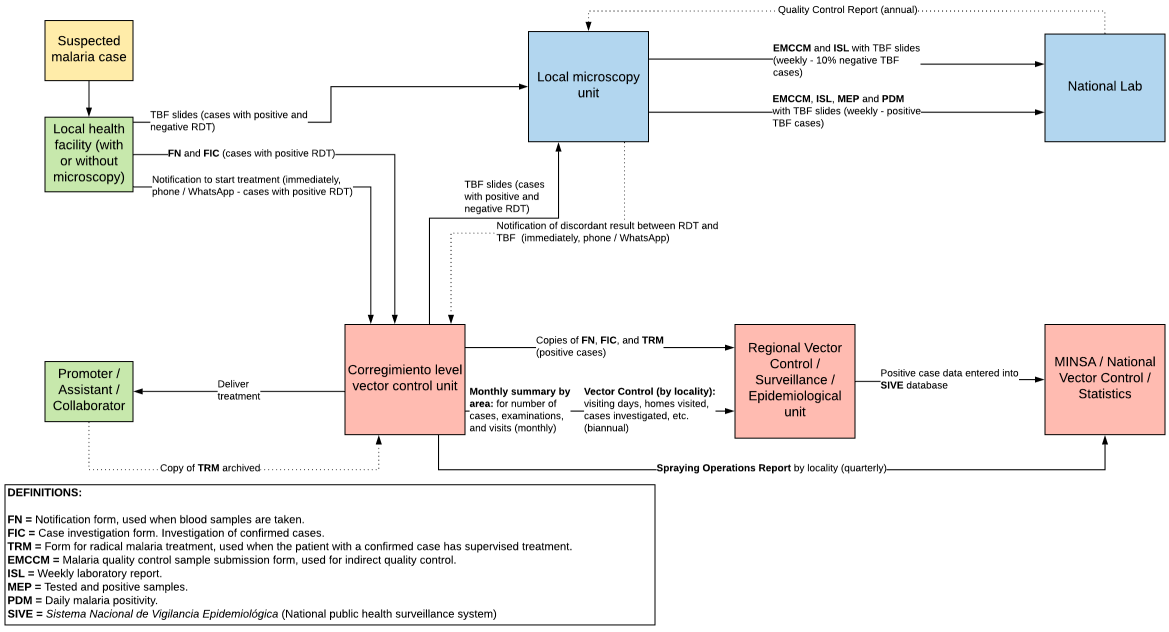
This chapter provides an overview of the malaria surveillance system in Panama based on the fact-finding visit and health facility surveys, and summarizes results related to case reporting and laboratory reporting and quality control indicators.

## 9.1 Background

The fact-finding trip in May 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 national health authorities of malaria test results. Negative results are informed in aggregate, once weekly or once monthly. Positive results are often notified immediately to relevant personnel in the *corregimiento*-level vector control program, at the national headquarters and laboratory, and at the point where the sample was taken. Any positive results will also be included in aggregate monthly or weekly laboratory reporting. Facilities with capacity to diagnose malaria are obligated to prepare monthly or weekly reports of any cases of notifiable diseases (malaria alongside other illnesses with obligatory notification), and to send these reports to the national headquarters.

*Figure 9.1: Panama surveillance system flow diagram*



## 9.2 Notification of malaria test results

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

The health facility interview included questions about notification of malaria test results. As described in Chapter 5, health facilities that do not have microscopic diagnostic capacity in-facility (or have it in-facility only at certain days or hours) send thick blood film slides to a microscopy post or laboratory for initial diagnosis (31 facilities). Table 9.1 and Table 9.2 show the method by which a patient is notified of a negative test result among the 24 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 75% of facilities). Among the 18 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 | 24 | 18 | 75 | (54 - 89) |
| Vector control personnel | 24 | 10 | 41.7 | (24 - 62) |
| Community health worker/promoter or community collaborator | 24 | 2 | 8.3 | (2 - 29) |

*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 | 18 | 18 | 100 | ( - ) |
| Phone call | 18 | 1 | 5.6 | (1 - 32) |

In the case of a positive test result, 28 facilities that send slides elsewhere for examination reported they receive positive test results for the slides they send. Among these facilities, 64.3% are sometimes or always responsible to notify the patient of the positive test result by their own personnel (Table 9.3). Among these 18 facilities, the most common modality for notification of a positive test result is in person (Table 9.4).

*Table 9.3: Notification to patient of positive test results (among facilities that send slides elsewhere for examination): personnel*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Who notifies the patient of a positive test result? | | | | |
| Health personnel from this facility | 28 | 18 | 64.3 | (45 - 80) |
| Vector control personnel | 28 | 15 | 53.6 | (35 - 71) |
| Community health worker/promoter or community collaborator | 28 | 5 | 17.9 | (7 - 37) |
| Volunteer collaborator | 28 | 1 | 3.6 | (0 - 22) |

*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 | 18 | 18 | 100 | ( - ) |

### 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 13 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 69.2% of facilities (Table 9.5). In the case that a positive test result is detected in the facility, 69.2% are sometimes or always responsible to notify the patient of the positive test result by their own personnel.

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

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Who notifies the patient of a negative test result? | | | | |
| Health personnel from this facility | 13 | 9 | 69.2 | (40 - 88) |
| Vector control personnel | 13 | 4 | 30.8 | (12 - 60) |
| Community health worker/promotor or community collaborator | 13 | 1 | 7.7 | (1 - 41) |
| The patient is not notified | 13 | 1 | 7.7 | (1 - 41) |
| Volunteer collaborator | 0 | 0 | | - |

*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 | 13 | 9 | 69.2 | (40 - 88) |
| Vector control personnel | 13 | 5 | 38.5 | (17 - 66) |
| Community health worker/promoter or community collaborator | 13 | 1 | 7.7 | (1 - 41) |
| Volunteer collaborator | 0 | 0 | | - |

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

When a case of malaria is confirmed in Panama, notification must be sent to health authorities. Among all facilities that either examine TBF slides or perform RDTs, 45.2% notify the regional health authority and 22.6% notify the regional laboratory (Table 9.7) (respondents could indicate multiple responses). The facilities that indicated an “other” response notified to the affiliated hospital.

*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? | | | | |
| Regional health authority | 31 | 14 | 45.2 | (28 - 63) |
| Regional laboratory | 31 | 7 | 22.6 | (11 - 41) |
| Epidemiological surveillance unit | 31 | 6 | 19.4 | (9 - 38) |
| Local vector control unit | 31 | 5 | 16.1 | (7 - 34) |
| National malaria program | 31 | 4 | 12.9 | (5 - 30) |
| National laboratory | 31 | 3 | 9.7 | (3 - 27) |
| Other | 31 | 4 | 12.9 | (5 - 30) |

## 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. Forty percent of primary care facilities, 57.1% of secondary care facilities, and 33.3% of administrative units reported access. Facilities with access to any electronic information system were asked if they have access to a system for entering information about malaria, and 80

percent of primary care facilities, 50% of secondary care facilities and 100% of administrative units with electronic system access reported a system used for malaria information.

*Table 9.8: Access to electronic information systems*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Primary care units | | | | |
| Access to an electronic health information system for capturing and/or consulting health statistics | 42 | 17 | 40.5 | (27 - 56) |
| Access to an electronic health information system for entering malaria-specific information | 15 | 12 | 80 | (52 - 94) |
| Secondary care units | | | | |
| Access to an electronic health information system for capturing and/or consulting health statistics | 7 | 4 | 57.1 | (22 - 86) |
| Access to an electronic health information system for entering malaria-specific information | 4 | 2 | 50 | (12 - 88) |
| Vector control units (Corregimiento) & National Lab | | | | |
| Access to an electronic health information system for capturing and/or consulting health statistics | 9 | 3 | 33.3 | (11 - 68) |
| Access to an electronic health information system for entering malaria-specific information | 3 | 3 | 100 | ( - ) |

### 9.3.1 Indicator 2.03: Malaria case reporting

RMEI monitoring indicator 2.03 has two parts: case reporting and laboratory reporting. For case reporting, health units in Panama that conduct malaria diagnosis (by RDT or microscopy) must send weekly or monthly reports to the regional or central headquarters that include the aggregate number of malaria cases detected during the week, or a notification that zero malaria cases were detected. The report can be specific to malaria or combined with other notifiable diseases, so long as the exact number of malaria cases can be determined from the report.

The format of the reports observed during the survey at the facilities responsible to send case reports to health authorities (primary and secondary facilities with diagnostic capacity) where at least one report was observed is shown in Table 9.9. The destination of the reports is shown in Table 9.10, and respondents could indicate more than one destination.

*Table 9.9: Format of case notification reports observed*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Format of case reports observed | | | | |
| Individual notification form for public health events | 6 | 5 | 83.3 | (35 - 98) |
| Aggregate laboratory production report | 6 | 1 | 16.7 | (2 - 65) |
| Case investigation form for malaria | 6 | 1 | 16.7 | (2 - 65) |

*Table 9.10: Destination of case notification reports observed*

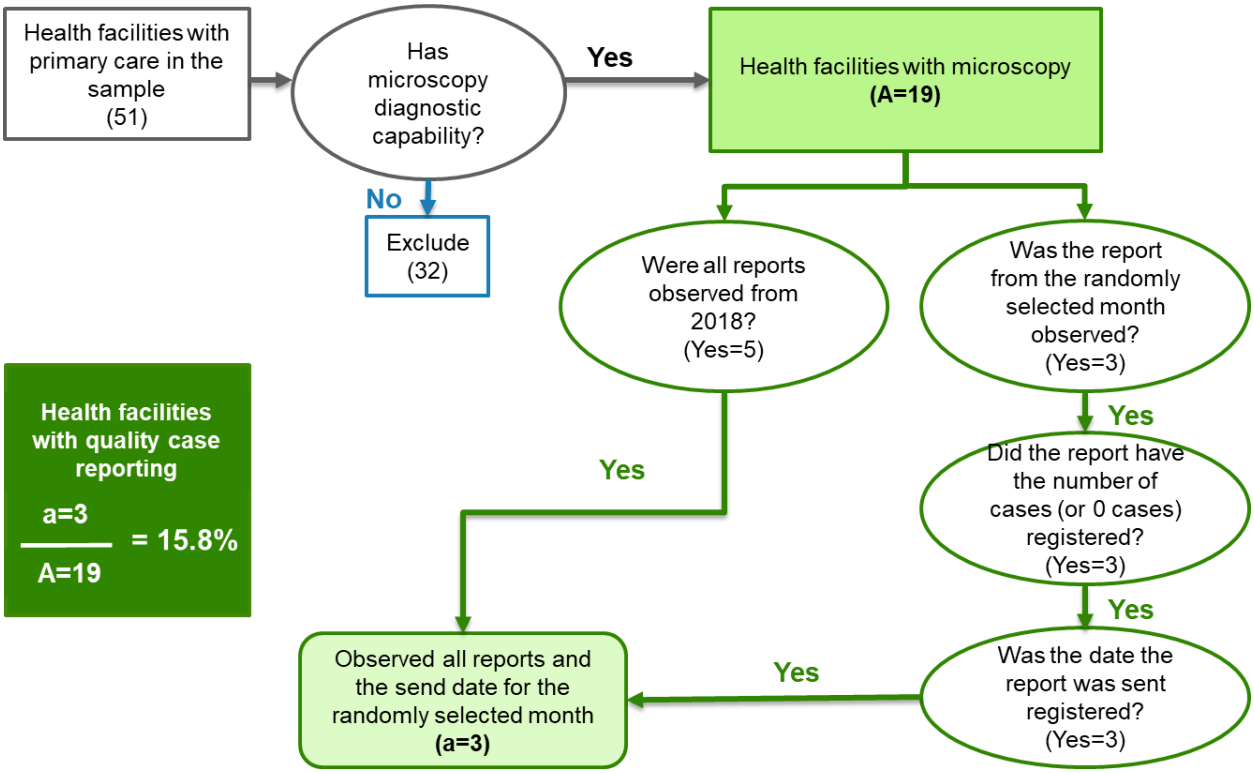
| | N | n | % | 95% CI |
|---|---|---|---|---|
| Where are case reports sent? | | | | |
| Regional health authority | 6 | 4 | 66.7 | (26 - 92) |
| Affiliated health facility | 6 | 1 | 16.7 | (2 - 65) |
| National lab | 6 | 1 | 16.7 | (2 - 65) |

Field personnel conducted an audit of all malaria case reports from 2018 stored at primary and secondary level facilities in the sample. They began by discerning whether the facility prepared monthly or weekly reports during 2018. They then sought to observe all 12 monthly reports or all 52 weekly reports for the year 2018. If a week was missing, they looked for written evidence of why the report was not submitted (for example, if the only microscopist was on holiday). Next, the electronic survey module presented a randomly selected month (or set of four epidemiological weeks). Surveyors sought to find the reports corresponding to this month, and then proceeded to enter detailed information from the report to the survey module, such as the number of malaria cases reported (or whether zero cases were reported) and the date sent or received as listed on the report (or as listed in a logbook of official correspondence sent and received, in facilities that use such a book). Health facility eligibility and completion of indicator according to a decision algorithm is shown in Figure 9.2.

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

- that the reports be in a weekly or monthly format
- that all 52 or 12 reports be observed for the year 2018
- that all four weekly reports or one monthly report be observed for the selected month with send date

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




19 facilities that provide attention to patients are eligible for consideration in the indicator. The results are shown in Table 9.11 and three units met all the requirements of the indicator. The breakdown of the case reporting component of the indicator is shown in Table 9.10.

*Table 9.11: Indicator 2.03: Case reporting*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Indicator: Attention units | | | | |
| Relevant units | 51 | 51 | 100 | ( - ) |
| Units with diagnostic capacity | 51 | 19 | 37.3 | (25 - 52) |
| Units indicating reporting of malaria cases | 19 | 19 | 100 | ( - ) |
| At least one weekly or monthly report from 2018 observed | 19 | 5 | 26.3 | (11 - 51) |
| All 52 or 12 monthly reports from 2018 observed | 19 | 3 | 15.8 | (5 - 40) |
| Report(s) for randomly selected month observed | 19 | 3 | 15.8 | (5 - 40) |
| Number of cases (or zero) recorded for report(s) of randomly selected month | 19 | 3 | 15.8 | (5 - 40) |
| Date(s) for report(s) of randomly selected month observed | 19 | 3 | 15.8 | (5 - 40) |
| Result: Malaria case reporting to standard | 19 | 3 | 15.8 | (5 - 40) |

*Table 9.10: Destination of case notification reports observed*

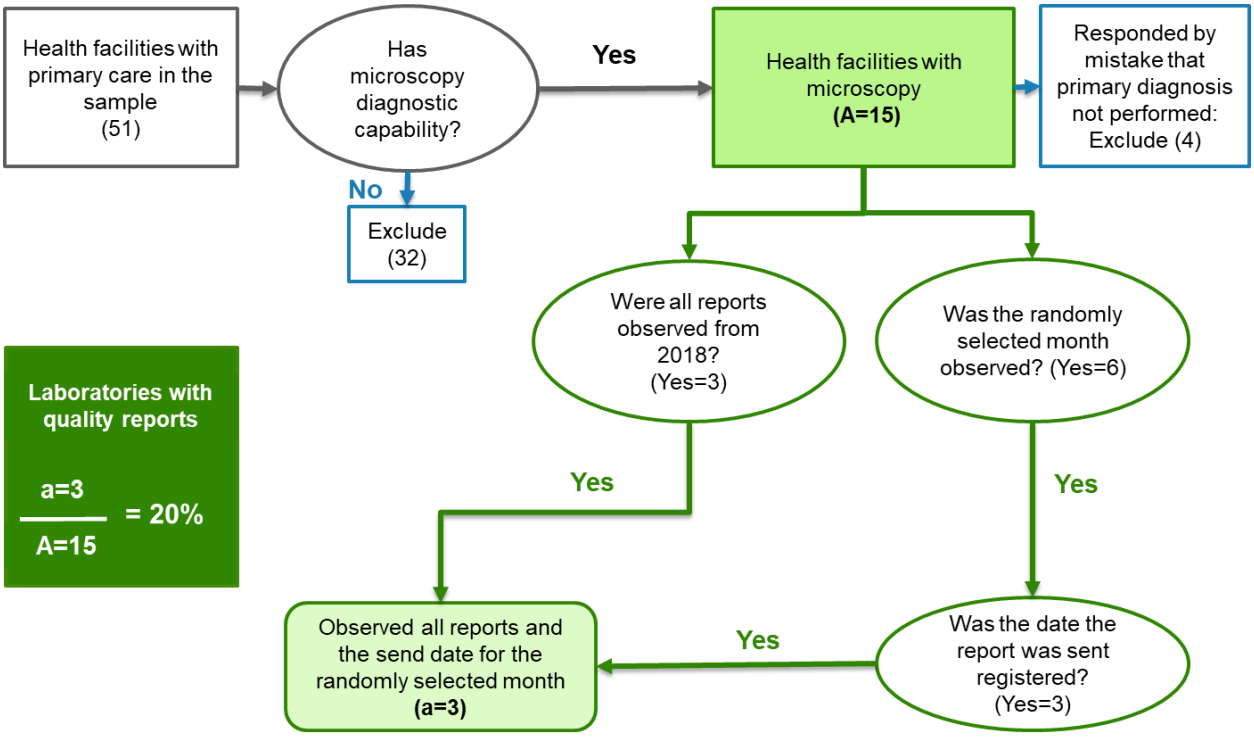
| | N | n | % | 95% CI |
|---|---|---|---|---|
| Malaria case reporting to standard | | | | |
| Stratum 3 | 2 | 0 | 0 | ( - ) |
| Stratum 4 | 17 | 3 | 17.6 | (6 - 44) |
| Total | 19 | 3 | 15.8 | (5 - 40) |

### 9.3.2 Indicator 2.03: Laboratory production reporting

The other component of Indicator 2.03 is the observation of weekly or monthly laboratory production reports that show the number of TBF slides examined and the number of RDTs performed. All facilities that conduct malaria diagnosis (by RDT or microscopy) must send these reports to the regional headquarters or regional laboratory. The observation of the laboratory reports during the survey was conducted in the same way as the case reports. Health facility eligibility and completion of indicator according to a decision algorithm is shown in Figure 9.3. The indicator required:

- that the reports be in a weekly or monthly format
- that all 52 or 12 reports be observed for the year 2018
- that all four weekly reports or one monthly report be observed for the randomly selected month with send date

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




15 facilities that provide attention to patients are eligible for consideration in the indicator. The results are shown in Table 9.12 and three 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 |
|---|---|---|---|---|
| Indicator: Attention units | | | | |
| Relevant units | 51 | 51 | 100 | ( - ) |
| Excluded due to survey error* | 51 | 4 | 7.8 | (3 - 20) |
| Units with diagnostic capacity | 47 | 15 | 31.9 | (20 - 47) |
| At least one weekly or monthly report from 2018 observed | 15 | 7 | 46.7 | (24 - 71) |
| All 52 or 12 monthly reports from 2018 observed | 15 | 3 | 20 | (6 - 48) |
| Report(s) for randomly selected month observed | 15 | 6 | 40 | (19 - 66) |
| Date(s) for report(s) of randomly selected month observed | 15 | 4 | 26.7 | (10 - 54) |
| Date(s) for report(s) of randomly selected month are valid | 15 | 2 | 13.3 | (3 - 42) |
| Result: Laboratory production reporting to standard | 15 | 3 | 20 | (6 - 48) |

*Missing data for 4 units with microscopy/RDT that incorrectly reported not making a primary diagnosis of malaria.

*Table 9.13: Comparison: result by department*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Laboratory reporting to standard | | | | |
| Bocas del Toro | 1 | 0 | 0 | ( - ) |
| Comarca Guna Yala | 10 | 3 | 30 | (10 - 63) |
| Darién | 1 | 0 | 0 | ( - ) |
| Panamá | 2 | 0 | 0 | ( - ) |
| Panamá Oeste | 1 | 0 | 0 | ( - ) |
| Total | 15 | 3 | 20 | (6 - 48) |

The destination where laboratory production reports are sent is shown in Table 9.14. Other entries show that laboratory production reports are sent to vector control.

*Table 9.14: Destination of lab production reports observed*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Where are laboratory production reports sent? | | | | |
| Regional health authority | 15 | 12 | 80 | (52 - 94) |
| National laboratory | 15 | 4 | 26.7 | (10 - 54) |
| Other | 15 | 2 | 13.3 | (3 - 42) |

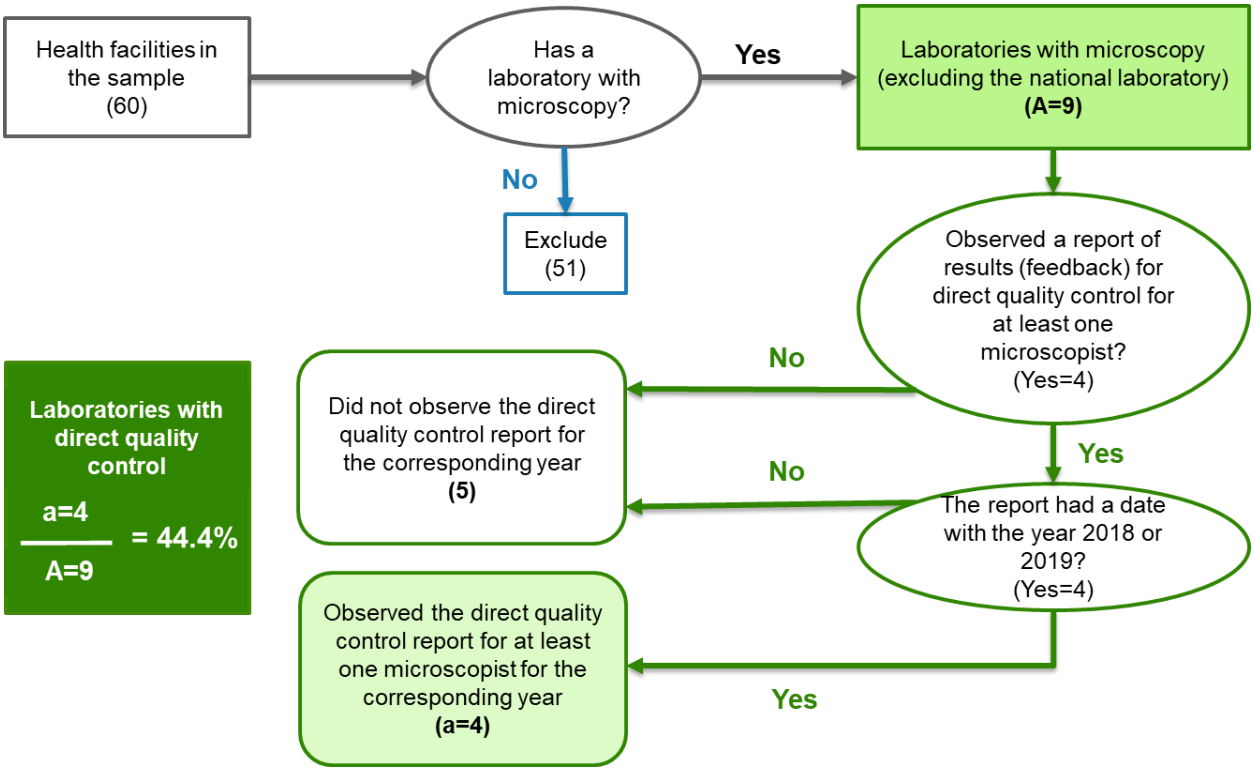
## 9.4 Indicator 3.02: Laboratory quality control

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 Panama 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, 9 laboratories at the primary and secondary 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 44.4% of local laboratories. The evidence required was a report of the results of the 2018 exam received back from the reference laboratory with feedback.

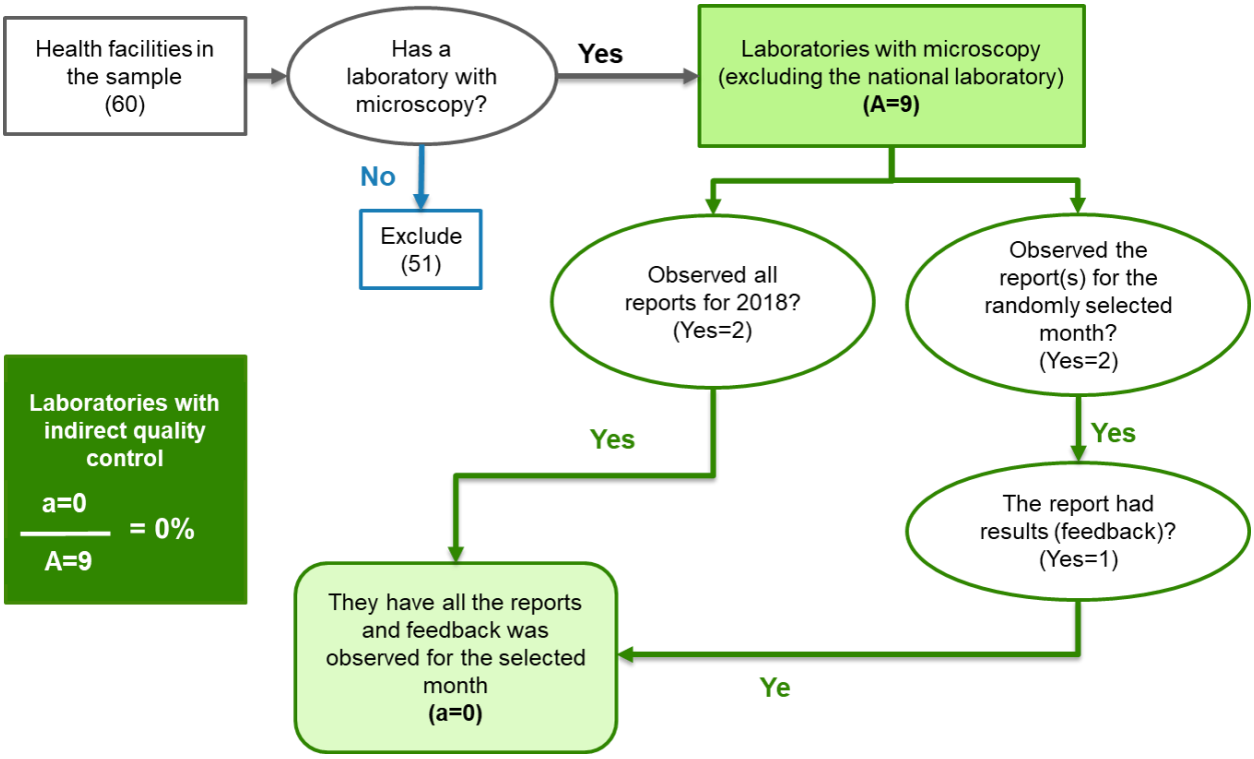
*Figure 9.4: Eligibility of health facilities for Indicator 3.02 (direct)*




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 Panama, 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 reference laboratory for cross-checking each week. 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 22.2% of local laboratories reported participating in quality control, none of them met the standards of the indicator based on the reporting observation. The evidence required was:

- that all 52 reports (or written evidence that no slides were examined in a given week without a report) be observed for the year 2018 for reports in a weekly format OR
- that all 12 reports be observed for the year 2018 for reports in a monthly format 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 | 9 | 4 | 44.4 | (17 - 76) |
| Indirect | 9 | 0 | 0 | ( - ) |

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

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Facilities with microscopy (excluding national lab) | 60 | 9 | 15 | (8 - 27) |
| Facilities passing direct quality control (DQC) component | 9 | 4 | 44.4 | (17 - 76) |
| Facilities that report participating in DQC | 9 | 6 | 66.7 | (32 - 89) |
| Feedback for at least one assessment in 2018 was observed | 9 | 5 | 55.6 | (24 - 83) |
| Feedback report with results was dated 2018 | 9 | 4 | 44.4 | (17 - 76) |
| Facilities passing indirect quality control (IDQC) component | 9 | 0 | 0 | ( - ) |
| Facilities that report participating in IDQC | 9 | 8 | 88.9 | (48 - 99) |
| Randomly selected month report was observed | 9 | 2 | 22.2 | (5 - 59) |
| Cross-checked results and feedback were observed on randomly selected report | 9 | 1 | 11.1 | (1 - 52) |
| All reports observed for 2018 | 9 | 2 | 22.2 | (5 - 59) |

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Facilities passing both direct and indirect quality control | 9 | 0 | 0 | ( - ) |

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

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Facilities who have microscopy (excluding national lab) | 60 | 9 | 15 | (8 - 27) |
| At least one report was observed for 2018 | 9 | 4 | 44.4 | (17 - 76) |
| Reports are monthly | 9 | 2 | 22.2 | (5 - 59) |
| 1-3 reports observed | 9 | 0 | 0 | ( - ) |
| 4-7 reports observed | 9 | 1 | 11.1 | (1 - 52) |
| 8-11 reports observed | 9 | 0 | 0 | ( - ) |
| 12 reports observed | 9 | 1 | 11.1 | (1 - 52) |
| Reports are weekly | 9 | 2 | 22.2 | (5 - 59) |
| 1-17 reports observed | 9 | 1 | 11.1 | (1 - 52) |
| 18-34 reports observed | 9 | 0 | 0 | ( - ) |
| 35-51 reports observed | 9 | 0 | 0 | ( - ) |
| 52 reports observed | 9 | 1 | 11.1 | (1 - 52) |
| All reports observed for 2018 | 9 | 2 | 22.2 | (5 - 59) |

*Table 9.18: Comparison: result by stratum*

| | N | n | % | 95% CI |
|---|---|---|---|---|
| Stratum 3 | | | | |
| Facilities passing direct quality control (DQC) component | 2 | 1 | 50 | (5 - 95) |
| Facilities passing indirect quality control (IDQC) component | 2 | 0 | 0 | ( - ) |
| Facilities passing both direct and indirect quality control | 2 | 0 | 0 | ( - ) |
| Stratum 4 | | | | |
| Facilities passing direct quality control (DQC) component | 7 | 3 | 42.9 | (14 - 78) |
| Facilities passing indirect quality control (IDQC) component | 7 | 0 | 0 | ( - ) |
| Facilities passing both direct and indirect quality control | 7 | 0 | 0 | ( - ) |

# Chapter 10: Challenges, Conclusions, and Recommendations

## 10.1 Challenges and limitations

### 10.1.1 Challenges for health facility data collection

In Panama, field personnel were generally able to gain authorization to interview in selected health facilities, although a few temporary or permanent facility closures were discovered in the field that led to substitutions in the sample. It was sometimes 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.

First-line malaria medications and RDTs were observed at relatively few facilities, and records of stock were sometimes not available or insufficiently detailed to determine stock-out over a three-month period. Often, laboratory supplies for malaria diagnosis and malaria treatments are tracked under a separate system from other pharmacy and laboratory inputs. Sometimes stock records are not maintained at the local facility, but rather at the *corregimiento* or regional headquarters of the malaria program.

### 10.1.2 Challenges for suspected case review

A key challenge for the review of suspected malaria cases was identification of a sufficient number of eligible cases, particularly in smaller health facilities. After substitutions to health facilities in the sample are taken into consideration, 31 primary and secondary care facilities from the sample were expected to complete suspected case medical record review. *Puestos de salud* were excluded because they do not keep medical records on site.

Because many facilities in the sample did not keep lists of fever cases nor International Classification of Diseases (ICD) code databases for electronic extraction that could be used as a sampling frame, the field team usually had to select the sample of suspected cases based on daily attention registries (*"Registro diario de atenciones médicas"*). Often, the total number of eligible attentions in the year 2018 was smaller than the quota for record revision. Occasionally, health facility personnel had difficulty locating selected records for review (for example, when medical record number was left blank on the attention registry).

Out of the 31 facilities, only 10 were able to meet the assigned quota of suspected cases. Eight facilities had medical records and the field team reviewed all eligible medical records from 2018, but did not meet the quota. Suspected case medical record review was not able to be completed at the 13 remaining health facilities and no medical records were reviewed. Out of those 13 health facilities, six did not keep medical records on site, five did not have any method to sample medical records, and two destroyed all records from 2018. Due to the low number of medical records being collected at the beginning of data collection, the quota was increased for the remaining facilities, but the expected quota of 1200 completed suspected case medical records was not met.

### 10.1.3 Challenges for confirmed case review

Based on the fact-finding trip and the surveillance reporting process, it was expected that all paper copies of malaria confirmed case reports (malaria notification, treatment, and investigation forms) from the *corregimiento* would be stored at the *corregimiento*-level vector control office. Early into data collection the field team notified us that they were unable to find these paper reports at the *corregimiento*-level vector control offices in the sample. At the end of data collection, only one confirmed case was collected at *corregimiento*-level vector control. The corresponding regional level vector control offices were visited to see if confirmed case reports could be collected, but no physical reports were found at this level either. Regional staff informed the team that when the electronic SIVE system was created, malaria case data

were entered into the system at the regions and the paper records stored at the region were subsequently destroyed.

When available, the field team collected confirmed case reports from primary and secondary level facilities that were visited, but these units only stored reports for cases diagnosed within the facility or by associated community health workers. At the end of data collection, the central-level vector control office in Panama was visited and 39 confirmed cases were collected, all corresponding to Comarca Guna Yala. Because paper reports from 2018 were not archived, substantially fewer confirmed cases were collected during the baseline evaluation than expected (only 95 collected out of 562 budgeted). It was determined that there was one duplicate case collected between the primary and secondary care facilities and the central-level vector control unit and the version collected at the central-level was excluded from calculations.

In Panama, malaria case notification, treatment, and investigation forms were generally found for the few confirmed cases of malaria that could be reviewed. 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, there was no space to register follow-up testing and results. From the fact-finding visit, we anticipated these obstacles to measurement.

### 10.1.4 Challenges for case and laboratory reporting review

In Panama, there are nationally standard forms for case and laboratory reporting, but when labs only encounter a few or no malaria cases each year, it is possible that these reports are not completed to the national standard. At times, rather than send the aggregate case report, a health facility will only send an individual notification form that is entered in SIVE, the national surveillance database. This database can then be used to review weekly or monthly statistics.

Copies of the forms are filed at the sending health facility and the receiving reference lab. Case and laboratory reporting formats do not typically include the date sent or received, complicating the attempt to evaluate timeliness of submission. Additionally, field personnel were sometimes unable to observe the forms from the year 2018 when facility personnel were unable to find the files. This was a particular problem where there had been changes in laboratory or statistics personnel since 2018. In Guna Yala, the health facility staff rotate every 20 days between sites. When interviewers visited a facility and the microscopist was not present or there was no microscopist assigned there for that rotation, often clinical staff were unable to find the relevant reports from 2018.

Reporting information for confirmed cases of malaria for 2018 were not available at the National Laboratory. An area of the records room in the National Laboratory that stored these reports was destroyed in 2019 from a burst water pipe. Case reporting indicators were not calculated from the National Laboratory, so this did not affect any RMEI indicators. This pipe burst also destroyed the 2018 PAHO external quality control certification stored at the National Laboratory, but a copy of this report was later obtained by Ministry of Health personnel and sent to IHME, so this component was included in RMEI indicator calculations.

### 10.1.5 Challenges for household data collection

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

## 10.2 Key findings and recommendations

Formats of paper documents should be reviewed in order to ensure essential information is captured, but more importantly, the pipeline from recording on paper in the field to the final electronic database should be reviewed and improved to ensure the highest data quality, and to ensure the inclusion of information on case management captured after malaria diagnosis (treatment administration and supervision and follow-up parasitological tests). Migration to electronic information systems must take into account the effectiveness of current paper-based practices and must ensure that patient information continues to be available at points of care, which may imply retaining paper formats in archives where electronic system access is not feasible. As discussed in Chapter 7, the baseline measurement uncovered substantial differences (in both data missingness, and timeliness of diagnosis and treatment) between records kept on paper and those accessed through the SIVE system. The emphasis must be on ensuring complete and precise data at the lowest levels of information, and in enabling effective data storage, processing, quality control, and analysis for decision-making at the department/ district and central levels.

Because malaria and other infectious disease programs have been managed for decades as parallel, vertically integrated systems, some disconnects between service provision in health facilities and through the vector control program persist. Different groups manage different activities for case detection, case management, and vector control, and there is not always a clear coordination plan. Vector control teams in the field must inform to the malaria program, while patients visit health facilities that are part of a separate reporting chain to the health region. 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 Panama, in particular adherence to aggregate notification requirements and laboratory quality control participation, and in terms of detection and record-keeping protocols for patients with fever presenting at a health facility (suspected malaria cases). At the local level, there is a notable variation in practices among health facilities, and sometimes a lack of understanding of central-level operations and goals. Respondents in certain facilities informed data collectors that RDT are not considered an official diagnosis and as such, RDT production numbers and cases detected by RDT are not reported on laboratory reports. 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 |
|---|---|---|---|---|
| 2.02 | Fever cases with blood sample | 16 | 56.2 | (22 - 85) |
| 3.02 | Quality control (external) | 1 | 100 | ( - ) |
| | Quality control (direct) | 9 | 44.4 | (17 - 76) |
| | Quality control (indirect) | 9 | 0 | ( - ) |
| 4.02 | Diagnosis within 48 hours | 559 | 8.9 | (7 - 12) |
| 4.01 | Treatment within 24 hours | 559 | 5.5 | (4 - 8) |
| 4.03 | Treatment complete and supervised | 562 | 6.6 | (5 - 9) |
| 6.01 | Vector control coverage | 1618 | 56.3 | (35 - 76) |
| 7.01 | Equipment and instruments for diagnosis and treatment | 51 | 17.6 | (9 - 31) |

## A.2 Monitoring indicator matrix

| # | Indicator | N | % | CI |
|---|---|---|---|---|
| M2.01 | Suspected cases with malaria test (MRR) | 555 | 9.4 | (7 - 12) |
| M2.03 | Case reporting with quality | 19 | 15.8 | (5 - 40) |
| | Lab production reporting | 15 | 20 | (6 - 48) |
| E2.04 | Notified within 24 hours of detection | 559 | 11.6 | (9 - 15) |
| E3.03 | Equipment and instruments for sampling, diagnosis and RDTs | 51 | 21.6 | (12 - 35) |
| E4.05 | Health facilities without stockouts of first-line treatments | 31 | 35.5 | (21 - 54) |
| E6.03 | Population protected by IRS | 1800 | 44.8 | (42 - 47) |
| E6.05 | Population protected by ITNs | 1809 | 28.5 | (26 - 31) |

| # | Indicator | N | Median | CI |
|---|---|---|---|---|
| E4.03 | Median time between onset of symptoms and start of treatment (days): passive surveillance | 51 | 3.0 | ( - ) |
| | Median time between onset of symptoms and start of treatment (days): active surveillance | 32 | 2.0 | ( - ) |
| | Median time between onset of symptoms and start of treatment (days): surveillance type not registered | 9 | 5.5 | ( - ) |

# Appendix B: Indicator Definitions

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

## M2.01: Suspected malaria cases with parasitological test

**Source:** Medical record review of suspected cases of malaria

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

*Sampling by ICD code - diagnoses eligible for review*

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

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

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

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

*Sampling by principal complaint - motives eligible for review*

- Fever
- Malaria
- Dengue
- Chikungunya

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

**Exclusions:**

1. Health facility in stratum 2 and 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 2 and 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

## P2.02: Fever cases with blood sample

**Source:** Household survey

**Denominator:** People in stratum 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)

## M2.03a: Malaria case reports with quality standards

**Source:** Health facility observation

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

**Numerator:** Health facilities with weekly epidemiological surveillance reports observed

- Reports list the aggregate number of malaria cases or report of zero cases
- Reports observed for all 12 months or 52 weeks of the year 2018
- Reports in randomly selected month list sending date

**Exclusions:** *Corregimiento*-level vector control units, national reference laboratory

## M2.03b: Malaria laboratory production reports with quality standards

**Source:** Health facility observation

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

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

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

**Exclusions:** *Corregimiento*-level vector control units, 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

- 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* : chloroquine + primaquine
- *P. falciparum* or mixed cases (from areas with or without 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

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

**Source:** Medical record review of confirmed cases of malaria

**Denominator:** Number of confirmed malaria cases reviewed

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

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

## P4.03: Malaria cases with complete and supervised treatment

**Source:** Medical record review of confirmed cases of malaria

**Denominator:** Number of confirmed malaria cases reviewed

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

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

**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 (as informed at surveyed health facility)

**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 *sub-centro de salud, centro de salud, "CAPSI", "CAPPS", "ULAPS"*, and hospitals

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

- Does not apply for any facilities in baseline sample

*Antimalarial medications for cases of P. falciparum* from areas of known chloroquine resistant malaria:* Derivatives or artemisinin (artemether + lumefantrine) without stockout in the three months prior to the survey

- Does not apply for any facilities in baseline sample

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

- All *puesto de salud, sub-centro de salud, centro de salud, "CAPSI", "CAPPS", "ULAPS"*, and hospitals

*Forms for sending slide samples*

- All *puesto de salud*

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

- All *puesto de salud, sub-centro de salud, centro de salud, "CAPSI", "CAPPS", "ULAPS",* and hospitals

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

- All stratum 2, stratum 3 and stratum 4 health facilities that reported microscopic diagnostic capacity, excluding *corregimiento*-level vector control units and the national lab

*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 stratum 2, stratum 3 and stratum 4 health facilities that reported microscopic diagnostic capacity, excluding *corregimiento*-level vector control units and the national lab

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

- All stratum 2, stratum 3 and stratum 4 health facilities that reported microscopic diagnostic capacity, excluding *corregimiento*-level vector control units and the national lab

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

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

*Forms for sending slide samples*

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

# Appendix C: Sample design and methods

## C.1 Sample size

The size of the sample of health facilities for Panama was defined as a part of the funding proposal to cover 60 points of measurement. In the case of the RMEI indicators, the “effective sample size”, or number of observations with data available for a specific indicator, varies from a fraction of the facility sample (e.g., participation in microscopy quality control assessment can only be measured in facilities with microscopy capabilities) to a much larger number (e.g., several hundred records of fever cases reviewed to verify if a malaria test was taken). The sample of 60 points was allocated purposively among different types of facilities based on the findings of the joint IDB-IHME fact-finding visit in order to satisfy minimum anticipated effective sample sizes. The LQAS measurement was defined as a part of the funding proposal to cover 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 Panama, the population variance was difficult to estimate a priori, necessitating review of a range of scenarios where population variance and sample size are allowed to vary, as shown in Figure C.1.

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

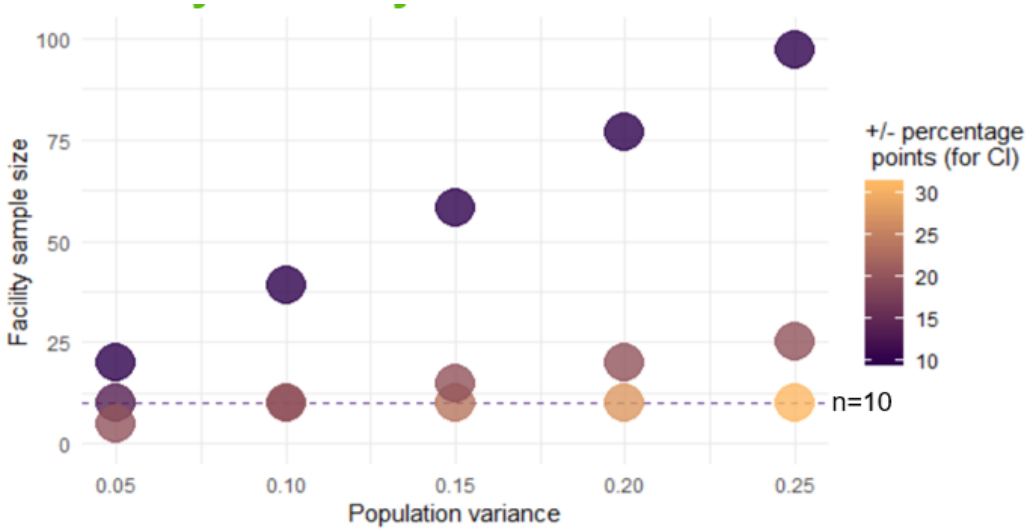



**Figure 1. Facility sample sizes and corresponding margins of error across different levels of population variance.** Potentially acceptable margins of error range from +/-10 ppts (ideal) to +/-30 ppts (considered high) on either side of the point estimate.

## C.2 Sample selection procedures

### C.2.1 Selecting health facilities

We prepared the sampling frame of facilities eligible for random selection by identifying all primary care facilities (*Puesto de salud, Sub Centro de Salud,* and *Centro de Salud*) in *corregimientos* in malaria strata 3 and 4 based on referral networks and facility lists provided by the Panama Ministry of Health. Eligible facilities were listed according to whether or not they provide malaria diagnosis by microscopy. Additionally, they were listed according to whether vector control activities (IRS or ITN distribution) were carried out within the catchment area, as noted in intervention activity lists that the Ministry of Health provided to IHME. Primary care facilities were sorted by a random variable and a sample was drawn in four strata: with and without microscopy capacity in malaria stratum 4, and with and without microscopy capacity in malaria stratum 3.

Facilities with autochtonous malaria cases in the catchment area during 2018 had first priority for selection in each sampling stratum. If all facilities with autochthonous cases had been selected in a given stratum and spaces still remained in the sample, facilities were selected at random among all eligible facilities in the stratum until the full sample size was reached. All remaining facilities were selected and added, in random order, to an alternate sample to be used in the case a selected facility could not be surveyed and required substitution.

Next, we built a list of the eligible *corregimiento*-level vector control units and referral hospitals according to the referral network, including each *corregimiento* with primary care units already selected to the sample. This sampling frame consisting of, respectively, *corregimiento*-level vector control units, CAPSI, CAPPS, ULAPS, and hospitals, was sorted by a random variable and the first facilities in the list selected up to a fixed sample size by facility type. The remaining facilities not selected from the sampling frame were ordered and listed to use as an alternate sample in case a facility could not be surveyed and required substitution. We assigned each *corregimiento*-level vector control unit to the maximum stratum found in its service area (*corregimientos* with any localities in stratum 4 are therefore assigned to stratum 4). The national reference laboratory for malaria was selected with certainty.

### C.2.2 Selecting suspected cases of malaria

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

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

### C.2.3 Selecting confirmed cases of malaria

The budgeted quota of confirmed cases of malaria was allocated among selected facilities based on the relative proportion of confirmed malaria cases in each *corregimiento* in 2018. If the number of confirmed

cases for 2018 available for review in the facility was smaller than the quota, all records from 2018 were reviewed. If the number of confirmed cases available for review was greater than the quota, which did not occue in data collection, interviewers used a list of confirmed malaria cases extracted from the digital system or attention records to select the sample manually using the same systematic method described in the previous section.

Based on the fac-finding trip to Panama, it was expected that physical records of 2018 confirmed cases of malaria would be stored at *corregimiento-level* vector control units. During data collection, only one confirmed case report from 2018 was collected at this level of vector control unit. The field team visisted regional vector control units to see if the physical records were stored there, but were informed that in many regions the physical reports were destroyed after they were entered into the SIVE database. At the end of data collection, the field team visisted the central-level vector control office where they found 39 2018 confirmed case reports from Guna Yala. The field team also collected 2018 confirmed case information from primary and secondary care facility if they were found.

No identifiable information was collected from the confirmed case reports, so key variables were used to compare confirmed cases collected at Guna Yala health facilities and the central-level vector control unit to see if duplicated cases were collected. It was determined that there was one duplicate case collected and the version collected at the central-level was excluded from calculations.

### C.2.4 Selecting communities

At each of the first 16 primary care facilities selected in malaria stratum 4, the field supervisor asked facility staff for information about the facility's catchment area, including the number of communities served, name and population of each community, and recent vector control activity in each community (IRS or distribution of ITN). The supervisor input the information to a Sample Selection Module which automated the process of selecting at random among eligible communities served by the facility. If any facilities in the catchment area had received vector control interventions, a community was selected at random among those with interventions. If no communities received interventions or the intervention status of all communities was unknown, a community in the catchment area was selected at random. A second community from the catchment area was selected as a backup in the event that the first community could not be surveyed due to security concerns, logistical challenges, or community refusal of the study. In Panama, many health posts were found to serve a single community, which accordingly was surveyed.

### C.2.5 Selecting households

In order to achieve the desired sample size of 400 households, we sought to complete interviews with residents of 25 randomly selected households in each of the 16 communities selected from the catchment areas of the ambulatory facilities in the health facility sample.

Field staff selected the sample of households using systematic manual sampling techniques with the dwelling as the unit of random selection. For each community, the Sample Selection Module discussed in the previous section output a random integer between 1 and 9 and a randomly selected cardinal direction to use as a starting point, and calculated a skip interval by dividing the total number of households in the community in order to achieve a sample of 25 households completed. If the calculated interval was greater than 9, an interval of 9 was output such that only a single sector of larger communities was surveyed to facilitate field operations. The field team started at the recognized center of the community (such as a plaza, church, or market) and began sample selection in the random direction provided by the sampling module, counting dwellings first to the random start point and subsequently according to the skip interval, along the right hand side of the street. Each selected household was approached to explain the study and request participation. Upon reaching a dead end or reaching the border of the community, field workers made a turn to the right (or turned around) and continued the systematic selection along the right hand side. If a selected dwelling contained more than one household, each of those households was eligible for the survey and counted toward the quota of 25 households per community. If a selected

household could not be interviewed due to absence or refusal, it was replaced with the household in the dwelling next door on the right side.

Informed consent was sought from each respondent to the household questionnaire. Occasionally, a survey was refused in course, resulting in a partially complete household result. Because multiple interviewers worked the sample simultaneously, in a handful of instances more than 25 surveys were completed. In the baseline, counts of complete households by community range from 25 to 29 households. Counts of absent households range from 0 to 6 households. Counts of refused households range from 0 to 1 household.

## 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

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

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

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**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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