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Regional Malaria Elimination Initiative Dominican Republic

Baseline Measurement (2019)

October 2020

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Acronyms

BMGF - Bill & Melinda Gates Foundation
CAPI - Computer-assisted personal interview
CC - *Colaborador comunitario*, Volunteer community health worker
CECOVEZ - *Centro de Prevención y Control de Enfermedades Transmitidad por Vectores y Zoonosis*, Center for Prevention and Control of Vector-Borne Diseases and Zoonoses
CHAI - Clinton Health Access Initiative
COMISCA - Council of Ministers of Central America and the Dominican Republic
CSF - Carlos Slim Foundation
DPS - *Dirección Provincial de Salud*, Provincial Health Office
DTI-R - Detection, Diagnosis, Treatment, Investigation, and Response
ICD - International Classification of Diseases
IDB - Inter-American Development Bank
IHME - Institute for Health Metrics and Evaluation
IRS - Indoor residual spraying
ITN - Long-lasting insecticide-treated nets
LQAS - Lot Quality Assurance Sampling
MRR - Medical record review
PAHO - Pan American Health Organization
RBA - Results-based aid
RDT - Rapid diagnostic test
RMEI - Regional Malaria Elimination Initiative
SNS - Servicio Nacional de Salud, National Health Service
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 the Dominican Republic, with input from the Ministry of Public Health and Social Assistance. The measurement included a health facility survey consisting of interview, observation, and records review components and a Lot Quality Assurance Sampled (LQAS) household survey in the catchment area of selected health facilities. The health facility survey sample was selected among eligible primary care facilities in malaria focus areas of the Dominican Republic. Secondary care facilities and *Dirección Provincial de Salud* (DPS), province-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 Dominican Republic baseline measurement is summarized in Table E1. The information sought as a part of the measurement varied by facility type.

Table E1: Dominican Republic data collection summary

Point of data collection	Number completed	Measurement completed
Primary care health facilities with/without malaria microscopy	41	Health facility questionnaire and observation
		Medical record review of suspected cases of malaria
		Treatment stock
		Lab supplies/reports, if microscopy
		Household measurement in catchment area
Secondary care health facilities	10	Health facility questionnaire and observation
		Medical record review of suspected cases of malaria
		Treatment stock
		Lab supplies/reports
Suspected malaria cases reviewed	*477*	
Dirección Provincial de Salud (DPS) vector control units	6	Record review of confirmed cases of malaria
		Stock of treatment and diagnostic supplies
Confirmed malaria cases reviewed	*486*	

Point of data collection	Number completed	Measurement completed
National malaria reference laboratory	1	Lab supplies and reporting
		Lab certification and quality control
Communities	32	Coverage of vector control interventions
		Fever cases with malaria test
		Treatment of confirmed malaria cases
Households interviewed	*803*	

Summary of results

Malaria prevention

In order to protect the populations most at risk of malaria infection, the public health system in the Dominican Republic 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	0%	5.3%
Both	2	0%	6.5%
None	29	2%	7.4%

Detection of malaria cases

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

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

	N	n	%	95% CI
Antimalarial medications[1]	46	2	4.3	(1 - 16)
Sampling and biosafety equipment[2]	19	11	57.9	(35 - 78)
Sample submission forms[3]	19	11	57.9	(35 - 78)
Rapid diagnostic tests (RDTs) for onsite testing[4]	55	21	38.2	(26 - 52)
Microscopy equipment	10	6	60	(29 - 85)
Equipment for staining and testing	10	7	70	(37 - 90)
Reagents for staining	10	4	40	(15 - 71)

	N	n	%	95% CI
Units with all required equipment and medications	**58**	**4**	**6.9**	**(3 - 17)**

[1]Antimalarial medications were only captured at 46/47 establishments due to survey error
[2]Sampling equipment was only captured at 19/57 facilities due to survey error
[3]Submission forms were only captured at 19/57 facilities due to survey error
[4]RDTs were only captured at 55/57 establishments due to survey error

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)	24	9	37.5	(24 - 54)
Suspected case with malaria test (medical record review)	460	13	2.8	(2 - 5)

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 *Centro de Prevención y Control de Enfermedades Transmitidas por Vectores y Zoonosis* (CECOVEZ) office. The indicator for timely diagnosis of malaria compares the date of initiation of fever or other symptoms with the date of diagnosis (if the patient received both an RDT and a TBF, the indicator is calculated using the earlier diagnosis date) as shown in Table E5. Cases with diagnosis two days or less after symptom initiation are considered to have timely diagnosis. Cases with fever/symptom initiation date or diagnosis date not registered are not considered to have timely treatment initiation.

Table E5: Diagnosis within two days, Confirmed case review

	N	n	%	95% CI
Cases diagnosed within 48 hours of onset	448	41	9.2	(7 - 12)
3 days	448	34	7.6	(5 - 10)
4-5 days	448	95	21.2	(18 - 25)
6-7 days	448	93	20.8	(17 - 25)
Over 7 days	448	128	28.6	(25 - 33)

	N	n	%	95% CI
Indicator result: Cases diagnosed within 48 hours of onset*	448	41	9.2	(7 - 12)

*38 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 information about malaria treatment administered to patients available in the records stored at CECOVEZ. In the Dominican Republic, there is no space on the malaria case notification and investigation forms to record treatment type or initiation date. 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	486	14	2.9	(2 - 5)
First dose treatment within 24 hours of diagnosis*	485	7	1.4	(1 - 3)
Correct treatment administered within 24 hours of diagnosis*	485	0	0	(-)

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

The indicator for complete and supervised treatment of malaria identifies the cases with evidence that all doses of the treatment scheme corresponding to the malaria diagnosis 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. None of the cases reviewed had evidence that treatment was adequate, complete, and supervised.

Table E7: Complete and supervised treatment, Confirmed case review

	N	n	%	95% CI
Adequate treatment and number of doses administered	486	0	0	(-)
Evidence of at least one supervised dose	486	0	0	(-)
Indicator Result: Complete treatment with supervision	486	0	0	(-)

Malaria reporting and surveillance

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

facility with malaria microscopy, and a report of external microscopy certification from the Pan American Health Organization was sought in the national reference laboratory.

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

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

	N	n	%	95% CI
Malaria case reporting to standard	29	1	3.4	(0 - 22)
Laboratory production reporting to standard	10	2	20	(5 - 55)
External quality control: 2018 National Lab Evaluation form observed	1	1	100	(-)
Facilities passing direct quality control (DQC) component	9	0	0	(-)
Facilities passing indirect quality control (IDQC) component	9	0	0	(-)

Key findings

The results of the Dominican Republic 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 the Dominican Republic draws closer to malaria elimination.

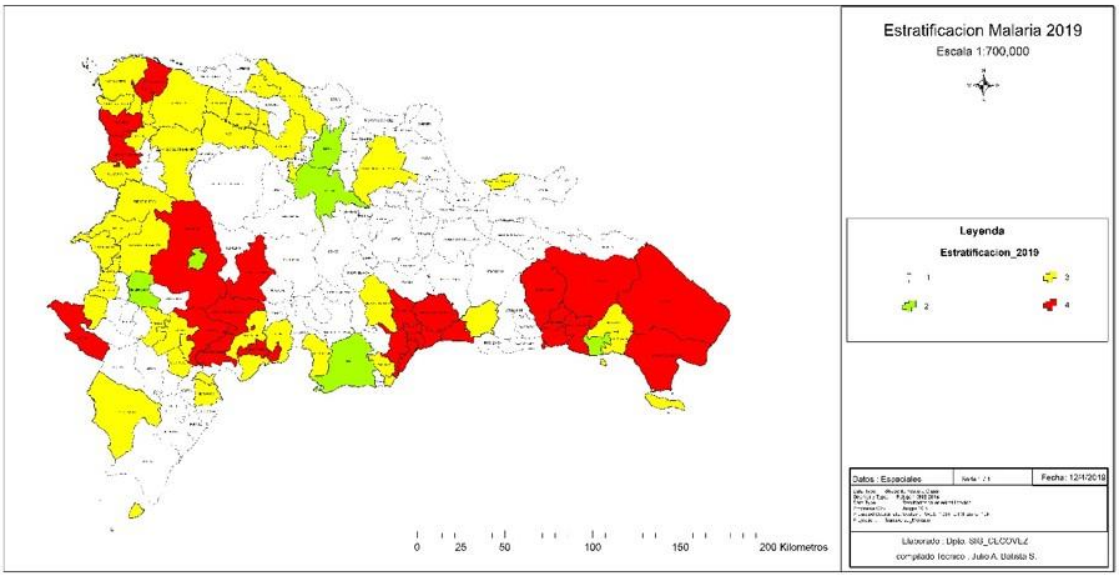
Chapter 1: Introduction

1.1 Overview

The Regional Malaria Elimination Initiative (RMEI) is a regional public-private partnership seeking to accelerate progress toward malaria elimination in Mesoamerica and the Dominican Republic. 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 administered by the Inter-American Development Bank (IDB) in close coordination with the Council of Ministers of Central America and the Dominican Republic (COMISCA) and with the Project Mesoamerica. 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 the Dominican Republic, and harness partnerships with the Pan-American Health Organization (PAHO), Clinton Health Access Initiative (CHAI), and the Global Fund. The malaria program in the Dominican Republic 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 will 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. 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 the Dominican Republic, active, residual, and inactive foci were defined, and each municipality was assigned to a stratum 1 through 4, as seen in Figure 1.1. This exercise was completed prior to the baseline measurement and served as a basis for defining the study area and selecting the sample.

Figure 1.1: Dominican Republic malaria stratification: national



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

Table 1.1: Dominican Republic malaria stratification: Initiative municipalities

Province	Municipality	Stratum
Azua	Padre las Casas	4
Barahona	Fundación	3
	Barahona	3
Dajabón	Loma de Cabrera	4
Distrito Nacional	Santo Domingo de Guzmán	4
Duarte	San Francisco de Macorís	3
El Seibo	Santa Cruz de el Seibo	4
La Altagracia	Higüey	4
	San Rafael del Yuma	4
La Romana	La Romana	3
San Cristóbal	San Cristóbal	4
	Bajos de Haina	4
	San Gregorio de Nigua	4
San Juan	San Juan	4
Santiago	Santiago	3
Santo Domingo	Santo Domingo Oeste	4
	Los Alcarrizos	4
	Santo Domingo Norte	4
	Pedro Brand	4
Valverde	Mao	3

Table 1.2: Dominican Republic malaria stratification: Definition and distribution of strata

Stratum	Number of municipalities	Definition
1	83	Non-receptive
2	6	Receptive, no autochthonous cases, no risk of importation
3	38	Receptive, risk of importation, no autochthonous cases
4	28	Receptive, presence of autochthonous cases in last 3 years

The Dominican Republic has several hundred cases of malaria each year, mostly concentrated in the greater Santo Domingo area. In 2018, the reference year for the baseline measurement, the Dominican Republic had 484 confirmed cases of malaria according to national public health surveillance data. The Dominican Republic has historically depended on a vertically integrated malaria program that operates in close coordination with programs for other vector-transmitted diseases. In the malaria elimination phase, the Dominican Republic will transition malaria detection and case management to be more closely horizontally integrated with the public primary care system managed by the *Servicio Nacional de Salud* (SNS or national health service), 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 evaluation 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 IDB negotiates with participating countries and implementation partners 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. Indicators for the Dominican Republic 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 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, laboratory reports, and pharmaceutical stock present in the facility, and a review of medical records of malaria and fever cases. It is designed to collect information on facility preparedness for detecting and treating malaria cases, as well as the quantity and quality of malaria care services provided in the baseline time period. Importantly, health facility data collection captures changes produced by interventions at the level of the health services access point, which may foretell changes in population health outcomes.

The household survey is designed to collect information on malaria detection, prevention practices, and knowledge in malaria focus areas of the Dominican Republic 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 malaria. Community data collection permits the observation of health status, 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 prepare for sample selection and data collection, IHME and IDB conducted a joint multi-day fact-finding visit in three regions of the Dominican Republic in June 2019. During the exploratory visit, the team visited a range of health facilities in endemic and non-endemic areas. The goal of the visit was to learn:

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

The trip also 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 performance 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 the Dominican Republic, the sample includes primary care facilities, hospitals, *"Dirección Provincial de Salud"* (DPS, Provincial Health Office) units, the *"Centro de Prevención y Control de Enfermedades Transmitidas por Vectores y Zoonosis"* (CECOVEZ, Center for Prevention and Control of Vector-Borne Diseases and Zoonoses) and the national reference laboratory for malaria located within CECOVEZ. Households within the catchment area of

primary care facilities selected to the sample were interviewed for the community survey. Table 1.3 shows the information collected at each point.

Table 1.3: Points of data collection for baseline measurement

Type of health unit	Measurement completed
Ambulatory health facilities with/without malaria microscopy	Health facility questionnaire and observation
	Medical record review of suspected cases of malaria
	Treatment stock
	Lab supplies/reports, if microscopy
	Household measurement in catchment area
Hospitals	Health facility questionnaire and observation
	Medical record review of suspected cases of malaria
	Treatment stock
	Lab supplies/reports
Dirección Provincial de Salud (DPS) units	Health facility questionnaire and observation
	Lab supplies/reports
	Treatment stock
National lab	Lab supplies and reporting
	Lab certification and quality control
Center for Prevention and Control of Vector-Borne Diseases and Zoonoses (CECOVEZ)	Record review of confirmed cases of malaria
Households	Coverage of vector control interventions
	Fever cases with malaria test
	Treatment of confirmed malaria cases

Another point of care of malaria detection and treatment in the Dominican Republic is the *"colaborador comunitario"* (CC), also known as *"colaborador voluntario"* (col-vol). These volunteer community health workers provide fever screening and malaria testing via rapid diagnostic test or thick blood film preparation, out of their own homes or around their communities. CCs do not manage their own supply stocks, keep records of patient care, nor have primary responsibility for case investigation and follow-up, the CC post is not eligible for inclusion in the performance indicators. All the necessary records to be reviewed for a patient with malaria detected by a CC, or with treatment supervised by a CC, will be filed at a health facility or vector control office rather than at the CC's home. Confirmed cases of malaria detected by a CC were included in the review of medical records, as paperwork for cases detected at any service point is always filed at CECOVEZ, where review took place, in the Dominican Republic.

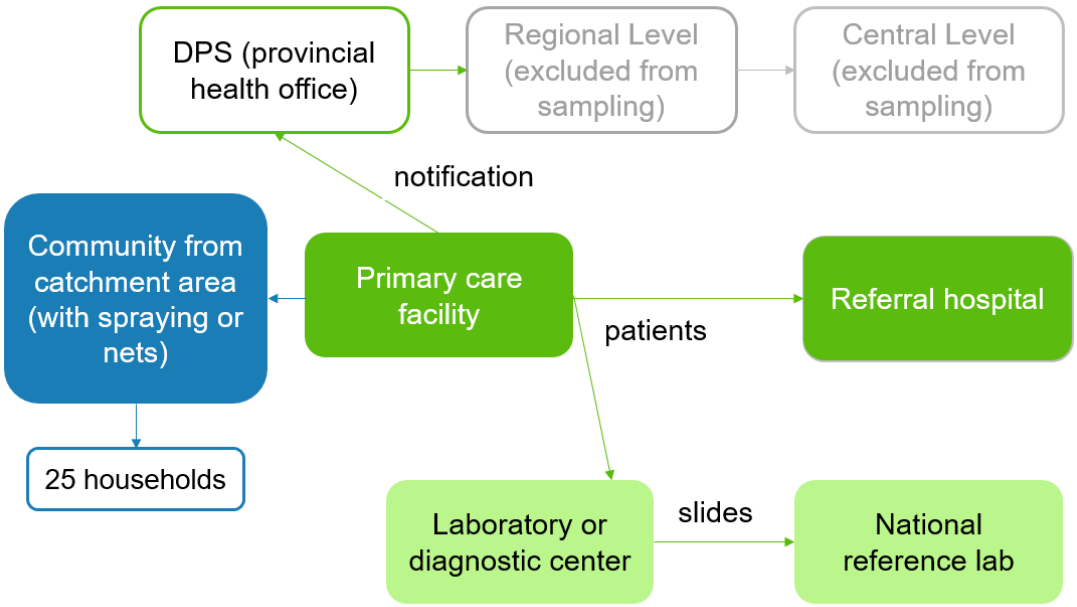
Chapter 2: Survey Methodology

2.1 Sample selection and description

The baseline measurement of the RMEI evaluation 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 not nationally representative of the population nor the public health care system, but rather targeted toward the 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 the Dominican Republic, 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 (*"unidad de atención primaria de salud," "centro clínico y diagnóstico," "policlínico"* and *"centro del primer nivel de atención"*) at random as the primary sampling unit, and then selected the other health services linked with it in malaria service provision, such as hospitals and DPS 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.

Figure 2.1: RMEI-Dominican Republic baseline health system structure



2.1.1 Health facility sample selection

In the Dominican Republic, malaria stratification was completed at the municipality level. Primary care facilities in municipalities classified as malaria stratum 3 or malaria stratum 4 were eligible to enter the sampling frame, with priority to facilities serving communities with autochthonous malaria cases during 2018. Most autochthonous cases were in the greater Santo Domingo area, so the sample was drawn separately inside and outside the metropolitan area to reduce the chance of concentrating the entire

sample in the capital zone to the exclusion of other provinces with active transmission. 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 also 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: inside and outside the Santo Domingo metropolitan area without microscopy capacity in malaria stratum 4, with microscopy capacity nationwide in malaria stratum 4, and nationwide in malaria stratum 3, regardless of microscopy capacity.

The sampling frame was built based on referral networks and facility lists provided by the Dominican Republic Ministry of Public Health and Social Assistance. Each health facility eligible to be selected for the sample was assigned to a malaria stratum 1 through 4 based on its municipality. We assigned each DPS unit to the maximum stratum found in its service area (provinces with any municipalities in stratum 4 are therefore assigned to stratum 4).

The initial sampling frame for the health facility survey is the list of facilities that provide primary care services for malaria. In order to ensure necessary information is captured for all indicators, for each selected facility we included the ancillary units from the reporting chain (DPS units and referral hospitals) associated with a selected primary care facility for measurement, up to a fixed sample size defined to balance budget considerations with statistical power for analysis. For example, once a local-level ambulatory facility was selected at random, several related units were identified for inclusion (or for random selection, if more than one qualifies). These include the hospital to which it refers severe malaria cases, and the DPS 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 household measurement in the zones with the most autochthonous transmission.

2.1.2 Substitutions within the sample

We selected two backup facilities per municipality in case sampled facilities could not be interviewed due to security or logistic concerns. When replacement was required, we replaced with a facility of the same level, with the same diagnostic capacity, and within the same municipality or a neighboring municipality when possible. If substitutes were not available in the same municipality, we replaced with a randomly selected facility from the same malaria stratum. In the Dominican Republic baseline, four primary care facilities, one hospital, and one DPS unit were replaced during data collection. The national malaria reference laboratory was discovered to be separate from the national public health reference laboratory and thus only the national malaria reference laboratory was surveyed.

Three primary care facilities refused to participate in the survey. All three facilities were replaced and the community survey was carried out in the catchment areas of the replacement facilities, rather than the originally selected facilities. One primary care facility had a manager who was on vacation during the time period the field team was in that region and permission for the survey could not be obtained. This facility was not replaced.

One hospital in the sample was replaced with another hospital from the same municipality because the originally selected hospital refused to participate. One DPS unit was replaced with the CECOVEZ national office. Originally the DPS unit belonging to the National District was selected but the field team was informed during data collection that none of the DPS units there are involved in the detection and management of malaria, instead CECOVEZ fulfills this function. It was also discovered that all confirmed case records for the country are archived centrally at the CECOVEZ and not at disparate DPS units. Additionally, the national reference laboratory for malaria was located at CECOVEZ. Given that CECOVEZ replaced both the national lab and the DPS unit and that one primary care facility was not

replaced, the total facilities tally to 58 (instead of the original 60). The total number of communities visited is 32.

2.1.3 Community and household sample selection

One community was selected for the Lot Quality Assurance Sampling (LQAS) household survey from the catchment area of each of the 32 primary care facilities selected to the facility sample in malaria stratum 4. The household survey could not be carried out in the catchment area of one selected health facility in malaria stratum 4 because of security concerns, and it was substituted with a community linked to a selected facility in malaria stratum 3.

Within the selected catchment area, a community that had received vector control measures (ITN distribution or IRS) interventions since the start of 2018 was intended to be selected at random among all communities with vector control interventions. If no communities received vector control interventions or intervention status was unknown, a community was selected at random among all communities in the catchment area. When information was available, field staff used an automated survey module to enter information about eligible communities in the catchment area, provided by health personnel at each selected facility (because complete data on vector control interventions was not received in a usable, geographically specific format from the Ministry of Public Health and Social Assistance despite requests from IHME). 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. In the Dominican Republic, random selection of the community and skip interval calculation were complicated by the fact that many health facilities do not store information about their catchment area populations.

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. Refusals were concentrated in municipalities in the greater Santo Domingo metropolitan area, in communities with heightened security concerns or where a large proportion of the population works outside the home.

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

	N	n	%	95% CI
Status of selected and replacement households				
Complete	1025	803	78.3	(76 - 81)
Refused	1025	95	9.3	(8 - 11)
Members absent	1025	77	7.5	(6 - 9)
Unoccupied dwelling	1025	41	4	(3 - 5)
Postponed	1025	5	0.5	(0 - 1)
Partially complete	1025	1	0.1	(0 - 1)
Other	1025	3	0.3	(0 - 1)

2.1.4 Confirmed case record review sample selection

For confirmed cases of malaria, the sample was designed to include review of all confirmed cases from 2018. The review of confirmed cases was scheduled for the DPS units where records were expected to be found based on the fact-finding visit. However, information on confirmed cases from 2018 could not be found at any DPS during data collection and interviewers were instructed that records from all provinces were filed in the CECOVEZ office. Field staff collected information from all case documents available at

the CECOVEZ office, including case notification, lab records, and treatment forms if available. All confirmed cases in 2018 were captured in the measurement, regardless of the source and place of detection. There was no major discrepancy between the number of confirmed cases according to the records and those found in the case review (484 vs. 486).

2.1.5 Suspected case record review sample selection

For suspected cases of malaria (fever and other complaints and diagnoses meeting the case definition), a random sample of eligible attentions from 2018 was selected for medical record review (MRR). The total budgeted quota of record reviews was divided equally among the primary care facilities and hospitals selected to the sample. Eligible attentions were identified in-facility using fever lists, 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. In the Dominican Republic, 51 facilities were visited but could not meet the quota for suspected cases of malaria. Field personnel were unable to review any suspected case records in 18 of the 51. Seventeen facilities had no registries that could be used for systematic manual sampling of records from 2018 (neither physical logbook nor electronic database) or did not maintain patient records in a way that the records could be linked to entries in the logbooks, so in these facilities, a convenience sample of 45 records was selected and reviewed for eligibility. Using this method of sampling, only 33 out of 51 facilities had any cases eligible for review.

Table 2.2 shows the total number of suspected cases reviewed (466), the number of cases selected based on diagnosis or principal complaint but found to be ineligible based on final diagnosis (44), and the cases selected and requested at facilities for which no paperwork could be located for review (122). In many facilities in the Dominican Republic, all eligible cases from the entire year 2018 were selected for review, because there were relatively few attentions with eligible diagnoses, and the number of attentions available was frequently insufficient to meet the record review quota, especially in small facilities. We planned to review around 1300 suspected case records, but fewer than 500 eligible records were able to be collected in the field. Additionally, 134 eligible cases across eight facilities were reviewed based only on daily attention logbooks because medical records were not kept at the facility during 2018 or were not available for observation the day of the survey (for example, because the facility was remodeling).

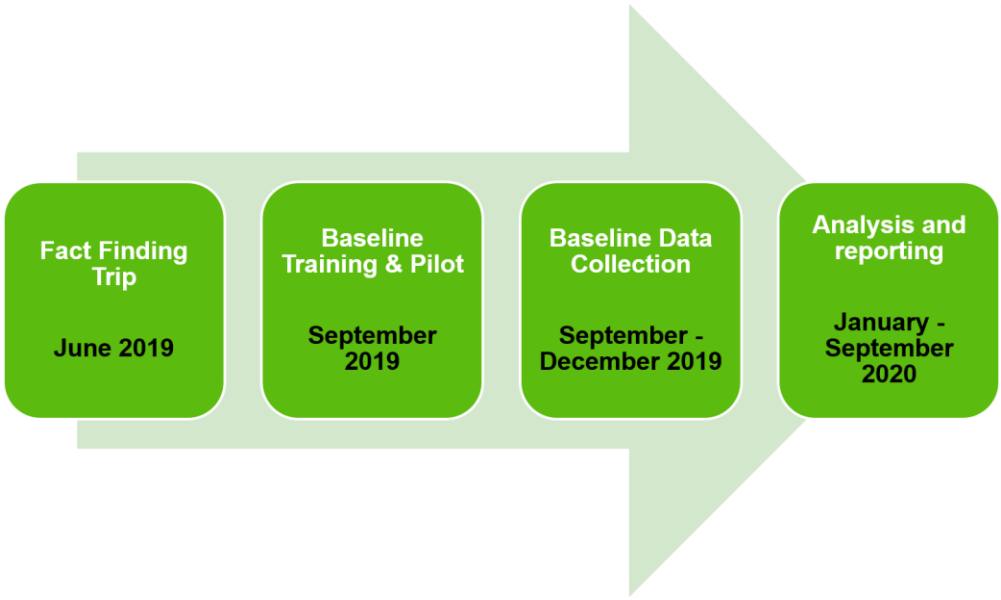
Table 2.2: Suspected case collection

	#
Total suspected cases selected for review	632
Suspected cases selected but could not be located for review	122
All suspected cases screened for eligibility	510
Ineligible suspected cases discarded	44
Eligible suspected cases collected	466

2.2 Survey implementation

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

Figure 2.2: RMEI-Dominican Republic 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). In order to allow the participation of non-Spanish speakers in the survey, the data collection team included interviewers proficient in French and Creole.

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

2.2.2 Survey content

The health facility survey includes several modules. An interview with the facility director records information about facility characteristics, services provided, and personnel employed by the facility. Observation modules are organized by room or category to facilitate visits to the rooms where care is provided to patients, the pharmacy, the laboratory, and other areas. 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 or notification forms that may be stored with or apart from the record. The MRR is not an interview, but a data collection method where the surveyor reviews the record and transfers the relevant information into the digital form. The questionnaire is filled out once per medical record selected to the sample of suspected malaria cases or to the sample of confirmed malaria cases. An additional module called 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 the Dominican Republic between September 10 and 14, 2019. The local agency contracted for data collection in the Dominican Republic, Borge y Asociados, hired four doctors, three nurses, and four additional field staff 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 Dominican Republic National Health Service and Ministry of Public Health and Social Assistance provided oversight during pilot exercises.

IHME and Borge y Asociados held debriefing and re-training sessions with surveyors post-pilot and provided continued training during the first week of data collection in communities and health facilities. Borge y Asociados continued providing retraining throughout data collection to maintain homogeneity and quality standards of the data collection teams over time. During the data collection launch from September 16-20 and during a supervisory trip November 4-8, 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 the Dominican Republic. 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 Dominican Republic Ministry of Public Health and Social Assistance.

2.2.5 Ethical considerations

The study was approved by the Institutional Review Board of the University of Washington, and authorized by the Dominican Republic Ministry of Public Health and Social Assistance and National Health Service to conduct data collection in health facilities and by local authorities to collect data in communities. All respondents to the household survey, and the senior responsible staff member at participating health facilities, signed informed consent forms prior to data collection. Signed consent forms were collected and managed by Borge y Asociados, the in-country data collection partner and this information was not transmitted to IHME for privacy reasons.

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

This chapter provides a descriptive summary of basic demographic, socioeconomic, and environmental characteristics, as well as knowledge and behaviors for malaria prevention, of the households interviewed for the RMEI-Dominican Republic Baseline LQAS Survey in households. All estimates reported in this chapter are weighted by the inverse probability of selection (see details in Appendix C) and account for clustering in variance calculations, except where otherwise noted.

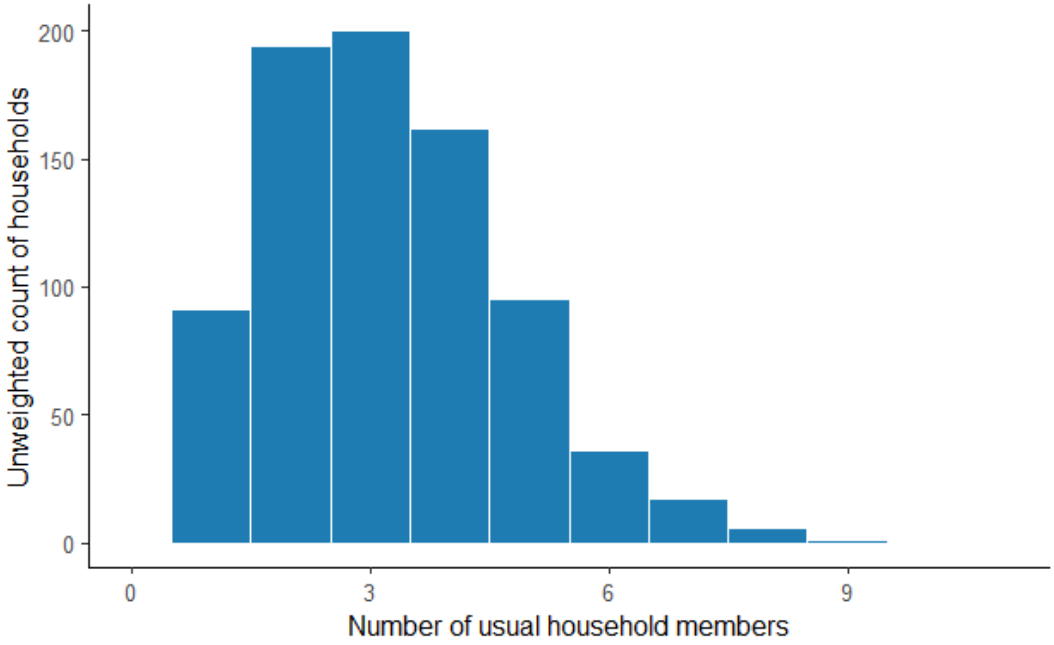
3.1 Characteristics of participating households

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

3.1.1 Household composition and household member characteristics

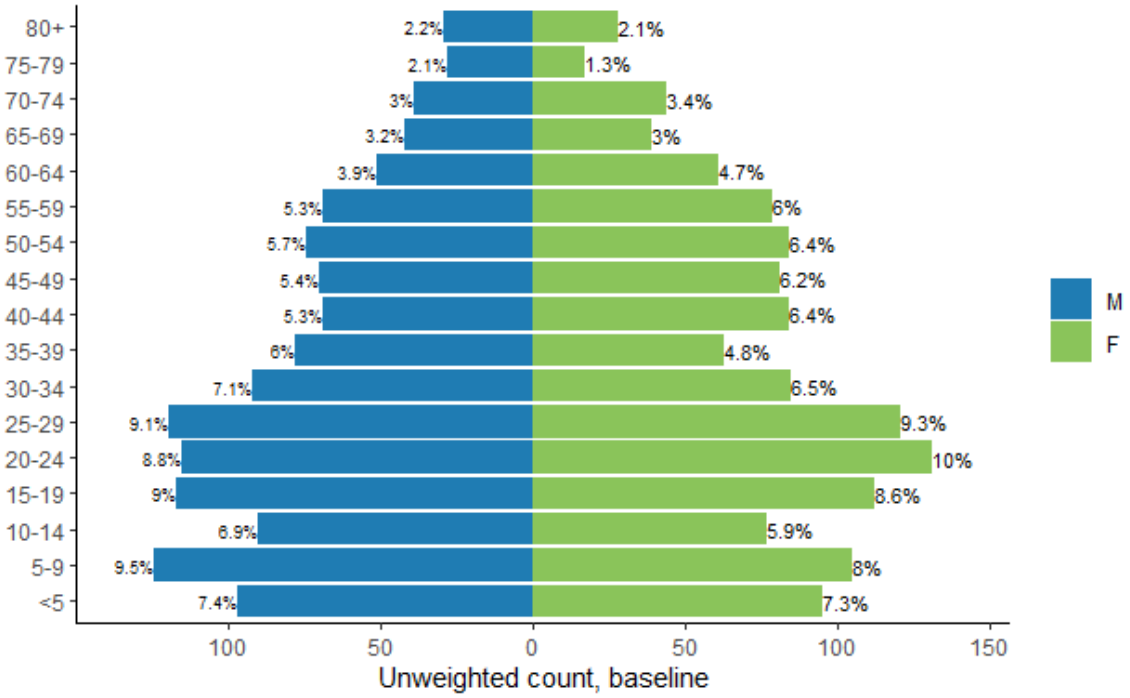
A total of 803 households in the Dominican Republic baseline survey completed the interview. The unweighted distribution of the number of members by household is shown in Figure 3.1. The survey sample for the Dominican Republic has a median household size of 3 and an unweighted average household size of 3.2.

Figure 3.1: Household size, unweighted percent distribution



The unweighted distribution of the de facto household population in the surveyed households in the Dominican Republic by five-year age groups and by sex is shown in Figure 3.2. The Dominican Republic 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, 23% of the population is under age 15 years, more than half (67%) of the population is in the economically productive age range (15-64), and the remaining 10% is age 65 and above.

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



The respondent was asked to indicate education level and languages spoken for all usual household members aged 15 or older. Respondents could indicate multiple languages spoken. The results are shown in Table 3.1, and Table 3.2 respectively. In the Dominican Republic, 11% of household members had no formal schooling, and 22.2% completed only primary education. Ninety-eight percent speak Spanish, 7.2% speak English and 6.2% speak Creole.

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	2021	262	11	(7 - 16)
Primary	2021	465	22.2	(19 - 26)
Secondary	2021	846	43.1	(40 - 46)
University	2021	393	20.9	(17 - 26)
Specialty	2021	19	1.1	(1 - 2)
Masters	2021	6	0.4	(0 - 1)
Don't know	2021	30	1.3	(1 - 2)

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

	N	n	%	95% CI
Languages spoken by household members age 15 and older				
Spanish	2021	1997	98.4	(96 - 99)
English	2021	129	7.2	(5 - 10)
Creole	2021	162	6.2	(3 - 14)
French	2021	63	2.3	(1 - 5)
Other	2021	22	1.1	(1 - 2)
Don't know	2021	1	0.1	(0 - 0)

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 the Dominican Republic, as seen in Table 3.3, Table 3.4, and Table 3.5, most homes are built with walls of cement block, concrete roofs, and ceramic tile floors.

Table 3.3: Exterior wall material as observed

	N	n	%	95% CI
Main material of exterior walls of dwelling				
Cement block	803	591	81.2	(73 - 87)
Polished wood	803	79	7.4	(5 - 11)
Plywood	803	72	6.3	(3 - 12)
Stone with lime/cement	803	33	3.2	(2 - 6)
Prefabricated material	803	3	0.5	(0 - 3)
Cardboard/waste material	803	7	0.4	(0 - 1)
Quarry stone	803	5	0.3	(0 - 1)
Palm/bamboo	803	4	0.1	(0 - 1)
Brick/covered adobe	803	3	0.1	(0 - 1)
Cane/palm/trunks	803	2	0	(-)
Other	803	4	0.5	(0 - 1)

Table 3.4: Roofing material as observed

	N	n	%	95% CI
Main material of roof of dwelling				
Concrete	803	381	52.2	(43 - 61)
Sheet metal (zinc/Alucin)	803	329	34.8	(26 - 44)
Cement tile	803	84	11.9	(7 - 19)
Clay tile	803	4	0.5	(0 - 2)
Cement fiber/asbestos sheet	803	2	0.3	(0 - 1)
Wood planks	803	1	0	(-)
Other	803	2	0.3	(0 - 1)

Table 3.5: Flooring material as observed

	N	n	%	95% CI
Main material of floor of dwelling				
Ceramic tile	803	329	44.1	(37 - 51)
Cement sheet/board	803	156	18.8	(13 - 26)
Cement brick or tile	803	141	18.3	(12 - 26)
Earth/sand	803	77	7.2	(4 - 12)
"Embarrada"	803	37	5	(2 - 10)
Granite/stone	803	37	4.5	(3 - 7)
Mud brick	803	4	0.5	(0 - 1)
Parquet or polished wood	803	12	0.4	(0 - 1)
Not observed	803	1	0.1	(0 - 0)
Wood planks	803	4	0.1	(0 - 0)
Other	803	5	1.1	(0 - 5)

Many houses (26.6%) have open roof eaves. Most have no glass in windows (60.5%), screens in windows (90.9%), nor screens in doors (96.2%).

Table 3.6: Open or closed roof eave as observed

	N	n	%	95% CI
Open gap between wall and roof eave	803	267	26.6	(20 - 35)

Table 3.7: Glass in windows as observed

	N	n	%	95% CI
Do windows have glass panes?				
None	803	507	60.5	(53 - 68)
Yes, in all windows	803	212	27.6	(22 - 34)
Yes, but only in some windows	803	77	10.9	(8 - 15)
There are no windows in the house	803	7	1	(0 - 3)

Table 3.8: Screens in windows as observed

	N	n	%	95% CI
Do windows have screens?				
None	803	729	90.9	(87 - 93)
Yes, in all windows	803	37	4.8	(3 - 8)
Yes, but only in some windows	803	33	3.8	(2 - 6)
There are no windows in the house	803	4	0.5	(0 - 3)

Table 3.9: Screens in doors as observed

	N	n	%	95% CI
Do doors have screens?				
None	803	771	96.2	(92 - 98)
Yes, in all doors	803	20	2.2	(1 - 7)
Yes, but only in some doors	803	12	1.6	(1 - 3)

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 3.10 shows that while 71.4% of homes had clean surroundings without standing water on the day of the survey, 2.4% had natural water bodies within or bordering the yard.

Table 3.10: Maintenance of dwelling surroundings as observed

	N	n	%	95% CI
Status of yard/surroundings of dwelling				
Clean, no trash or standing water	803	573	71.4	(62 - 79)
Trash, tires, or other refuse present, but no standing water	803	114	11.1	(7 - 17)
Yes, pond or other natural water body	803	20	2.4	(1 - 5)
Yes, puddles	803	14	2.2	(1 - 4)
Yes, water collected in trash, tires, or other small containers	803	12	1.4	(1 - 3)
Other	803	77	12.2	(7 - 21)

Table 3.11 shows the principal water source of the household as reported by the respondent; 72.9% of households have water piped to their house. The most common type of sanitation facility is a flush toilet (78.2% of households), as seen in Table 3.12.

Table 3.11: Principal water source

	N	n	%	95% CI
Main source of drinking water				
Piped into dwelling	803	563	72.9	(64 - 80)
Bottled water	803	60	8	(4 - 16)
Tanker truck	803	41	5.4	(3 - 9)
Public tap/standpipe	803	20	2.8	(2 - 5)
Piped to yard/plot	803	26	1.7	(1 - 3)
Tube well or borehole	803	25	1.6	(1 - 3)
Protected dug well	803	15	1.1	(1 - 2)
Cart with small tank	803	6	0.7	(0 - 2)
Large jug of purified water	803	2	0.4	(0 - 3)
Protected spring	803	1	0	(-)
Other	803	44	5.4	(3 - 9)

Table 3.12: Type of sanitation facility used

	N	n	%	95% CI
Type of toilet used				
Flush toilet	803	595	78.2	(71 - 84)
Pour flush toilet	803	136	18.5	(13 - 26)
Pit latrine	803	67	2.9	(2 - 5)
Dry latrine	803	3	0.3	(0 - 1)
Hanging latrine	803	1	0.1	(0 - 1)
No facility/bush/field	803	1	0	(-)

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 3.13. Most households do their cooking in the house (Table 3.14).

Table 3.13: Cooking fuel source

	N	n	%	95% CI
Principal cooking fuel				
Gas tank	803	762	96.9	(95 - 98)
Charcoal	803	96	6.7	(5 - 10)
Electricity	803	39	5.3	(3 - 9)
Wood	803	57	2.4	(1 - 4)
No food cooked in household	803	1	0.2	(0 - 1)
Straw/shrubs/grass	803	0	0	(-)
Agricultural crop	803	0	0	(-)
Other	803	0	0	(-)

Table 3.14: Cooking location

	N	n	%	95% CI
Where cooking is done				
In the house	802	772	98.4	(97 - 99)
In a separate building	802	14	0.7	(0 - 2)
Outdoors	802	12	0.6	(0 - 2)
Other	802	3	0.2	(0 - 1)
Decline to respond	802	1	0.1	(0 - 1)

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 3.15 and Table 3.16 show the proportion of households with at least one of each item. Many households (99.1%) have electricity. Of the 55 households that own livestock, most own poultry (69.5% of households, as in Table 3.16). Table 3.17 shows the proportion of households with agricultural land.

Table 3.15: Household assets

	N	n	%	95% CI
Electricity	800	772	99.1	(97 - 100)
Radio	803	499	64.4	(59 - 70)
Sound system	803	188	25.1	(20 - 32)
Television	803	698	89.9	(85 - 93)
Home telephone	803	178	26.1	(21 - 32)
Mobile phone	803	606	79.2	(70 - 86)
Refrigerator	803	705	91.2	(86 - 95)
Washing machine	803	673	86.4	(82 - 90)
Computer	803	232	32	(25 - 40)
Electric fan	803	674	89.9	(87 - 92)
Air conditioner	803	106	13.1	(10 - 17)
Watch	803	436	59.1	(53 - 65)
Guitar	803	27	3.3	(2 - 6)
Bike	803	147	18.9	(14 - 25)
Motorcycle or scooter	803	208	25.4	(20 - 31)
Animal-drawn cart	803	4	0.3	(0 - 1)
Car	803	167	23.3	(17 - 31)
Truck	803	20	2.7	(2 - 4)
Motor boat	803	2	0.2	(0 - 1)
Bank account	731	423	61.5	(54 - 68)

Table 3.16: Livestock ownership

	N	n	%	95% CI
Cattle	55	21	37	(21 - 57)
Horses, donkeys or mules	55	10	8.9	(3 - 23)
Goats or sheep	55	5	7.9	(3 - 20)
Chickens or other poultry	54	30	69.5	(54 - 81)
Pigs	55	18	23.6	(12 - 41)

Table 3.17: Ownership of agricultural land

	N	n	%	95% CI
Does any member of the household own, rent, or share agricultural land?				
No	803	761	95.8	(94 - 97)
Yes, own	803	34	3.6	(2 - 5)
Yes, rent	803	3	0.2	(0 - 1)
Yes, share	803	2	0.1	(0 - 1)
Don't know	803	3	0.2	(0 - 1)

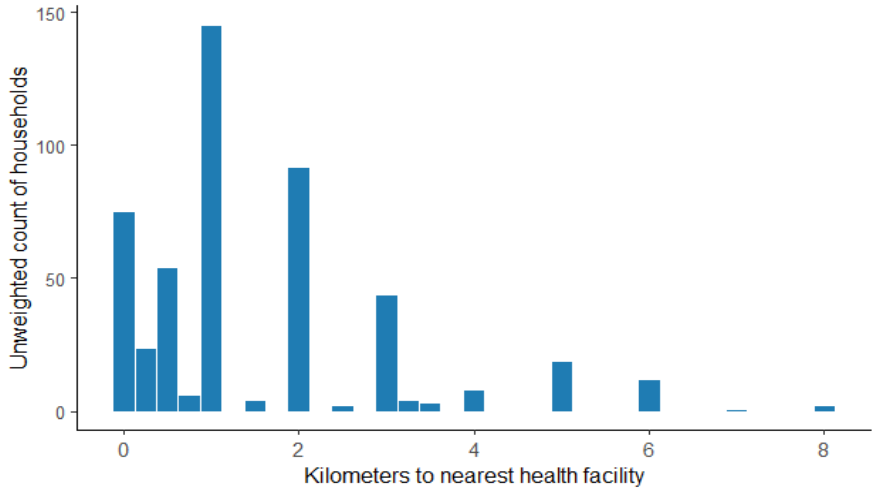
As a part of the interview, respondents estimated their monthly household income (including money earned by all members of the household and received from other sources such as public benefits or remittances). Though some households are hesitant to report their income, the estimates as reported are shown in Table 3.18.

Table 3.18: Monthly household income, all sources

	N	n	%	95% CI
Monthly household income, Dominican Pesos (DOP)				
Less than 2000 DOP	803	21	2.2	(1 - 4)
2001 - 5000 DOP	803	53	6	(4 - 9)
5001 - 10000 DOP	803	72	8.8	(7 - 11)
10001 - 15000 DOP	803	77	10.1	(8 - 13)
15001 - 20000 DOP	803	87	11.4	(9 - 14)
20001 - 30000 DOP	803	48	6	(4 - 8)
30001 - 50000 DOP	803	38	5.7	(4 - 8)
50001 - 75000 DOP	803	21	2.5	(1 - 4)
More than 75000 DOP	803	13	2.3	(1 - 5)
Don't know	803	222	25	(18 - 33)
Decline to respond	803	151	20.1	(15 - 26)

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

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



3.2 Malaria knowledge

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

3.2.1 Disease knowledge

As Table 3.20 shows, most respondents had heard of malaria before (65.6%). Respondents were asked the cause of malaria (Table 3.21) and the mode of transmission of malaria (Table 3.22) and interviewers could register more than one response. Many respondents are aware of the role of mosquitoes in malaria transmission.

Table 3.20: Malaria awareness

	N	n	%	95% CI
Heard of illness called malaria	792	495	65.6	(58 - 72)

Table 3.21: Knowledge of cause of malaria

	N	n	%	95% CI
In your opinion, what causes malaria?				
Mosquito bites	495	291	59.7	(55 - 64)
Dirty surroundings	495	42	9.2	(7 - 12)
Stagnant water	495	33	7.2	(5 - 11)
Contaminated air	495	27	4.5	(3 - 7)
Anopheles mosquito bite	495	8	2.4	(1 - 5)
Weedy surroundings	495	11	1.7	(1 - 4)
Eating dirty food/drinking dirty water	495	4	0.3	(0 - 1)
Cold or changing weather	495	3	0.3	(0 - 1)
Malaria parasite (plasmodium)	495	1	0.2	(0 - 1)
Other	495	34	6.5	(4 - 10)
Don't know	495	130	25.2	(20 - 31)

Table 3.22: Knowledge of malaria transmission

	N	n	%	95% CI
How is malaria transmitted?				
By mosquitoes	495	296	60.4	(55 - 66)
Stagnant water	495	30	7.5	(5 - 11)
Poor personal hygiene	495	27	6.3	(4 - 9)
Contaminated air	495	19	3.8	(2 - 6)
Eating dirty food/drinking dirty water	495	8	1.4	(0 - 4)
Passes from one person to another	495	4	0.8	(0 - 2)
Other	495	10	1.6	(1 - 3)
Don't know	495	153	29.9	(24 - 36)

Respondents were also asked the main sign or symptom of malaria and more than one response could be registered (Table 3.23). Many respondents recognize fever as a key symptom. Throughout the question series about malaria knowledge, however, there were some respondents who indicated they did not know how to respond to the questions, as displayed in the tables.

Table 3.23: Knowledge of malaria symptoms

	N	n	%	95% CI
Main sign or symptom of malaria known				
Fever	495	341	69.2	(63 - 75)
Headache	495	200	40.3	(35 - 46)
Nausea and vomiting	495	111	23.1	(18 - 29)
Body ache or joint pain	495	104	20.8	(17 - 25)
Diarrhea	495	61	11.6	(9 - 15)
Chills	495	39	7.7	(5 - 11)
Body weakness	495	36	6.6	(4 - 11)
Dizziness	495	14	2.8	(2 - 5)
Loss of appetite	495	14	2.4	(1 - 5)
Pale eyes or skin	495	7	1.8	(1 - 5)

	N	n	%	95% CI
Cough	495	4	0.9	(0 - 2)
Sweating	495	4	0.7	(0 - 2)
Other	495	20	3.7	(3 - 5)
Don't know	495	127	26.8	(21 - 33)

Respondents were asked how many people in their own community they knew who had had malaria during the last year. Most did not report to know anyone who had malaria in the last year (Table 3.24).

Table 3.24: Knowledge of community transmission

	N	n	%	95% CI
In your community, during the last year, how many people do you know who had a case of malaria?				
None	495	440	88.4	(84 - 92)
One person	495	27	5.7	(3 - 10)
2-4 people	495	11	1.9	(1 - 4)
5-10 people	495	3	1	(0 - 4)
Don't know	495	14	3	(2 - 5)

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, 39.1% had heard messages about malaria during the last year. Of those who had heard messages, the specific information heard is detailed in Table 3.25. Some of the responses indicate that people may confuse messages about preventing dengue or other arboviruses with malaria prevention messages. However, many had learned to seek medical attention for fevers. Next, respondents were asked to indicate whether or not they had heard malaria messages from each source in a list of media. The sources and the proportion of those who had heard messages through each, among respondents who had heard any messages about malaria in the past year, are in Table 3.26.

Table 3.25: Malaria messages heard in last year

	N	n	%	95% CI
Messages seen or heard in last year				
If have fever go to health facility	183	71	37.1	(29 - 46)
Eliminate breeding sites/clean up trash	183	29	14	(9 - 22)
Nets are used to protect from mosquitoes	183	11	5.8	(3 - 12)
Sleep under an insecticide-treated mosquito net	183	12	5.6	(3 - 11)
Malaria kills	183	7	2.8	(1 - 8)
Treatment for severe malaria is available free of charge	183	4	2.6	(1 - 7)
Sleep under a net every night to protect yourself against malaria	183	4	2.4	(1 - 6)
Always test before treating malaria	183	5	2.3	(1 - 6)
Anopheles mosquitoes transmit malaria by biting people at night	183	3	1	(0 - 3)
Nets are being distributed free of charge	183	1	0.4	(0 - 3)
Treat malaria with ACTs	183	1	0.2	(0 - 2)
Other	183	51	29.2	(22 - 38)
Don't know	183	35	20.4	(15 - 26)

Table 3.26: Source of malaria messages

Source of messages, among those who heard them	N	n	%	95% CI
On the radio	180	61	29	(19 - 41)
On TV	182	133	73.2	(65 - 80)
On a poster or billboard	178	11	6.2	(3 - 12)
From a community health worker	178	10	4.9	(2 - 11)
From personnel at a health facility	179	36	22.1	(16 - 29)
At a community event	179	12	6	(3 - 11)
At school	178	5	2.8	(1 - 8)
On the internet or social media	179	31	17.9	(11 - 28)
Somewhere else	177	8	5.2	(2 - 11)

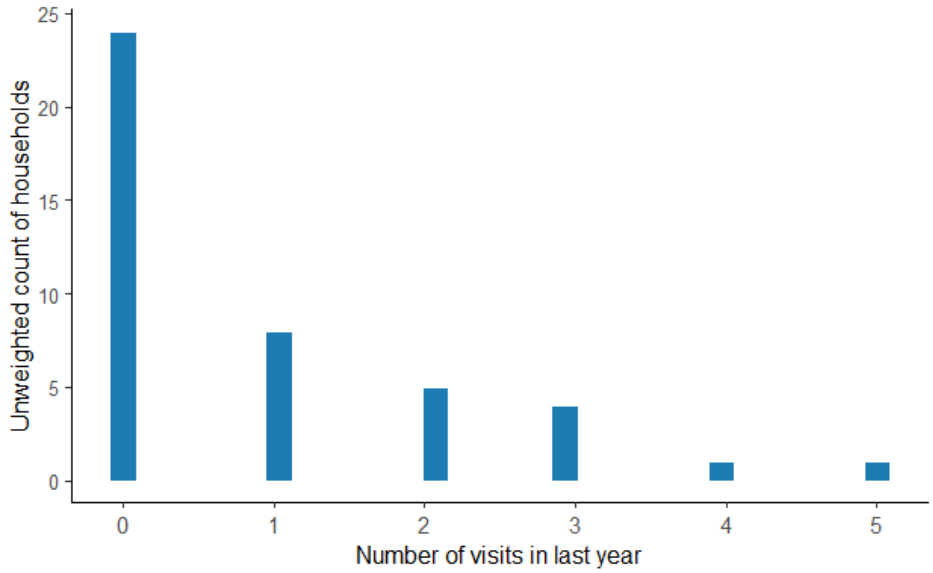
3.2.3 Knowledge of community resources

A key component of malaria detection in many regions in the Dominican Republic is the community collaborator program. Community collaborators (*colaboradores comunitarios*), or 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 Dominican Republic baseline survey, 8.8% of households know of a CC in their community. Of those who knew of a CC, 47.5% reported receiving a home visit by that volunteer during the year before the date of the survey (Table 3.27). The number of visits received from the CC is shown in Figure 3.5.

Table 3.27: Knowledge of CCs

	N	n	%	95% CI
Know of col-vol in own community	579	44	8.8	(5 - 15)
Visited by col-vol in last year	43	19	47.5	(34 - 61)

Figure 3.4: Number of visits from CCs in last year



Malaria testing and treatment is provided free of charge in the Dominican Republic, and 43.2% of respondents are aware of this benefit (Table 3.28). Because cost and knowledge of where services are available may be barriers to seeking care, the survey asked respondents where someone could access testing and treatment. Respondents could indicate multiple health facility types they knew provided the service, and interviewers classified them according to the options in the survey. A majority of households knew that they could seek malaria care at public hospitals (Table 3.29, Table 3.30).

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

	N	n	%	95% CI
Aware malaria diagnosis and treatment are provided free by the government	425	199	43.2	(38 - 49)

Table 3.29: Knowledge of where to go for malaria testing

	N	n	%	95% CI
Where can someone go to be tested for malaria?				
Public Sector: Government hospital	495	386	77.6	(72 - 82)
Public Sector: Government primary level health center	495	101	19	(13 - 27)
Private medical sector: Private hospital/clinic	495	75	17.3	(12 - 24)
Private medical sector: Private doctor	495	18	3.8	(2 - 8)
Public Sector: mobile clinic	495	13	1.5	(1 - 3)
Private medical sector: mobile clinic	495	5	1.1	(0 - 3)
Other public sector	495	6	0.9	(0 - 2)
Public Sector: Fieldworker/Community Health Worker	495	3	0.8	(0 - 2)
Other private sector	495	4	0.8	(0 - 2)
Private medical sector: Pharmacy	495	1	0.3	(0 - 2)
Traditional healer	495	1	0.2	(0 - 1)
Other	495	13	2.3	(1 - 5)
Don't know	495	43	8.9	(6 - 13)

Table 3.30: Knowledge of where to go for malaria treatment

	N	n	%	95% CI
Where can someone receive treatment for malaria?				
Public Sector: Government hospital	444	381	84.3	(79 - 88)
Public Sector: Government primary level health center	444	84	18.5	(13 - 25)
Private medical sector: Private hospital/clinic	444	61	15.4	(11 - 22)
Private medical sector: Private doctor	444	15	3.1	(2 - 6)
Private medical sector: Pharmacy	444	7	1.9	(1 - 5)
Other private sector	444	4	1	(0 - 3)
Public Sector: mobile clinic	444	7	0.8	(0 - 2)
Private medical sector: mobile clinic	444	3	0.8	(0 - 2)
Other public sector	444	5	0.7	(0 - 2)
Public Sector: Fieldworker/Community Health Worker	444	2	0.5	(0 - 2)
Traditional healer	444	0	0	(-)
Other	444	4	0.7	(0 - 2)
Don't know	444	24	6	(4 - 9)

3.3 Risk Factors for malaria

Certain lifestyles, professions, and living conditions raise an individual's risk for malaria infection. Traveling may expose people to infection if they move from an area with relatively less malaria transmission, to an area with more transmission. Travel by individuals also raises the risk that malaria transmission could be re-introduced to receptive areas where it has been interrupted. Few households reported members who migrated for work (Table 3.31). Among individuals in surveyed households, 10.2% reported travel outside the community in the last two weeks (Table 3.32). According to respondents, most household members did not participate in any of the risk activities listed in Table 3.33 in the two months prior to the survey.

Table 3.31: Temporal migration within surveyed households

	N	n	%	95% CI
At least one member migrates seasonally	800	61	7.8	(6 - 10)
At least one member migrates weekly	802	31	3.9	(3 - 5)

Table 3.32: Recent travel by individuals in surveyed households

	N	n	%	95% CI
Individual traveled outside community in last 2 weeks	2600	254	10.2	(8 - 13)

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

	N	n	%	95% CI
Individuals participating in malaria risk activities				
None of these	2609	2443	94.8	(93 - 96)
Cultivating crops or working in the fields	2609	112	3.4	(2 - 5)
Sleeping outdoors overnight	2609	10	0.4	(0 - 1)
Gathering firewood in the forest	2609	15	0.3	(0 - 1)
Collecting shellfish	2609	7	0.3	(0 - 2)
Producing charcoal	2609	4	0.1	(0 - 0)
Working in a mine	2609	0	0	(-)
Working in timber/lumber industries in the forest	2609	2	0	(-)
Don't know	2609	29	1.1	(1 - 2)
Decline to respond	2609	1	0.1	(0 - 0)

Respondents were also asked what can be done to protect against malaria (Table 3.34), and what practices they follow in their own households (Table 3.35). The respondent replied in free form, and the interviewer classified the answers according to the options in the survey. The responses again show evidence of some conflation of malaria prevention measures with arbovirus prevention measures, though a few responses also referred to use of mosquito nets or other practices that protect against all mosquito vectors. Only 3.4% of households said they do not use any malaria prevention measures at home.

Table 3.34: Protective measures known by household

	N	n	%	95% CI
Methods known to protect against malaria				
Eliminate mosquito breeding areas (tires, bottles, or others)	342	195	56.3	(49 - 63)
Clean water storage tanks with bleach	342	115	35.3	(29 - 42)
Add bleach temephos (Abate) to the water tank	342	83	23.8	(20 - 28)
Keep house surroundings clean	342	67	18.4	(13 - 25)

	N	n	%	95% CI
Cut the grass around the house	342	57	16.7	(12 - 22)
Sleep under a mosquito net	342	39	10.8	(8 - 15)
Use insect repellent	342	28	8.7	(6 - 13)
Fumigate or spray house with insecticides	342	28	8.4	(6 - 12)
Fill in puddles (stagnant water)	342	16	4.8	(2 - 9)
Avoid mosquito bites	342	17	4.1	(2 - 7)
Can't be prevented	342	13	3.7	(2 - 8)
Put mosquito screens on the windows	342	11	2.9	(1 - 5)
Sleep under an insecticide-treated mosquito net	342	1	0.5	(0 - 3)
Take preventive medication	342	1	0.2	(0 - 2)
Use mosquito coils	342	0	0	(-)
Other	342	36	10.3	(7 - 15)
Don't know	342	25	7.1	(5 - 10)

Table 3.35: Protective measures used by household

	N	n	%	95% CI
Primary methods used in household to protect against malaria				
Eliminate mosquito breeding areas (tires, bottles, or others)	342	185	52	(46 - 58)
Clean water storage tanks with bleach	342	127	37.8	(30 - 46)
Keep house surroundings clean	342	74	21	(16 - 28)
Add bleach or temephos (Abate) to the water tank	342	66	19.6	(15 - 25)
Cut the grass around the house	342	58	17.5	(11 - 27)
Fumigate or spray house with insecticides	342	38	10.6	(7 - 15)
Use insect repellent	342	31	8.8	(6 - 13)
Sleep under a mosquito net	342	23	7.2	(5 - 10)
Fill in puddles (stagnant water)	342	21	6.2	(3 - 11)
Does nothing to protect from malaria	342	12	3.4	(2 - 6)
Avoid mosquito bites	342	8	2	(1 - 5)
Organize community cleaning work days	342	4	1.2	(0 - 3)
Put mosquito screens on the windows	342	7	1.1	(0 - 3)
Sleep under an insecticide-treated mosquito net	342	1	0.5	(0 - 3)
Use mosquito coils	342	1	0.5	(0 - 3)
Take preventive medication	342	0	0	(-)
Other	342	60	18	(13 - 24)
Don't know	342	14	3.6	(2 - 6)

Chapter 4: Vector control activities

This chapter provides a descriptive summary of vector control measures used in the households selected for the RMEI-Dominican Republic Baseline LQAS Survey. All estimates reported in this chapter are weighted by the inverse probability of selection (see details in Appendix C) and account for clustering in variance calculations, except where otherwise noted.

4.1 Vector control measures carried out in the Dominican Republic households

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

In the Dominican Republic, the community sample was designed to capture data from 32 communities with vector control measures implemented during 2018. Health facilities were listed for selection to the sample based on whether they had autochthonous malaria cases during 2018 in the localities they serve, under the assumption that such localities are more likely to have received interventions to prevent or interrupt transmission. IHME received some information on IRS and ITN interventions carried out from the Ministry of Public Health and Social Assistance prior to selection of the sample, but the geographical units used for recordkeeping by the vector control program could not be matched to health facilities in the referral network nor to localities via online mapping. Because IHME did not receive the information on the communities with vector control activities in a complete and usable format, the method for community selection had to rely on the knowledge of local health facility personnel about interventions carried out in the facility catchment area, which was also found to be incomplete and uncertain during the survey. In order to account for this risk, field personnel were instructed to visit the DPS first during data collection in each province and to request lists of vector control activity carried out during 2018 and 2019 to assist with community selection at subsequent health facilities. However, they often found such lists were not available in the DPS either.

According to data collected at the local-level health facilities via the Community Selection Module, only 3 of 32 communities surveyed had vector control interventions carried out, and these communities showed very little evidence of intervention uptake during the household survey. There are a few feasible explanations for the discrepancy: the intervention activity may have been planned in a selected community, but not yet carried out at the date of the survey; it may have been carried out in the past, but not within the last one to two years; or the local health facility staff may not have been an accurate source for intervention information, as vector control technicians are not affiliated to local health facilities in the Dominican Republic because vector-borne disease programs are run through the Ministry of Public Health and Social Assistance while health care services are provided by the National Health Service.

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.

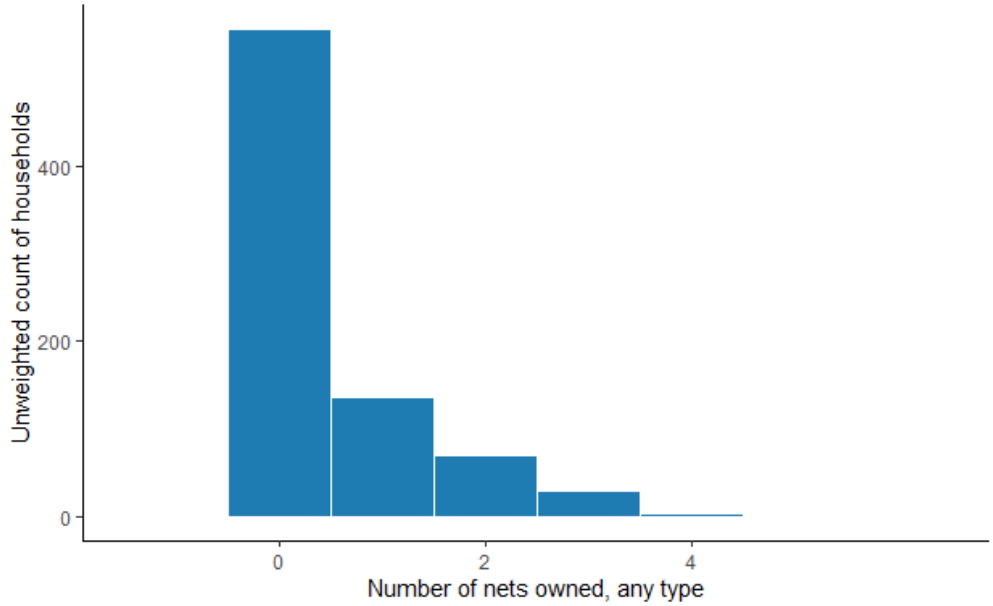
4.2.1 Ownership of nets by surveyed households

As Table 4.1 shows, 26.4% of households own at least one treated or untreated mosquito net. The number of nets owned (regardless of type) is shown in Figure 4.1.

Table 4.1: Ownership of mosquito nets by households

	N	n	%	95% CI
Households with at least one mosquito net	799	243	26.4	(21 - 32)

Figure 4.1: Number of nets owned by households, unweighted percent distribution



Respondents were asked where they obtained each mosquito net. As shown in Table 4.2, most nets treated with insecticide were obtained from health personnel in a facility. Most untreated nets were purchased in a store (88.9%, in Table 4.3).

Table 4.2: Source of insecticide-treated nets

	N	n	%	95% CI
Source of net				
Government health facility	31	25	80.6	(63 - 91)
Shop/market	31	1	3.2	(0 - 20)
Religious institution	31	0	0	(-)
Private health facility	31	0	0	(-)
Pharmacy	31	0	0	(-)
Other	31	4	12.9	(5 - 30)
Decline to respond	31	1	3.2	(0 - 20)

Table 4.3: Source of untreated nets

	N	n	%	95% CI
Source of net				
Shop/market	368	327	88.9	(85 - 92)
Pharmacy	368	7	1.9	(1 - 4)
Religious institution	368	1	0.3	(0 - 2)
Private health facility	368	1	0.3	(0 - 2)
Other	368	24	6.5	(4 - 10)
Don't know	368	7	1.9	(1 - 4)
Decline to respond	368	1	0.3	(0 - 2)

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	204	168	82.4	(76 - 87)
Only thumb-sized holes	204	26	12.7	(9 - 18)
At least one fist or head-sized hole	204	6	2.9	(1 - 6)
Net never used	204	4	2	(1 - 5)

Table 4.5: Reported condition of nets not observed

	N	n	%	95% CI
Condition of mosquito net as reported				
No holes	194	133	68.6	(62 - 75)
Only thumb-sized holes	194	31	16	(11 - 22)
At least one fist or head-sized hole	194	20	10.3	(7 - 15)
Net never used	194	6	3.1	(1 - 7)
Don't know	194	4	2.1	(1 - 5)

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 percent distribution)

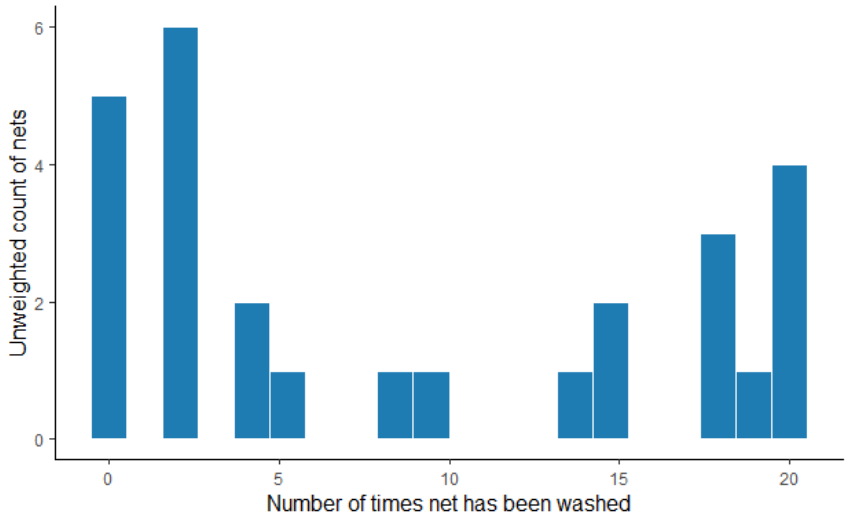


Table 4.6: Care of insecticide-treated nets - drying

	N	n	%	95% CI
Method of drying net				
In the sun	22	21	95.5	(74 - 99)
In the shade	22	1	4.5	(1 - 26)
In a dryer	22	0	0	(-)

4.2.2 Use of nets by individuals in surveyed households

In order for the household to be fully protected, all household members should sleep under an insecticide-treated net for the entire night. Table 4.7 shows the reported use of nets on the night prior to the survey. Among all usual household members who slept in the house the previous night, 0.8% were reported to have slept under a mosquito net treated with insecticide. Among children under age 5 who were usual members of the household and slept there the previous night, 1.9% 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	2570	46	0.8	(0 - 2)
Slept under untreated net	2570	541	17.2	(13 - 23)
Under 5				
Slept under treated net	191	3	1.9	(1 - 7)
Slept under untreated net	191	56	25	(15 - 38)
Pregnant				
Slept under treated net	26	1	3.8	(0 - 24)
Slept under untreated net	26	3	4.7	(1 - 19)
Reported usually sleeping under net during pregnancy	27	5	8.6	(3 - 26)

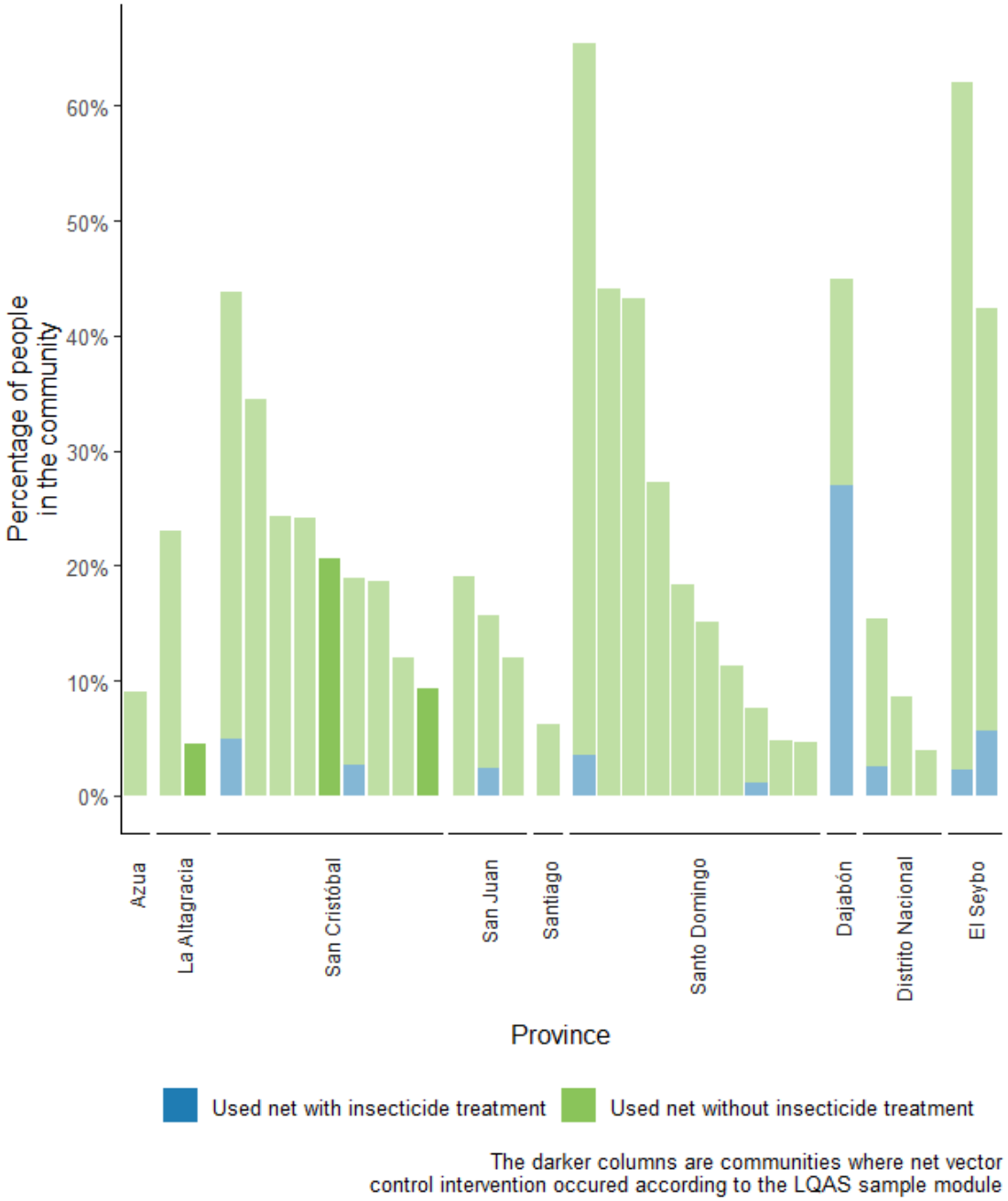
When households had nets that were not used the previous night, or reported that not all household members slept under a net, they were asked why they do not sleep under a mosquito net. The reasons given are shown in Table 4.8. Most frequently, households reported that mosquito nets are too hot to use. When respondents specified an “other” response, they often claimed they do not like mosquito nets without explaining why.

Table 4.8: Reasons for not using net

	N	n	%	95% CI
Reasons for not sleeping under mosquito net				
Too hot	101	33	38.6	(27 - 52)
Not necessary, using fan instead	101	14	17.4	(9 - 31)
Don't have enough nets	101	16	14.3	(8 - 26)
No mosquitoes	101	11	7.5	(4 - 15)
Net too expensive	101	14	7.3	(3 - 15)
Feel closed in/afraid	101	6	6.8	(3 - 14)
Saving net for later	101	3	2.3	(1 - 10)
Don't like smell/insecticide is too strong	101	1	1.9	(0 - 11)
Net too old/torn	101	2	1.8	(0 - 9)
Extra net/more nets available than sleeping areas	101	5	1.1	(0 - 3)
No malaria now	101	2	0.6	(0 - 3)
Usual user(s) did not sleep here last night	101	1	0.5	(0 - 3)
Not necessary, house has been sprayed	101	1	0.5	(0 - 3)
It is bad for the skin, it causes irritation	101	1	0.2	(0 - 1)
Other	101	9	13.4	(7 - 25)
Don't know	101	5	3.3	(1 - 8)
Decline to respond	101	1	1.3	(0 - 8)

Figure 4.3 shows by province the proportion of individuals who slept in the household the previous night using a mosquito net in each of the communities surveyed. The communities expected to receive the net intervention are highlighted in darker colors. In the Dominican Republic, no insecticide-treated nets were observed nor reported in the three communities that received the net intervention, according to staff at the corresponding local health facility. The community in Dajabón that had the highest observed level of use of treated nets was not identified by the health facility as a community that received vector control interventions. A few communities have high levels of use of untreated nets.

Figure 4.3: Net use by province and community



4.3 Indoor Residual Spraying

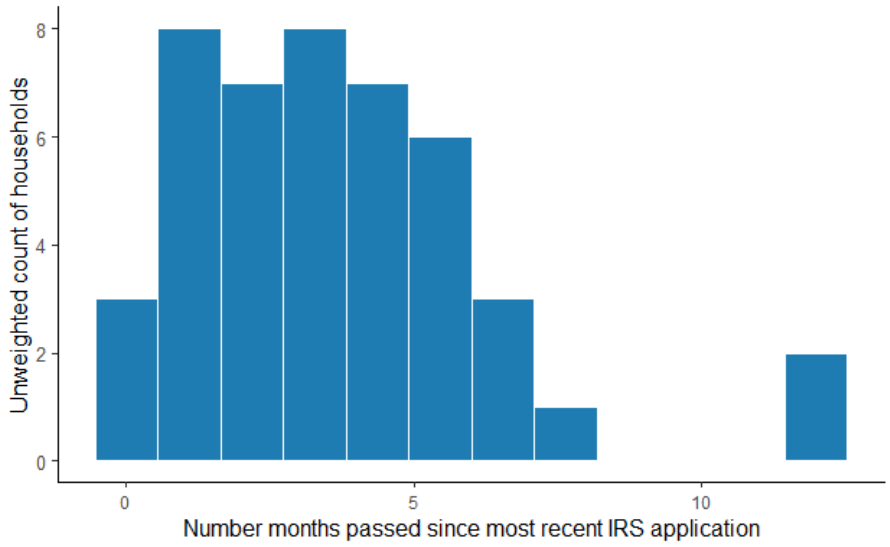
The other key vector control intervention of the Initiative is to offer to spray the interior walls of the dwelling against mosquitoes (usually with deltamethrin or a comparable insecticide). Insecticide application is usually carried out by staff or contractors of the vector control program every 4 to 6 months during the intervention time frame. The interviewer asked respondents if their household had been offered insecticide application to the interior of the dwelling during the last year. As seen in Table 4.9, 6% of households were offered IRS, and spraying was carried out in 72.5% of the households where it was offered. The interviewer also asked to see evidence of the most recent spray application, such as a sticker, house card, or chalk mark left by the vector control personnel. Such evidence was observed in 51.1% of households that received IRS. The response “don’t know” was given to the question about observing evidence of IRS completion in three households.

Table 4.9: Households offered and accepting spraying

	N	n	%	95% CI
Offered indoor residual spraying	772	58	6	(4 - 9)
Accepted indoor residual spraying	57	45	72.5	(60 - 82)
Evidence observed (card, sticker, mark)	42	22	51.1	(28 - 73)

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. Some “other” responses given included not feeling safe about letting strangers into the home and the sprayers not showing proper identification.

Table 4.10: Reasons for not accepting spraying

	N	n	%	95% CI
Reason house was not sprayed				
No one was at home	12	6	41.8	(17 - 71)
Causes ill health effects	12	1	9.7	(1 - 48)
Dangerous for animals	12	1	9.7	(1 - 48)

	N	n	%	95% CI
Dangerous for children	12	1	6.5	(1 - 31)
Other	12	3	35.5	(9 - 76)
Don't know	12	1	6.5	(1 - 31)

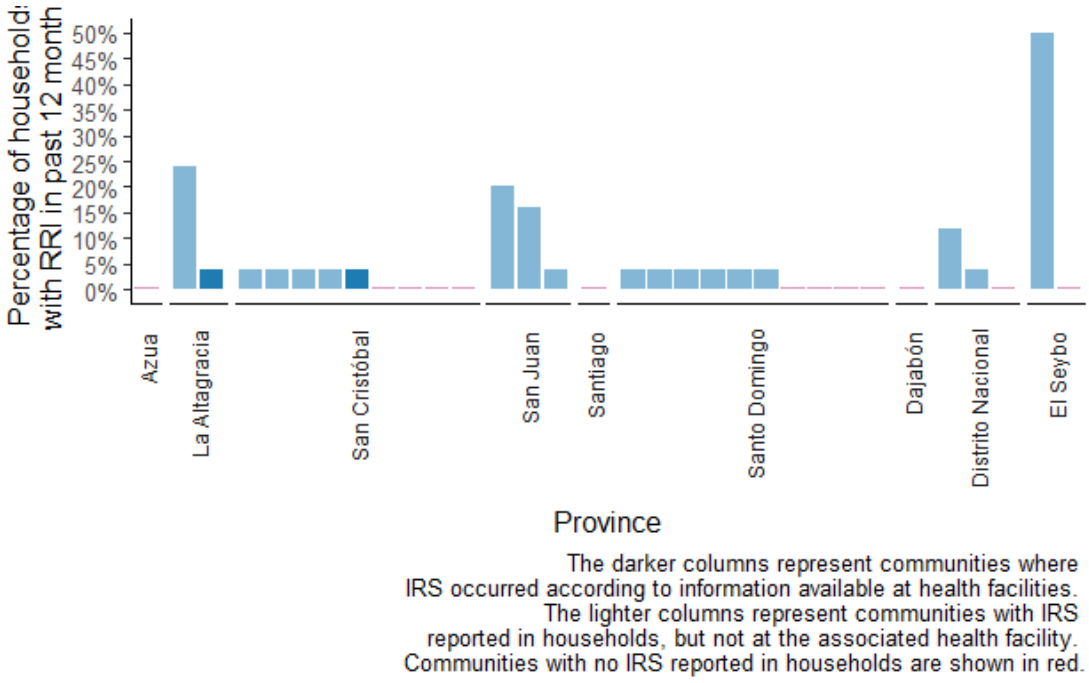
Households receiving IRS were asked whether they washed, painted, or plastered any walls since the most recent application (which diminishes the effectiveness of the insecticide), as shown in Table 4.11.

Table 4.11: Post-spraying practices

	N	n	%	95% CI
Walls painted since last IRS	45	9	28.5	(16 - 45)
Walls washed since last IRS	45	12	28.4	(17 - 44)
Walls plastered since last IRS	45	3	8.6	(2 - 28)

Figure 4.5 shows by province the proportion of households that received IRS in each of the communities surveyed. The communities expected to receive the IRS intervention according to staff at the corresponding health facility are highlighted in darker colors. The measured coverage of IRS is quite low in all but one community (in El Seybo, with 50% coverage), and is below 5% in the two communities expected to receive the intervention. In order to avoid confusion of IRS with other insecticide interventions such as fogging among respondents, application to interior walls was emphasized in the conduct of the survey.

Figure 4.5: Indoor residual spraying by province and community



4.4 Indicator 6.01: Vector control coverage

Individual-level coverage by one of the two interventions was negotiated as an indicator for RMEI. The indicator is measured on the subset of usual household members who slept in the house the night prior to the survey (because net use is measured for the night prior to the survey) in the communities identified 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. Results by intervention are shown in Table 4.12). Table 4.13 shows the indicator results, with 6.2% 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	0%	5.3%
Both	2	0%	6.5%
None	29	2%	7.4%

Table 4.13: Vector control indicator

	N	n	%	95% CI
Usual household members in vector control communities who slept in house last night	244	242	99.3	(98 - 100)
Slept under insecticide treated net	242	0	0	(-)
House sprayed with mosquito treatment past 12 months	226	14	6.2	(3 - 11)
Omitted from household spraying calculations due to 'do not know' responses	242	16	5.7	(2 - 17)
'DK' responses included in indicator because they slept under treated net	16	0	0	(-)
Received either vector control to standard	226	14	6.2	(3 - 11)

Chapter 5: Malaria Diagnostic Capacity

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

5.1 Characteristics of health facility sample

As previously described, the health facility sample included 58 facilities of various types as shown in Table 5.1. Forty-one of the surveyed facilities provide primary level care, and 10 offer secondary level services, though they may also provide primary attention as demanded. The remaining facilities in the sample are DPS units that manage stock, reporting, and malaria programming for the entire province. The measurement included the national malaria reference lab.

Table 5.1: Health facility survey sample by facility type

	Facility Type	#
Primary care	Primary care center	41
Secondary care	Hospital	10
Administrative unit/ National Lab	Dirección Provincial de Salud (DPS unit)	6
	National Reference Laboratory	1
Total		58

The health facility interview includes questions about services provided in the facility as summarized in this chapter. The interview is conducted with 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 DPS unit). When conducting the survey, interviewers are trained to emphasize that all questions need not be answered by a single respondent and encourage the primary respondent to invite colleagues who know the topic best to contribute to answering for each section (e.g., human resources personnel, head of nursing, laboratory staff).

All attention facilities in the sample provided services from Monday through Friday. A smaller number were open on the weekends (Table 5.2). Twelve percent of primary care units and 100% of secondary care units had services open 24 hours (Table 5.3).

Table 5.2: Workweek of facility

	N	n	%	95% CI
Primary care centers: Days of the week service is provided				
Monday	41	41	100	(-)
Tuesday	41	41	100	(-)
Wednesday	41	41	100	(-)
Thursday	41	41	100	(-)
Friday	41	41	100	(-)
Saturday	41	5	12.2	(5 - 27)
Sunday	41	5	12.2	(5 - 27)
Hospitals: Days of the week service is provided				
Monday	10	10	100	(-)
Tuesday	10	10	100	(-)
Wednesday	10	10	100	(-)
Thursday	10	10	100	(-)
Friday	10	10	100	(-)
Saturday	10	10	100	(-)
Sunday	10	10	100	(-)

Table 5.3: Hours of operation

	N	n	%	95% CI
Primary care centers: Hours of operation				
Open less than 24 hours	41	36	87.8	(73 - 95)
Open 24 hours	41	5	12.2	(5 - 27)
Hospitals: Hours of operation				
Open 24 hours	10	10	100	(-)

Survey respondents indicated the type and number of personnel employed at the health facility. Table 5.4 shows the proportion of facilities that employ at least one of each personnel type. Physicians are employed at all primary and secondary level facilities. In terms of laboratory diagnosis, microbiologists are employed at 4.9% and lab technicians at 17.1% of primary care units. Only 2.4% of primary level units employ epidemiology personnel, and 14.6% employ other statistics personnel, important functions for malaria notification and reporting.

Table 5.4: Facility personnel

	N	n	%	95% CI
Primary care centers				
General physician	41	41	100	(-)
Pediatrician	41	6	14.6	(7 - 29)
Nutritionist /dietician	41	3	7.3	(2 - 21)
Pharmacist	41	3	7.3	(2 - 21)
Auxiliary nurse	41	32	78	(62 - 88)
Practical nurse	41	6	14.6	(7 - 29)
Registered nurse	41	27	65.9	(50 - 79)
Professional midwife	41	1	2.4	(0 - 16)
Social worker	41	31	75.6	(60 - 87)
Microbiologist (laboratory)	41	2	4.9	(1 - 18)
Lab technician	41	7	17.1	(8 - 32)
Dispenser at pharmacy	41	15	36.6	(23 - 53)
Epidemiology personnel	41	1	2.4	(0 - 16)
Other personnel specific for statistics and reporting	41	6	14.6	(7 - 29)
Hospitals				
General physician	10	9	90	(52 - 99)
Pediatrician	10	5	50	(22 - 78)
Nutritionist /dietician	10	7	70	(37 - 90)
Pharmacist	10	7	70	(37 - 90)
Auxiliary nurse	10	10	100	(-)
Practical nurse	10	4	40	(15 - 71)
Registered nurse	10	10	100	(-)
Professional midwife	10	0	0	(-)
Social worker	10	5	50	(22 - 78)
Microbiologist (laboratory)	10	6	60	(29 - 85)
Lab technician	10	10	100	(-)
Dispenser at pharmacy	10	9	90	(52 - 99)
Epidemiology personnel	10	10	100	(-)
Other personnel specific for statistics and reporting	10	10	100	(-)
Provincial Health Offices				

	N	n	%	95% CI
Epidemiology personnel	6	6	100	(-)
Other personnel specific for statistics and reporting	6	6	100	(-)

5.2 Rapid diagnostic tests

Rapid diagnostic tests (RDT) are used in the Dominican Republic 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 the Dominican Republic distinguish between *P. falciparum* and *P. vivax* malaria infections. When a blood sample is taken for an RDT, a thick blood film (TBF) slide is routinely prepared for microscopic diagnosis as well, since the rapid test does not measure parasite density. The slide may be examined at the facility where the patient sought care, or may be sent to a facility with a lab or microscopy post for examination.

5.2.1 Rapid diagnostic test practices

In the Dominican Republic, 24.4% of primary care facilities store RDTs, and 48.8% provide testing with RDTs (Table 5.5). In 47.5% of primary care facilities, personnel test with RDTs inside the facility, and personnel conduct testing in the community in 17.1% of facilities (Table 5.6). Testing in the community is most often conducted daily (50% of facilities that conduct testing in the community), as shown in Table 5.7.

Table 5.5: Rapid diagnostic testing according to interview and observation

	N	n	%	95% CI
Primary care centers				
Unit stores RDTs	41	10	24.4	(13 - 40)
Unit conducts RDT testing	41	20	48.8	(34 - 64)
Hospitals				
Unit stores RDTs	10	8	80	(45 - 95)
Unit conducts RDT testing	10	9	90	(52 - 99)
Provincial Health Offices				
Unit stores RDTs	6	3	50	(16 - 84)
Unit conducts RDT testing	6	6	100	(-)

Table 5.6: Rapid diagnostic testing practices (interview)

	N	n	%	95% CI
Primary care centers				
Do health personnel perform rapid diagnostic testing for malaria in this facility?	40	19	47.5	(32 - 63)
Do health personnel in this facility perform rapid diagnostic testing for malaria in the community?	41	7	17.1	(8 - 32)
Hospitals				
Do health personnel perform rapid diagnostic testing for malaria in this facility?	10	9	90	(52 - 99)
Do health personnel in this facility perform rapid diagnostic testing for malaria in the community?	10	1	10	(1 - 48)
Provincial Health Offices				
Do health personnel perform rapid diagnostic testing for malaria in this facility?	6	4	66.7	(26 - 92)

	N	n	%	95% CI
Do health personnel in this facility perform rapid diagnostic testing for malaria in the community?	6	6	100	(-)

Table 5.7: Community rapid diagnostic testing frequency

	N	n	%	95% CI
Frequency of rapid diagnostic testing in the community				
Daily	14	7	50	(25 - 75)
At least once per week	14	2	14.3	(3 - 44)
At least once per month	14	1	7.1	(1 - 38)
Only in reaction to a positive malaria case	14	1	7.1	(1 - 38)
Other	14	3	21.4	(7 - 50)

Respondents at facilities that reported using both RDTs and microscopic diagnosis methods were asked which of the two methods are more commonly used. While 65.4% of facilities reported using both RDT and microscopy routinely for the same patient, 23.1% reported taking only a TBF sample routinely (Table 5.8).

Table 5.8: More commonly used testing method among facilities that report use of both RDTs and microscopy

	N	n	%	95% CI
For malaria diagnosis, is it most common to take a thick blood film only, use an RDT only, or take both samples (thick blood film and RDT) for diagnosis?				
Both RDT and thick blood film: Samples are routinely taken for both tests at the same time	26	17	65.4	(45 - 81)
Only thick blood film used more commonly	26	6	23.1	(10 - 43)
Only RDT used more commonly	26	1	3.8	(1 - 24)
Other	26	2	7.7	(2 - 27)

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, 58.3% of primary care facilities and 55.6% of secondary care facilities that used RDTs reported that they require confirmation by TBF examination in order to start treatment (Table 5.9).

Table 5.9: Microscopy confirmation of RDT results, attention units conducting RDT

	N	n	%	95% CI
Do you require a positive thick blood film test as confirmation after a positive RDT to start malaria treatment?				
Primary care centers	12	7	58.3	(30 - 82)
Hospitals	9	5	55.6	(24 - 83)

5.2.2 Rapid diagnostic testing as measured in medical record review

The health facility survey included a medical record review of confirmed cases of malaria to evaluate diagnosis and case management practices, and a review of suspected cases of malaria (patients presenting with fever). Chapters 6 and 7 discuss the results in detail. The review captured whether each case from the year 2018 included in the sample received a rapid diagnostic test based on case notification and investigation paperwork stored at CECOVEZ (for confirmed cases) and based on patient charts, attention registries, and lab records (for suspected cases). As seen in Table 5.10, 65% of confirmed cases reviewed had evidence of an RDT, and 1.1% of suspected cases reviewed had evidence of receiving an RDT.

Table 5.10: Rapid diagnostic testing observed in medical record review

	N	n	%	95% CI
RDT observed in record				
Confirmed cases	486	316	65	(61 - 69)
Suspected cases	466	5	1.1	(0 - 3)

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 12.2% of primary care facilities. No rapid tests were observed the day of the survey in 75.6% of primary care facilities (Table 5.11).

Table 5.11: Rapid diagnostic test supply observed

	N	n	%	95% CI
Primary care centers				
P. falciparum rapid detection card equipment observed	41	10	24.4	(13 - 40)
P. falciparum + P. vivax rapid detection card equipment observed	41	5	12.2	(5 - 27)
None of these rapid detection cards observed	41	31	75.6	(60 - 87)
Hospitals				
P. falciparum rapid detection card equipment observed	10	8	80	(45 - 95)
P. falciparum + P. vivax rapid detection card equipment observed	10	2	20	(5 - 55)
None of these rapid detection cards observed	10	2	20	(5 - 55)
Provincial Health Offices				
P. falciparum rapid detection card equipment observed	4	3	75	(23 - 97)
P. falciparum + P. vivax rapid detection card equipment observed	4	1	25	(3 - 77)
None of these rapid detection cards observed	4	1	25	(3 - 77)

As shown in Table 5.12, 41.5% of primary care facilities, 70% of secondary care facilities, and 16.7% of administrative facilities routinely store RDTs.

Table 5.12: Rapid diagnostic test routine storage (questionnaire)

	N	n	%	95% CI
Primary care centers: Does this facility routinely store any malaria rapid diagnostic tests (RDTs)?				
None of the above	41	20	48.8	(34 - 64)
Yes, stores malaria rapid diagnostic tests (RDTs)	41	17	41.5	(27 - 57)
No, picked up from another facility	41	2	4.9	(1 - 18)
No, delivered when services are being provided	41	1	2.4	(0 - 16)
Don't know	41	1	2.4	(0 - 16)
Hospitals: Does this facility routinely store any malaria rapid diagnostic tests (RDTs)?				
None of the above	10	2	20	(5 - 55)
Yes, stores malaria rapid diagnostic tests (RDTs)	10	7	70	(37 - 90)
No, picked up from another facility	10	0	0	(-)

	N	n	%	95% CI
No, delivered when services are being provided	10	0	0	(-)
Don't know	10	1	10	(1 - 48)
Provincial Health Offices: Does this facility routinely store any malaria rapid diagnostic tests (RDTs)?				
None of the above	6	1	16.7	(2 - 65)
Yes, stores malaria rapid diagnostic tests (RDTs)	6	5	83.3	(35 - 98)
No, picked up from another facility	6	0	0	(-)
No, delivered when services are being provided	6	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 colaboradores comunitarios (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 the Dominican Republic, all facilities providing primary care to patients are expected to have the capacity to prepare TBF slides. In the health facility interview and observation, 34.1% of primary care facilities were found to take TBF samples. Administrative units often have this capacity as well, when the unit has vector control technicians affiliated (66.7% of administrative facilities, as in Table 5.13). The health facility survey (interview and observation) determined microscopic diagnostic capacity at 4.9% of primary care facilities, 70% of secondary care facilities, and 0% of DPS units.

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

	N	n	%	95% CI
Primary care centers				
Unit takes thick blood film samples	41	14	34.1	(21 - 50)
Unit has microscopy capacity	41	2	4.9	(1 - 18)
Hospitals				
Unit takes thick blood film samples	10	9	90	(52 - 99)
Unit has microscopy capacity	10	7	70	(37 - 90)
Provincial Health Offices				
Unit takes thick blood film samples	6	4	66.7	(26 - 92)
Unit has microscopy capacity	6	0	0	(-)

According to the interview alone and as seen in Table 5.14, 46.6% of all facilities (regardless of type) have personnel that take TBF samples in-facility, and 22.4% have personnel that take TBF samples in the community.

Table 5.14: Thick blood film sampling according to interview

	N	n	%	95% CI
Health personnel in this facility take thick blood film samples in-facility	58	27	46.6	(34 - 60)
Health personnel take thick blood film samples in the community	58	13	22.4	(13 - 35)

As shown in Table 5.15 and regardless of facility type, 46.2% 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. Of those 12 facilities that report conducting initial diagnosis, 33.3% also examine samples taken by community health workers or volunteer collaborators, and 72.7% sometimes send slides elsewhere for initial diagnosis (for example, when the sole laboratorist is on leave). Among the 14 facilities that do not conduct initial diagnosis, 100% send samples to another facility for initial diagnosis.

Among all 20 facilities that send samples to another facility (sometimes or always), 30% report sending them to another health care facility, while 35% report sending them directly to the national laboratory for initial diagnosis (Table 5.16).

Table 5.15: Microscopy capacity in facility according to interview

	N	n	%	95% CI
Thick blood film samples examined for initial diagnosis of malaria in-facility	26	12	46.2	(28 - 65)
Thick blood film samples taken by community health workers (health promotors/volunteer collaborators) examined for malaria in-facility	12	4	33.3	(13 - 63)
Samples sometimes sent elsewhere for initial diagnosis of malaria, among facilities with capacity	11	8	72.7	(40 - 91)
Samples sent elsewhere for initial diagnosis of malaria, among facilities without capacity	14	14	100	(-)

Table 5.16: Samples sent elsewhere: location

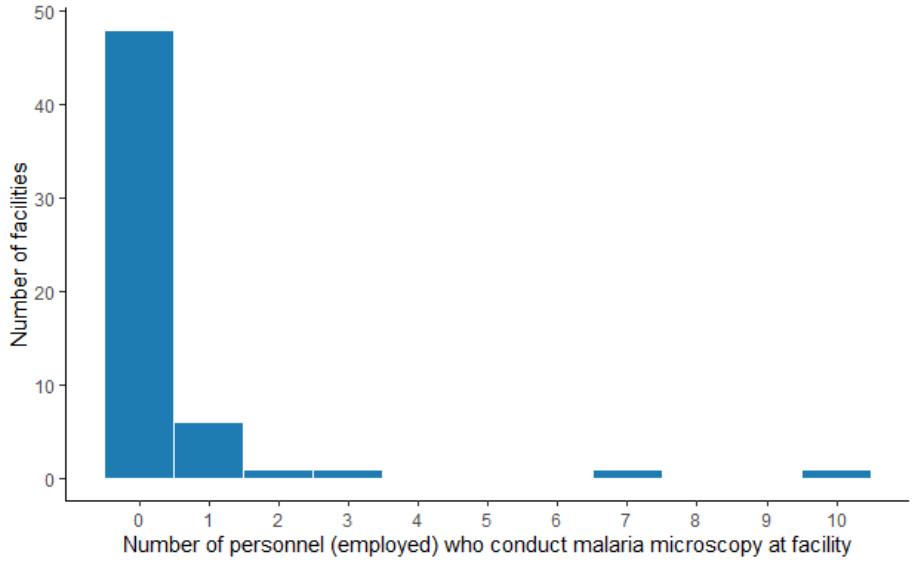
	N	n	%	95% CI
Location of initial diagnosis				
National laboratory	20	7	35	(17 - 58)
Another health facility	20	6	30	(14 - 53)
DPS unit	20	5	25	(11 - 49)
Other	20	1	5	(1 - 29)
Don't know	20	1	5	(1 - 29)

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 41.7% of facilities there is at least one malaria microscopist, 41.7% of facilities have at least one microbiologist who conducts malaria diagnosis, and 41.7% have other lab personnel that read malaria slides (Table 5.17). Figure 5.1 shows the number of employed personnel of all personnel types who conduct malaria diagnosis at each facility in the sample.

Table 5.17: Personnel responsible for malaria microscopy testing

	N	n	%	95% CI
Personnel responsible for TBF examination				
Malaria microscopist	12	5	41.7	(18 - 70)
Microbiologist (laboratory)	12	5	41.7	(18 - 70)
Other lab technician	12	5	41.7	(18 - 70)
Other	12	2	16.7	(4 - 49)

Figure 5.1: Diagnostic personnel employed by facilities



The health facility survey also asked about any affiliated personnel (employed by another institution rather than by the facility directly) who conduct malaria diagnosis. Only three facilities had affiliated personnel involved in diagnosis (Table 5.18), and each of these facilities reported one affiliated person involved in diagnosis.

Table 5.18: Diagnostic personnel not employed but working in facility

	N	n	%	95% CI
Affiliated microscopists work at but are not employed by facility	58	3	5.2	(2 - 15)

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

In order to be able to detect and treat malaria, facilities must have certain basic supplies and equipment on hand. The indicator negotiated for RMEI considers whether these required basic inputs were observed at the facilities in the sample. The requirements vary by facility type, as detailed in Table 5.19.

Table 5.19: Indicator 7.01: Required components by facility type

Component	Primary level (41)	Secondary level (10)	Administrative Units / National Lab (7)
Medications (basic)	Stratum 4 or if reported diagnostic capacity	All	If reported diagnostic capacity
Sampling equipment	All	All	If reported diagnostic capacity
Forms for sending samples	All	All	If reported diagnostic capacity
Equipment for on-site diagnosis (RDT)	All	All	If reported diagnostic capacity
Microscopy equipment	If reported microscopy capacity		
Staining and sample reading equipment	If reported microscopy capacity		
Staining reagents	If reported microscopy capacity		

The indicator results are shown in Table 5.20. Only 6.9% of all the facilities in the sample had all of the inputs required for the corresponding facility type. Table 5.21 shows, for comparison, the results in malaria stratum 4 versus malaria stratum 3.

Table 5.20: Indicator 7.01: Equipment and medications

	N	n	%	95% CI
Antimalarial medications[1]	46	2	4.3	(1 - 16)
Medications for basic treatment: Chloroquine	46	4	8.7	(3 - 22)
Medications for basic treatment: Primaquine (5 or 15 mg tablets)	46	4	8.7	(3 - 22)
No stockout of chloroquine or primaquine in past 3 months	46	2	4.3	(1 - 16)
Sampling and biosafety equipment	19	11	57.9	(35 - 78)
Disposable gloves	19	14	73.7	(49 - 89)
Lancets[2]	20	15	75	(51 - 89)
Microscope slides (frosted or non-frosted)	19	13	68.4	(44 - 85)
Sample submission forms	19	11	57.9	(35 - 78)
Rapid diagnostic tests (RDTs) for onsite testing	55	21	38.2	(26 - 52)
Microscopy equipment	10	6	60	(29 - 85)
Binocular microscope (with 100x retractable lens)[3]	10	7	70	(37 - 90)
Cell counter (manual or automatic)	10	7	70	(37 - 90)
Equipment for staining and testing	10	7	70	(37 - 90)
Immersion oil	10	9	90	(52 - 99)
Staining tray/ container	10	7	70	(37 - 90)
Laboratory stopwatch	10	10	100	(-)
Container for mixing dye/ stain	10	9	90	(52 - 99)
Pipettes/ droppers/ syringes	10	9	90	(52 - 99)
Reagents for staining	10	4	40	(15 - 71)
GIEMSA solution (or alternative: Methylene blue + Solution A + Solution B + Methanol)	10	4	40	(15 - 71)
Buffer solution or buffered water	10	5	50	(22 - 78)
No stockout of reagents in past 3 months	10	4	40	(15 - 71)
Units with all required equipment and medications	58	4	6.9	(3 - 17)

[1]Antimalarial medications were only captured at 46/47 establishments due to survey error
[2]Sampling equipment and sample submission forms were only captured at 19/57 facilities due to survey error
[3]RDTs were only captured at 55/57 establishments due to incomplete data collection at 2 facilities

Table 5.21: Comparison: result by facility stratification

	N	n	%	95% CI
P7.01 Equipment Indicator				
Stratum 3	14	1	7.1	(1 - 38)
Stratum 4	44	3	6.8	(2 - 20)
Total	58	4	6.9	(3 - 17)

5.3.3 Stock of microscopy inputs and equipment

The observation module of the health facility survey checked stock of sample-taking and microscopy supplies and equipment. Each item in the observation list had to be observed by the surveyor, checked for functionality, in the case of equipment, and recorded to the electronic module. Table 5.22 and Table

5.23 show the proportion of facilities where each item for sample-taking and microscopy, respectively, was observed on the day of the survey. 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 5.22: Sample-taking supplies observed

	N	n	%	95% CI
Disposable gloves	20	15	75	(51 - 89)
Alcohol swabs	20	13	65	(42 - 83)
Cotton-wool swabs	20	12	60	(37 - 79)
Acetone or Acetone alcohol (antiseptic)	20	10	50	(29 - 71)
Lancets	20	15	75	(51 - 89)
Syringes (for taking blood)	20	12	60	(37 - 79)
Needles	20	9	45	(25 - 67)
Vacutainer-type needles	20	8	40	(21 - 63)
Capillary tubes	20	10	50	(29 - 71)
Sharps box	20	10	50	(29 - 71)
Microscope slides (not frosted)	20	11	55	(33 - 75)
Frosted microscope slides	20	11	55	(33 - 75)

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

	N	n	%	95% CI
Lens-cleaning tissues	10	6	60	(29 - 85)
Spare bulbs (for microscopes)	10	3	30	(10 - 63)
Spare fuses (for microscopes)	10	1	10	(1 - 48)
Immersion oil	10	9	90	(52 - 99)
Oil immersion lens-cleaning solution	10	5	50	(22 - 78)
Staining rack	10	7	70	(37 - 90)
Drying rack (or sheet)	10	7	70	(37 - 90)
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	6	60	(29 - 85)
Filter paper (or other input to act as filter paper)	10	4	40	(15 - 71)
Slide holders or wooden dowels	10	7	70	(37 - 90)
Containers for mixing dye or stain	10	4	40	(15 - 71)
Concave staining surface	10	2	20	(5 - 55)
Staining tray/sheet/container	10	7	70	(37 - 90)
Glass petri dish	10	6	60	(29 - 85)
Plastic petri dish	6	5	83.3	(35 - 98)
Syringes	10	3	30	(10 - 63)
Disposable droppers	10	9	90	(52 - 99)
Test tubes with screw caps	10	9	90	(52 - 99)
Safety glasses (including the over-spectacle type)	10	7	70	(37 - 90)
Gowns	10	9	90	(52 - 99)
Markers	10	8	80	(45 - 95)
Detergents	10	10	100	(-)
Timer in laboratory	10	6	60	(29 - 85)

Each microscope present at facilities in the sample was observed separately for characteristics. The number of microscopes at each facility is detailed in Figure 5.2. The observed characteristics, by microscope, are shown in Table 5.25.

Figure 5.2: Functional microscopes per facility

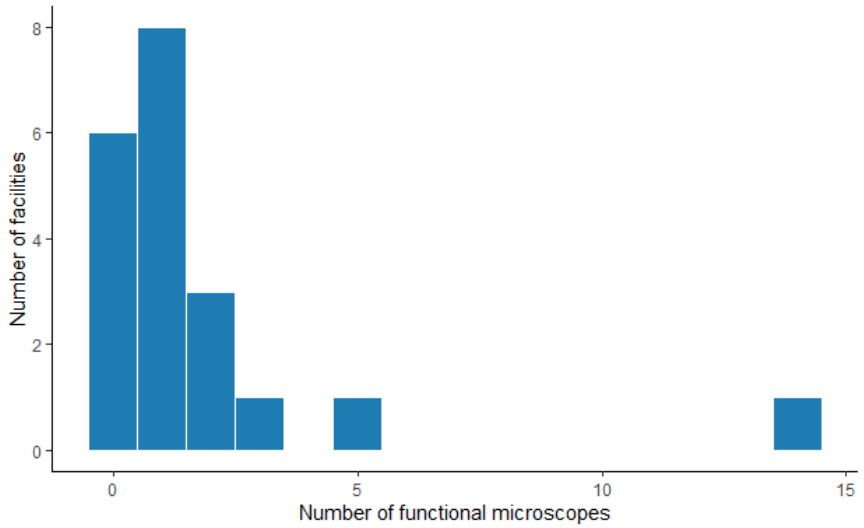


Table 5.25: Microscope characteristics among all observed microscopes

	N	n	%	95% CI
Is this a binocular microscope?	36	36	100	(-)
Is this a light microscope?	36	36	100	(-)
Is this a fluorescence microscope?	36	32	88.9	(73 - 96)
Is this a dark field microscope?	36	13	36.1	(22 - 54)
Is this a solar power microscope?	36	2	5.6	(1 - 21)
Lens observed: 4x	36	22	61.1	(44 - 76)
Lens observed: 10x	36	32	88.9	(73 - 96)
Lens observed: 20x	36	0	0	(-)
Lens observed: 40x	36	29	80.6	(64 - 91)
Lens observed: 100x	36	29	80.6	(64 - 91)
Lens observed: 1000x	36	0	0	(-)
Does the binocular microscope have an oil immersion lens?	36	36	100	(-)

Chapter 6: Malaria Case Detection

Crucial to any malaria elimination program is quick detection of new malaria cases. Quickly administering treatment to the patient and enacting reactive activities in the community to search for additional cases and to monitor and control vector populations can interrupt the chain of transmission. In the Dominican Republic, active case detection is carried out by vector control personnel of the Ministry of Public Health and Social Assistance 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 the Dominican Republic, 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 comunitarios* or CCs) based in localities with difficult access to health facilities. Community members experiencing fever or other malaria symptoms can seek out the CC, who will take a blood sample if he or she suspects the patient may have malaria.

6.1 Community case detection and malaria prevention activities

As a part of the health facility interview, respondents were asked about vector control personnel and community health workers affiliated with the facility. In the Dominican Republic no primary or secondary care facilities, which are managed by the National Health Service (SNS), had any vector control technicians affiliated. Vector control activities are managed by DPS units, where 33.3% had vector control personnel affiliated. Community health workers were affiliated with primary care as well DPS units but not with hospitals (Table 6.1).

Table 6.1: Affiliated malaria personnel

	N	n	%	95% CI
Primary care centers				
Community health workers/volunteer collaborators	30	9	30	(16 - 49)
Community health workers/volunteer collaborators involved in malaria activities (such as vector control, diagnosis, case detection, or treatment)	9	9	100	(-)
Other personnel involved in malaria diagnosis or treatment	41	1	2.4	(0 - 16)
Hospitals				
Community health workers/volunteer collaborators	8	0	0	(-)
Other personnel involved in malaria diagnosis or treatment	10	0	0	(-)
Provincial Health Offices				
Vector control personnel	6	6	100	(-)
Community health workers/volunteer collaborators	6	3	50	(16 - 84)
Community health workers/volunteer collaborators involved in malaria activities (such as vector control, diagnosis, case detection, or treatment)	3	3	100	(-)
Other personnel involved in malaria diagnosis or treatment	6	2	33.3	(8 - 74)

As shown in Table 6.2, 48.8% of primary care facilities and 40% of hospitals reported that facility personnel participate in active searches for malaria. All DPS units and CECOVEZ reported conducting active searches. Most DPS units also reported storing mosquito nets for distribution (83.3%) and employing personnel involved with indoor residual spraying (66.7%). Educational campaigns about malaria were conducted by 100% of DPS units.

Table 6.2: Active case detection and community activities

	N	n	%	95% CI
Primary care centers				
Conducts active search for malaria cases	41	20	48.8	(34 - 64)
Stores insecticide-treated mosquito nets for distribution in the community	41	3	7.3	(2 - 21)
Performs indoor residual spraying	41	1	2.4	(0 - 16)
Conducts educational campaigns about malaria in the community	41	27	65.9	(50 - 79)
Other malaria outreach activities	41	11	26.8	(15 - 43)
Hospitals				
Conducts active search for malaria cases	10	4	40	(15 - 71)
Stores insecticide-treated mosquito nets for distribution in the community	10	1	10	(1 - 48)
Performs indoor residual spraying	10	0	0	(-)
Conducts educational campaigns about malaria in the community	10	6	60	(29 - 85)
Other malaria outreach activities	10	2	20	(5 - 55)
Provincial Health Offices				
Conducts active search for malaria cases	6	6	100	(-)
Stores insecticide-treated mosquito nets for distribution in the community	6	5	83.3	(35 - 98)
Performs indoor residual spraying	6	4	66.7	(26 - 92)
Conducts educational campaigns about malaria in the community	6	6	100	(-)
Other malaria outreach activities	6	6	100	(-)
National Reference Laboratory				
Conducts active search for malaria cases	1	1	100	(-)
Stores insecticide-treated mosquito nets for distribution in the community	1	1	100	(-)
Performs indoor residual spraying	1	1	100	(-)
Conducts educational campaigns about malaria in the community	1	1	100	(-)
Other malaria outreach activities	1	0	0	(-)

Facilities that reported participation in active search for malaria cases were asked about how active case detection activities are planned in the community. As shown in Table 6.3, many facilities (regardless of facility type) reported they do active case detection on a scheduled periodic basis (22.6% of facilities) or after there is a case of malaria in the catchment area (22.6% of facilities). The most common “other” reason provided for doing an active search was an uptick in fever cases. The only facility that reported doing active search according to direction from health authorities, said that when to do search was decided internally.

Table 6.3: Determinants of active case detection

	N	n	%	95% CI
When do you search for suspected malaria cases in your catchment area?				
On a scheduled periodic basis	31	7	22.6	(11 - 41)
After there is a case of malaria in the catchment area	31	7	22.6	(11 - 41)
When events (market, celebrations, vacations) are happening in the community	31	5	16.1	(7 - 34)
Daily	31	5	16.1	(7 - 34)
Based on seasonality	31	2	6.5	(2 - 23)
When directed from health authorities	31	1	3.2	(0 - 21)
Other	31	12	38.7	(23 - 57)

Table 6.4: Active case detection direction from health authorities

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

The facilities that reported storing mosquito nets (regardless of type) 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				
Personnel from this health facility distributes the nets in the community	10	6	60	(29 - 85)
Vector control personnel distributes the nets in the community	10	2	20	(5 - 55)
Given at the health facility, but only at request of the patient	10	1	10	(1 - 48)
Other	10	3	30	(10 - 63)

Respondents were also asked a series of questions about malaria detection activities in the community. When asked about referrals from community health workers, 4.9% of primary care units and 20% of secondary care units reported receiving referrals from CC or other community health workers to treat malaria. Diagnosis activities were common, with 19.5% of primary care facilities receiving referrals for malaria testing, 14.6% of primary care units taking TBF samples in the community, and 17.1% of primary care units taking RDTs in the community. DPS units were also involved in diagnostic activities in the community.

Table 6.6: Community malaria activities - questionnaire

	N	n	%	95% CI
Primary care centers				
Do you receive referred patients from community health workers or volunteer collaborators for malaria testing?	41	8	19.5	(10 - 35)
Do you receive referred patients from community health workers or volunteer collaborators for malaria treatment?	41	2	4.9	(1 - 18)
Do health personnel take thick blood film samples in the community?	41	6	14.6	(7 - 29)
Do health personnel in this facility perform rapid diagnostic testing for malaria in the community?	41	7	17.1	(8 - 32)

	N	n	%	95% CI
Do community health workers or volunteer collaborators receive malaria rapid tests from this facility for use in the community? (among facilities that reported storage of RDTs)	17	4	23.5	(9 - 49)
Hospitals				
Do you receive referred patients from community health workers or volunteer collaborators for malaria testing?	10	1	10	(1 - 48)
Do you receive referred patients from community health workers or volunteer collaborators for malaria treatment?	10	2	20	(5 - 55)
Do health personnel take thick blood film samples in the community?	10	1	10	(1 - 48)
Do health personnel in this facility perform rapid diagnostic testing for malaria in the community?	10	1	10	(1 - 48)
Do community health workers or volunteer collaborators receive malaria rapid tests from this facility for use in the community? (among facilities that reported storage of RDTs)	7	0	0	(-)
Provincial Health Offices				
Do you receive referred patients from community health workers or volunteer collaborators for malaria testing?	6	2	33.3	(8 - 74)
Do health personnel take thick blood film samples in the community?	6	6	100	(-)
Do health personnel in this facility perform rapid diagnostic testing for malaria in the community?	6	6	100	(-)
Do community health workers or volunteer collaborators receive malaria rapid tests from this facility for use in the community? (among facilities that reported storage of RDTs)	5	5	100	(-)
National Reference Laboratory				
Do you receive referred patients from community health workers or volunteer collaborators for malaria testing?	1	1	100	(-)
Do you receive referred patients from community health workers or volunteer collaborators for malaria treatment?	0	0		-
Do health personnel take thick blood film samples in the community?	1	0	0	(-)
Do health personnel in this facility perform rapid diagnostic testing for malaria in the community?	1	0	0	(-)
Do community health workers or volunteer collaborators receive malaria rapid tests from this facility for use in the community? (among facilities that reported storage of RDTs)	1	1	100	(-)

6.2 Passive case detection practices as measured in health facility questionnaire

Personnel in health facilities are trained to suspect and test for malaria in patients who present with fever or other symptoms to the facility, known as passive case detection. Patients presenting with suspicious symptoms will sometimes have a sample taken, usually of capillary blood, to prepare a TBF slide or could have a rapid diagnostic test for detection. 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 the DPS. In facilities that do not have capacity for TBF nor RDTs, the facility refers patients to a nearby hospital that has this capacity. Another scenario was encountered where a hospital does not have the capacity for malaria microscopy, but CECOVEZ staff are stationed there and provide this service to patients who require malaria testing. 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 100% of primary care facilities and 88.9% of secondary care facilities, and nurses order the test or take the sample at triage in 5% of primary care facilities.

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

	N	n	%	95% CI
Primary care centers: Who decides whether a patient presenting at this facility will receive a malaria test?				
Nurse at triage or pre-clinic	20	1	5	(1 - 29)
Doctor during consult	20	20	100	(-)
Lab staff or microscopy staff	20	0	0	(-)
Other	20	1	5	(1 - 29)
Hospitals: Who decides whether a patient presenting at this facility will receive a malaria test?				
Nurse at triage or pre-clinic	9	0	0	(-)
Doctor during consult	9	8	88.9	(48 - 99)
Lab staff or microscopy staff	9	0	0	(-)
Other	9	1	11.1	(1 - 52)

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 consultations, high fever was an important criterion that determined testing (in 75% of facilities). General malaise (35.7%), chills (42.9%) and sweating (28.6%) were also frequently mentioned. Other common criteria used in triage as well as consultations were headache, arthralgia and myalgia. 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	1	1	100	(-)
Chills	1	1	100	(-)
Sweating	1	1	100	(-)
General malaise	1	1	100	(-)
Other	1	1	100	(-)

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	28	21	75	(55 - 88)
Chills	28	12	42.9	(26 - 62)
General malaise	28	10	35.7	(20 - 55)
Sweating	28	8	28.6	(15 - 48)
History of recent travel to areas with endemic malaria	28	3	10.7	(3 - 29)
History of recent fever	28	2	7.1	(2 - 25)

	N	n	%	95% CI
Weakness (asthenia or adynamia)	28	2	7.1	(2 - 25)
Prior history of malaria	28	2	7.1	(2 - 25)
Fever without nonspecific digestive symptoms (vomiting, abdominal pain, loss of appetite)	28	1	3.6	(0 - 22)
Fever without rash	28	1	3.6	(0 - 22)
Other	28	17	60.7	(41 - 77)

6.3 Suspected malaria cases with test as measured in households

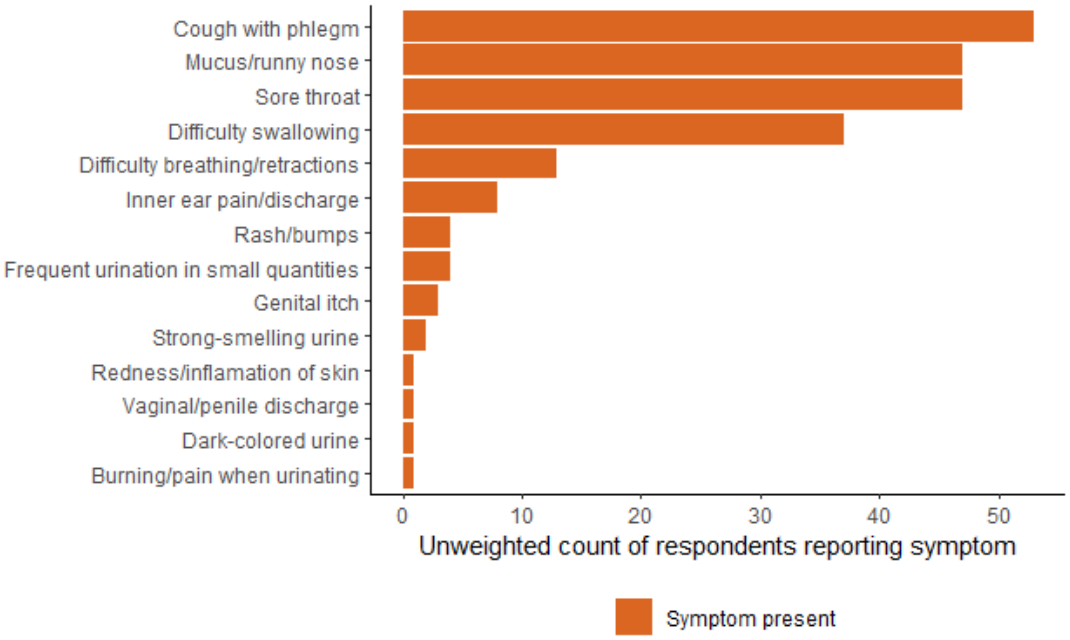
In the community survey (LQAS), interviews with households included questions about history of fever during the two weeks prior to the survey for all usual members of the household. The estimates from the LQAS survey reported in this section are not weighted due to the very small size of the sub-sample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

If the primary interview respondent reported that a household member had a recent fever, the interviewer asked to speak to the person who had the fever, or in the case that a child or adolescent had a fever, with the child's primary caregiver. If the person with the fever was not available and the primary respondent knew the details of their recent fever, that person was permitted to respond on behalf of the fever patient. The respondent answered questions about other symptoms suffered during the febrile illness and whether and where they sought medical attention. As seen in Table 6.10, 4.1% 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 107 respondents who reported experiencing fever, the majority experienced other symptoms that suggested a condition other than malaria. Only 25 people, or 23.4% 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 6.1.

Table 6.10: Eligible fever cases reported in LQAS household survey

	N	n	%	95% CI
LQAS respondents	2625	2625	100	(-)
Fever cases	2598	107	4.1	(3 - 5)
Fever without exclusion symptoms	107	25	23.4	(13 - 38)

Figure 6.1: Exclusion symptoms experienced by respondents reporting fever



6.3.1 Indicator 2.02: Suspected malaria cases with 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, 37.5% 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	2598	107	4.1	(3 - 5)
Fevers with no exclusion symptoms	107	25	23.4	(13 - 38)
Omitted due to 'do not know' responses	25	1	4	(1 - 25)
Fevers with any blood sample	24	9	37.5	(24 - 54)
Capillary blood test	25	2	8	(2 - 24)
Venal blood test	25	8	32	(18 - 50)

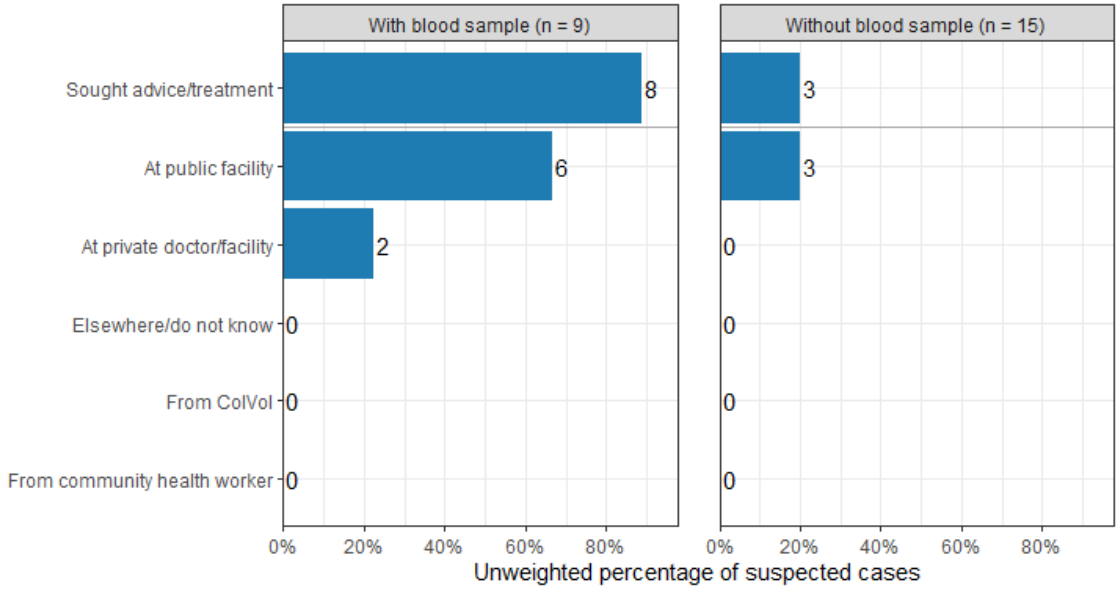
Respondents who reported a blood sample draw were asked whether their blood was tested for malaria, and if so, the result of the test. As seen in Table 6.12, 33.3% of respondents with a blood sample reported a malaria test, and 100% of those who had the malaria test reported a negative result.

Table 6.12: Result of blood tests, LQAS fevers

	N	n	%	95% CI
Blood tested for malaria	9	3	33.3	(12 - 65)
Result of malaria test				
Negative malaria	3	3	100	(-)

Figure 6.2 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 6.2: Treatment sought by respondents with fever cases

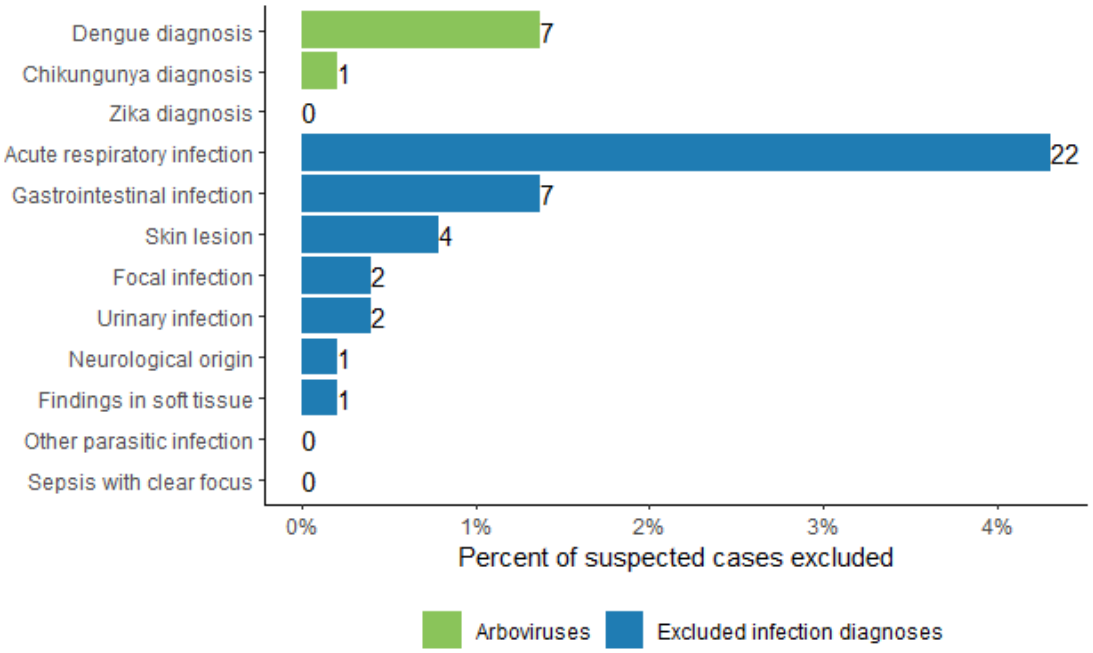


6.4 Suspected malaria cases with test as measured in medical record review

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

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 6.3. 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 most primary care facilities in the Dominican Republic, field personnel found an inadequate number of eligible attentions from the year 2018 to meet the quota, and all eligible cases from 2018 were reviewed. In some facilities, sampled records could not be located due to records being stored under the name of a family member who had first sought care in the facility instead of under the patient's name. Thus a convenience sample of records from 2018 was reviewed to look for any eligible attentions instead in these facilities.

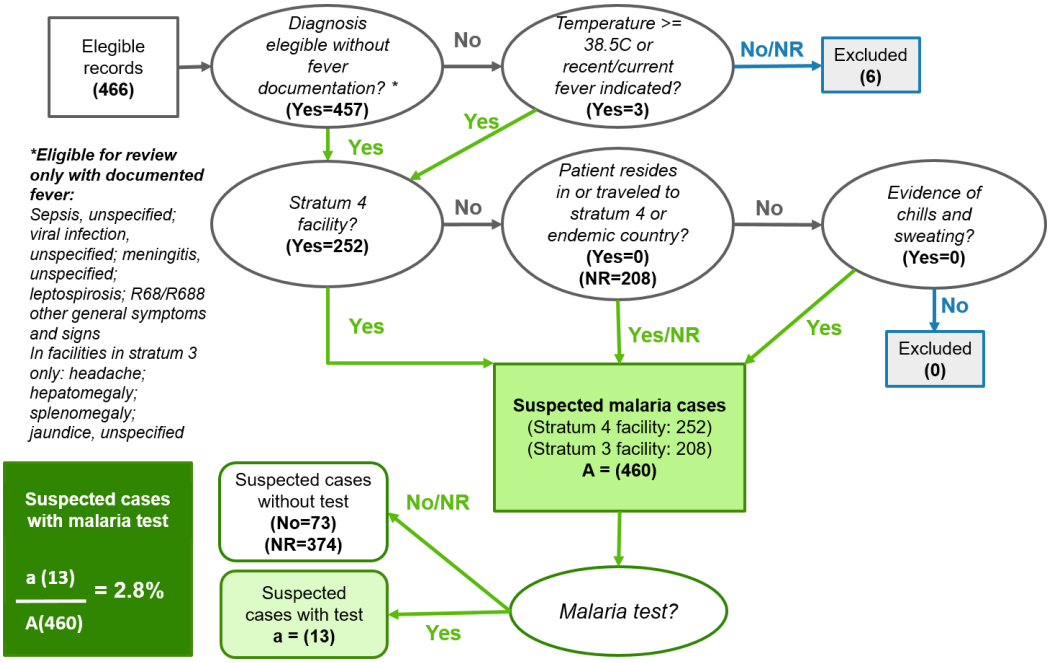
Figure 6.3: Exclusion diagnoses for review of suspected malaria cases



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 6.4. 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 6.4: Eligibility of suspected cases reviewed for Indicator 2.01



In total in the Dominican Republic, 460 of the 466 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 6.13, 2.8% of patients with suspected malaria had evidence that a malaria test was received. Of these 13 patients with evidence of a test, 30.8% received an RDT and 92.3% a TBF. Table 6.14 shows the results by malaria stratum for comparison.

Table 6.13: Indicator 2.01: Suspected cases with malaria test

	N	n	%	95% CI
Suspected case with malaria test	460	13	2.8	(2 - 5)
Rapid diagnostic test	13	4	30.8	(12 - 59)
Thick blood film	13	12	92.3	(61 - 99)

Table 6.14: Comparison: result by facility stratification

	N	n	%	95% CI
Suspected cases with malaria test				
Stratum 3	208	12	5.8	(3 - 10)
Stratum 4	252	1	0.4	(0 - 3)
Total	460	13	2.8	(2 - 5)

6.5 Timely diagnosis of confirmed malaria cases as measured in medical record review

Early diagnosis of malaria is essential to interrupt transmission in a timely manner and to ensure the patient receives treatment before illness becomes more severe or complicated. The health facility survey included a record review of confirmed malaria cases. At CECOVEZ, field personnel reviewed all confirmed malaria cases from the year 2018. All case records that were stored at the CECOVEZ headquarters were sought out and considered for the review, including case notification forms, case investigation forms, and any patient charts, laboratory records, or treatment forms found. Figure 6.5 shows that the majority of confirmed malaria case reviews used the MAL-0-03 case notification form followed by the MAL-0-01 active search form and clinical history or medical record. Few case reviews used the CENCET-2 case notification form.

Figure 6.5: Sources of confirmed case medical record review

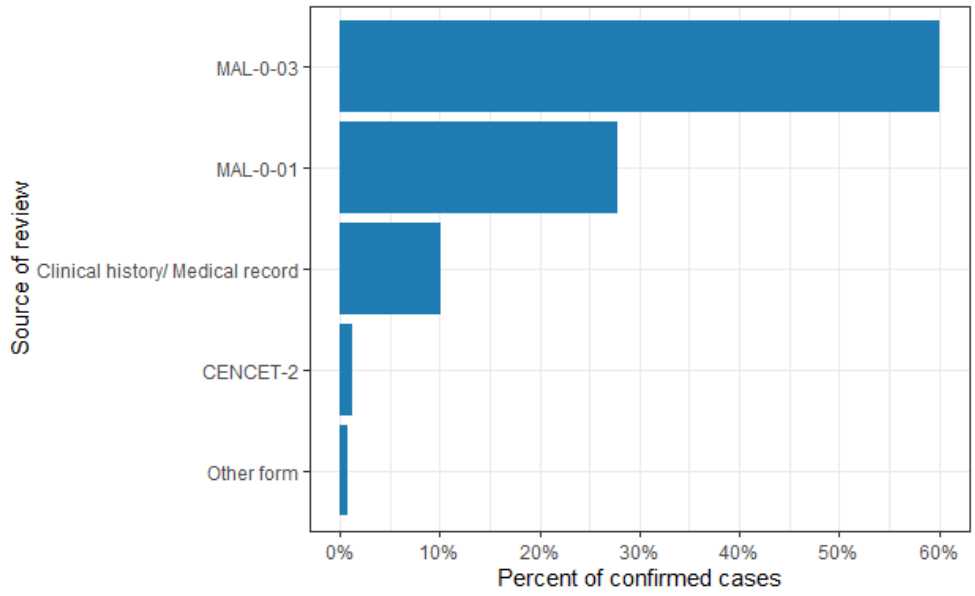
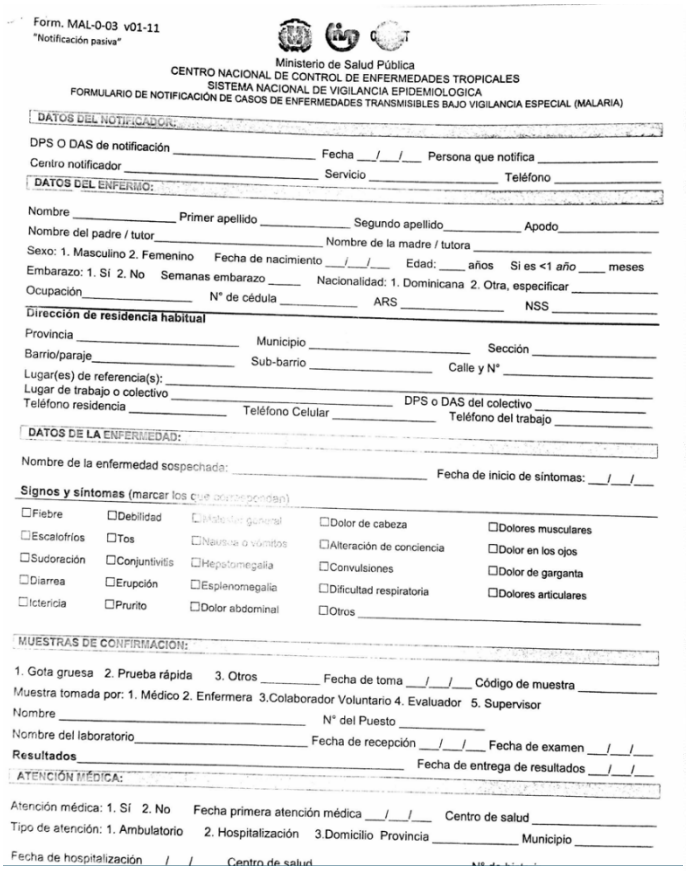


Figure 6.6: MAL-0-03 blank case notification form, MAL-0-01 active search form and CENCET-2 case notification form



Form. MAL-0-03 v01-11
"Notificación pasiva"

Ministerio de Salud Pública
CENTRO NACIONAL DE CONTROL DE ENFERMEDADES TROPICALES
SISTEMA NACIONAL DE VIGILANCIA EPIDEMIOLOGICA
FORMULARIO DE NOTIFICACIÓN DE CASOS DE ENFERMEDADES TRANSMISIBLES BAJO VIGILANCIA ESPECIAL (MALARIA)

DATOS DEL NOTIFICADOR:

DPS O DAS de notificación _____ Fecha __/__/__ Persona que notifica _____
Centro notificador _____ Servicio _____ Teléfono _____

DATOS DEL ENFERMO:

Nombre _____ Primer apellido _____ Segundo apellido_____ Apodo_____
Nombre del padre / tutor_____ Nombre de la madre / tutora _____
Sexo: 1. Masculino 2. Femenino Fecha de nacimiento __/__/__ Edad: ___ años Si es <1 *año* ___ meses
Embarazo: 1. Sí 2. No Semanas embarazo ____ Nacionalidad: 1. Dominicana 2. Otra, especificar _____
Ocupación_____ N° de cédula _____ ARS _____ NSS _____

Dirección de residencia habitual

Provincia _____ Municipio _____ Sección _____
Barrio/paraje_____ Sub-barrio _____ Calle y N° _____
Lugar(es) de referencia(s): _____
Lugar de trabajo o colectivo _____ DPS o DAS del colectivo _____
Teléfono residencia _____ Teléfono Celular _____ Teléfono del trabajo _____

DATOS DE LA ENFERMEDAD:

Nombre de la enfermedad sospechada: _____ Fecha de inicio de síntomas: __/__/__

Signos y síntomas (marcar los que correspondan)

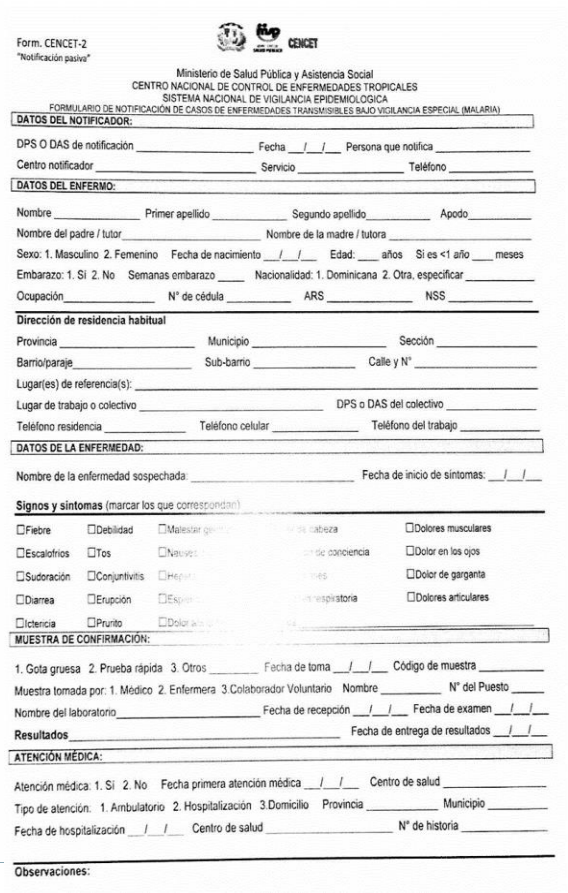
☐Fiebre ☐Debilidad ☐Malestar general ☐Dolor de cabeza ☐Dolores musculares
☐Escalofríos ☐Tos ☐Nausea o vómitos ☐Alteración de conciencia ☐Dolor en los ojos
☐Sudoración ☐Conjuntivitis ☐Hepatomegalia ☐Convulsiones ☐Dolor de garganta
☐Diarrea ☐Erupción ☐Esplenomegalia ☐Dificultad respiratoria ☐Dolores articulares
☐Ictericia ☐Prurito ☐Dolor abdominal ☐Otros _____

MUESTRAS DE CONFIRMACIÓN:

1. Gota gruesa 2. Prueba rápida 3. Otros _____ Fecha de toma __/__/__ Código de muestra _____
Muestra tomada por: 1. Médico 2. Enfermera 3.Colaborador Voluntario 4. Evaluador 5. Supervisor
Nombre _____ N° del Puesto _____
Nombre del laboratorio_____ Fecha de recepción __/__/__ Fecha de examen __/__/__
Resultados_____ Fecha de entrega de resultados __/__/__

ATENCIÓN MÉDICA:

Atención médica: 1. Sí 2. No Fecha primera atención médica __/__/__ Centro de salud _____
Tipo de atención: 1. Ambulatorio 2. Hospitalización 3.Domicilio Provincia _____ Municipio _____
Fecha de hospitalización __/__/__ Centro de salud _____



Form. CENCET-2
"Notificación pasiva"

CENCET

Ministerio de Salud Pública y Asistencia Social
CENTRO NACIONAL DE CONTROL DE ENFERMEDADES TROPICALES
SISTEMA NACIONAL DE VIGILANCIA EPIDEMIOLOGICA
FORMULARIO DE NOTIFICACIÓN DE CASOS DE ENFERMEDADES TRANSMISIBLES BAJO VIGILANCIA ESPECIAL (MALARIA)

DATOS DEL NOTIFICADOR:

DPS O DAS de notificación _____ Fecha __/__/__ Persona que notifica _____
Centro notificador _____ Servicio _____ Teléfono _____

DATOS DEL ENFERMO:

Nombre _____ Primer apellido _____ Segundo apellido_____ Apodo_____
Nombre del padre / tutor_____ Nombre de la madre / tutora _____
Sexo: 1. Masculino 2. Femenino Fecha de nacimiento __/__/__ Edad: ___ años Si es <1 *año* ___ meses
Embarazo: 1. Sí 2. No Semanas embarazo ____ Nacionalidad: 1. Dominicana 2. Otra, especificar _____
Ocupación_____ N° de cédula _____ ARS _____ NSS _____

Dirección de residencia habitual

Provincia _____ Municipio _____ Sección _____
Barrio/paraje_____ Sub-barrio _____ Calle y N° _____
Lugar(es) de referencia(s): _____
Lugar de trabajo o colectivo _____ DPS o DAS del colectivo _____
Teléfono residencia _____ Teléfono celular _____ Teléfono del trabajo _____

DATOS DE LA ENFERMEDAD:

Nombre de la enfermedad sospechada: _____ Fecha de inicio de síntomas: __/__/__

Signos y síntomas (marcar los que correspondan)

☐Fiebre ☐Debilidad ☐Malestar ge... ☐...de cabeza ☐Dolores musculares
☐Escalofríos ☐Tos ☐Nausea... ☐...de conciencia ☐Dolor en los ojos
☐Sudoración ☐Conjuntivitis ☐Hepa... ☐...nes ☐Dolor de garganta
☐Diarrea ☐Erupción ☐Esple... ☐...respiratoria ☐Dolores articulares
☐Ictericia ☐Prurito ☐Dolor a... ☐...

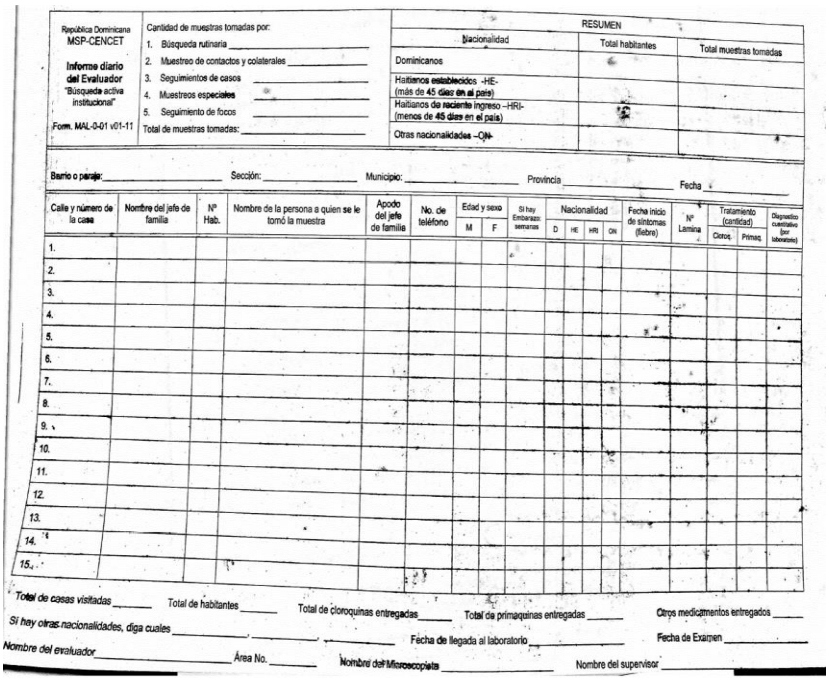
MUESTRA DE CONFIRMACIÓN:

1. Gota gruesa 2. Prueba rápida 3. Otros _____ Fecha de toma __/__/__ Código de muestra _____
Muestra tomada por: 1. Médico 2. Enfermera 3.Colaborador Voluntario Nombre _____ N° del Puesto _____
Nombre del laboratorio_____ Fecha de recepción __/__/__ Fecha de examen __/__/__
Resultados_____ Fecha de entrega de resultados __/__/__

ATENCIÓN MÉDICA:

Atención médica: 1. Sí 2. No Fecha primera atención médica __/__/__ Centro de salud _____
Tipo de atención: 1. Ambulatorio 2. Hospitalización 3.Domicilio Provincia _____ Municipio _____
Fecha de hospitalización __/__/__ Centro de salud _____ N° de historia _____

Observaciones:



República Dominicana
MSP-CENCET

Informe diario del Evaluador
"Búsqueda activa institucional"
Form. MAL-0-01 v01-11

Cantidad de muestras tomadas por:
1. Búsqueda rutinaria _____
2. Muestreo de contactos y colaterales _____
3. Seguimientos de casos _____
4. Muestreos especiales _____
5. Seguimiento de focos _____
Total de muestras tomadas: _____

RESUMEN

Nacionalidad	Total habitantes	Total muestras tomadas
Dominicanos		
Haitianos establecidos –HE– (más de 45 días en el país)		
Haitianos de reciente ingreso –HRI– (menos de 45 días en el país)		
Otras nacionalidades –ON–		

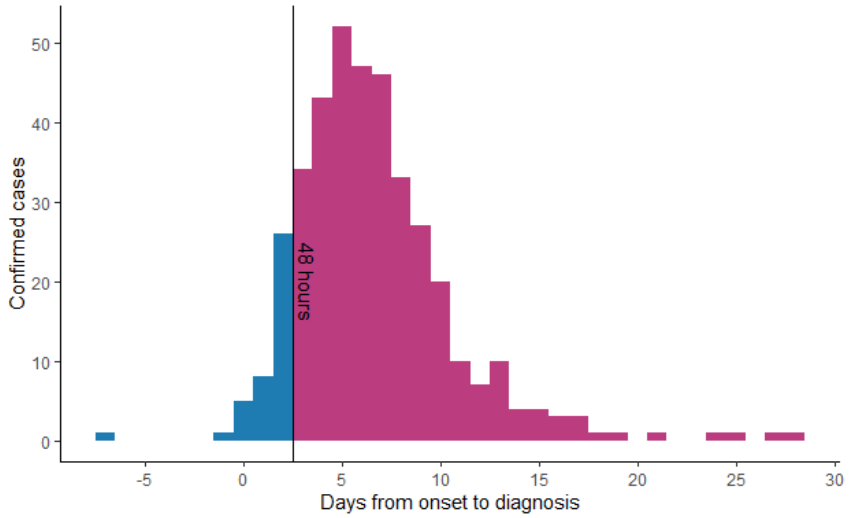
Barrio o paraje:_____ Sección: _____ Municipio: _____ Provincia _____ Fecha _____

Calle y número de la casa	Nombre del jefe de familia	Nº Hab.	Nombre de la persona a quien se le tomó la muestra	Apodo del jefe de familia	No. de teléfono	Edad y sexo M	Edad y sexo F	Si hay Embarazo semanas	Nacionalidad D	Nacionalidad HE	Nacionalidad HRI	Nacionalidad ON	Fecha inicio de síntomas (fiebre)	Nº Lamina	Tratamiento (cantidad) Cloro.	Tratamiento (cantidad) Primaq.	Diagnóstico cuantitativo (por laboratorio)
1.																	
2.																	
3.																	
4.																	
5.																	
6.																	
7.																	
8.																	
9.																	
10.																	
11.																	
12.																	
13.																	
14.																	
15.																	

Total de casas visitadas _____ Total de habitantes _____ Total de cloroquinas entregadas _____ Total de primaquinas entregadas _____ Otros medicamentos entregados _____
Si hay otras nacionalidades, diga cuales _____ Fecha de llegada al laboratorio _____ Fecha de Examen _____
Nombre del evaluador_____ Área No. _____ Nombre del Microscopista _____ Nombre del supervisor _____

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 MAL-0-03 and MAL-0-01 forms. Figure 6.7 shows the number of days from fever onset (or onset of other malaria symptoms, if date of fever onset was not recorded) to the date of diagnosis. If diagnosis was recorded more than seven days before or more than 30 days after fever onset, the case is excluded from the indicator because of the suspicion of recording error (on the investigation form or in the survey module). This suspected error affected 38 cases which are excluded from the figure. In cases, diagnosis was recorded before symptom onset which is a plausible scenario for cases tested through active case detection or for other reasons where testing was recommended before symptoms presented.

Figure 6.7: Time from symptom onset to diagnosis



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

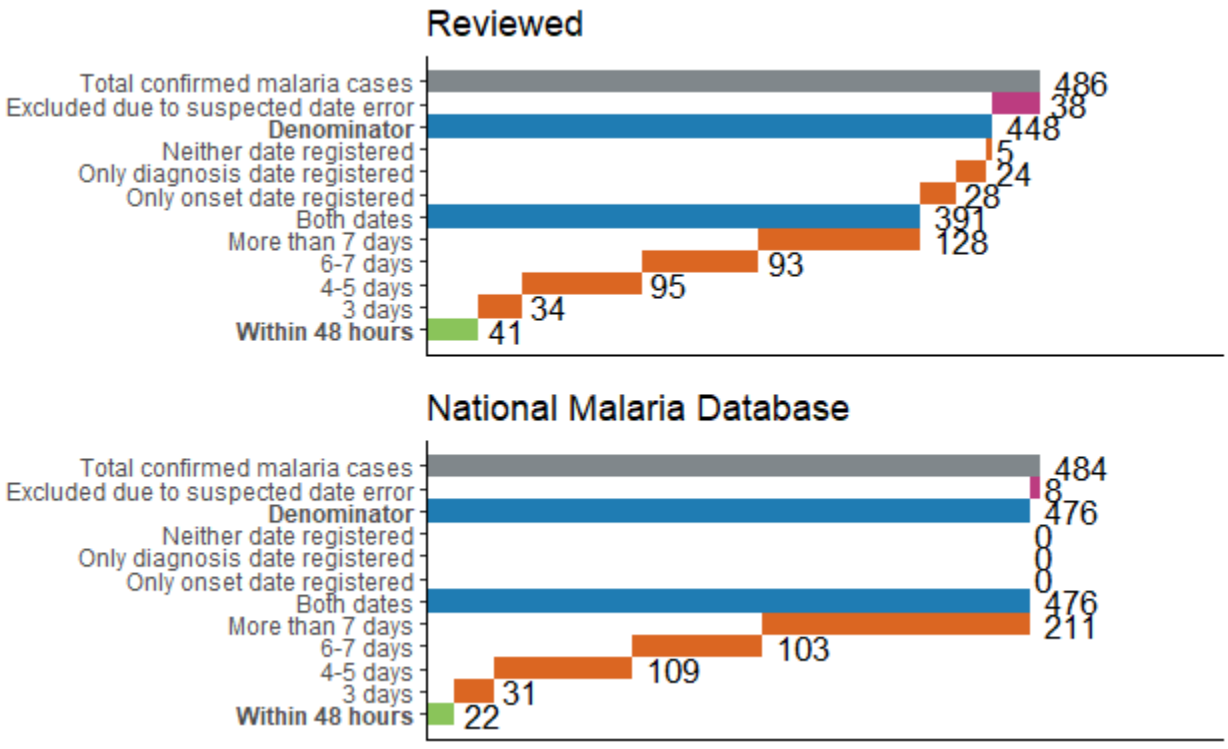
Diagnosis within two days (48 hours) of symptom onset was negotiated as an indicator for RMEI. As shown in Table 6.15, 87.3% of confirmed case records in the Dominican Republic had both fever/symptom onset and diagnosis dates registered. Only 9.2% of cases were diagnosed within 48 hours of fever/symptom onset, and 28.6% were diagnosed more than a week after fever/symptom onset.

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

	N	n	%	95% CI
Total confirmed malaria cases	486	486	100	(-)
Excluded due to suspected inscription/data entry error (<-7 day or >30 day window)	486	38	7.8	(6 - 11)
Denominator: Confirmed cases with valid dates	448	448	100	(-)
Fever/symptom onset date registered	448	419	93.5	(91 - 95)
Diagnosis date registered	448	415	92.6	(90 - 95)
Both dates registered	448	391	87.3	(84 - 90)
Diagnosis before onset (presumptive)	448	2	0.4	(0 - 2)
Cases diagnosed within 48 hours of onset	448	41	9.2	(7 - 12)
3 days	448	34	7.6	(5 - 10)
4-5 days	448	95	21.2	(18 - 25)
6-7 days	448	93	20.8	(17 - 25)
Over 7 days	448	128	28.6	(25 - 33)
Indicator result: Cases diagnosed within 48 hours of onset	448	41	9.2	(7 - 12)

Figure 6.8 shows the same indicator results in a graphic format, with results of the RMEI data collection (upper panel) compared to the Dominican Republic's National Malaria Database (lower panel). The data from the surveillance database had no missing dates, a smaller 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 6.8: Indictor 4.02: Cases categorized, reviewed and National Malaria Database



6.5.2 Case detection and classification

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

During the confirmed case medical record review, field personnel reviewed 486 cases, of which 318 were detected passively, 154 were detected during active search, and twelve did not have the source of the case registered (Table 6.16). The National Malaria database showed 32.9% of cases detected through active search.

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

The majority of cases did not have the classification registered on the case notification forms, but the National Malaria database reported a high percentage of autochthonous cases (89.5%). The discrepancy is likely due to data being updated in the National Malaria database after investigations were completed by CECOVEZ personnel.

Table 6.16: Source of confirmed case detection

	N	n	%	95% CI
Reviewed: Case detection source:				
Not registered	486	12	2.5	(1 - 4)
Passive search	486	318	65.4	(61 - 70)
Active search	486	154	31.7	(28 - 36)
Other	486	2	0.4	(0 - 2)
National Malaria Database: Case detection source:				
Passive search	484	325	67.1	(63 - 71)
Active search	484	159	32.9	(29 - 37)

Table 6.17: Classification of confirmed malaria cases

Classification	#	%
Reviewed		
Autochthonous	0	0%
Imported	1	0.2%
Introduced	1	0.2%
Not registered	484	99.6%
Total cases	486	
National Malaria Database		
Autochthonous/indigenous/local	433	89.5%
Imported	51	10.5%
Total cases	484	

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

Notification within 24 hours of diagnosis was negotiated as an indicator for RMEI. All confirmed cases of malaria were expected to have a notification report, but as shown in Figure 6.9 not all collected cases had a reviewed notification form and not all notification forms had a date recorded for when notification occurred. As shown in Table 6.18, 49.2% of confirmed case records in the Dominican Republic had both diagnosis and notification dates registered. Only 41.1% were notified within 24 hours of diagnosis.

Figure 6.9: Confirmed cases: source of notification information

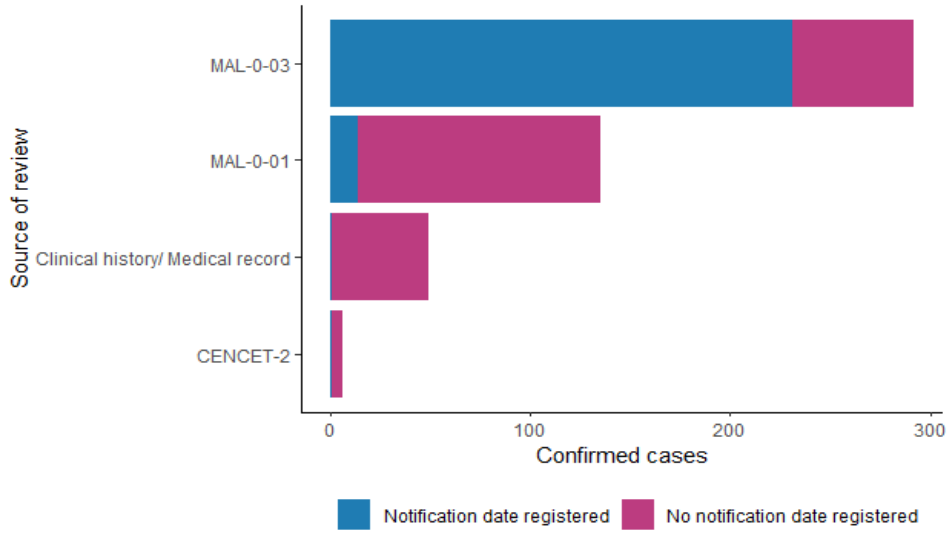


Table 6.18: Indicator E2.04: Notification within 24 hours of diagnosis

	N	n	%	95% CI
Diagnosis date registered	486	453	93.2	(91 - 95)
Notification date registered	486	249	51.2	(47 - 56)
Both dates registered	486	239	49.2	(45 - 54)
Excluded due to suspected inscription/data entry error (<-7 day or >30 day window)	486	4	0.8	(0 - 2)
Notification within 24 hours of diagnosis	482	198	41.1	(37 - 46)

Chapter 7: Malaria treatment

In the Dominican Republic, routine malaria treatment is managed by the vector control program based at the DPS. At the fact-finding visit, IHME learned that primary care facilities may stock a small amount of chloroquine and primaquine in order to administer the first dose upon diagnosis of a new malaria case, but vector control personnel see to the remaining doses, usually delivering them to the patient's home. Supervision of ingestion of all doses is the norm in most areas of the Dominican Republic in order to ensure each patient completes the radical cure. Occasionally the patient may be expected to visit a health facility in order to receive medication or follow-up malaria tests instead of receiving services through home visits, and to treat severe malaria or chloroquine-resistant *P. falciparum*, the patient may be admitted to the hospital. The survey results in the following sections align to some extent with these expectations, though they suggest substantial variation in administration and supervision practices by facilities (or at least in knowledge of standard practices by personnel in health facilities that may diagnose malaria cases infrequently).

7.1 Treatment administration practices

The health facility interview includes questions about malaria service provision (in all health facilities and DPS 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). Most primary care facilities are not involved in malaria treatment services (80%). A majority of secondary care facilities report supervising treatment at the facility (62.5%). Many DPS units report that facility personnel supervise treatment in the community, as in home visits (80%).

Table 7.1: Services provided by facilities for malaria treatment

	N	n	%	95% CI
Primary care centers: Services provided for malaria treatment				
Prescribe treatment to pharmacy at this facility	30	1	3.3	(0 - 21)
Supervise ingestion (in the facility)	30	1	3.3	(0 - 21)
Supervise ingestion (in the community)	30	1	3.3	(0 - 21)
None of the above	30	24	80	(61 - 91)
Other	30	5	16.7	(7 - 35)
Hospitals: Services provided for malaria treatment				
Prescribe treatment to pharmacy at this facility	8	1	12.5	(2 - 55)
Provide prescription to external pharmacy	8	1	12.5	(2 - 55)
Supervise ingestion (in the facility)	8	5	62.5	(28 - 88)
Supervise ingestion (in the community)	8	1	12.5	(2 - 55)
Other	8	3	37.5	(12 - 72)
Provincial Health Offices: Services provided for malaria treatment				
Prescribe treatment to pharmacy at this facility	5	1	20	(3 - 70)
Supervise ingestion (in the facility)	5	2	40	(10 - 81)
Supervise ingestion (in the community)	5	4	80	(30 - 97)

In countries nearing malaria elimination, it is important to supervise all doses of treatment to ensure the patient completes the radical cure. If the respondent reported that personnel supervise ingestion in-facility, the interviewer asked how many doses are supervised at the facility. At 100% of facilities that supervise treatment regardless of type, all doses are supervised at the facility.

Table 7.2: Doses supervised in-facility

	N	n	%	95% CI
Doses supervised in-facility				
All doses	11	11	100	(-)

All facilities that provide malaria care were asked if personnel ever administer malaria treatment before a positive test result, and only 3.4% replied that they do. Respondents reported that community personnel administer presumptive treatment in only 3.7% of facilities.

Table 7.3: 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)	29	1	3.4	(0 - 22)
Do community health workers, volunteer collaborators, or vector control personnel associated with this facility ever treat suspected malaria without waiting for a positive malaria test result? (Among all facilities excluding national lab)	54	2	3.7	(1 - 14)

7.2 Storage and stock of antimalarial medications

The health facility survey included an observation of antimalarial medications in stock on the day of the survey and of stock records for the three months prior (in all health facilities and administrative units except the national reference laboratory). First, the respondent (typically the pharmacist or pharmacy technician) was asked if the facility routinely stocks any antimalarial medications. As shown in Table 7.4, 0% of primary care facilities, 30% of secondary care facilities, and 100% of DPS units reported stock of antimalarials.

Table 7.4: Facility types reporting stock of antimalarials

	N	n	%	95% CI
Facilities reporting antimalarial stock in past 3 months				
Primary care centers	39	0	0	(-)
Hospitals	10	3	30	(10 - 63)
Provincial Health Offices	5	5	100	(-)
National Reference Laboratory	0	0		-

Next, the respondent was asked to respond whether or not the facility stocks each of a list of antimalarial medications including those shown in Table 7.5. No primary care units reported stocking antimalarials. Any drugs that were reported to be stocked were then sought for observation by survey personnel. The drug presentation was registered and the surveyor checked the expiration date to see if at least one dose of the medication was valid on the day of the survey. As seen in Table 7.6, among the three facilities reporting to stock artesunate, no doses or only expired doses were often observed of each presentation, suggesting challenges in maintaining supply or replacing expired stock. As malaria case numbers have decreased in the Dominican Republic, facilities may not use up their supply of antimalarial medications before it expires, creating new challenges to effectively manage pharmaceutical supply from provincial and central levels to avoid excess waste and ensure valid doses are accessible where new malaria cases may be diagnosed.

Table 7.5: Reported stock of antimalarials

	N	n	%	95% CI
Hospitals				
Has this facility stocked any antimalarials for at least one day over the past three months?	10	3	30	(10 - 63)
Chloroquine	3	1	33.3	(4 - 86)
Primaquine	3	1	33.3	(4 - 86)
Quinine	3	1	33.3	(4 - 86)
Provincial Health Offices				
Has this facility stocked any antimalarials for at least one day over the past three months?	5	5	100	(-)
Chloroquine	5	4	80	(30 - 97)
Primaquine	5	3	60	(19 - 90)
Artesunate	5	3	60	(19 - 90)

Table 7.6: Antimalarials observed in facility, among those reporting stock

	N	n	%	95% CI
Chloroquine tablets observed				
At least one observed and valid	5	4	80	(30 - 97)
Not observed	5	1	20	(3 - 70)
Primaquine tablets observed				
At least one observed and valid	4	4	100	(-)
Artesunate tablets observed				
At least one observed, but none valid	3	2	66.7	(14 - 96)
Not observed	3	1	33.3	(4 - 86)
Artesunate suppositories observed				
At least one observed, but none valid	3	2	66.7	(14 - 96)
Not observed	3	1	33.3	(4 - 86)
Injectable artesunate observed				
At least one observed and valid	3	2	66.7	(14 - 96)
At least one observed, but none valid	3	1	33.3	(4 - 86)

The health facility interview also asked about antimalarial medication stock and administration. Table 7.7 shows some discrepancies with Table 7.4, indicating that facility authorities may not be aware of pharmaceutical stock-outs or of changing strategies for treatment storage as malaria transmission decreases.

Table 7.7: Antimalarials medications stored, questionnaire

	N	n	%	95% CI
Questionnaire: Does this facility store medications to treat malaria?				
Primary care centers	41	1	2.4	(0 - 16)
Hospitals	10	2	20	(5 - 55)
Provincial Health Offices	6	6	100	(-)
National Reference Laboratory	0	0		-

Because most health facilities do not store medications to treat severe malaria or chloroquine-resistant malaria, the interview asked how a patient with severe or resistant malaria receives treatment (Table 7.8). Many facilities (regardless of type) informed that the treatment is delivered to this health facility by vector control or malaria program staff (29.8% of facilities).

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

	N	n	%	95% CI
If a case of severe or drug-resistant malaria is detected in this facility, how does the patient get special antimalarial medication that is not stored here?				
Treatment is delivered to this health facility by vector control or malaria program staff	57	17	29.8	(19 - 43)
Patient is referred to a location that stores medication	57	15	26.3	(16 - 40)
Treatment is delivered to the patient's home by vector control or malaria program staff	57	2	3.5	(1 - 13)
Other	57	25	43.9	(31 - 57)
Don't know	57	1	1.8	(0 - 12)

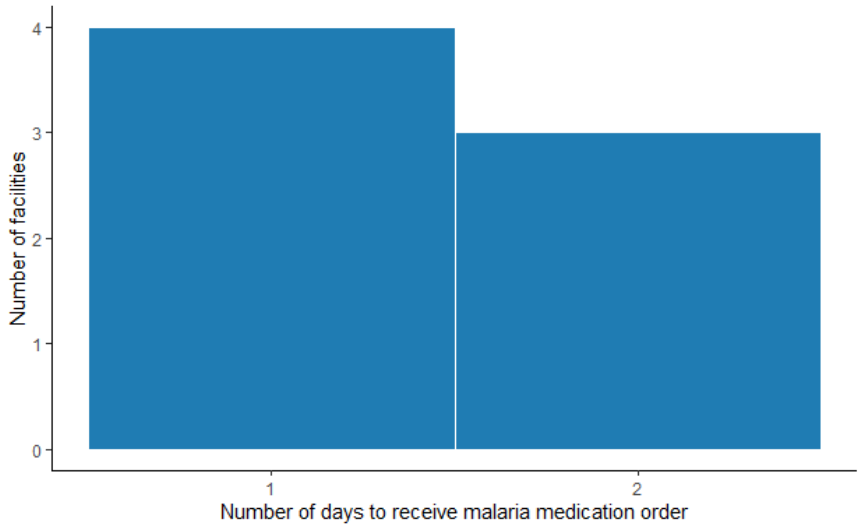
The interview also asked about how antimalarial supplies are managed. As seen in Table 7.9, 100% of secondary care facilities and 83.3% of DPS units order their own antimalarials. One DPS unit reported that the amount is determined at the central level.

Table 7.9: Determination of malaria medication needs

	N	n	%	95% CI
Hospitals: How is the quantity of malaria medication needed by this facility determined?				
The health facility determines the quantity of antimalarials required and orders it	2	2	100	(-)
The amount of each antimalarial sent to this facility is determined elsewhere	2	0	0	(-)
Provincial Health Offices: How is the quantity of malaria medication needed by this facility determined?				
The health facility determines the quantity of antimalarials required and orders it	6	5	83.3	(35 - 98)
The amount of each antimalarial sent to this facility is determined elsewhere	6	1	16.7	(2 - 65)

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 receive the expected quantities of antimalarial

medications (Table 7.10). As seen in Table 7.11, if there is a shortage, many facilities reported that it is handled by borrowing from another facility (100% of secondary care facilities that stock antimalarials).

Table 7.10: Medication order reliability

	N	n	%	95% CI
Hospitals: During the past 6 months, have you always, almost always, or almost never received the amount of each medicine that you ordered (or that you are supposed to routinely receive)?				
Always	2	2	100	(-)
Almost always	2	0	0	(-)
Provincial Health Offices: 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	6	6	100	(-)
Almost always	6	0	0	(-)

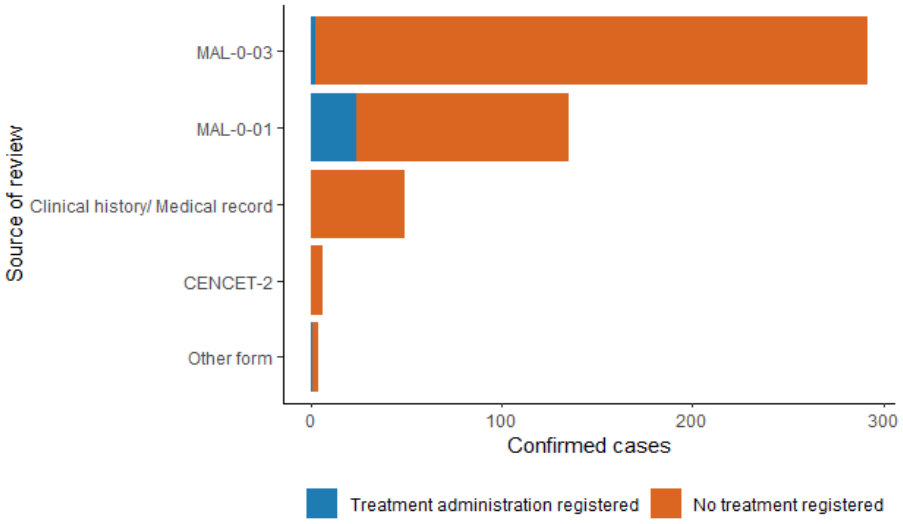
Table 7.11: Malaria medication shortages

	N	n	%	95% CI
Hospitals: If there is a shortage of a specific malaria medication between routine orders, what is the most commonly used procedure in this facility?				
Borrow from another health facility	2	2	100	(-)
Provincial Health Offices: 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	6	2	33.3	(8 - 74)
Borrow from another health facility	6	3	50	(16 - 84)
Don't know	6	1	16.7	(2 - 65)

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 attempted to capture the dates of diagnosis and of treatment initiation and completion, as well as the medications administered, dosage, and the number of doses provided. All relevant forms, including any treatment logs, were requested for review at CECOVEZ for each 2018 case and the forms reviewed for each case are shown in Figure 7.2. The case notification form most commonly observed, MAL-0-03, does not have a place to register treatment data. The active detection form, MAL-0-01 does have a space to note some treatment information but the treatment section was observed to be blank in the majority of cases where the form was available.

Figure 7.2: Confirmed cases: source of treatment information



Antimalarial treatment is prescribed according to the test result. In the Dominican Republic, first-line regimens of chloroquine and primaquine are used for both *Plasmodium vivax* malaria and *Plasmodium falciparum* malaria without chloroquine resistance (including all locally transmitted *P. falciparum* cases in Hispaniola). For imported *P. falciparum* or mixed infection cases from countries with chloroquine resistance, an artemisinin-based regimen is used. As seen in Table 7.12, 0% of *P. vivax* cases and 3.5% of *P. falciparum* cases had the correct regimen registered. Sixty-nine of the cases reviewed did not have parasite species registered on any of the forms reviewed, and thus the corresponding regimen could not be identified. These cases are not considered to have had the correct treatment regimen administered, because of the failure to register the species.

Table 7.12: Confirmed cases: Appropriate treatment by parasite species

	N	n	%	95% CI
Total cases with adequate treatment for species	486	14	2.9	(2 - 5)
P. vivax with adequate treatment for species	18	0	0	(-)
P. falciparum (non-resistant) with adequate treatment for species	399	14	3.5	(2 - 6)
Mixed cases (non-resistant) with adequate treatment for species	0	0		-
Chloroquine-resistant area P. falciparum/mixed cases treated correctly	0	0		-
Species not registered	486	69	14.2	(11 - 18)

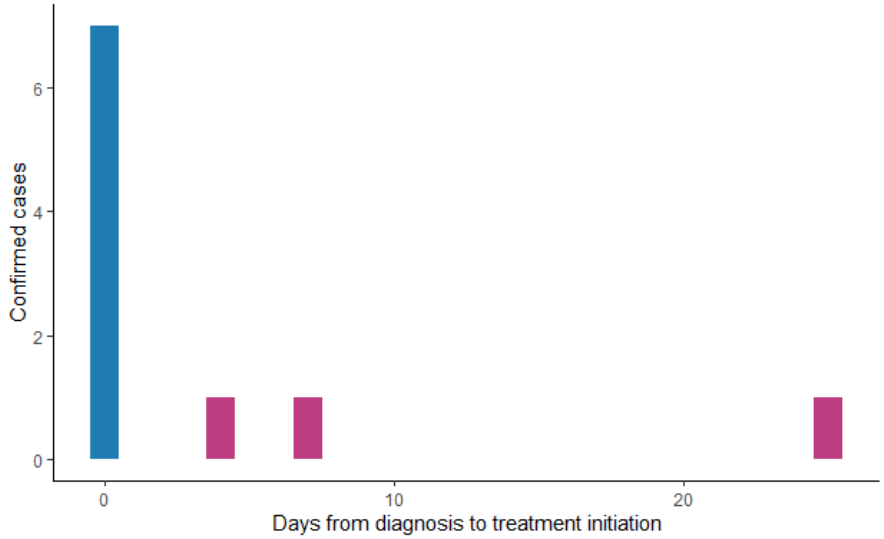
Table 7.13 shows the timing of administration of the first dose of antimalarial treatment. In only 2.3% of the cases reviewed, both diagnosis and treatment date were registered. Evidence of any antimalarial treatment within one day of diagnosis was found in 1.4% of cases reviewed.

Table 7.13: Confirmed cases: Treatment timeliness

	N	n	%	95% CI
Diagnosis date registered	486	453	93.2	(91 - 95)
Treatment start date registered	486	13	2.7	(2 - 5)
Both dates registered	486	11	2.3	(1 - 4)
Excluded due to suspected inscription/data entry error (<-7 day or >30 day window)	486	1	0.2	(0 - 1)
Any treatment within 24 hours of diagnosis	485	7	1.4	(1 - 3)

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 the Dominican Republic. 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 investigation form or in the survey module). This suspected error affected one case which is 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 7.14. Among the cases reviewed, 2.9% had the antimalarial treatment corresponding to the parasite species registered correctly on the forms. In 1.4% of the cases, the first dose of any treatment was registered as administered within one day (24 hours) of diagnosis, and in 0% of the cases, the first dose of the appropriate treatment was registered as administered within one day of diagnosis.

Table 7.14: Indicator 4.01: Timely treatment initiation

	N	n	%	95% CI
Total malaria cases (omitting 1 death on day of diagnosis)	486	486	100	(-)
Correct treatment administered for species	486	14	2.9	(2 - 5)
Diagnosis and treatment dates registered	486	11	2.3	(1 - 4)
Excluded due to suspected inscription/data entry error (<-7 day or >30 day window)	486	1	0.2	(0 - 1)
First dose treatment within 24 hours of diagnosis	485	7	1.4	(1 - 3)
Correct treatment administered within 24 hours of diagnosis	485	0	0	(-)

7.4 Confirmed cases: Adequate and complete treatment

In order to ensure radical cure with chloroquine, primaquine, or artemisinin-based treatment, patients must take medication daily for a period of 3-14 days, even though symptoms may start to subside within a few days of treatment initiation. In the Dominican Republic, 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 one day of 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 Dominican Republic malaria case notification forms (CENCET-2, MAL-0-03) and investigation form (MAL-3-01) do not include space to register the treatment type and the date treatment was started. The investigation form (MAL-3-01) includes a space for “date of last medication” but 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. The active search form (CENCET-1, MAL-0-01) has spaces for amount of chloroquine and primaquine administered, but no dates of administration nor evidence of supervision. The active search form MAL-0-01 was observed for around 25% of the cases reviewed, but most often no treatment administrations were registered on the form for the corresponding patient. There were no additional treatment logs or registers stored at CECOVEZ for 2018 malaria cases available for the record review.

Table 7.15 shows treatment completion by parasite species as registered on the notification forms observed during baseline data collection. Documentation of the number of days treatment was taken by the patient or type of drugs prescribed was not found in any of the reviewed cases, thus none of the reviewed cases had recorded evidence of adequate and complete treatment.

Table 7.15: Confirmed cases: Complete treatment by malaria species

	N	n	%	95% CI
Total cases with adequate treatment complete	486	0	0	(-)
P. vivax cases with adequate treatment complete	18	0	0	(-)
P. falciparum (non-resistant) with adequate treatment complete	399	0	0	(-)
Mixed cases (non-resistant) with adequate treatment complete	0	0		-
Chloroquine-resistant area P. falciparum/mixed cases with adequate treatment complete	0	0		-

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 the Dominican Republic, no treatment supervision forms were found with confirmed malaria case records stored at the CECOVEZ headquarters where record review was carried out. Table 7.16 shows the indicator results. None of the cases reviewed had evidence that treatment was adequate, complete, and supervised.

Table 7.16: Indicator 4.03: Complete treatment with supervision

	N	n	%	95% CI
Denominator: Total malaria cases (omitting 1 death on day of diagnosis)	486	486	100	(-)
Adequate treatment and number of doses administered	486	0	0	(-)
Evidence of at least one supervised dose	486	0	0	(-)
Indicator Result: Complete treatment with supervision	486	0	0	(-)

7.5 Patient follow-up testing

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

7.5.1 Health facility interview: Follow up testing practices

According to the health facility interview and as shown in Table 7.17, 77.4% of respondents said that malaria patients receive at least one follow-up test. Table 7.18 shows that the thick blood film sample is most frequent for follow-up testing.

Table 7.17: 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?	31	24	77.4	(59 - 89)

Table 7.18: 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	37	31	83.8	(68 - 93)
Both RDT and thick blood film: Samples are routinely taken for both tests at the same time	37	3	8.1	(3 - 23)
Only RDT used more commonly	37	1	2.7	(0 - 18)
Other	37	2	5.4	(1 - 20)

The interview also asked how many follow-up tests are routinely administered according to facility practices (Figure 7.4), and when the first and last samples are taken from the patient for follow-up testing (Figure 7.5). Primary and secondary care health facilities report conducting follow-up testing beginning one or two weeks after diagnosis. Some primary care facilities only conduct, or are only aware of, the first follow-up test within two weeks of diagnosis.

Figure 7.4: Follow-up tests administered according to facility practices

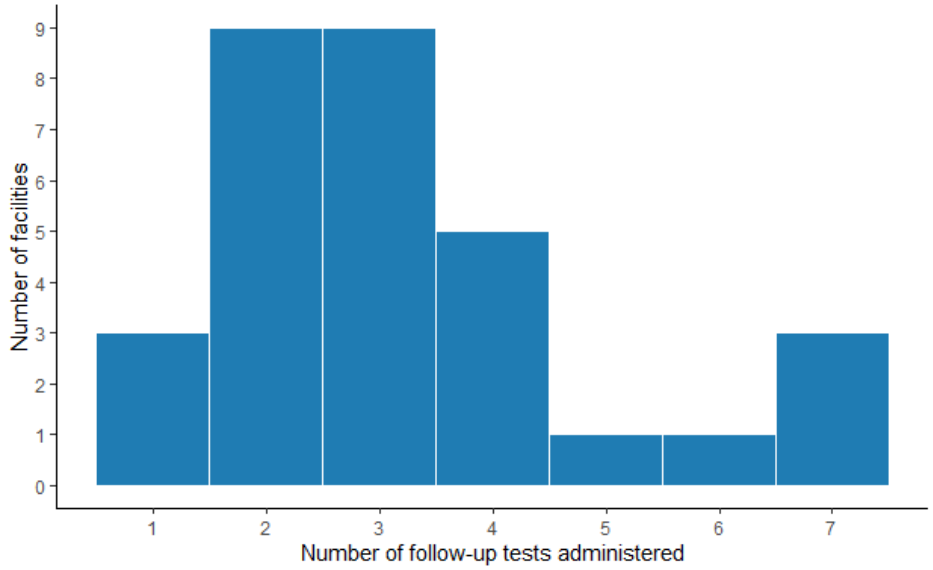
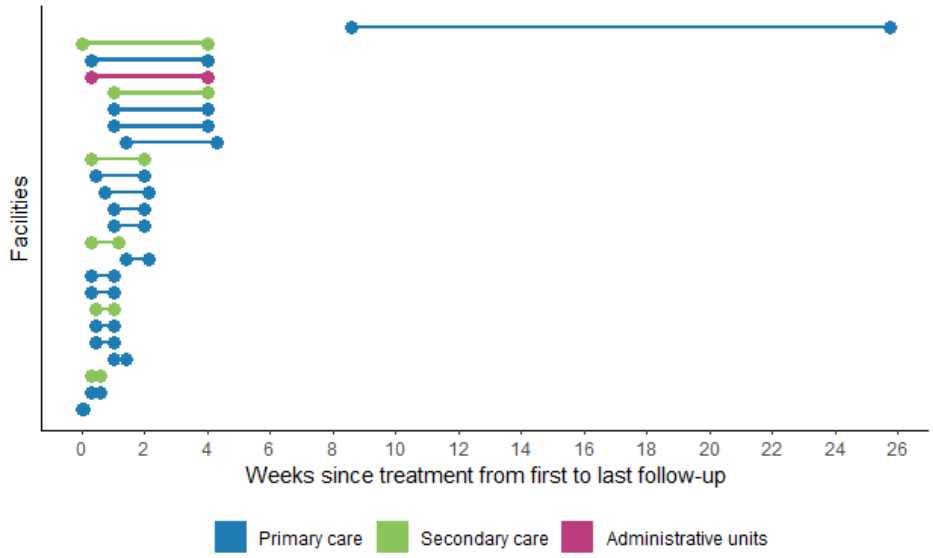


Figure 7.5: Timing from first to last follow-up test



7.5.2 Confirmed cases: Follow-up testing practices

In the Dominican Republic, follow-up tests may be tracked in the patient's medical record or according to other local practices, but the case investigation form (MAL-3-01) does not have space to track follow-up malaria testing. This investigation form is completed soon after the malaria diagnosis is made and the follow-up tests can occur weeks later. Evidence of follow-up tests was observed for only 1.6% of the confirmed cases reviewed (Table 7.19).

Table 7.19: Follow-up testing after malaria treatment: medical record review

	N	n	%	95% CI
Received at least one follow-up test for malaria?	486	8	1.6	(1 - 3)

Chapter 8: Surveillance, Notification, and Reporting

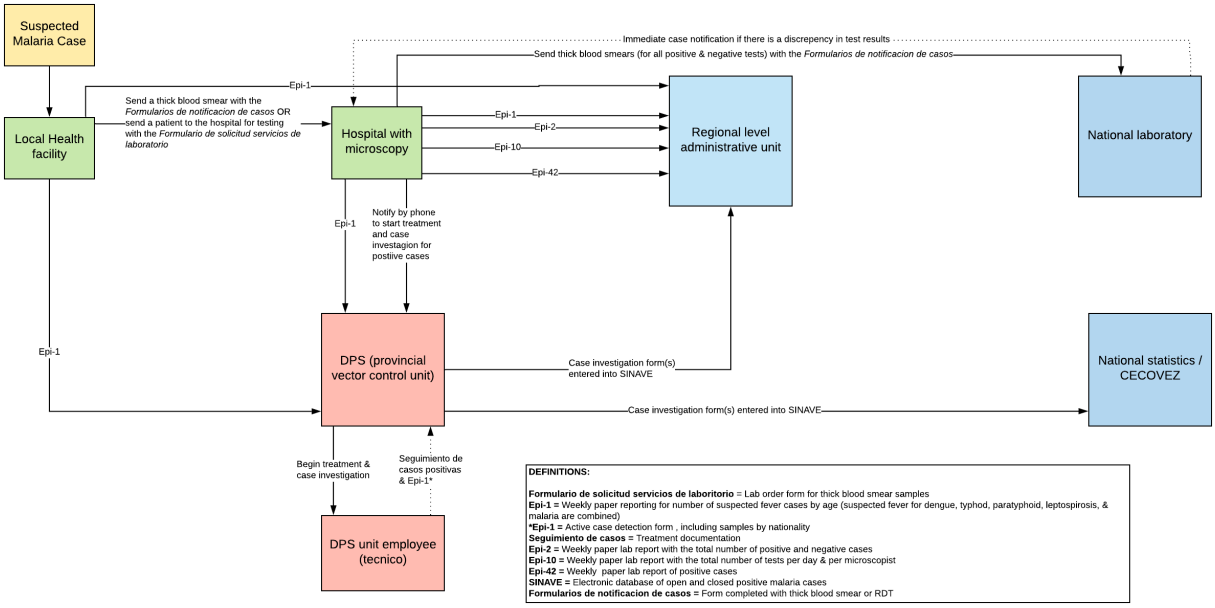
This chapter provides an overview of the malaria surveillance system in the Dominican Republic based on the fact-finding visit and health facility surveys, and summarizes results related to case reporting and laboratory reporting and quality control indicators.

8.1 Background

The fact-finding trip in June 2019 allowed for an understanding of notification and reporting flows at the local, provincial, 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 provincial and central levels to stay aware of malaria transmission activity, and the data can be used as an input for planning and directing resources where they are most needed.

Figure 8.1 shows the information flows beginning with a patient with malaria symptoms. The left side of the diagram shows sample-taking and examination practices, already discussed in Chapters 5 and 6. Once a slide has been examined, the patient must be informed of the test result. Additionally, the laboratory is obligated to inform the provincial health authorities of malaria test results. Negative results are informed in aggregate, once weekly or once monthly. Positive results are often notified immediately to relevant personnel in the vector control program (DPS unit). 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 DPS.

Figure 8.1: Dominican Republic surveillance system flow diagram



8.2 Notification of malaria test results

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

The health facility interview included questions about notification of malaria test results. As described in Chapter 5, health facilities that do not have microscopic diagnostic capacity in-facility (or have it in-facility only at certain days or hours) send thick blood film slides to a microscopy post or laboratory for initial

diagnosis. Table 8.1 and Table 8.2 show the method by which a patient is notified of a negative test result among the 10 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 60% of facilities). Among the 6 facilities where facility personnel are responsible to notify at least some patients of the test result, the notification is often in person (in 83.3% of facilities).

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

	N	n	%	95% CI
Who notifies the patient of a negative test result?				
Health personnel from this facility	10	6	60	(29 - 85)
Vector control personnel	10	4	40	(15 - 71)
Community health worker	10	1	10	(1 - 48)
Other	10	1	10	(1 - 48)

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

	N	n	%	95% CI
How is the patient notified of a negative test result? (among those notified by facility personnel)				
In person	6	5	83.3	(35 - 98)
Other	6	1	16.7	(2 - 65)

In the case of a positive test result, 15 facilities that send slides elsewhere for examination reported they receive positive test results for the slides they send. Among these facilities, 60% are sometimes or always responsible to notify the patient of the positive test result by their own personnel (Table 8.3). Among these Nine facilities, the most common modality for notification of a positive test result is in person (Table 8.4).

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

	N	n	%	95% CI
Who notifies the patient of a positive test result?				
Health personnel from this facility	15	9	60	(34 - 81)
Vector control personnel	15	7	46.7	(24 - 71)
Community health worker	15	1	6.7	(1 - 37)
Other	15	1	6.7	(1 - 37)
Don't know	15	1	6.7	(1 - 37)

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

	N	n	%	95% CI
How is the patient notified of a positive test result? (among those notified by facility personnel)				
In person	9	7	77.8	(41 - 95)
Phone call	9	2	22.2	(5 - 59)
Other	9	1	11.1	(1 - 52)

8.2.2 Notification to patient among facilities that examine slides for malaria

Other health facilities reported their own microscopic diagnosis capacity in-house. In these 12 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 66.7% of facilities (Table 8.5). In the case that a positive test result is detected in the facility, 66.7% are sometimes or always responsible to notify the patient of the positive test result by their own personnel (Table 8.6).

Table 8.5: 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	12	8	66.7	(37 - 87)
The patient is not notified	12	2	16.7	(4 - 49)
Vector control personnel	12	1	8.3	(1 - 43)
Volunteer collaborator	0	0		-
Other	12	2	16.7	(4 - 49)

Table 8.6: 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	12	8	66.7	(37 - 87)
Vector control personnel	12	2	16.7	(4 - 49)
Volunteer collaborator	0	0		-
Other	12	4	33.3	(13 - 63)

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

When a case of malaria is confirmed in the Dominican Republic, notification must be sent to health authorities. Among all facilities that either examine TBF slides or perform RDTs, 52.8% notify the provincial health authority and 41.7% notify the local vector control unit (Table 8.7). There may be overlap in the destination of notification when the vector control or surveillance units mentioned are located at the DPS.

Table 8.7: Notification to health authorities of positive test results

	N	n	%	95% CI
Who is notified when a confirmed case of malaria is detected?				
Provincial health authority	36	19	52.8	(36 - 69)
Local vector control unit	36	15	41.7	(27 - 59)
Regional health authority	36	7	19.4	(9 - 36)
Epidemiological surveillance unit	36	7	19.4	(9 - 36)
National malaria program	36	4	11.1	(4 - 27)
National laboratory	36	3	8.3	(3 - 23)
Regional laboratory	36	1	2.8	(0 - 18)
Other	36	8	22.2	(11 - 39)

8.3 Malaria surveillance data and reporting

All health facilities in the sample were asked if they have access to an electronic health information system as shown in Table 8.8. Eighty-five percent of primary care facilities, 80% of secondary care facilities, and 100% of administrative units reported access. Facilities with access to any electronic information system were asked if they have access to a system for entering information about malaria, and 83.3% of administrative units reported access to a system used for malaria information.

Table 8.8: Access to electronic information systems

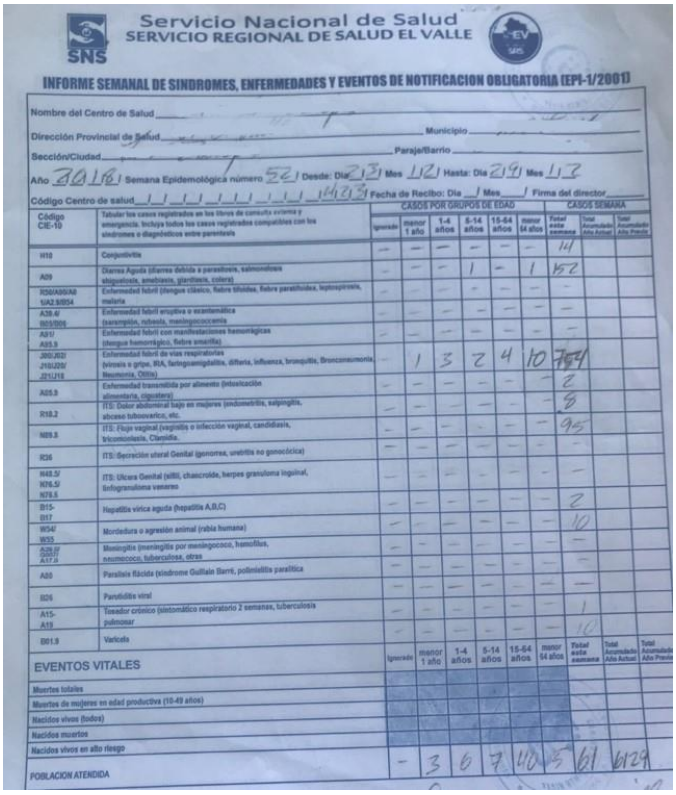
	N	n	%	95% CI
Primary care centers				
Access to an electronic health information system for capturing and/or consulting health statistics	40	34	85	(70 - 93)
Access to an electronic health information system for entering malaria-specific information	35	13	37.1	(23 - 54)
Hospitals				
Access to an electronic health information system for capturing and/or consulting health statistics	10	8	80	(45 - 95)
Access to an electronic health information system for entering malaria-specific information	7	7	100	(-)
Provincial Health Offices				
Access to an electronic health information system for capturing and/or consulting health statistics	6	6	100	(-)
Access to an electronic health information system for entering malaria-specific information	6	5	83.3	(35 - 98)
National Reference Laboratory				
Access to an electronic health information system for capturing and/or consulting health statistics	1	1	100	(-)
Access to an electronic health information system for entering malaria-specific information	1	1	100	(-)

8.3.1 Indicator 2.03: Malaria case reporting

RMEI indicator 2.03 has two parts: case reporting and laboratory reporting. According to the negotiated definition for case reporting in the RMEI indicator manual, health units in the Dominican Republic that conduct malaria diagnosis (by RDT or microscopy) must send weekly reports to the DPS that include the aggregate number of malaria cases detected during the week, or a notification that zero malaria cases were detected. There is no required time window for the report to be sent or received in the Dominican Republic, but the report should include the date sent. 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. However, a limitation of the standard format used for general notification reports in the Dominican Republic (Epi-1 form as shown in Figure 8.2) is that it does not disaggregate malaria from other febrile illnesses such as dengue, typhoid, and leptospirosis. If cases of any of these diseases are diagnosed, a case count will appear on the report, but it is impossible to distinguish how many of the positive cases (if any) were malaria and not some other febrile disease. Based on the fact-finding visit, we expected to find the MAL-4-02 aggregate case report form specific to malaria cases. However, this form was infrequently observed during the survey. Thus, even when case reports were observed during data collection, they generally did not meet the quality standards established.

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 8.9. One unit specified that its “other” response referred to the *Casos positivos de malaria por semana EPI año 2018* report. The destination of the reports is shown in Table 8.10, and respondents could indicate more than one destination.

Figure 8.2: Epi-1 blank form



Servicio Nacional de Salud
SERVICIO REGIONAL DE SALUD EL VALLE

INFORME SEMANAL DE SINDROMES, ENFERMEDADES Y EVENTOS DE NOTIFICACION OBLIGATORIA (EPI-1/2001)

Nombre del Centro de Salud
Dirección Provincial de Salud — Municipio
Sección/Ciudad — Paraje/Barrio
Año 2018 / Semana Epidemiológica número 52 / Desde: Día 23 Mes 12 / Hasta: Día 29 Mes 12
Código Centro de salud 1403 / Fecha de Recibo: Día __ / Mes __ / Firma del director

Código CIE-10	Tabular los casos registrados en los libros de consulta externa y emergencia. Incluya todos los casos registrados compatibles con los síndromes o diagnósticos entre paréntesis	CASOS POR GRUPOS DE EDAD						CASOS SEMANA		
		Ignorado	menor 1 año	1-4 años	5-14 años	15-64 años	mayor 64 años	Total esta semana	Total Acumulado Año Actual	Total Acumulado Año Previo
H10	Conjuntivitis	–	–	–	–	–	–	11		
A09	Diarrea Aguda (diarrea debida a parasitosis, salmonelosis shigatosis, amebiasis, giardiosis, colera)	–	–	–	1	–	1	52		
R50/A93/A9 1/A2.8/B54	Enfermedad febril (dengue clásico, fiebre tifoidea, fiebre paratifoidea, leptospirosis, malaria	–	–	–	–	–	–	–		
A39.4/ B03/B06	Enfermedad febril eruptiva o exantemática (meningococcemia, rubeola,	–	–	–	–	–	–	–		
A91/ A95.9	Enfermedad febril con manifestaciones hemorragicas (dengue hemorrágico, fiebre amarilla)	–	–	–	–	–	–	–		
J00,J02/ J10,J20/ J11,J18	Enfermedad febril de vias respiratorias (sinusis o gripe, IRA, faringoamigdalitis, difteria, influenza, bronquitis, Bronconeumonia, Neumonia, Otitis)	–	1	3	2	4	10	764		
A05.9	Enfermedad transmitida por alimento (intoxicación alimentaria, cigoatera)	–	–	–	–	–	–	2		
R10.2	ITS: Dolor abdominal bajo en mujeres (endometritis, salpingitis, absceso tuboovarico, etc.	–	–	–	–	–	–	8		
N89.8	ITS: Flujo vaginal (vaginitis o infección vaginal, candidiasis, tricomoniasis, Clamidia.	–	–	–	–	–	–	95		
R36	ITS: Secreción uteral Genital (gonorrea, uretritis no gonocócica)	–	–	–	–	–	–	–		
H40.5/ N76.5/ N76.6	ITS: Ulcera Genital (sífili, chancroide, herpes granuloma inguinal, linfogranuloma venereo	–	–	–	–	–	–	–		
B15-B17	Hepatitis vírica aguda (hepatitis A,B,C)	–	–	–	–	–	–	2		
W54/ W55	Mordedura o agresión animal (rabia humana)	–	–	–	–	–	–	10		
A39.0/ G00.0/ A17.0	Meningitis (meningitis por meningococo, hemofilus, neumococo, tuberculosa, otras	–	–	–	–	–	–	–		
A80	Parálisis flácida (síndrome Guillain Barré, poliomielitis paralítica	–	–	–	–	–	–	–		
B26	Parotiditis viral	–	–	–	–	–	–	–		
A15-A19	Toseador crónico (sintomático respiratorio 2 semanas, tuberculosis pulmonar	–	–	–	–	–	–	1		
B01.9	Varicela	–	–	–	–	–	–	16		
EVENTOS VITALES		Ignorado	menor 1 año	1-4 años	5-14 años	15-64 años	mayor 64 años	Total esta semana	Total Acumulado Año Actual	Total Acumulado Año Previo
Muertes totales										
Muertes de mujeres en edad productiva (10-49 años)										
Nacidos vivos (todos)										
Nacidos muertos										
Nacidos vivos en alto riesgo										
POBLACION ATENDIDA		–	3	6	7	40	5	61	6129	

Table 8.9: Format of case notification reports observed

	N	n	%	95% CI
Format of case reports observed				
Epi-1	31	26	83.9	(66 - 93)
Epi-2	31	1	3.2	(0 - 21)
Epi-42	31	1	3.2	(0 - 21)
Other	31	4	12.9	(5 - 30)

Table 8.10: Destination of case notification reports observed

	N	n	%	95% CI
Where are case reports sent?				
Associated DPS unit	24	18	75	(54 - 89)
SINAVE	24	3	12.5	(4 - 33)
CECOVEZ	24	2	8.3	(2 - 29)
Gerencia de área	24	2	8.3	(2 - 29)
Other	24	2	8.3	(2 - 29)

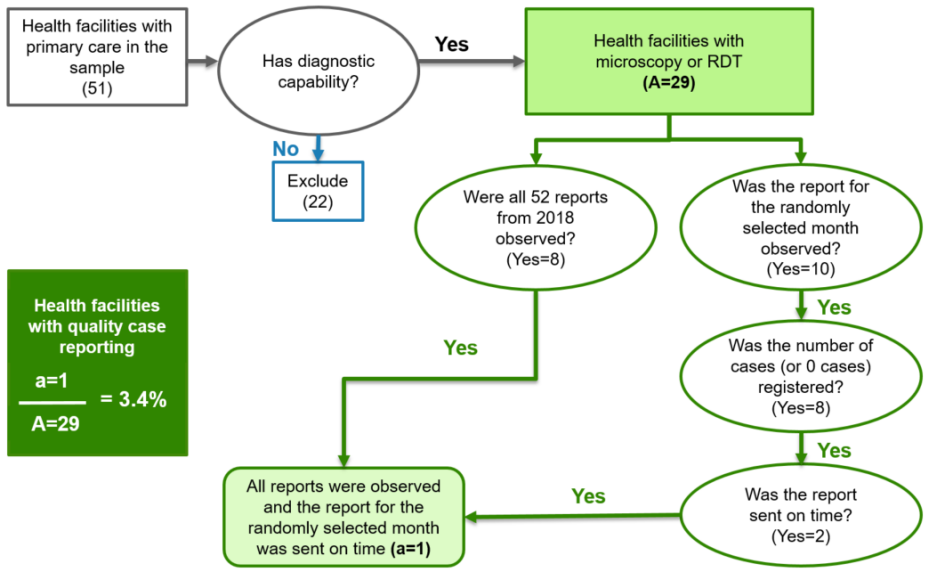
Field personnel conducted an audit of all malaria case reports from 2018 stored at primary and secondary level facilities in the sample. They began by discerning whether the facility prepared monthly or weekly reports during 2018. They then sought to observe all 12 monthly reports or all 52 weekly reports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

the date sent or received as listed on the report (or as listed in a logbook of official correspondence sent and received, in facilities that use such a book). Health facility eligibility and completion of indicator according to a decision algorithm is shown in Figure 8.3.

Table 8.11 shows the results of the case reporting component of the indicator, which requires the following:

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

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



29 facilities that provide attention to patients are eligible for consideration in the indicator. The results are shown in Table 8.11 and 1 unit met all the requirements of the indicator.

Table 8.11: Indicator 2.03: Case reporting

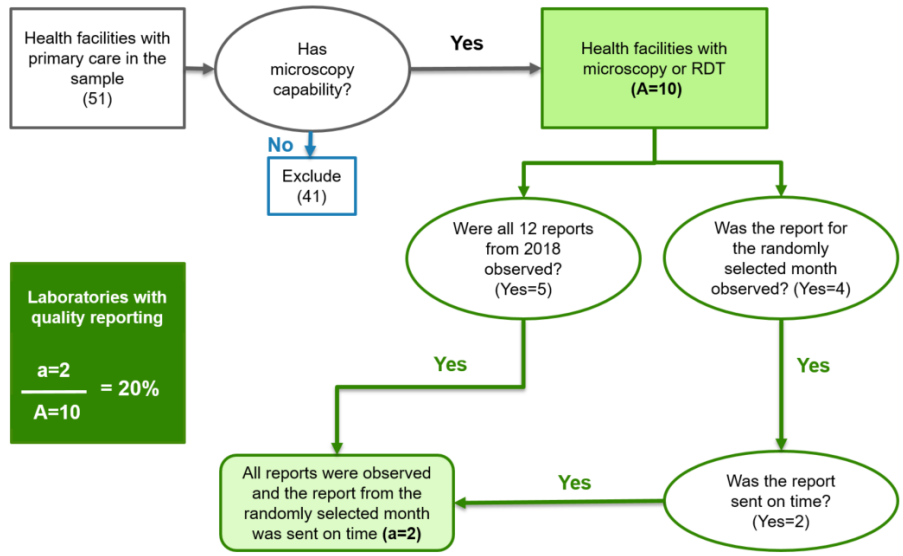
	N	n	%	95% CI
Units with diagnostic capacity	29	29	100	(-)
Units indicating reporting of malaria cases	29	28	96.6	(78 - 100)
At least one weekly report from 2018 observed	29	13	44.8	(28 - 63)
All 52 weekly reports from 2018 observed	29	8	27.6	(14 - 47)
Four weekly reports for randomly selected month observed	29	9	31	(17 - 50)
Number of cases (or zero) recorded for all reports of randomly selected month	29	7	24.1	(12 - 43)
Dates for reports of randomly selected month observed	29	2	6.9	(2 - 25)
Dates for reports of randomly selected month are valid	29	2	6.9	(2 - 25)
Result: Malaria case reporting to standard	29	1	3.4	(0 - 22)

8.3.2 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 associated DPS unit. Health facility eligibility and completion of indicator according to a decision algorithm is shown in Figure 8.4. The observation of the laboratory reports during the survey was conducted in the same way as the case reports. The indicator required:

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

Figure 8.4: Eligibility of health facilities for Indicator 2.03 (laboratory reporting)



10 facilities that provide attention to patients are eligible for consideration in the indicator. The results are shown in Table 8.12. Laboratory reporting by malaria stratum is shown in Table 8.13.

Table 8.12: Indicator 2.03: Lab reporting

	N	n	%	95% CI
Indicator: Attention units				
Relevant units	51	51	100	(-)
Excluded due to survey error	51	19	37.3	(25 - 52)
Units with diagnostic capacity	32	10	31.3	(17 - 50)
At least one weekly or monthly report from 2018 observed	10	6	60	(29 - 85)
All 52 or 12 montly reports from 2018 observed	10	5	50	(22 - 78)
Report(s) for randomly selected month observed	10	4	40	(15 - 71)
Date(s) for report(s) of randomly selected month observed	10	2	20	(5 - 55)
Date(s) for report(s) of randomly selected month are valid[1]	10	2	20	(5 - 55)
Result: Malaria case reporting to standard[1]	10	2	20	(5 - 55)

[1]No specific date limit set for validity

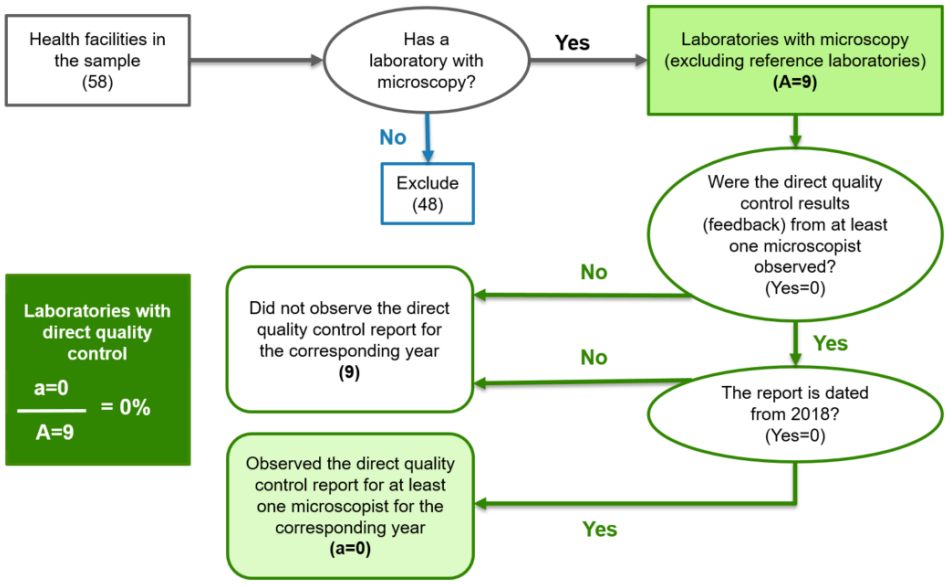
8.4 Indicator 3.02: Laboratory quality control

The RMEI indicators also require participation of the national reference laboratory for malaria in an external quality control certification with the Pan-American Health Organization, which was observed at the Dominican Republic 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, nine laboratories at the primary and secondary levels are eligible for the indicator. The evidence from the measurement suggests that quality control programs were not universally implemented in 2018, and where they were taking place, that the documentation filed was not sufficient to meet the standards of the indicator.

The first exercise, direct quality control, is a yearly slide panel exam administered by the reference laboratory in which the evaluated microscopist must examine several slides (for which the results are known by the reference laboratory) and submit the test result of each with parasite density and species. The reference laboratory then checks the results submitted and provides feedback to the evaluated microscopist. According to Table 8.14, complete evidence of participation in direct quality control was not observed at any local laboratories. The evidence required was a report of the results of the 2018 exam received back from the reference laboratory with feedback. Health facility eligibility was determined according to a decision algorithm shown in Figure 8.5.

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

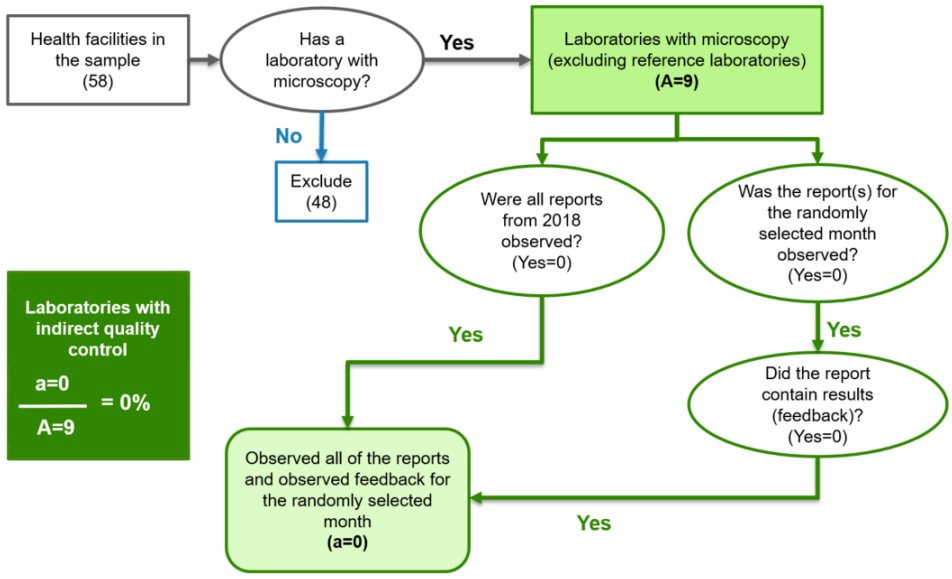


The second exercise, indirect quality control, is a cross-check of a set proportion of the slides initially diagnosed by each local laboratory by a senior microscopist. In the Dominican Republic, local laboratories must send 10% of the slides with a negative test result for malaria and 100% of the slides with a positive test result to the national lab for cross-checking each month. The selection method for the 10% of negative slides may vary locally. Health facility eligibility was determined according to a decision algorithm shown in Figure 8.6. While nine local laboratories reported participating in direct quality control, none met the standards of the indicator based on the reporting observation. The evidence required was:

- that all 52 reports (or written evidence that no slides were examined in a given week without a report) be observed for the year 2018 for reports in a weekly format OR
- that all 12 reports be observed for the year 2018 for reports in a monthly format AND

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

Figure 8.6: Eligibility of health facilities for Indicator 3.02 (indirect)



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

Table 8.14: Indicator 3.02: Quality control

	N	n	%	95% CI
External quality control: 2018 National Lab Evaluation form observed	1	1	100	(-)
Direct	9	0	0	(-)
Indirect	9	0	0	(-)

Table 8.15: Indicator 3.02: Indirect and direct quality control

	N	n	%	95% CI
Facilities with microscopy (excluding national lab)	59	9	15.3	(8 - 27)
Facilities passing direct quality control (DQC) component	9	0	0	(-)
Facilities that report participating in DQC	9	1	11.1	(1 - 52)
Feedback for at least one assessment in 2018 was observed	9	0	0	(-)
Feedback report with results was dated 2018	9	0	0	(-)
Facilities passing indirect quality control (IDQC) component	9	0	0	(-)
Facilities that report participating in IDQC	9	4	44.4	(17 - 76)
Randomly selected month report was observed	9	0	0	(-)
Cross-checked results and feedback were observed on randomly selected report	9	0	0	(-)
All reports observed for 2018	9	0	0	(-)
Facilities passing both direct and indirect quality control	9	0	0	(-)
At least one report was observed for 2018	9	0	0	(-)

Chapter 9: Challenges, Conclusions, and Recommendations

9.1 Challenges and limitations

9.1.1 Challenges for health facility data collection

In the Dominican Republic, field personnel could not always gain access easily to survey in health facilities, despite prior authorization obtained from the Ministry of Public Health and Social Assistance and SNS. Data collection was refused by the person in charge at four primary care facilities and one hospital. Interviewers were able to conduct revisits within the span of a few days if key personnel were not available at the initial visit or were unavailable to attend them, but in some facilities, access barriers persisted after multiple visits. Once consent was obtained, facility staff were usually collaborative, but sometimes staff present at the time of the visit were not able to find records of past stock or reporting files, especially in facilities with recent turnover.

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 lab inputs.

9.1.2 Challenges for suspected case review

The review of suspected malaria cases encountered challenges at every step of the process in the Dominican Republic. First, it was often difficult to obtain the consent of the facility director to conduct the review, even though no identifiable patient information was collected. Second, in some facilities, no registries were available to select the sample of eligible cases (4 facilities), medical records and registries had been destroyed since 2018 after changes to the catchment area or remodeling (3 facilities), or medical records are not routinely opened for fever attentions (3 facilities) or for foreign nationals.

Third, when records did exist, often the total number of eligible attentions during the year 2018 was less than the quota of reviews. The quota was met in only five health facilities, and in 18 facilities there were no eligible records available for review at all. Fourth, when a sample could be selected based on the registry, interviewers together with facility staff were often unable to find records for selected attentions because of the *ficha familiar* filing system (10 facilities), whereby medical records are filed according to the name of the head of the family (which is not recorded on the attention registry) rather than the name of the patient (which is recorded on the attention registry, but often does not match the name on the record). Furthermore, three facilities refused the medical record review portion of the survey.

When records could be found and reviewed, often little information was registered about fever attentions, and in certain cases, selected records were completely empty with no visits registered at all.

9.1.3 Challenges for confirmed case review

In the Dominican Republic, review of confirmed malaria cases was planned for the DPS units based on expectations from the fact-finding visit, but data collectors found that records of malaria from 2018 were not stored in the provinces but rather at CECOVEZ in Santo Domingo. Thus, all 486 case reviews were conducted at CECOVEZ, relying on the records archived there which usually lacked any information about case investigation and treatment.

For most cases, interviewers found malaria case notification forms (MAL-0-03) and some active search forms (MAL-0-01). The case investigation form (MAL-3-01) was almost never available at CECOVEZ. These forms often lacked crucial information to measure the confirmed case indicators, such as the species of the parasite, date of treatment initiation, and course of treatment including which medications and how many doses were administered and supervised. From the fact-finding visit, we anticipated some of these obstacles to measurement, but expected to find somewhat more complete records based on recent example cases that had been viewed at DPS offices.

9.1.4 Challenges for case and lab reporting review

The weekly malaria case reporting form (MAL-4-02) was not observed for 2018 in most facilities, and the frequently observed nationally standard form for aggregate weekly reporting of cases of notifiable diseases does not include malaria as a separate line item, but rather groups it with other febrile illnesses such as dengue, typhoid, and leptospirosis. Thus, when cases of any of these illnesses are detected, it is impossible to discern from the general notification report how many of them were malaria cases. Notification of zero cases is not required as a part of the form. Case and lab reporting formats do not typically include the date sent or received, complicating the attempt to evaluate timeliness of submission.

Laboratory quality control programs appear not to have been universally implemented during 2018 (and where they took place, records of participation were either not kept or not sufficient to meet the standards of the indicator). Additionally, field personnel were sometimes unable to observe the forms from the year 2018 when facility personnel were unable to find the files. This was a particular problem where there had been changes in lab or statistics personnel since 2018.

9.1.5 Challenges for household data collection

Household data collection in the Dominican Republic encountered some logistical challenges. The vector control intervention information received from the Ministry of Public Health and Social Assistance could not be linked to the facilities in the service network based on location, so communities for the household survey had to be selected in the field using an automated module at each health facility. Supplemental information on interventions during 2018 was requested at the DPS units visited during the survey, but was not available for surveyors to use for the field selection. The majority of primary care facilities lacked information about the population of the catchment area and vector control interventions that had been carried out there. Even communities where vector control was reported did not have much evidence of interventions having been carried out once households were visited. One community was substituted with one associated with a different health facility in the sample because of security concerns. Some households refused the survey, which is typical in urban areas. 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 observed in only about half of the households that reported spraying.

9.2 Key findings and recommendations

Migration to electronic information systems must take into account the effectiveness of current paper-based practices, and must consider timelines that ensure updated information is recorded in the electronic system but also on the paper forms that are archived. Forms should be reviewed in order to ensure essential information is captured, but more importantly, the pipeline from recording on paper in the field to the final electronic database should be reviewed and improved to ensure the highest data quality, in particular as regards the information captured after malaria diagnosis that requires updates after initial notification (treatment administration and supervision and follow-up parasitological tests). The emphasis must be on ensuring complete and precise data at the lowest levels of information (not only within the electronic surveillance system), and in enabling effective data storage, processing, quality control, and analysis for decision-making at the provincial and central levels.

Because malaria and other infectious disease programs have been managed for decades as parallel, vertically integrated systems by the Ministry of Public Health and Social Assistance, while health care services are provided by the SNS, 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 within the SNS, and there are gaps in current procedures regarding aggregate notification of confirmed malaria cases. To reach malaria elimination, stakeholders will have to work to bridge gaps and reduce fragmentation in service provision.

Among primary care facilities at the local level, there is a notable variation in practices, such as in recordkeeping for ambulatory attentions and in who is responsible for taking blood samples for malaria tests (sample is taken by facility staff, vector control personnel is called to take the sample on demand, or the patient is referred to a facility with a laboratory). Sometimes a lack of understanding of central-level operations and goals, which may not be translated effectively from the Ministry of Public Health and Social Assistance to the SNS, is also evident. It is crucial to reach a shared understanding of how each part of the system connects with the others in order to reach success in malaria elimination and other projects in the Mesoamerican region.

Appendix A: Indicator Matrices

A.1 Performance indicator matrix

#	Indicator	N	%	CI
P2.02	Fever cases with blood sample	24	37.5	(24 - 54)
P2.03	Case reporting with quality	29	3.4	(0 - 22)
	Lab production reporting	10	20	(5 - 55)
P3.02	Quality control (external)	1	100	(-)
	Quality control (direct)	9	0	(-)
	Quality control (indirect)	9	0	(-)
P4.02	Diagnosis within 48 hours	448	9.2	(7 - 12)
P4.01	Treatment within 24 hours	485	0	(-)
P4.03	Treatment complete and supervised	486	0	(-)
P6.01	Vector control coverage	226	6.2	(3 - 11)
P7.01	Equipment and instruments for diagnosis and treatment	58	6.9	(3 - 17)

A.2 Monitoring indicator matrix

#	Indicator	N	%	CI
M2.01	Suspected cases with malaria test (MRR)	460	2.8	(2 - 5)
E2.04	Notified within 24 hours of detection	482	41.1	(37 - 46)
E3.03	Equipment and instruments for sampling, diagnosis and RDTs	58	19	(11 - 32)
E4.05	Health facilities without stockouts of first-line treatments	46	4.3	(1 - 16)
E6.03	Population protected by IRS	2490	7.3	(6 - 8)
E6.05	Population protected by ITNs	2570	1.8	(1 - 2)

#	Indicator	N	Median	CI
E4.03	Median time between onset of symptoms and start of treatment (days): passive surveillance	318	2	(-)
	Median time between onset of symptoms and start of treatment (days): active surveillance	154	8	(-)
	Median time between onset of symptoms and start of treatment (days): surveillance type not registered	14	0	(-)

Appendix B: Indicator Definitions

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

P2.01: Suspected malaria cases with parasitological test

Source: Medical record review of suspected cases of malaria

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

Sampling by ICD code - diagnoses eligible for review

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

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

Sampling by presumptive or final diagnosis - diagnoses eligible for review

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

Sampling by principal complaint - motives eligible for review

- Fever
- Malaria
- Dengue
- Chikungunya

Numerator: Cases with evidence a malaria test was ordered

Exclusions:

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

- Diagnoses ineligible without a documented fever:

All health facilities:

Sampling by ICD code

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

Sampling by presumptive or final diagnosis

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

Only health facilities in stratum 3:

Sampling by ICD code

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

Sampling by presumptive or final diagnosis

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

P2.02: Fever cases with blood sample

Source: Household survey

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

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

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

P2.03a: Malaria case reports with quality standards

Source: Health facility observation

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

Numerator: Health facilities with weekly epidemiological surveillance reports observed

1. Reports list the aggregate number of malaria cases or report of zero cases
2. Reports observed for all 52 weeks of the year 2018
3. Reports in randomly selected month list sending date

Exclusions: Municipal and regional health units, national reference laboratory

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

Source: Health facility observation

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

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

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

Exclusions: Municipal and regional health 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 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 microscopic diagnostic capacity

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

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

Exclusions: National reference laboratory

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

Source: Medical record review of confirmed cases of malaria

Denominator: Number of confirmed malaria cases reviewed

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

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

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

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

Source: Medical record review of confirmed cases of malaria

Denominator: Number of confirmed malaria cases reviewed

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

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

P4.03: Malaria cases with complete and supervised treatment

Source: Medical record review of confirmed cases of malaria

Denominator: Number of confirmed malaria cases reviewed

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

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

2. For *P. falciparum* cases without documented resistance to chloroquine: 3 days of chloroquine and one day of primaquine

3. For mixed infections cases without documented resistance to chloroquine: 3 days of chloroquine and 7 or 14 days of primaquine

4. For imported *P. falciparum* cases from areas with documented resistance to chloroquine: 3 days of artemisinin-based treatment (artemether + lumefantrine) and one day of primaquine

5. For mixed infection cases with *P. falciparum* cases from areas with documented resistance to chloroquine: 3 days of artemisinin-based treatment (artemether + lumefantrine) and 7 or 14 days of primaquine

6. For severe malaria cases: If IV treatment with artesunate started, when completed: 3 days of artemisinin-based treatment (artemether + lumefantrine) and one pay of primaquine (according to national norm)

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)

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

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

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

Source: Health facility observation

Denominator: Points of care and laboratories

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

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

1. Stratum 4 Unidad de atención primaria de salud, Centro clínico y diagnóstico, Policlínico, Centro del primer nivel de atención, and Hospitals.
2. All DPS units

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

1. All Unidad de atención primaria de salud, Centro clínico y diagnóstico, Policlínico, Centro del primer nivel de atención, Hospitals, and DPS units.

Forms for sending slide samples

1. All Unidad de atención primaria de salud, Centro clínico y diagnóstico, Policlínico, Centro del primer nivel de atención, Hospitals, and DPS units.

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

1. All Unidad de atención primaria de salud, Centro clínico y diagnóstico, Policlínico, Centro del primer nivel de atención, Hospitals, and DPS units.

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

1. All health facilities that reported microscopic diagnostic capacity, including 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

1. All health facilities that reported microscopic diagnostic capacity, including national lab

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

1. All health facilities that reported microscopic diagnostic capacity, including national lab

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

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

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

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

Forms for sending slide samples

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

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

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

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

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

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

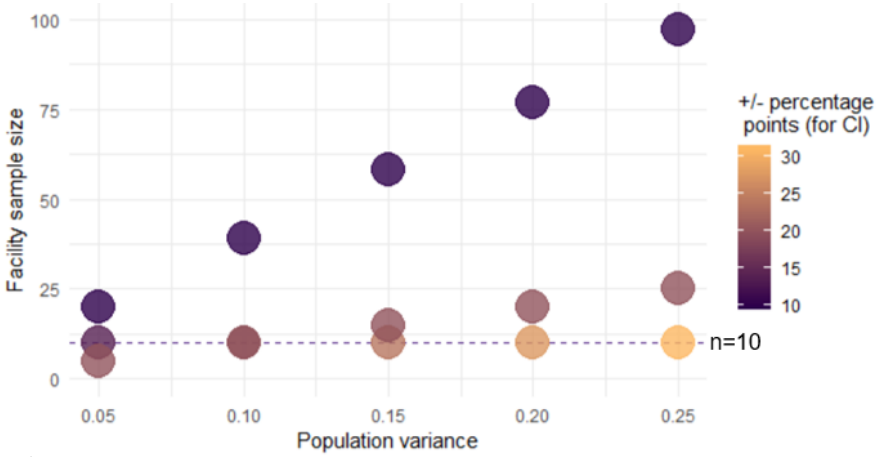


Figure 1. Facility sample sizes and corresponding margins of error across different levels of population variance. Potentially acceptable margins of error range from +/-10 ppts (ideal) to +/-30 ppts (considered high) on either side of the point estimate.

C.2 Sample selection procedures

C.2.1 Selecting health facilities

We prepared the sampling frame of facilities eligible for random selection by identifying all primary care facilities (*"unidad de atención primaria de salud," "centro clínico y diagnóstico," "policlínico"* and *"centro de primer nivel de atención"*) in municipalities in malaria strata 3 and 4 based on referral networks and facility lists provided by the Dominican Republic Ministry of Public Health and Social Assistance. Eligible facilities were listed according to whether or not they provide malaria diagnosis by microscopy. Because Ministry of Public Health and Social Assistance-provided lists of vector control activities (IRS or ITN distribution) carried out were insufficiently geographically precise to match to health facilities for creation of the sampling frame, facilities were instead listed according to presence of autochthonous malaria cases in their catchment area during 2018, as matched from locality-level surveillance data that the Ministry of Public Health and Social Assistance provided to IHME. Primary care facilities were sorted by a random variable and a sample was drawn in four strata: inside and outside the Santo Domingo metropolitan area without microscopy capacity in malaria stratum 4, with microscopy capacity nationwide in malaria stratum 4, and nationwide in malaria stratum 3, regardless of microscopy capacity.

Facilities with autochthonous 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. Two additional facilities per municipality were selected and added, in random order, to an alternate sample to be used in the case a selected facility could not be surveyed and required substitution.

Next, we built a list of the eligible DPS units and referral hospitals according to the referral network, including each municipality with primary care units already selected to the sample. The DPS units of provinces with autochthonous cases during 2018 were selected with certainty for the survey. The sampling frame of hospitals was sorted by a random variable and the first facilities in the list selected up to a fixed sample size. The remaining hospitals 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 DPS unit to the maximum stratum found in its service area (regions with any municipalities in stratum 4 are therefore assigned to stratum 4). The national reference laboratory for malaria was selected with certainty.

C.2.2 Selecting suspected cases of malaria

The data collection team was responsible for compiling and reviewing the full random sample of medical records at each facility. The sample may be selected in one of three ways, depending on the resources of the facility and the type of registries maintained. First, where the facility keeps a list or registry of all fever attentions, this list can serve as the sampling frame. Second, where there is access to a coded digital database of attentions or diagnoses, the sampling frame is extracted based on a list of eligible codes as seen in Appendix B, Indicator 2.01. If there is no fever list nor electronic database, the sample is selected from daily registries or logbooks of all types of attentions, identifying the eligible complaints or diagnoses in the process. In the Dominican Republic the quota for suspected case review was met in only 5 out of 51 facilities. In 18 facilities, 0 files could be reviewed. Among these 18, three facilities refused to allow the field team access to the patient records citing patient confidentiality, despite prior authorization from Ministry of Public Health and Social Assistance to review records. Another five no longer stored the records or logbooks from 2018 or could not access them due to accidental damage, relocation, or other logistical reasons. In 10 additional facilities, records sampled could not be found in the archives because they are stored under the name of the patient but rather under the name of the first family member to visit the facility (*"fichas familiares*) or because records are not opened for fever cases.

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. If the number of eligible cases available during the year 2018 was less than the quota, all eligible cases were reviewed. Personnel made a list of selected records to search out and review, but identifiable patient information was never entered to the survey modules.

C.2.3 Selecting communities

At each selected primary care facility in malaria stratum 4, the field supervisor asked for information about the facility's catchment area, including the number of communities served, name and population of each community, and recent vector control activity in each community (IRS or distribution of ITN). In the Dominican Republic, this information was often unavailable or incomplete at the health facility. 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 (ITN distribution or IRS), a community was selected at random among those with interventions. If no communities received interventions or the intervention status of all communities was unknown, a community in the catchment area was selected at random. A second community from the catchment area was selected as a backup in the event that the first community could not be surveyed due to security concerns, logistical challenges, or community refusal of the study.

C.2.4 Selecting households

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

Field staff selected the sample of households using systematic manual sampling techniques with the dwelling as the unit of random selection. 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. If catchment area population information available at the health facility was insufficient to calculate the skip interval for manual sampling, the field team estimated the number of dwellings in the community upon arrival and calculated the skip interval accordingly.

The field team started at the recognized center of the community (such as a plaza, church, or market) and began sample selection in the random direction provided by the sampling module, counting dwellings first to the random start point and subsequently according to the skip interval, along the right hand side of the street. Each selected household was approached to explain the study and request participation. Upon reaching a dead end or reaching the border of the community, field workers made a turn to the right (or turned around) and continued the systematic selection along the right hand side. If a selected dwelling contained more than one household, each of those households was eligible for the survey and counted toward the quota of 25 households per community. If a selected household could not be interviewed due to absence or refusal, it was replaced with the household in the dwelling next door on the right side.

Informed consent was sought from each respondent to the household questionnaire. Occasionally, a survey was refused in course, resulting in a partially complete household result. Because multiple interviewers worked the sample simultaneously, in a handful of instances more than 25 surveys were completed. In the baseline, counts of complete households by community range from 25 to 26 households. Counts of absent households range from 0 to 16 households. Counts of refused households range from 0 to 13 households.

C.3 Sampling weights for the household survey

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

Where

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

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

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

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

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

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

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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, MSPH
Data Analyst, IHME

Emily Linebarger, BA
Data Analyst, IHME

Erin Palmisano, MPH
Senior Research Manager, IHME

Max Thom, BS
Data Specialist, IHME

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