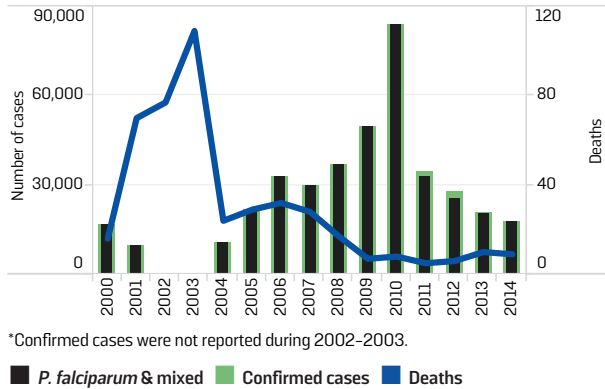


HAITI

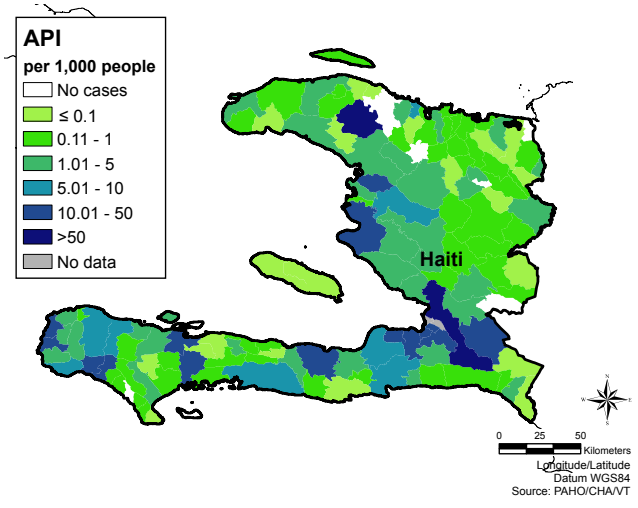
Haiti has the highest number of malaria cases among the Caribbean Islands and Central American countries (17,696 in 2014). Inadequate coverage of surveillance in previous years preempts assessing progress of the country towards meeting its RBM and WHA 58.2 goals for MDG 6C (Figures 1 and 2).

Figure 2. Number of cases and deaths due to malaria in Haiti, 2000–2014



After the 2010 earthquake, malaria increased dramatically, though it is difficult to assess the validity of data collected during this period. Data collected from years prior to the earthquake were of poor quality, and that from 2010 may include people tested more than once due to the chaotic atmosphere following the disaster. There were 9 malaria-related deaths reported in 2014, though considerable under-reporting

Figure 1. Malaria by Annual Parasite Index (API) at commune level (ADM3), Haiti 2014



is presumed. A death registry has not been available in the country since 2004, when there were reported 24 deaths or 0.5% of all deaths reported and classified that year. In neighboring Dominican Republic with similar epidemiology, better surveillance, and quality of health-care, case fatality rates of 8 deaths per 1,000 malaria cases were reported, much higher than that estimated in Haiti (0.5 deaths per 1,000 malaria cases).

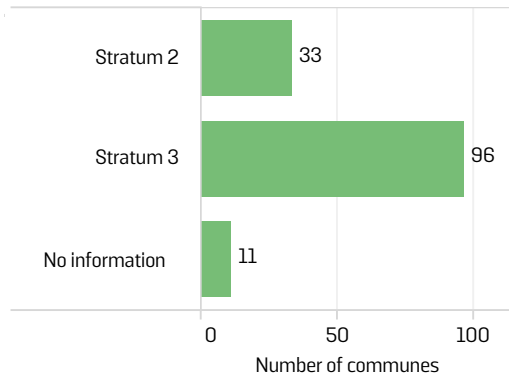
Recently, there has been a country-wide effort of improving testing with the roll-out of RDTs, moving away from giving treatment to patients presumptively, and increased focus on receiving complete reports from all health centers as part of the Test-Treat-Track (T3) strategy. In 2014, 94.5% of the 273,707 suspected

Figure 3. Communes (ADM3) with the highest malaria cases in Haiti, 2012–2014

Commune	Department	2012	2013	2014
Croix Des Bouquets	Ouest	3,076	1,842	1,989
Delmas	Ouest	2,284	1,919	1,822
Petit Goave	Ouest	1,510	1,336	1,164
Carrefour	Ouest	1,025	1,059	1,036
Port au Prince	Ouest	1,342	856	767
Dame Marie	Grand-Anse	71	160	642
Cabaret	Ouest	182	205	516
Ganthier	Ouest	1,041	753	502
Gros Morne	Artibonite	112	72	490
Jeremie	Grand-Anse	557	587	465
Petion Ville	Ouest	626	326	404
Port De Paix	Nord-Ouest	2,931	1,123	395
Leogane	Ouest	321	67	370
Gressier	Ouest	117	548	359
Anse d'Hainault	Grand-Anse	84	33	334

Legend: Decrease (green bar), Increase (blue bar)

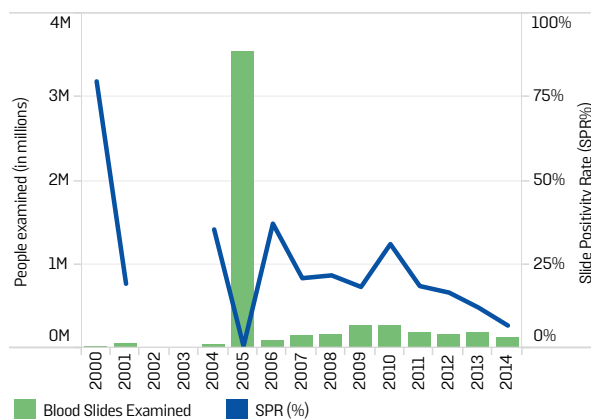
Figure 4. Number of communes (ADM3) by strata in Haiti, 2012-2014



*Stratum 1: No autochthonous malaria case during 2012-2014;
 Stratum 2: <1 case per 1000 inhabitants during 2012-2014;
 Stratum 3: >1 case per 1000 inhabitants in more than 1 year during 2012-2014

malaria cases were tested with microscopy or RDT, increasing from 72.4% and 68.9% in 2013 and 2012, respectively (Figure 6). Only 11.9% of suspected cases were treated presumptively decreasing from 41.8% and 36.3% in 2012 and 2013, respectively (Figure 5). Furthermore, the proportion of health units reporting monthly to the national malaria program increased to 83% in 2014 from 60% in 2013 and 67% in 2012. This implies that data reported by Haiti have become more reliable and trends can be aptly measured in subsequent years.

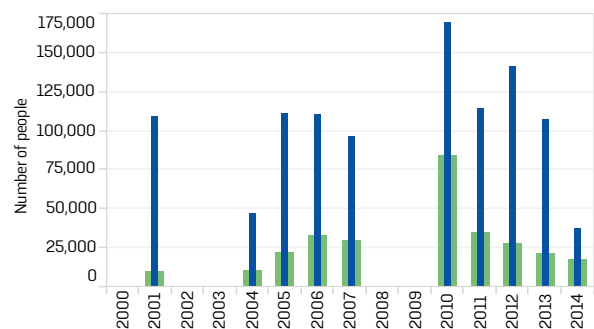
Figure 6. Blood slides examined and SPR in Haiti, 2000-2014



*Data unavailable for 2002-2003.

Owing to this improvement in surveillance, it becomes more reasonable to believe that the Marmelade commune in Artibonite department had zero (0) cases in 2014. All of the 466 suspected cases in 2014 were tested, 54% with RDTs, and none were confirmed positive with reports having been received for all 12 months. However, the Artibonite department itself received only 85% of monthly reports from its health centers in 2014 for a total of 2,001 confirmed malaria cases reported. Studies conducted in the department have reported prevalence of malaria parasite in rural areas of 3.1% and 3% in women of child-bearing age (35,36).

Figure 5. Number of malaria cases and those treated with first-line treatment in Haiti, 2000-2014



*Data unavailable for 2000, 2002-2003, 2008-2009.

■ First-line treatments ■ Confirmed cases

Although the department of Ouest contains the communes with the highest malaria cases in the country and accounts for 53% of all cases (Figure 3), prevalence in the department in subsequent surveys has been reportedly low (0.3-3%) (35). This could be because the department contains about one-third of the population of the country. The national capital is located in the department, with migration from other departments leading to a sizable amount of malaria cases diagnosed and possibly imported from other departments. Nonetheless, only 68% of monthly reports expected were received from its health centers in 2014. Port-de-Paix commune in Nord-Ouest department has reported a notable decrease (86.5%) in confirmed malaria cases since 2012: from around 3,000 (2012) to 400 (2014) with around 9,000 suspected cases each year of which 88%, 84%, and 95% were tested in 2012, 2013, and 2014 respectively. In 2014, 39% were tested using RDTs and completeness of reporting was adequate: 89% (2012), 94% (2013), and 94% (2014).

Along the Dominican Republic border, the communes Ouanaminthe in Nord-Est and Ganthier in Ouest report many cases. Good quality passive surveillance along with active case detection conducted as part of the Haiti-Dominican Republic binational project has led to a relatively accurate estimation of malaria burden in Ouanaminthe. However, active case detection is not conducted in other parts of the country.

Grand Anse has a reportedly high transmission of malaria – six deaths due to malaria were reported in the department in 2014. Yet parasite prevalence surveys conducted in the department show that the transmission intensity varies between localities. This is also the case in other parts of the country: in Sud-est department the prevalence by quality-assured microscopy varied between 0–34.5% (37). Thus, country-wide parasite prevalence surveys are of limited use and efforts should be directed at improving surveillance and reporting of individual malaria cases.

Malaria cases are currently reported and mapped by the health center where they were diagnosed, which may not represent an accurate picture. In one study conducted in Corail commune in Grand Anse, it was found that 85% of patients diagnosed in the hospital were from the same commune (38). This may also be the case in some other communes. Nonetheless, an effort to build a case-based surveillance system with cases mapped to origin of infection is advisable. Although a case notification form was designed and approved by the National Malaria Program, it is still to be implemented across the country.

A weekly integrated disease surveillance program (IDSP) is slowly but steadily being implemented across the country by the epidemiology department– 182 of over 900 health centers were included at the end of 2014 in IDSP (39). It will support the case-based surveillance in prompt identification of outbreaks.

As cases are not investigated, malaria cases reported are considered to have been transmitted locally. Based on the stratification methodology used in the country's current strategic plan, 7 communes in Haiti reported having insufficient data in the last 3 years (2012–2014). A total of 96 communes had more than 1 case per 1,000 inhabitants in one or more of the last 3 years (stratum 3) (Figure 4), while another 33 had less than 1 case per 1,000 inhabitants in all 3 years (stratum 2). No commune has reported data with sufficient quality to be included in stratum 1 (3 years without a single locally transmitted malaria case).

Almost all malaria cases in Haiti are caused by *P. falciparum*, although there have been reports of *P. malariae* cases having been imported from the island (40). No *P. vivax* case has been reported since 2008,

although cases in the Dominican Republic were identified. Inadequate surveillance and inadequate quality of diagnosis are considered as reasons for this discrepancy in Haiti.

Anopheles albimanus is the main malaria vector in the country as well as the entire Hispaniola Island. However, entomological surveillance is not routinely conducted in Haiti. The vector is considered to be largely zoophilic, exophagic, and exophilic; however, this varies widely. In human landing catches conducted in 2013 in Dajabon province of Dominican Republic, which borders the Ouanaminthe commune of Haiti, 49.6% of *An. albimanus* bit indoors with a peak biting rate of 14 bites per person-hour between 11p.m. –12a.m. indoors. *An. pseudopunctipennis* has been found in the south of the country, but has not been implicated in malaria transmission due to paucity of data. *An. vestitipennis* and *An. grabhamii* have also been found to bite humans in Dajabon province and could be present in adjoining areas of Haiti.

Priority Groups

Gender and age data were not available with the exception of cases in children under the age of 5 in 2014. Children <5 years had 22.4% of all malaria infections in Haiti, although they were found to have 11% of all malaria infections in Corail commune of Grand Anse department during 2012–2013 (38). However, at the national level, the incidence of malaria in 2012 in children under 5 years was almost twice (403 cases per 100,000 children) that of any other age group.

Reported incidences in pregnant women decreased from an estimated 307 to 166 malaria cases per 100,000 pregnant women between 2011 and 2014. In 2012, the incidence rate in pregnant women (292 cases per 100,000 pregnant women) was significantly higher than that in women of child-bearing age (195 cases per 100,000 15–49 year old women). The high incidence in children under 5 years of age and in pregnant women could indicate that a significant proportion of malaria is being transmitted inside the house and interventions targeted at household risk factors like long-lasting insecticide-treated bed nets (LLINs) and indoor residual spraying (IRS) would be a useful asset in reducing malaria transmission in areas of high and moderate transmission.

The paucity of case-based surveillance impedes the identification of other high-risk groups in the country.

Diagnosis and Treatment

Microscopy is the main method of diagnosis, though use of RDTs has increased in the past 3 years: from 46 patients examined with RDTs in 2012 to around 124,000 patients examined in 2014 (Figure 6). This has led to a veritable increase in the number of suspected patients being tested

before treatment in all 10 departments, of the country. Especially in the Center, Nord, and Nord-est departments, over 90% of the health centers had more people tested than treated presumptively in 2014, increasing from <50% in previous years. Yet more than 25% of health centers in Artibonite and Ouest departments and over 20% in Nippes and Grand Anse treated more patients than they tested.

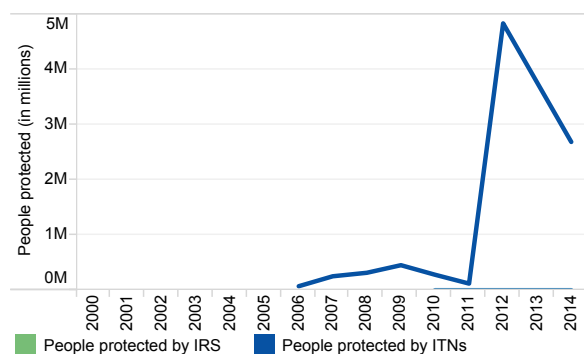
Chloroquine is used as the first-line treatment for *P. falciparum* infections. Some studies have suggested that resistant strains may be present in Haiti and surveillance of anti-malarial efficacy is necessary (41). A recently published drug efficacy trial conducted by Okech et al. found that chloroquine continues to be efficacious for treatment of *P. falciparum* (5).

Additionally, primaquine as a 1-day dose equivalent to 0.75 mg/kg of body weight has been recently included for treatment of *P. falciparum* infections in 2012. Severe and moderate glucose-6-phosphate dehydrogenase (G6PD) deficiency was reported to be present in 22.8% of study participants in Ouest and Sud-est departments of the country and 10.6% were considered to be at risk of developing severe adverse reactions (drug-induced hemolysis) due to primaquine (42). Use of a single dose of 0.25 mg/kg of body weight has been recommended by WHO to be safe for use in all patients irrespective of the G6PD deficiency status. Nonetheless, no adverse event reporting and monitoring program exists in the country and in its absence may be appropriate to consider reducing the dosage. It is imperative that health centers be trained in identifying and managing adverse events that may arise as a consequence of anti-malarial treatment.

Vector Control

Haiti has not used IRS for vector control in recent years and instead focuses on the use of LLINs since 2007 (Figure 7). A study conducted in 2011 found that only 6.4% of all households surveyed had at least one LLIN, while only 0.002% of households had 3 LLINs – the latter may be considered adequate to protect everyone in the family

Figure 7. People protected by IRS and by ITNs in Haiti, 2000-2014



(average family size is considered to be 5.5 in Haiti) (43). Besides decreasing individual risk of malaria, high LLIN coverage both at the household level and at the locality/community level is recommended to have an adequate population effect. Despite the low coverage with LLINs, around 16% of children <5 years old and 11.8% of pregnant women were using bed nets. In 2012, around 3 million bed nets were distributed as part of the Global Fund project. It is estimated that more than 2.6 million Haitians currently possess an LLIN (Figure 7). A country-wide study conducted in 2013 demonstrated that the primary malaria vector remains susceptible to pyrethroids, the insecticide used in LLINs.

Haiti uses chemical and biological larvicides for treating breeding spots of *An. albimanus* to reduce mosquito density. It also uses fumigation with malathion insecticide in peri-domicillary settings, especially when there are malaria outbreaks or malaria cases increase. An investigation for testing the efficacy of these measures has been included in the new Global Fund project to commence from 2016.

Funding

The majority of the funding for malaria has come from external sources (Figure 8). Projects financed by the Global Fund have provided the majority of funds for malaria in the past decade. USAID provides resources through the Umbrella Grant Agreement with PAHO/WHO for reinforcement of malaria efforts in the country. CDC and CHAI are other agencies that have provided technical support to the country. New initiatives have been launched recently that will provide more resources for the country: around 30 million dollars (over 5 years) will be provided by the Malaria Zero project funded by the Bill and Melinda Gates Foundation. EMMIE, a Global Fund-financed multi-country project aimed at elimination, also provides technical support and might provide more financial resources in the future. In the past, the Carter Center has provided resources to improve surveillance along the border of Haiti and the Dominican Republic, especially in the Ouanaminthe - Dajabon area. The country aims to eliminate malaria by the year 2020 and the aforementioned agencies and projects are supporting this goal.

Figure 8. Funding for malaria in Haiti, 2000-2014

