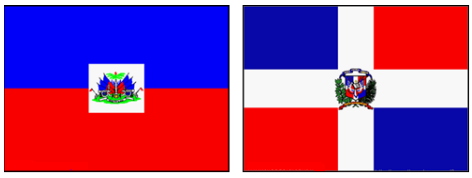
ELIMINATING MALARIA FROM HISPANIOLA:

A BINATIONAL EFFORT



Executive Summary

Hispaniola, shared by Haiti and the Dominican Republic, is the only Caribbean island where malaria still persists. In 2007, approximately 33,000 confirmed cases of malaria and 200 deaths were reported on the island (total pop. 20 million), with Haiti accounting for 90% of the cases. Malaria also extracts a substantial economic toll, especially on the island's agriculture and tourism industry.

Compelling biologic and epidemiologic evidence indicates that malaria can be eliminated from Hispaniola. Furthermore, recent disquieting developments imply that malaria should be eliminated without delay. Outbreaks of introduced malaria since 2006 in neighboring Caribbean islands underline the threat of re-introduction unless malaria is eliminated from Hispaniola. The discovery in Haiti in 2006-2007 of malaria parasites with genetic mutations linked to chloroquine resistance suggests that malaria transmission should be stopped in Hispaniola before the widespread emergence of drug resistance.

Elimination of malaria from Hispaniola can now be realistically considered, thanks to a favorable combination of circumstances. The Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM) has provided substantial malaria grants for the period 2009-2013 to Haiti (45 m USD) and the Dominican Republic (7.3 m USD). Both countries, with the encouragement of the Pan American Health Organization (PAHO/WHO) and the financial support of The Carter Center, have conducted since October 2008 a pilot project in the border area of Ouanaminthe-Dajabón (total pop. 120,000), to assess the possibility of a binational approach to malaria control and elimination. Based on the encouraging results of this project, the governments of Haiti and the Dominican Republic now propose to coordinate their anti-malaria activities in a binational effort, with its stated goal the elimination of malaria from Hispaniola by the year 2020.

This 10-year binational effort will be conducted in three overlapping phases: transition and build-up (years 1-2), coordinated attack (years 3-5), and coordinated consolidation (years 6-10). The binational approach will be reflected in harmonized long-term plans and short-term activities; maximal uniformization of technical protocols; coordinated research activities; frequent exchange of personnel; and shared electronic surveillance system and geographic database.

The effort will be organized through two national semi-vertical programs working in close coordination; supported by adequate personnel, commodities and infrastructures; and deploying an evidence-based, comprehensive menu of interventions. The interventions will include intensive epidemiologic surveillance (total geographic coverage, near-real-time electronic reporting and mapping); response to outbreaks; timely and correct diagnosis (laboratory confirmed) and treatment of all infected persons; integrated vector control measures (including indoor residual insecticide spraying); long-lasting insecticide-treated nets (LLINs), where proven protective; community sensitization; and intersectorial collaboration.

The budget for this 10-year binational effort will be 193.9 m USD, of which 63% will be allocated to Haiti, 32% to the Dominican Republic, and 5% to a common binational fund.

1. Rationale:

Hispaniola is the only Caribbean island where malaria still persists. However, compelling evidence indicates that malaria can be eliminated from this island:

- The only prevailing malaria parasite is *Plasmodium falciparum*, which does not have persistent liver stages which can cause relapses.
- *Anopheles albimanus*, the principal vector, is relatively inefficient at transmitting malaria.
- The parasite remains clinically susceptible to chloroquine, an inexpensive and safe antimalarial drug.
- All other Caribbean islands have eliminated malaria, underlining the technical feasibility of this achievement in Hispaniola.

This technical feasibility is further enhanced by newly available tools. Electronic communications and geographic information systems, immuno-chromatogaphic ("rapid") diagnostic tests, and molecular methods for monitoring drug resistance, can greatly increase the effectiveness of surveillance, prevention, and treatment of malaria.

In spite of these possibilities, recent developments are causes for concern:

- Outbreaks of introduced malaria, occurring since 2006 in neighboring Caribbean islands (The Bahamas and Jamaica), have been attributed to importation from Hispaniola and underline the risk of spreading the disease to neighboring malaria-free countries should malaria continue unchecked in Hispaniola.
- Genetic mutations associated with resistance to chloroquine have been detected in some malaria parasites isolated in 2006-2007 in Haiti, underlining the need to eliminate the disease before drug resistant parasites can emerge.

Thus, not only is it feasible to eliminate malaria from Hispaniola. It is also urgently needed, to prevent the problem from increasing in severity on the island and from expanding into neighboring malaria-free countries.

2. Malaria in Hispaniola:

In 2007 on the island of Hispaniola (total pop. 20 million), approximately 33,000 confirmed cases of malaria and 200 deaths attributed to the disease were reported. These statistics however are not reliable, because in Haiti the diagnosis of malaria often is not based on reliable microscopy results.

Haiti (pop. 9.7 million) bears the heaviest disease burden, accounting for about 90% of the confirmed cases in the island in 2007. However, an estimated 200,000 clinically suspected malaria episodes (without confirmation by microscopy) were estimated to have occurred in Haiti in 2007. Malaria risk is found in all locations of Haiti under 300 m altitude, including cities.

In the Dominican Republic (pop. 9.4 million) malaria occurs at high endemicity in only some of the country's 133 *municipios* (14 and 7 *municipios* in 2007 and 2008, respectively). According to 2008 statistics, 25 % of cases in the DR reportedly occur in migrants from Haiti, or persons of Haitian origin, most of whom are migrant laborers in construction or agriculture.

Malaria in Hispaniola affects all age groups. In many (but not all) areas a seasonal trend is observed, with an increase in case numbers in November-December.

The parasite responsible for malaria in Hispaniola is *Plasmodium falciparum*, the species that can cause fatal disease and that is most prone to developing drug resistance. The malaria mosquito vector in Hispaniola is *Anopheles albimanus*. While this vector is relatively inefficient in transmitting the infection, its biting behavior (no strong preference for indoors blood feeding on humans) makes it a more elusive target for vector control measures such as indoor residual spraying (IRS) and long-lasting insecticide-treated net (LLINs).

3. Cost of Malaria in Hispaniola:

While the health burden of malaria in Hispaniola does not reach the severe proportions seen in hyperendemic areas (such as Africa), its persistence on the island extracts a substantial cost.

Because *P. falciparum* malaria is a febrile illness that is potentially severe or even fatal, it must be considered in most febrile patients, requiring an additional diagnostic test (malaria blood smear) in each febrile patient without an obvious cause of fever (e.g., pneumonia). In addition, the persistence of malaria complicates the differential diagnosis of prevailing febrile illnesses in Hispaniola (e.g., dengue fever, typhoid) and increases the risk of incorrect diagnosis resulting in ineffective, potentially dangerous treatment.

Every year malaria control activities cost an estimated 3 million USD to the government of Haiti (most of the costs being supported by a grant from GFATM), and an estimated 2 million USD to the government of the Dominican Republic. The annual cost of malaria control in Hispaniola is most likely several-fold higher than the 5 million USD spent cumulatively by the two governments, considering the additional costs to international aid agencies, non-governmental organizations, missionary groups, the private sector, and private households.

The health costs of malaria are compounded by direct economic costs, such as lost productivity when the disease incapacitates rural workers or migrant laborers. Indirect economic costs derive from international concern about the persistence of malaria in Hispaniola, hindering foreign investments and inhibiting tourism, a key industry in Caribbean islands.

4. Challenges:

In spite of their participation in the Global Malaria Eradication Campaign started in 1955, Haiti and the Dominican Republic have not succeeded in eliminating the disease. The reasons include:

- Inadequate funding: Most countries depended on external assistance to support their malaria eradication campaigns. However, by 1969 the lack of progress in many countries led the international community to renounce its goal of global eradication. Consequently, international donors (e.g., USAID in Haiti) curtailed their support to the eradication programs, which then became unsustainable.
- Reversion to a malaria “control” approach: Following the abandonment of the “eradication” approach, a “control” approach was adopted that aimed at limiting the health impact of the disease without attempting to eliminate it. In Haiti this consisted of integrating malaria into primary health care services, with adoption of policies such as presumptive treatment, where most patients suspected of malaria were treated for the disease without confirmatory microscopic

diagnosis. This “control” approach, while less costly in the short term, failed in identifying many malaria infected patients and thus surrendered the long-term goal of eradicating the disease.
- Inadequate health infrastructures: Implementation of the control strategy was further hindered by fragmentation of the health system and lack of personnel and supplies, particularly on the western side of the island.
- Episodic social and political unrest.
- Lack of coordination between the two countries: In spite of their extensive common border and inter-country migration, Haiti and the Dominican Republic did not share their experience and did not
coordinate their malaria control efforts.

5. Addressing the Challenges:

While the challenges remain daunting, favorable developments now permit the two countries and their partners to consider again the possibility of malaria elimination:

- Substantial funding was recently granted by the GFATM to Haiti (45 million USD) and the Dominican Republic (7.3 million USD) to support their fight against malaria during the period 2009-2013.
- A progressive strengthening of health infrastructures in Haiti was made possible by the commitment of the country’s leadership and by the mobilization of international assistance.
- Haiti recently adopted a new 5-year malaria strategic plan (2009-2013), whose stated goal is the elimination of the disease by 2020, with several policies suitable to an elimination program (e.g., emphasis on microscopic diagnosis).
- The Dominican Republic has maintained a malaria program structured in an eradication perspective (e.g., semi-vertical organization, active case detection), which will facilitate the reconversion of both national programs to an elimination approach.
- A pilot project since October 2008, supported by The Carter Center, in the border area of Ouanaminthe-Dajabón (total pop. 120,000) has permitted the two countries to assess the possibility of a binational approach to malaria control and elimination, with encouraging results.
- Based on the promising outcomes of the Ouanaminthe-Dajabón project, the governments of Haiti and the Dominican Republic now propose to coordinate their anti-malaria activities in a binational effort, with its stated goal the elimination of malaria from Hispaniola by the year 2020.

6. Objective:

Eliminate, within 10 years, malaria from the island of Hispaniola through coordinated efforts between Haiti and the Dominican Republic.

7. Approach:

7a. Binational collaboration:

The two countries will aim at achieving maximal effectiveness in their binational efforts through:

- Harmonization of long-term plans and short-term scheduled activities, aimed at achieving maximal impact, through regular consultations and meetings.

- Adoption of technical protocols that will be as uniform as permissible by national circumstances.
- Research activities that avoid duplication, are designed in a coordinated manner, and address issues of interest to both countries.
- Frequent exchanges of personnel (meetings, training, selected field activities by binational teams).
- Shared electronic surveillance system and geographic database.

7b. Chronology:

The activities will be conducted in 3 stages which will overlap to some extent, and whose duration may vary depending on developments:

Years 1-2 (Transition and build-up): The two countries decide how to coordinate their strategies and interventions; recruit and train new personnel and strengthen their organizational infrastructures; begin to implement a coordinated approach, making the necessary adjustments as they progress; and initiate research to identify the most cost effective interventions.

Years 3-5 (Coordinated attack): In close coordination, the two countries initiate intensive interventions in their most affected areas; the interventions will be tailored to local circumstances, but will include at minimum a combination of diagnosis and treatment, intensive surveillance, and focused indoor residual spraying (IRS); as the situation improves in these areas, using the acquired experience, the countries expand their efforts into less endemic areas, employing combined interventions tailored to local circumstances; the countries continuously document their efforts and outcomes and conduct research to guide their interventions.

Years 6-10 (Coordinated consolidation): In close coordination, the two countries continue the interventions, focusing on remaining foci; maintain intensive surveillance in all areas of the island, focusing on locales and population groups most at risk; detect outbreaks in a timely manner and conduct intensive interventions to control the outbreaks; conduct investigations to prevent reintroduction of infection into areas freed of malaria; and continuously document the malaria situation island-wide.

7c. Strategies and Interventions:

The elimination effort will be implemented by two national semi-vertical programs, which will be supported by adequate personnel, commodities, equipment and infrastructures. The two national programs will work in close coordination and follow technical protocols that will be as uniform as possible.

The two countries will adopt an evidence-based approach to deploy in a timely manner a comprehensive menu of interventions, including:

- *Epidemiologic surveillance:*
  - based on biologic confirmation (microscopy in the majority of cases; in selected circumstances, rapid diagnostic tests (RDTs) and molecular tests).
  - through both passive case detection and active case detection, and periodic parasite surveys in communities as required; serologic surveys will be conducted in areas recently freed of infections.
  - covering all localities of the island.

- with rapid communication of data (electronic network, portable telephones) into a surveillance database shared by the two countries.
- spatial analysis and constantly updated mapping of malaria distribution in the island.

- *Case management:*
  - accurate, timely diagnosis based on biologic confirmation (microscopy in the majority of cases).
  - uniform treatment protocol island-wide (using, for uncomplicated cases, chloroquine and primaquine; the latter compound aims to prevent transmission by killing the gametocyte stages infective to mosquitoes).

- *Prevention:*
  - vector control (indoor residual insecticide spraying, focused in time and space; outdoor/spatial spraying for outbreak controls; complemented by source reduction and larviciding; supported by entomological surveillance; as part of integrated vector management).
  - personal protection using long lasting insecticide-treated nets (LLINs) and/or curtains (years 1-2; continuation contingent on findings from research on protective effect).

- *Response to outbreaks:*
  - surveillance (early warning system).
  - active case detection, insecticide spraying, mass drug administration in severe situations.

- *Support strategies:*
  - training and supervision of personnel.
  - procurement of commodities.
  - information-education-communication.
  - community mobilization.
  - multisectorial collaboration.
  - advocacy (government, local businesses, international agencies).

7d. Research:

Research will aim at identifying the tools and methods that are most cost-effective to achieve elimination. The main topics include:

- assessment of the protective effect of LLINs.
- monitoring of parasite resistance to chloroquine, of *Anopheles* resistance to insecticides, and of adverse events due to primaquine.
- entomologic investigations to identify optimal combinations of vector control measures.
- epidemiologic investigations on patterns of transmission and re-introduction (e.g. migrant workers).
- identification of optimal methods for intersectorial collaboration (public/private sector intervention mix) and inter-country coordination.

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7e. Documentation:

The progress of the elimination effort will be documented, including:

- monitoring and evaluation, to assess at defined time intervals the program outcomes and the health impacts of the elimination effort.

- cost of the various components of the elimination effort.

8. Potential added benefits:

In addition to the direct health and economic benefits derived from the absence of the disease, elimination of malaria from Hispaniola will:

- strengthen health infrastructures in Hispaniola (e.g., surveillance system, laboratory components, binational collaboration in other health issues).
- decrease the risk of introduced malaria in the neighboring countries (including other Caribbean islands).
- provide an experience that may guide efforts of other countries considering malaria elimination (e.g., through development of mathematical models using data from Hispaniola).

9. Budget:

9a. Table: [1]

	Haiti [2]	**Dominican Republic** [2]	**Binational collaboration** [2]	**TOTAL**
Surveillance (Personnel)	3.8 [0.9-0.9-2.0]	1.9 [0.4-0.5-1]	0.5 [0.1-0.1-0.3]	6.2
Surveillance (Equipment, supplies)	3.9 [1.4-0.7-1.8]	2.1 [0.8-0.4-0.9]	0.6 [0.3-0.1-0.2]	6.6
Diagnosis (Personnel)	3.2 [0.8-0.8-1.6]	1.7 [0.4-0.4-0.9]	0.2 [0.05-0.05-0.1]	5.1
Diagnosis (Equipment, supplies)	3.8 [2.0-0.7-1.1]	2.0 [1.0-0.6-0.4]	0.2 [0.05-0.05-0.1]	6.0
Treatment (Personnel)	3.2 [1.0-0.7-1.5]	0.9 [0.3-0.2-0.4]	0.2 [0.05-0.05-0.1]	4.3
Treatment (Drugs, supplies)	8.2 [3.5-2.2-2.5]	2.6 [1.0-0.8-0.8]	0.2 [0.05-0.05-0.1]	11.0
Vector Control (Personnel)	7.5 [2.0-3.0-2.5]	5.0 [1.2-1.8-2.0]	1.0 [0.2-0.3-0.5]	13.5
Vector Control (Materials)	26.5 [12.0-7.0-7.5]	14.5 [5.5-4.0-5.0]	1.0 [0.4-0.2-0.4]	42.0
LLINs (Personnel)[3]	0.8 [0.2-0.3-0.3]	0.5 [0.2-0.15-0.15]	0.1 [0.05-0.03-0.02]	1.4
LLINs (Materials) [3]	30.0 [17.0-5.0-8.0]	10.0 [5.0-2.0-3.0]	1.0 [0.4-0.2-0.4]	41.0
Outbreaks control and other contingencies	6.5 [2.0-1.5-3.0]	4.0 [1.0-1.0-2.0]	1.0 [0.3-0.2-0.5]	11.5
Research	3.0 [1.5-0.75-0.75]	3.0 [1.5-0.75-0.75]	1.5 [0.5-0.5-0.5]	7.5
Mapping and stratification	1.4 [0.7-0.3-0.4]	1.4 [0.7-0.3-0.4]	0.5 [0.2-0.1-0.2]	3.3
Other support strategies not covered in above items (health education, training, monitoring & evaluation, intersectorial work, infrastructure, etc.)	10.0 [3.0-2.0-5.0]	6.0 [2.0-1.5-2.5]	1.5 [0.4-0.3-0.8]	17.5
Administrative and miscellaneous support	10.0 [2.0-3.0-5.0]	6.0 [1.2-1.8-3.0]	1.0 [0.2-0.3-0.5]	17.0
TOTAL	**121.8**	**61.6**	**10.5**	**193.9**

Footnotes:

[1]: The Table gives a budget estimate (in million USD) for each of the two countries, as well as for specific activities conducted under binational collaboration.
[2]: For each cell, the top line indicates the total cost for the 10-year period, while the bottom line shows, between brackets, the cost for each of the 3 stages of the 10-year period as follows: [years1-2 - years 3-5 - years 6-10]
[3]: Cost of LLINs assumes that research during years 1-2 demonstrates meaningful protective effect from long-lasting insecticide treated nets (LLINs). Should no such effect be demonstrated, 18.6 millions USD of the projected 41 millions USD budgeted for LLINs (Materials) would be saved and would be available for other purposes.

9b. Cost comparisons with current health expenses:

- The budget represents a cost of 1 USD per year per inhabitant to eliminate malaria from Hispaniola, over a 10-year period. The annual total health expenditure per capita is 42 USD in Haiti and 223 USD in the Dominican Republic (2006 values, WHOSIS).

- The budget represents a cost of 20 million USD per year during a 10-year period. It is estimated that the governments of Haiti and the Dominican Republic spend a total of 5 million USD annually on their current malaria control activities, and that the total cost of malaria control in Hispaniola (including international aid agencies, non-governmental organizations, missionary groups, the private sector, and private households) is several-fold higher than this amount.

9c. Potential contributions from funds currently available:

- This 10-year budget, tentatively for the period 2010-2019, will be partially covered by funds already available for fighting malaria in the two countries. These include:

Haiti:
GFATM: 45 million USD over 5 years (2009-2014)
Ministry of Health (MSPP): Up to 3 million USD per year (current budget for malaria control)

Dominican Republic:
GFATM: 7.3 million USD over 5 years (2009-2014)
Ministry of Health (SESPAS): 2 million USD per year (current budget for malaria control)