

RESEARCH ARTICLE

Lymphatic filariasis elimination in the Dominican Republic: History, progress, and remaining steps

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Abstract

Lymphatic filariasis (LF) is a mosquito-transmitted parasitic disease that is a leading cause of disability globally. The island of Hispaniola, which the Dominican Republic shares with Haiti, accounts for approximately 90% of LF cases in the Americas region. In 1998, the Dominican Ministry of Public Health created the Program to Eliminate Lymphatic Filariasis (PELF) with the goal of eliminating LF transmission by 2020. Baseline mapping revealed 19 (12% of total) endemic municipalities clustered into three geographic foci (Southwest, La Ciénaga and East), with a total at-risk population of 262,395 people. Beginning in 2002, PELF sequentially implemented mass drug administration (MDA) in these foci using albendazole and diethylcarbamazine (DEC). In total, 1,174,050 treatments were given over three to five annual rounds of house-to-house MDA per focus with a median coverage of 81.7% (range 67.4%–92.2%). By 2018, LF antigen prevalence was less than 2% in all foci, thus meeting criteria to stop MDA and begin post-treatment surveillance (PTS). This success has been achieved against a shifting landscape of limited domestic funding, competing domestic public health priorities, and sporadic external donor support. Remaining steps include the need to scale-up morbidity management and disability prevention services for LF and to continue PTS until LF transmission is interrupted across Hispaniola.

Author summary

Lymphatic filariasis (LF) is a neglected tropical disease caused by thin worms transmitted to humans by the bites of mosquitoes. LF is a leading cause of disability globally, resulting from the long-term physical (swelling of legs and genitals) and psycho-social impact on affected individuals. The Dominican Republic is one of four LF-endemic countries in the Americas. This report describes the efforts to eliminate the disease in the country, including a review of disease mapping and implementation of mass drug administration (MDA) and the provision of safe and effective medicine to at-risk communities to interrupt parasite transmission. Particular emphasis is given to program planning and community mobilization for MDA due to the divergent environments of endemic foci, which ranged

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Data Availability Statement: Survey data were recorded manually on paper forms and have not been systematically converted to electronic format. The data underlying the results presented in the study are available from the Dominican Ministry of Public Health (despacb@salud.gob.do).

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from rural agricultural regions to densely populated urban neighborhoods. Impact evaluation data for each focus demonstrate interruption of LF transmission and that criteria to stop MDA have been met. Finally, plans for post-treatment surveillance and the scale-up of clinical care services for those who remain affected by chronic LF are presented. Required elements for eliminating LF as a public health problem.

Introduction

Data sources

Program implementation and impact evaluation data were obtained from program reports or primary data records maintained by PELF.

Results

Disease burden and mapping

Early studies from the mid-20th century summarized by Vincent [15] documented MF prevalence ranging from 2%±7% in the capital Santo Domingo, with higher prevalence (8%±26%) found in rural areas surrounding the city. Vincent's own work in 1980 found 8% MF prevalence from hospital in-patients in Barahona in the southwest region, but zero infections out of 100 samples in the eastern town of La Romana. More extensive household studies from 1981±1985 recorded MF prevalence of 3.8% in Santo Domingo and surrounding areas with prevalence significantly higher in males and adolescents 10±19 years old [10]. Geographically, infection was highest (9.8% MF positivity) in the urban. <https://doi.org/10.1371/journal.pone.0130879>

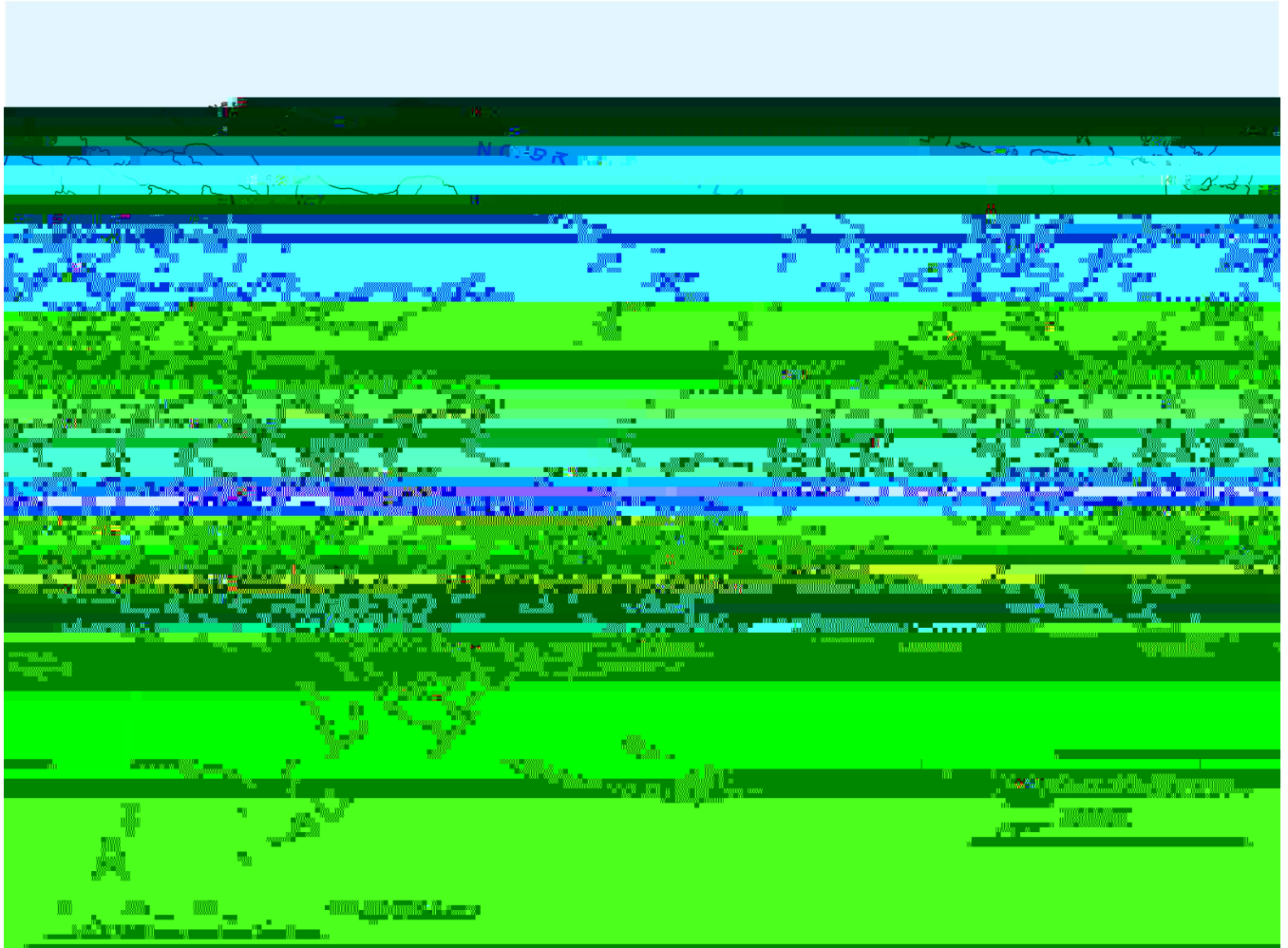


Fig 1. Map of the Dominican Republic showing LF-endemic areas (dark red) and associated municipalities (light red) identified from baseline mapping. The map was created using ArcGIS Pro version 2.8.1. No basemap was used in the map. The source of the shapefiles is the Oficina Nacional de Estadística (ONE) of the Dominican Republic.

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PELF spent a year training health workers for drug distribution, conducting a household census for MDA, and launching community mobilization. Drug distributors and supervisors were recruited from the local communities with a ratio of one distributor for every 50 target households and one supervisor for every four distributors. Distributors were required to be responsible, respected members of the community, while supervisors were local leaders who had participated in past community campaigns. Day-long trainings for distributors and supervisors were conducted in groups of 30 or fewer. All distributors and supervisors were required to take one dose of albendazole and DEC so that they would be sympathetic to complaints of side effects. Prior to MDA, PELF also conducted community awareness campaigns through school, church and other local meetings, house-to-house education, media messages using radio, television, and mobile loudspeakers in the targeted areas and print media with photographs of lymphedema, hydrocele and other clinical manifestations of LF. The purpose of these campaigns was to inform residents about LF, the drugs used for MDA, and the schedule of MDA campaigns in their community.

reported coverage rate of 80.5% of the total population, while post-MDA coverage surveys found 86% of heads of households were retreated. The estimated cost of the first MDA was USD \$1.87 per person [17].

Subsequent MDAs targeted an expanded population of 342,759 across 29 municipalities to treat communities adjacent to endemic municipalities. Despite more than doubling the target population, reported epidemiological coverage for the 2nd (2003) and 3rd (2004) MDAs was 73.2% and 69.2%, respectively (Table 1). Still above the 65% minimum coverage level recommended [8]. Coverage surveys in 2003 found 78% of households were retreated. Baker and colleagues previously described how engagement with the local primary health care system (Unidades de Atención Primaria (UNAPs)) enabled this expanded effort [18]. Cost of the 2nd MDA was estimated at USD \$0.87 per person due to reduced start-up costs as well as devaluation of the Dominican Peso [17]. Funding limitations led to delays in the 4th MDA, which did not take place until March 2006. Once conducted, the 4th MDA included an extended 12-day house-to-house campaign in targeted areas resulting in coverage of nearly 80% (Table 1). Sentinel site monitoring surveys conducted several months prior to the 3rd and 4th MDA campaigns showed that CFA antigen prevalence among individuals older than five years of age declined by an average of 95% between 2002 and 2005 to 0.5% in Pueblo Nuevo and La Sombra de Tamayo and 2.6% in Batey 7, while MF prevalence also declined by 95% overall to 0% in Pueblo Nuevo in 2004 and 2005, 0.3% in La Sombra de Tamayo, and 1.0% in Batey 7 (Fig 2).

Criteria for stopping MDA proposed by WHO at that time included reduction of MF prevalence to less than 1% in ad. 35agcp6431.15 492.548 cm 0.83 0.64 0.02 0 k (17)Tj 696 03F

Table 2. Results from transmission assessment surveys (TAS) in the Dominican Republic, by age and by focus area.

	TAS-1		TAS-2		TAS-3	
	6–7 years	>15 years	6–7 years	>15 years	6–7 years	>15 years
Southwest	0 / 1692,0%(0%±0.22%)	2 / 1026,0.19%(0.02%±0.70%)	4 / 1588,0.25%(0.07%±0.64%)	1 / 1030,0.10%(0%±0.54%)	4 / 1620,0.25%(0.07%±0.63%)	---
La Ciénaga	1 / 539,0.19%(0%±1.03%)	---	0 / 815,0%(0%±0.45%)	---	0 / 594,0%(0%±0.6%)	---
East	1 / 1049,0.10%(0%±0.53%)	---	---	---	---	---

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participated in a multi-country evaluation of the transmission assessment survey (TAS) by conducting community-based surveys in the 10 originally endemic municipalities in 2009 (two years after the last MDA) and in 2012 (five years after the last MDA) with the entire focus comprising a single evaluation unit (EU) [13]. TAS is a LQAS-type survey of children 6±7 years old, as this population was born during the MDA intervention period and should be free of infection if transmission has been interrupted. TAS-1 is conducted to make stop-MDA decisions, while repeated surveys (TAS-2 and TAS-3) are currently recommended for PTS. Since stop-MDA surveys were not conducted at the time of MDA halt in the Southwest PELF conservatively considered the 2009 and 2012 surveys as TAS-1 and TAS-2, respectively. In 2009, none (0%) of the 1,692 children aged 6±7 years old tested by ICT in 38 randomly selected village clusters across the entire focus were CFA-positive, meaning that the Southwest passed TAS-1 (Table 2). PELF also simultaneously tested individuals older than 15 years in the same households. Out of 1,026 adults tested by ICT, only two CFA-positive individuals were identified (0.19% age group prevalence, 0.07% overall prevalence): one Dominican resident and a Haitian immigrant, both of whom were MF-positive. In 2012, five CFA-positive individuals (0.19% overall prevalence) were identified among 1,030 adults (0.10% age group prevalence) and 1,588 children (0.25% age group prevalence), respectively, tested by ICT in 40 randomly selected clusters. The antigen-positive adult and two of the four children were MF-negative. Three of the four CFA-positive children belonged to recently immigrated Haitian families, suggesting exposure outside the Southwest while the fourth lived in a household that refused MDA. A result of four CFA-positive children was below the TAS critical cut-off of 18, meaning the Southwest focus also passed TAS-2.

In 2018, eleven years after the halt of MDA, community-based TAS-3 was again conducted in the 10 IUs of the Southwest. Of 1,620 children tested by filariasis test strip (FTS), four (0.25%) were CFA positive, significantly below the critical cut-off of 18 (Table 2). None of the antigen-positive individuals were MF-positive. However, in contrast to TAS-2 results all four were resident Dominicans, raising the possibility of sustained low-level transmission in the Southwest. Follow-up investigations were not conducted surrounding the index cases.

La Ciénaga focus

The second focus of LF transmission in the Dominican Republic is La Ciénaga. Meaning "a swamp", La Ciénaga is an impoverished urban area along the banks of the Ozama River in the capital Santo Domingo. Approximately 50,000 people live in La Ciénaga and the surrounding sub-urban area of Los Guandules and Guachupita. Surveys from the early 1980s identified the area as a hot-spot of transmission with MF prevalence of 9.8% [10]. Pre-MDA sentinel site data from 2002 revealed CFA prevalence by ICT of 10.7% and MF prevalence of 2.5%.

The first MDA in La Ciénaga was conducted in May to June 2004, with each sub-barrio considered an individual IU and an achieved coverage of 67.4% (Table 3). As in the Southwest, MDA was conducted over weekends and drug distributors and supervisors were recruited by PELF from within the community. However, unlike the largely rural Southwest, the urban environment of La Ciénaga presented different challenges: the density and geographical layout of households, complicated censu

in 2014 [14]. In 2018, a school-based TAS-3 was conducted using a similar study design. Zero (0%) of 594 children were CFA-positive by FTS, confirming transmission elimination in the area. The La Ciénaga experience provided empiric evidence that elimination of transmission can be achieved in areas of lower transmission with less than the 4±6 years of MDA currently recommended by WHO [8]. Fewer rounds of MDA resulted in program costs savings and prevented unnecessary drug administration to healthy individuals.

East focus

The East focus is a low-land tropical area, with vast expanses of sugarcane and other agricultural industries that rely on migrant labor force as in the Southwest focus. Due to funding limitations and the lower intensity of transmission, the East was the last focus to initiate MDA. Sentinel site assessments conducted in 2011 revealed that transmission was limited to an at-risk population of 67,874 residing in of eight municipalities across five provinces (Hato Mayor, San Pedro de Macoris, El Seibo, La Romana and La Altagracia). Mean CFA prevalence by ICT in sentinel sites (one per province) was 2.6% (range 0.6%±4.6%). MDA took place August to September 2014, when 52,854 people were treated resulting in epidemiological coverage of 77.9% (Table 4), despite funding shortages that limited pre-MDA social mobilization. Funding limitations also prevented the MDA planned for 2015. MDA resumed in 2016, this time accompanied by enhanced social mobilization that included community meetings, neighborhood announcements, and media distribution. A total of 55,879 people were treated in 2016 (85.1% coverage). A third treatment occurred in 2017, in which 56,985 persons were treated (81.7% coverage). Sentinel site monitoring conducted in 2018 with FTS revealed a 77% reduction in mean CFA prevalence to 0.6% (range 0.0%±1.3%).

Based on these results, the low baseline intensity of transmission in the East and the absence of recrudescence in La Ciénaga after only three treatment rounds, PEL elected to conduct a stop-MDA TAS-1 in the East focus (considered as 1 EU) in 2018 after only three rounds DEC-albendazole MDA. Of 1049 children ages 6±7 years tested by FTS in community-based surveys, only one (0.1%) was CFA-positive, a 6-year-old male, MF-negative resident (Table 2). The area easily passed TAS against a critical value of 11. The halt of MDA in the East signaled the halt of MDA across all formerly LF-endemic areas of Dominican Republic.

Post-treatment surveillance

Following the halt of MDA in the East region, a minimum of four years of PTS must occur for the country to fulfill WHO requirements for validation of elimination as a public health problem. The primary approach will be to conduct TAS-2 (scheduled for 2020 but delayed until 2021 due to COVID-19) and TAS-3 (scheduled for 2023) surveys in the East region. PEL also

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