Costs of Integrated Mass Drug Administration for Neglected Tropical Diseases in Haiti

Ann S. Goldman,* Molly A. Brady, Abdel Direny, Luccene Desir, Roland Ocard, Jean-Francois Vely,†
Mary Linehan, and Margaret Baker

*The George Washington University School of Public Health and Health Services, Washington, District of Columbia;
RTI International, Washington, District of Columbia; IMA World Health, Port-au-Prince, Haiti; Hôpital Ste. Croix, Leogane, Haiti;
University of Notre Dame, South Bend, Indiana; Ministère de la Santé, Port-au-Prince, Haiti;
Georgetown University, Washington, District of Columbia*

Abstract. We conducted a cost analysis of Haiti's Ministry of Public Health and Population neglected tropical disease program, *Projet des Maladies Tropicales Negligées* and collected data for 9 of 55 communes participating in the May 2008–April 2009 mass drug administration (MDA). The *Projet des Maladies Tropicales Negligées* Program partnered with IMA World Health and Hôpital Ste. Croix to implement MDA for treatment of lymphatic filariasis and soil-transmitted helminthiasis by using once a year treatment with albendazole and diethylcarbamazine in a population of approximately 8 million persons. Methods included analyzing partner financial records and conducting retrospective surveys of personnel. In the nine communes, 633,261 persons were treated at a cost of U.S. \$0.64 per person, which included the cost of donated drugs, and at a cost of U.S. \$0.42 per person treated, when excluding donated drug costs. The MDA for lymphatic filariasis in Haiti began in 2000, with the treatment of 105,750 persons at a cost per person of U.S. \$2.23. The decrease in cost per person treated is the result of cumulative implementation experience and economies of scale.

INTRODUCTION

Neglected tropical diseases (NTDs), although not well known in high-income countries, cause severe physical and economic burdens in low-income countries.¹ Recent experiences in co-implementing and integrating NTD program activities have shown progress toward achieving programmatic and cost efficiencies. Two of the diseases included in integrated programs, lymphatic filariasis (LF) and soil-transmitted helminthiasis (STH), are endemic to Haiti. Both infections can be controlled through preventive chemotherapy programs that target at-risk populations with annual distribution of diethylcarbamazine (DEC) and albendazole.

Haiti is the poorest country in the Western Hemisphere. It had a 2008 gross national income per capita of U.S. \$660, and 55% of the population lived below the international poverty line (U.S. \$1.25 a day).² Access to health care is challenging for most Haitians; only 47% of the population are served by the national health system. Haiti's national health system includes networks of local health units, community hospitals operated by the government and nongovernmental organizations (NGOs), departmental reference hospitals, and university hospitals. The health network is organized into 54 communal health units, each serving a population of 80,000–140,000 inhabitants and responsible for offering a minimum package of services and for coordinating the local health units. However, inadequate human and financial resources throughout the Haitian health system result in serious problems in functionality, organization, management, and quality control at all levels. In addition, many health services provided by the private sector, particularly the nonprofit sector, are often poorly integrated with public services.³

Haiti has the highest prevalence of LF infection in the Western Hemisphere. The Haitian Ministry of Public Health and Population (MSPP) conducted a national survey of

LF prevalence in 2001 by using an assay to detect the presence of filarial antigen in the blood among school children 6–11 years of age. Among Haiti's 133 communes, 117 (87.9%) met the World Health Organization (WHO) criteria for implementing mass drug administration (MDA) to treat LF; an antigen prevalence > 1%.⁴ Given internal population migration, Haiti's current national strategy is to implement MDA in all communes.

The prevalence of LF in Haiti by commune is shown in Figure 1. The lightest areas represent high-prevalence zones in which MDA had occurred. The darkest areas represent high-prevalence zones in which MDA had not yet begun.

The prevalence of STH among school age children in Haiti is shown by department in Figure 2. In 2002, it ranged from 21% in Center Department to 74% in Grande Anse Department. All departments have prevalence rates above the threshold for mass treatment, according to WHO guidelines.⁵

Antifilarial medications such as albendazole are known to have an effect on helminths, such as *Ascaris*, *Trichuris*, and hookworm. Studies on the impact of antifilarial medications in sentinel research areas of Leogane, in the West Department, where mass treatment with DEC and albendazole was conducted, showed a significant decrease in the intensity of *Ascaris*, *Trichuris*, and hookworm infections.⁶

The MSPP established the LF program in 2001, approximately one year after the establishment of the STH program in 2000, with the objectives of reducing LF prevalence to the point of elimination and controlling STH. Preventive chemotherapy is an important component of both programs. Since their establishment, these programs have been underfunded and have relied on external partners to aid in implementation.

In 2008, Haiti formed a national NTD program, *Projet des Maladies Tropicales Negligées* (MTN), which consolidated plans for scaling up the elimination of LF and control of STH with a joint strategic plan. This joint strategy resulted in increasing school-based distribution platforms and community-based LF drug distributions, developing social mobilization materials with integrated disease control and hygiene messages, and pooling resources of staff from the MSPP LF and Family Health Programs to support MDA training, supervision, and monitoring activities.

*Address correspondence to Ann S. Goldman, The George Washington University School of Public Health and Health Services, 2100 West Pennsylvania Avenue, NW, 8th Floor, Washington, DC 20037. E-mail: sphasg@gwumc.edu

†Deceased.

FIGURE 1. Lymphatic filariasis prevalence in Haiti, 2004. Mapping was conducted using a modified lot quality assurance sampling method in school age children.⁴ MDA = mass drug administration; MSPP = Ministry of Public Health and Population.
Source: MSPP and Partners.

The MSPP MTN Program in Haiti has received technical support and resources from the U.S. Agency for International Development (USAID), University of Notre Dame (UND), and the U.S. Centers for Disease Control and Prevention (CDC) through implementers, including MSPP, Hôpital Ste. Croix (HSC), and IMA World Health (IMAWH), and funded by USAID through its Neglected Tropical Disease Control Program, managed by RTI International.

In 2008–2009, the MTN Program treated 55 of 134 disease-endemic communes for at least one of the two diseases, with plans to reach full national coverage during 2011. The MTN Program uses community leaders, promoters, teachers, and distributors to mobilize the population and deliver preventive chemotherapy for LF and STH. Diethylcarbamazine and albendazole are delivered once a year through MDA at community distribution posts and elementary schools. Each post is equipped to serve at least 800 persons over 4–5 days of mass treatment with a staff of three community drug distributors per post. One or two community leaders per section are responsible for leading information, education, and communication activities; choosing distribution sites; and training promoters and drug distributors. Community promoters supervise 2–3 distribution sites and help implement information, education, and communication activities directly before MDA. In schools, 2–3 teachers per institution distribute drugs over the course of 2–3 hours. These teachers have been trained by the directors of the schools, who in turn have been trained by zonal school inspectors working for the Ministry of Education.

All persons greater than two years of age are targeted for treatment except pregnant mothers and the infirm. Children of school age are primarily targeted through school-based distributions. Community-based distributions target children 2–5 years of age, school-age children not reached through school-based distributions, and adults.

The goal of this study was to provide data on the cost of implementing the MTN Program in 2008–2009. Although not

a specific goal, one also may make some interesting inferences to data from a cost study conducted in 2002.^{7,8}

METHODS

Study protocol. The cost analysis sought to collect cost information for the first year of implementation of the 2008–2020 MTN strategic plan. The study sought to answer the following questions: What are annual costs of NTD activities? Who pays? What is the cost distribution by activity? Which activities consume the largest amount of resources? Methods followed previous protocols developed for cost data collection for LF elimination programs and subsequent NTD integration projects.^{9,10}

Perspective. The analysis was prepared from the perspective of the Haitian MTN Program. In Haiti, nongovernmental partners are responsible for implementing the program in selected geographic areas on behalf of the national government. In-country resources incurred by NGOs participating in the MDA campaigns were taken into account, but their overseas management and administrative costs were not included. The analysis included in-country costs for IMAWH and HSC, which were provided by USAID and the Bill and Melinda Gates Foundation, respectively.

Time frame. The analysis was carried out during May 2008–April 2009. The MDA campaigns began in early November 2008 and were completed by April 2009.

Level of analysis and sampling frame. The MDA targeted a total of 55 communes. Of these communes, 10 were chosen for the cost analysis. The costing exercise gathered information from the government and NGO partners at the national and commune levels. The 10 communes were selected by dividing the 55 communes targeted for MDA into 10 geographic clusters of approximately 5 communes each, which were then ranked randomly. Two communes were chosen randomly from each of the five clusters that appeared at the top of the ranked

FIGURE 2. Soil-transmitted helminthiasis (STH) prevalence in Haiti, 2002. Results of mapping activities were conducted according to World Health Organization (WHO) Guidelines.⁶ MSPP = Ministry of Public Health and Population.

Source: MSPP and Partners.

list. After a consultation with partners, some communes were changed to ensure more equal distribution of the study communes among the implementing partners.

One of the communes is considered primarily urban, five are peri-urban, and four are rural. Four of the communes

selected were implementing an MDA campaign for the first time. The other six communes previously had implemented an average of 3.5 MDAs, with coverage rates that ranged from 34% to 81% (Table 1). Coverage rates are defined as epidemiologic coverage, which is the number of persons reported to

TABLE 1
Characteristics of 10 communes chosen for data collection, Haiti*

Department	Commune	2008 population adjusted (from 2003 figures)	Type of locale	Prior no. MDAs	Previous MDA epidemiologic coverage rate (treated/at-risk), %	Previous MDA program coverage rate (treated/eligible), %	Implementing agency/funder
North	Grande Riviere du Nord	32,543	Peri-urban	0	—	—	IMAWH/USAID
North	Limbe/Bas Limbe	88,715	Rural	2	29–39	34–46	IMAWH/UND
Northeast	Ste Suzanne	24,920	Rural	2	58	68	MSPP
Northwest	Port de Paix	154,869	Urban	4	44	52	MSPP
Northwest	Bassin Bleu	53,597	Rural	0	—	—	IMAWH/USAID
Artibonite	Gros Morne	124,191	Peri-urban	0	—	—	IMAWH/USAID
Artibonite	Ennery	41,099	Peri-urban	0	—	—	IMAWH/USAID
Artibonite	Verretes	116,144	Rural	4	67	79	MSPP
West	Cabaret	60,585	Peri-urban	2	69	81	HSC/UND
West	Leogane	175,209	Peri-urban	7	49	58	HSC/UND
Total Haiti population 2008 adjusted (from 2003 figures)		8,145,069					

*MDA = mass drug administration; IMAWH = IMA World Health; USAID = U.S. Agency for International Development; UND = University of Notre Dame; MSPP = Ministry of Public Health and Population; HSC = Hôpital Ste. Croix. Limbe and Bas Limbe are considered to be separate communes in MSPP administrative lists. In this study, they were treated as one commune. Source: UND.

have ingested the drugs divided by the total at-risk population in the commune; and as program coverage, which is the number of persons reported to have ingested the drugs divided by the total population eligible to take the drugs.

MDA coverage information for the IMAWH/UND commune of Limbe/Bas Limbe was obtained, but data were not available for costs of implementing MDA in these communes. Thus, they were excluded from the cost analysis.

The 2002 cost analysis, also conducted from the program perspective, reported costs for three years of MDA in a much smaller program in Leogane from 2001 through 2002. The program was a demonstration project to serve as the foundation for a national filariasis elimination program in Haiti. HSC implemented the MDA funded by two donors, CDC and the Bill and Melinda Gates Foundation.

Data collection. Administrators and finance staff working for the MTN Program, IMAWH, UND, and HSC provided retrospective cost information to a single interviewer. Costs were collected in 12 NTD program activity categories: advocacy, mapping, social mobilization and education, training, drug distribution, field supervision, data management, monitoring and evaluation, planning, procurement, morbidity control and surgery, and other (tasks included in the activity categories) (Table 2). Because the MTN Program does not include latrine construction and vector control, those categories were not included. Morbidity control and surgery costs were collected as part of overall program costs. However, for this report, we excluded them because our focus is on costs related only to MDA. In addition, because no sentinel sites were active in 2008–2009, there were no sentinel site costs to be included in the monitoring and evaluation category.

Costs were also categorized by input: personnel, per diem, travel/transportation, equipment/facilities, supplies and other recurrent operating costs, and intervention drugs. Drugs for serious adverse effects were purchased as supplies by HSC and MSPP; those obtained by IMAWH were donated. The information concerning human resources devoted to NTDs was gath-

ered through retrospective interviews (short questionnaire) of selected staff from implementing organizations. Measurement of volunteer time was not included in the cost analysis.

Per diems issued to MDA volunteers (e.g., community leaders, promoters, distributors, and school inspectors) were included in the analysis. The analysis did not include in-kind or opportunity costs to the people receiving drugs through the MDA campaigns.

Capital costs, defined as items with a life expectancy of more than one year, were collected for transport (vehicles), equipment (computers and printers), and facilities inputs. These costs were annualized by using a procedure that included years of useful life, scrap value, and a discount rate of 3%.¹⁰

The cost data were collected in U.S. dollars and Haitian Gourdes, which were converted to U.S. dollars by using historical exchange rate information calculated during the study period (May 2008–April 2009) by the Financial Management Service of the U.S. Department of the Treasury.

A modified version of the protocol for costing integrated NTD studies¹⁰ in 2008–2009 accounts for the differences in the activities categories used in 2002. The 2002 study collected data for the following activities: mapping, social mobilization, the delivery of the MDA intervention, adverse event treatment, monitoring, and general administration.⁸ Thus, certain costs could have been classified under different activities in 2002 and in 2008–2009, as in the case of training, which is a separate category in this study but was included in the social mobilization and MDA categories listed in the report by de Rochars et al.⁸ Adverse event treatment was a separate activity category in 2002, but in the recent cost study, the acquisition of the adverse event drugs was considered part of the expenditures for the delivery and distribution of the intervention.

The 2002 cost analysis used the same input categories as the current study, with one exception; per diem for program-related activities was included in personnel costs. Subsequent protocols have separated it from other categories because it is easier to gather independently and represents an important

TABLE 2
MDA cost categories, Haiti*

Activity	Definition
Advocacy	Included visits to key stakeholders and opinion leaders at all levels to garner political and financial support for NTD program interventions.
Mapping	Included epidemiological mapping of NTDs included in the integration package.
Social mobilization and education	Included formal and informal IEC for NTD interventions, such as production of materials, radio, and television spots. Mobilization included sensitization of and awareness-raising among all community leaders and members to accept the intervention program before activity begins.
Training	Included training for any aspect of NTD interventions for health system employees and community volunteers.
Drug distribution	Included all aspects of implementing MDA from national level to community level, including treatment of severe adverse reactions.
Field supervision	Included routine supervision of used personnel and volunteers during drug distribution and M&E activities.
Data management	Included all routine data collection—treatment and programmatic data; data entry and analysis; and report generation, writing, distribution, and dissemination.
M&E	Included all routinely scheduled monitoring of program activities. Included program reviews (e.g., midterm review/evaluation, impact evaluation, special projects). Included all aspects related to the evaluation such as preparation of protocol, data collection, data analysis, and reporting. Included investigations of severe adverse reactions.
Planning	Involved planning and budgeting for all activities in the NTD program for the year.
Procurement	Included ordering and purchasing of drugs, equipment, and supplies.
Morbidity control and surgery	Involved field and clinical management of disease, including hydrocele surgery for LF.
Other	Any other activity not falling into the above categories.

* Adapted from the protocol of MaFarland and Hooper.¹⁰ MDA = mass drug administration; NTD = neglected tropical disease; IEC = information, education, and communication; M&E = monitoring and evaluation; LF = lymphatic filariasis.

cost component. Documentation of the proportion of personnel time devoted to different program activities was done primarily through interviews with program administrators.

The 2002 cost per person treated of U.S. \$1.30 was adjusted for inflation to the year 2008 by using the inflation gross domestic product deflator (annual), which “shows the rate of price change in the economy as a whole,” and not all prices in all sectors may have changed at the same rate.¹¹

Data analysis. The data collected were entered into a Microsoft (Redmond, WA) Access database and extracted to Microsoft Excel for analysis. Retrospective survey data from program employees provided the proportion of time each employee dedicated to NTD activities. This proportion was used to calculate the salary amount included for each staff member as costs to the MTN Program. For each implementing partner, the size of the population treated in the study communes was divided by the size of the population in all communes to calculate a proportion of salary costs applicable to the study communes (Table 3).

In addition, for IMAWH, cost data were collected in aggregate for all communes in which MDA was implemented in 2008–2009. Therefore, this proportion was applied to all costs collected. For HSC and MSPP, costs other than staff annual compensation were collected for the study communes only.

The proportion of study costs applicable to the study communes for each partner was also used to allocate the cost per partner of a coverage study conducted in February 2009 after completion of the MDA. Designed by CDC and funded by USAID, the Bill and Melinda Gates Foundation, UND, and CDC, the study collected data in 10 communes. The results for this study will be reported elsewhere.

The percentage of time devoted to NTD activities collected in the retrospective personnel interview was applied to other input categories, such as transportation, recurrent costs for supplies, and recurrent and capital costs for facilities and equipment for IMAWH and HSC, which were collected at an organization level. Information about per diem was collected by activity. All drug costs were allocated to the procurement activity as an input.

To obtain drug costs, the size of the population treated (collected from MSPP coverage data) was used to calculate the amount of the DEC and albendazole distributed during the MDA. The multiplier used for DEC was 6.9 tablets per person and was derived from an analysis of previous patterns of drug distribution in Haiti. The Haiti MTN Program used 50-mg tablets, and the dose per person ranged from 50 mg to 400 mg, depending on age.⁵ The multiplier used for albendazole was 1.1, which included the standard 10% excess to account for wastage (GlaxoSmithKline, unpublished data). The drug costs were calculated using the following data: U.S. \$0.036 per DEC tablet distributed by IMAWH (IMAWH, unpublished data), U.S. \$0.0048 per DEC tablet purchased by UND for distribution by HSC and

MSPP (UND, unpublished data), and U.S. \$0.19 per albendazole tablet (GlaxoSmithKline, unpublished data). GlaxoSmithKline changed the valuation of the donated albendazole in late 2008 (published in 2009) to U.S. \$0.045 per tablet. Because the drugs were obtained before that date, we have used the earlier valuation (GlaxoSmithKline, unpublished data.)

The summary measure calculated is the cost per person treated. We report it in two ways: 1) program costs, which include the costs of transportation, supplies, equipment, and facilities (if applicable); and the cost of DEC. 2) Economic costs include those inputs, as well as the value of the albendazole donation.

RESULTS

Cost analysis estimates are based on the data collected, covering MDA efforts in nine of the 10 communes originally selected: Bassin Bleu, Cabaret, Ennery, Grande Rivière du Nord, Gros Morne, Leogane, Port de Paix, Verrettes, and Ste Suzanne. Cost data for the tenth commune, Limbe/Bas Limbe, were not available at the time of the study. Approximately 663,261 persons were treated in the 2008–2009 MDA in these nine communes. A total population of 2,890,719 was treated in the 55 communes in Haiti in 2008–2009.

The program cost for the treatment of 633,261 persons in the nine study communes, excluding the cost of the albendazole donation from GlaxoSmithKline, amounted to U.S. \$264,970, or U.S. \$0.42 per person treated. The DEC purchase costs totaled U.S. \$15,274. Extending the estimate to the 55 communes listed as participating in the MDA in 2008–2009, which included treatment of 2,890,719 persons, totaled U.S. \$1,214,102. Total program and economic costs and program and economic costs per person for the targeted and treated populations and by implementing partner are shown in Table 4.

Taking the economic costs into account, which include the cost of donated albendazole, we estimated the MDA cost to be U.S. \$403,000 and the average economic cost per person treated as U.S. \$0.64. The economic cost for treating 2,890,719 persons in the 55 MDA communes was approximately U.S. \$1,850,060. The drugs represented 37% of the total.

For program costs, most resources were dedicated to the activities of delivery and distribution (50%), training (15%), and field supervision (8%, which could have covered supervision of either of the two previous activities). Distribution of program costs by activity is shown in Figure 3.

The most substantial inputs included per diem (35% of total economic costs and 52% of program costs), supplies and other recurrent costs (14% of total economic costs and 21% of program costs), and personnel (7% of total economic costs and 11% of program costs). Per diem costs to volunteers and program personnel for drug distribution were 69% of total drug distribution costs. The analysis included four IMAWH

TABLE 3
Proportion of population treated in study communes versus total communes, by implementer, Haiti*

Implementer	Study communes	2008 implementation communes	Population† treated in study communes	Population† treated in total communes	Population† treated in study communes (%)
IMAWH/USAID	4	26	238,416	1,393,466	17
HSC/UND	2	9	165,829	583,106	28
MSPP	3	9	229,016	528,703	43

* IMAWH = IMA World Health; USAID = U.S. Agency for International Development; HSC = Hôpital Ste. Croix; UND = University of Notre Dame; MSPP = Ministry of Public Health and Population.

† Source: Haitian Institute of Statistics and Informatics.

TABLE 4
MDA cost estimates for nine study communes (US \$), Haiti*

Implementing organization	No. study communes	At-risk population	Targeted (eligible) population	Population treated	Coverage rate (reported†) (treated/at-risk)	Total MDA economic cost	Economic CPPT	Total MDA program cost	Program CPPT
IMAWH	4	251,430	213,715	238,416	95%	169,150	0.73	119,321	0.50
HSC	2	235,794	200,424	165,829	70%	104,308	0.62	69,650	0.41
MSPP‡	3	295,933	251,543	229,016	77%	127,038	0.55	79,173	0.34
Total study communes	9	783,157	665,682	633,261	78%	403,000	0.64	264,970	0.42
Projection to total Haiti MDA 2008–2009§	55	3,413,383	2,907,497	2,890,719	85%	1,850,153		1,214,102	

* MDA = mass drug administration; CPPT = costs per person treated; IMAWH = IMA World Health; HSC = Hôpital Ste. Croix.

† Not verified by coverage surveys.

‡ Approximately US \$37,658 of the Ministry of Public Health and Population costs were funded by the University of Notre Dame.

§ Based on the 55 communes for which there is information documenting the MDA.

personnel (program manager, driver, accountant, and pharmacist/logistician), five HSC personnel (program director, administrator, depot manager, education officer, and accounting administrator), and six national government personnel (national coordinator, national coordinator for education, administrator, nurse program supervisor, nurse evaluation officer, and nurse communications officer). These inputs as a proportion of total economic and program costs are shown in Table 5. Economic costs shown in US dollars, disaggregated by inputs and activities, are shown in Table 6.

USAID funding through IMAWH accounted for 46.3% of the program costs. UND and its partners provided 43.4% of the funds. This included approximately U.S. \$37,658 provided to MSPP by HSC for the communes that the MSPP was responsible for coordinating. The MSPP contribution was 10.3% of all program costs.

For the earlier study, De Rochars and others reported a cost per person treated (i.e., the cost excluding donated drugs and volunteer time) of U.S. \$2.23 in Leogane in 2000 (the first year of MDA in Haiti), U.S. \$1.96 in 2001, and U.S. \$1.30 in 2002.⁸ When adjusted for inflation, the 2002 price is equivalent to U.S. \$3.20 in 2008.

Sensitivity analysis. The inputs that consumed the highest proportion of resources, excluding the costs of the donated drugs, included per diem (51%), supplies and other recurrent costs (21%), and personnel (11%). We performed sensitivity

analyses to assess how much changes in the value of these inputs would affect overall results. Each input was increased between 10% and 300%. The results for all three at 300% were U.S. \$1.33 for per diem, U.S. \$0.66 for supplies and other recurrent costs, and U.S. \$0.59 for personnel. With large increases in per diem, supplies, or personnel, the resulting cost per person treated is within an acceptable range considering the current program cost per person treated (U.S. \$0.41) and the cost for the Leogane MDA in 2002 (U.S. \$1.30). When all three inputs were increased simultaneously, the cost per person treated reached the end of the range at U.S. \$1.28 (200% increase) and went beyond it to U.S. \$1.79 (300% increase).

Limitations. This study set out to collect cost data for 10 communes. Nine are included in this analysis because the data available from IMAWH did not include costs for Limbe/Bas Limbe, which were funded at the time by UND. Capital costs, which tend to be low in these programs, could have been underreported, particularly those capital costs of MSPP. Because some of the commune-level cost data came from the central level and the partners sought to maximize costs with joint activities, it was difficult to produce differential estimates at the commune level.

The study did not report a per person cost per commune because not all partners carried out their activities in the same way. Certain partners minimized costs through joint activities, involving groups of communes at one time, particularly training. Thus, there was no effort to explore cost per person and coverage per commune. All three partners reported aggregate coverage rates that were above the WHO-recommended 65% of total population coverage.

DISCUSSION

The differences in the cost per person treated among the partners can be attributed in part to start-up costs associated with implementing the first round of MDA in some communes. IMAWH had slightly higher program costs (U.S. \$0.50

FIGURE 3. Distribution of estimated program costs by activity in the nine study communes, Haiti, 2008–2009 mass drug administration. Mob&Ed = Mobilization and Education; MGMT = management; M&E = monitoring and evaluation.

TABLE 5
Inputs as a percentage of total economic and program costs, Haiti

Inputs	% Of total economic costs	% Of total program costs
Equipment/facilities	3	5
Supplies/recurrent costs	14	21
Transportation	3	5
Per diem	35	51
Personnel	7	11
Intervention drugs	37	7

TABLE 6
Program input economic costs by activity (US \$), Haiti*

Input	Advocacy	Mapping	Training	Distribution	Field supervision	Social mobilization and education	Data management	M&E	Planning	Procurement	Other	Total
Equipment/facilities	233	—	1,429	1,242	2,004	1,535	1,906	537	2,484	687	509	12,567
Supplies/recurrent costs	986	—	11,648	31,270	340	9,472	85	1,292	170	100	170	55,036
Transportation	298	264	1,802	3,953	2,348	698	879	3,142	1,383	393	—	10,725
Personnel	883	340	4,969	3,918	5,129	2,083	3,900	865	4,368	2,206	766	29,427
Per diem	3,280	—	20,617	91,505	10,747	3,841	—	7,517	185	—	154	131,424
DEC	—	—	—	—	—	—	—	—	—	15,274	—	—
Albendazole	—	—	—	—	—	—	—	—	—	132,352	—	—
SAE	—	—	—	—	—	—	—	—	—	5,678	—	153,304
Total	5,681	604	40,465	131,888	20,569	17,629	6,770	13,353	8,590	154,158	1,599	403,000

* M&E = monitoring and evaluation; DEC = diethylcarbamazine; SAE = serious adverse events.

per person treated) than either HSC (U.S. \$0.41) or MSPP (U.S. \$0.34). This was the first year for MDA for the four IMAWH communes included in the cost analysis, which allocated approximately U.S. \$0.13 per person treated to training costs. In contrast, in the four HSC communes, which all had participated previously in MDA between one and seven times, approximately U.S. \$0.01 per person treated went to training activities. Similarly, in MSPP communes, which had 2–4 previous MDAs, approximately U.S. \$0.04 per person treated supported training.

The results of the 2008–2009 MDA highlight per diem as an important MDA cost driver. As noted in the results, per diem accounts for 69% of drug distribution costs. This could limit options for achieving further cost reductions.

The MSPP cost per person treated of U.S. \$0.34 for the 2008–2009 study is considerably lower than the costs for the other two partners. This finding may have resulted from the other two partners funding activities such as the coverage survey or, as in the case HSC, directly funding some of the MSPP MDA activities.

In terms of comparisons over time, the program cost per person treated of U.S. \$0.42 for the 2008–2009 Haiti study is considerably lower than the costs for each of the first three years during which the MDA was conducted in Haiti.^{7,8} The cost per person treated had decreased from U.S. \$2.23 in 2000 in Leogane to U.S. \$1.30 in 2002 because the program treated more persons and streamlined its methods for distributing drugs and treating adverse reactions.

Likewise, a portion of the difference between the 2002 and 2008–2009 costs could be attributed to the increase in the size of the population treated. The number of persons treated in Leogane in 2002 represented only 4% of the population treated by MDAs throughout Haiti in 2008–2009.

Since 2002, the MTN Program has honed its methods of implementing MDA, in part by increasing the involvement of local leadership. Given resource constraints at the national level, the program has relied on the expertise and cachet of local community leaders and promoters, which has helped decrease costs and maintain appropriate coverage levels. In 2002, a total of 121,139 persons were treated for U.S. \$157,672 in Leogane. Social mobilization costs in 2002 were 28% of total costs, U.S. \$43,547, or U.S. \$0.35 per person treated, whereas in 2008–2009, these represented 7% and amounted to U.S. \$17,562 or U.S. \$0.03 per person treated. Distribution costs came to 40% of total program costs; in 2009, they represented 50%. Transportation costs decreased from 10% of total costs in 2002 to 5% in 2008–2009. Equipment and facilities

remained within the same range at 4% of total costs in 2002 and approximately 5% in 2008–2009.

The LF Support Center (LFSC) cost analysis of MDA for LF programs in seven countries published in 2007, including the results from 2002 in Haiti, supports the notion of increased cost efficiencies over time, as programs scale up population covered and refine implementation strategies.⁷

The current study documents participation by the MTN Program in an environment where the country's fragile health system depends greatly on outside organizations. Government contribution to LF programs in the LFSC cost analysis ranged from 9% to 99%, with an average of approximately 56% for 5 of the 7 participating countries (there were no data for Haiti). The current contribution of 10.3% for Haiti is similar to the 9% reported by the Dominican Republic in the earlier study.⁷ The 2000–2002 demonstration MDAs in Leogane were carried out with funds from the CDC and UND.⁸

In the LFSC MDA costing study, costs per person treated, excluding drug donations and volunteer costs, for countries other than Haiti ranged from U.S. \$0.11 to U.S. \$1.87.⁷ The current program costs per person treated for the MTN Program in Haiti are solidly within this range. Using this estimate, we can project that full geographic MDA coverage of Haiti in 2008–2009, with an estimated total population of 8,145,069, would cost approximately U.S. \$4,170,275, including the costs of intervention drugs, and U.S. \$2,736,743, excluding donated drug costs.

The change in the valuation of albendazole will have a substantial effect on economic costs. In the MDA reported here, the drugs would represent 12% of the costs, including the value of the donated drugs, amounting to a reduction of 25%; the economic cost per person treated would have been reduced to U.S. \$0.47. This finding means that with the new valuation, the economic cost to achieve full geographic MDA coverage in 2008–2009 would have been reduced to close to U.S. \$3 million.

This study restricted the costing analysis to the costs from the perspective of the national program, enabling governments to assess the cost to the national health system of implementing an MDA. Nonetheless, donor management and administrative and pharmaceutical drug costs associated with running a donor-supported program also are significant and often critical to the implementation of many programs. It is recommended that this perspective be addressed in future studies. It is hoped the results of this study will serve as a reference to implementing partners for tracking and analyzing cost trends and evaluating program progress and results.

Received November 9, 2010. Accepted for publication July 6, 2011.

Acknowledgments: We dedicate this manuscript to the memory of Doctor Jean-Francois Vely, Coordinator of the National Programs for Malaria and Lymphatic Filariasis, Ministry of Public Health and Population, Haiti. We thank Michael Ritter for collecting cost data in Haiti; and the Haiti Ministry of Public Health and Population, and its partners in the Haiti Projet des Maladies Tropicales Négligées, IMA World Health, and University of Notre Dame/Hôpital Ste. Croix for their continued support and assistance to this study.

Financial support: This study was supported by the US Agency for International Development, as part of the Neglected Tropical Disease Control Program led by RTI International.

Disclaimer: The contents of this article are the responsibility of the authors and do not necessarily reflect the views of the US Agency for International Development or the United States Government.

Authors' addresses: Ann S. Goldman, Department of Epidemiology and Biostatistics, George Washington School of Public Health and Health Services, Washington, DC, E-mail: sphasg@gwumc.edu. Molly A. Brady, RTI International, Washington, DC, E-mail: mollyabrad@ gmail.com. Abdel Direny, NTD Country Program Manager, IMA World Health, Hôpital Saint Francois de Sales, Port-au-Prince, Haiti, E-mail: abdeldireny@imaworldhealth.org. Luccene Desir, Hôpital Ste. Croix, Leogane, Haiti College of Science, Haiti Program University of Notre Dame Notre Dame, IN, E-mail: Luccene.Desir.2@nd.edu. Roland Ocard, Coordonnateur Programme National de Contrôle de la Malaria, Ministère de la Santé Publique et de la Population, 111 Rue St. Honore Hôpital Militaire, Port-au-Prince, Haiti, E-mail: Roroscar@yahoo.fr. Mary Linehan, U.S. Agency for International Development/Indonesia, American Embassy, Jl. Medan Merdeka Selatan, No. 5, Jakarta 10110, Indonesia, E-mail: marylinehan609@gmail.com. Margaret Baker, Department of International Health, School of Nursing and Health Studies, Georgetown University, Washington, DC, E-mail: mcb93@georgetown.edu.

REFERENCES

1. Conteh L, Engels T, Molyneux DH, 2010. Socioeconomic aspects of neglected tropical diseases. *Lancet* 375: 239–247.
2. UNICEF, 2010. *At a Glance: Haiti*. Available at: http://www.unicef.org/infobycountry/haiti_statistics.html?q=printme.
3. Ministère de la Santé Publique et de la Population, 2010. *Plan Interiminaire du Secteur Sante: Avril 2010–Septembre 2011*. Available at: http://www.mspp.gouv.ht/site/download/plan_interiminaire.pdf.
4. Beau de Rochars MV, Milord MD, St Jean Y, Désormeaux AM, Dorvil JJ, Lafontant JG, Addiss DG, Streit TG, 2004. Geographic distribution of lymphatic filariasis in Haiti. *Am J Trop Med Hyg* 71: 598–601.
5. World Health Organization, 2006. *Preventive Chemotherapy in Human Helminthiasis: Coordinated Use of Anthelmintic Drugs in Control Interventions: A Manual for Health Professionals and Programme Managers*. Geneva: World Health Organization.
6. de Rochars MB, Direny AN, Roberts JM, Addiss DG, Radday J, Beach MJ, Streit TG, Dardith D, Lafontant JG, Lammie PJ, 2004. Community-wide reduction in prevalence and intensity of intestinal helminths as a collateral benefit of lymphatic filariasis elimination programs. *Am J Trop Med Hyg* 71: 466–470.
7. Goldman AS, Guisinger VH, Aikins M, Amarillo ML, Belizario VY, Garshong B, Gyapong J, Kabali C, Kamal HA, Kanjilal S, Kyelem D, Lizardo J, Maleceda M, Mubyazi G, Nitiema PA, Ramzy RM, Streit TG, Wallace A, Brady MA, Rheingans R, Ottesen EA, Haddix AC, 2007. National mass drug administration costs for lymphatic filariasis elimination. *PLoS Negl Trop Dis* 1: e67.
8. de Rochars MB, Kanjilal S, Direny AN, Radday J, Lafontant JG, Mathieu E, Rheingans RD, Haddix AC, Streit TG, Beach MJ, Addiss DG, Lammie PJ, 2005. The Leogane, Haiti demonstration project: decreased microfilaremia and program costs after three years of mass drug administration. *Am J Trop Med Hyg* 73: 888–894.
9. *A Generic Protocol for Analyzing the Costs of Mass Drug Administration Programs for the Elimination of Lymphatic Filariasis*, 2003. Decatur, GA: Lymphatic Filariasis Support Center.
10. McFarland DA, Hooper PJ, 2008. *Protocol for Data Collection of Costs in NTD Integration Projects*. Atlanta, GA: Rollins School of Public Health of Emory University.
11. The World Bank, 2011. *World Development Indicators: Inflation, GDP Deflator (Annual %)*. Available at: <http://data.worldbank.org/indicator/NY.GDP.DEFL.KD.ZG>. Accessed May 20, 2011.