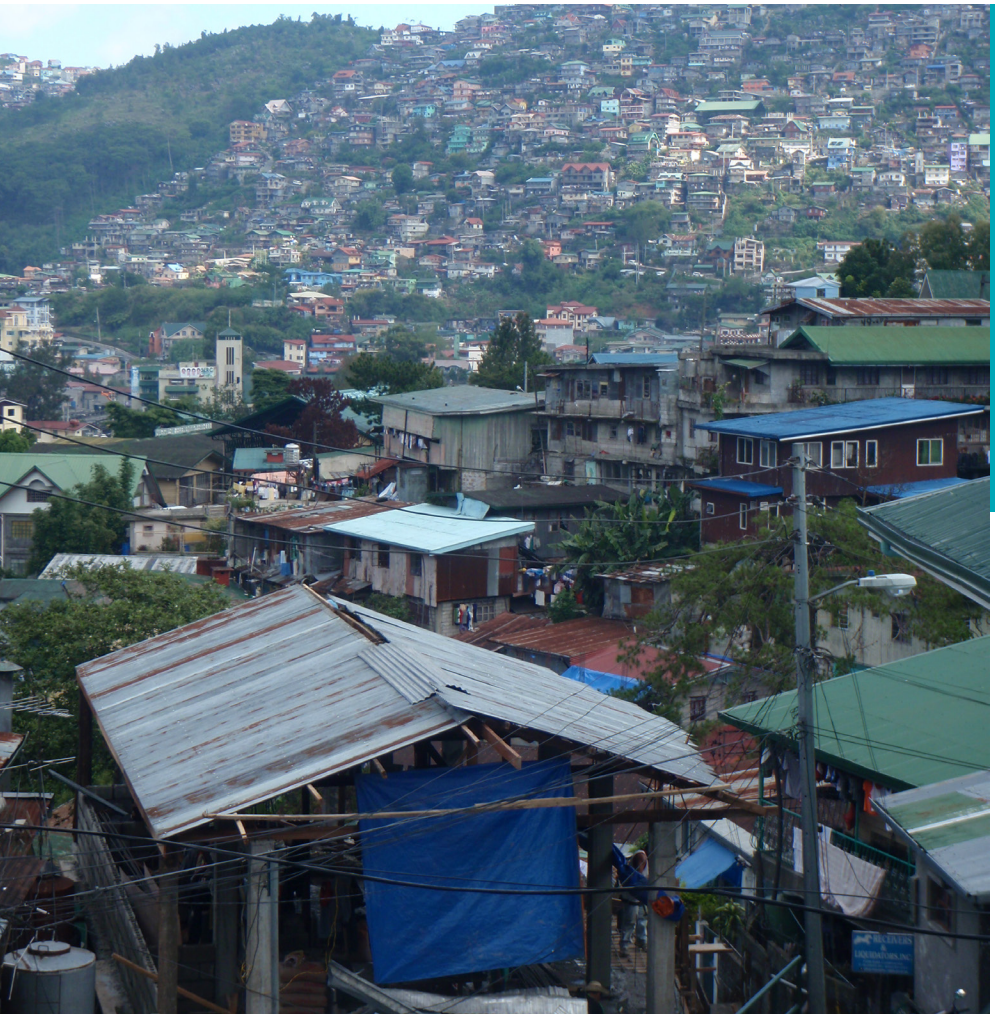

An Investment Case for Malaria Elimination in the Philippines

UCSF Global Health Sciences
Global Health Group

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A report by the UCSF Global Health Group, the Pilipinas Shell Foundation, Inc., and the National Malaria Control and Elimination Program, Philippines

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The **Malaria Elimination Initiative (MEI)** at the University of California San Francisco (UCSF) Global Health Group believes a malaria-free world is possible within a generation. As a forward-thinking partner to malaria-eliminating countries and regions, the MEI genterates evidence, develops new tools and approaches, disseminates experiences, and builds consensus to shrink the malaria map. With support from the MEI's highly-skilled team, countries around the world are actively working to eliminate malaria—a goal that nearly 30 countries will achieve by 2020.

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Contents

Key Terms and Acronyms

Active case detection	ACD
Asia Pacific Leaders Malaria Alliance	APLMA
Barangay health worker	BHW
Bill & Melinda Gates Foundation	BMGF
Department of Health	DOH
Diagnosis	D
Dichloro-diphenyl-trichloroethane	DDT
Field Health Services Information System	FHSIS
Global Fund to Fight AIDS, Tuberculosis and Malaria	Global Fund
Global Health Group	GHG
Indoor residual spraying	IRS
Information, education, communication	IEC
Inpatient	IP
Insecticide-treated bed net	ITN
Long lasting insecticidal net	LLIN
Local government unit	LGU
Malaria Elimination Initiative	MEI
Monitoring and evaluation	ME
National Malaria Control and Elimination Program	NMCEP
National Strategic Plan	NSP
Out-of-pocket	OOP
Outpatient	OP
Passive case detection	PCD
Philippine Malaria Information System	PhilMIS
Philippine Integrated Surveillance and Response	PIDSR
Pilipinas Shell Foundation, Inc.	PSFI
Prevention and vector control	PVC
Program management	PM
Rapid diagnostic test	RDT
Regional malaria coordinator	RMC
Rural health unit	RHU
Severe malaria	SM
Surveillance and epidemic management	SEM
Treatment and prophylaxis	TP
Uncomplicated malaria	UM
Useful life years	ULY
World Health Assembly	WHA
World Health Organization	WHO

Executive Summary

In disease settings, burden is a function of wider socio-economic and political factors that are key determinants in shaping the distribution of disease. The resources currently available for malaria elimination are surpassed by the need. Without evidence and a snapshot of a country's financial landscape, this gap will not be met and gains thus far may be threatened.

The main objective of this study is to develop an investment case that will inform malaria program budgeting and strategic planning, domestic resource mobilization, and advocacy in the Philippines.

The Philippines has made substantial progress towards malaria elimination, reducing cases by 89% and deaths by 98% between 2005 and 2014. These considerable gains have been achieved in part by increased political and financial commitments from both domestic and external sources. While these achievements are worthy of note, the burden of malaria still exists.

In conjunction with the Philippines National Malaria Control and Elimination Program and Pilipinas Shell Foundation, Incorporated, the University of California, San Francisco Global Health Group conducted a micro-costing of the Philippines malaria program in 2015 to estimate the cost of elimination and prevention of reintroduction activities. The cost of resurgence, illustrative of the potential benefits of investing in malaria, and the potential hazards of underinvestment, was calculated using a hypothetical scenario of resurgence based on historical case data. This cost was then used to calculate the return on investment (ROI) of malaria elimination.

We estimated the the total cost of elimination activities in the Philippines in 2015 was 1.03 United States dollars (USD) per capita. The major cost drivers among malaria activities were prevention and vector control (42% of total cost), diagnosis (24% of total cost), and program management (15% of total cost). We estimated the benefits of elimination and prevention of reintroduction by calculating the cost of resurgence under a hypothetical scenario.

Findings in this investment case advocate for continued and increased financing for malaria elimination, both domestically and globally. In an environment of financial uncertainty, malaria programs are confronted with the challenge of mobilizing resources on a domestic scale in the context of a declining disease burden.There are currently several opportunities for resource mobilization in the Philippines at the local level. Among these opportunities is the Sin Tax Reform Bill, which was passed in 2012. This law, which increased taxes on tobacco and alcohol, generated USD 2.3 billion within two years of its passing and increased the Depart-ment of Health budget by 63% in 2015 compared to a 2013 baseline. This sin tax represents a potential sustain-able source of financing and the national malaria program could benefit from earmarked funds from its revenue.

Context

The global movement for malaria elimination is gaining momentum as many countries are experiencing huge successes in reducing the morbidity and mortality from malaria. While elimination targets are being realized, economic and financial challenges must be overcome to ensure that countries can sustain a malaria-free future. To reach countrywide elimination by 2030, the Philippines National Malaria Control and Elimination Program (NMCEP) must secure appropriate funding and political commitment at a time when the focus on malaria is waning and donor funding to malaria-eliminating countries is declining.

The Philippines, made up of 81 provinces dispersed over more than 7,100 islands, has made great progress in malaria control and elimination. Due to the complex geographical and socioeconomic makeup of the country, the NMCEP has embarked on a sub-national approach to malaria elimination, targeting provinces in phases [1]. Over the last ten years, malaria incidence has significantly declined. Between 2005 and 2014, there was an 89% reduction of malaria cases and a 93% reduction in malaria deaths [2]. In 2015, there were 5,135 presumed and confirmed cases and 20 reported deaths [3]. In the same year, 39% of the population was residing in malaria-free zones, 54% in low transmission zones, and 7% inhabiting high transmission zones [3]. Among the 81 provinces of the Philippines, 32 are malaria-free and in the prevention of re-introduction (POR) phase [2], 26 are in the eliminating phase, nine are in the pre-elimination phase, and 14 are in the control phase [4]. According to the National Strategic Plan (NSP), the Philippines aims to declare 50 provinces malaria-free and 21 provinces in the elimination phase (achieving zero indigenous cases) by 2020 [4].

Despite these gains, the malaria program faces challenges in achieving its elimination goal. Indigenous populations can typically be found in geographically remote areas with inadequate access to health care. In the Philippines, the indigenous population make up 16% of the total population but account for 35% of malaria cases [1]. Furthermore, the frequent occurrence of natural disasters, coupled with a highly decentralized malaria program, foster an environment where malaria activities can be disrupted.

To maintain its gains and progress to full elimination, the NMCEP needs to ensure that adequate resources are mobilized to interrupt transmission in malaria-prone areas and prevent re-introduction in malaria-free zones. Historically, when countries experience a decline in malaria, there is a tendency to reallocate resources to other health priorities. A systematic review of malaria resurgence demonstrated that 91% of 75 separate malaria resurgence events were associated with reduced malaria control activities, more than half attributed to resource limitations [5]. Disruptions in funding can play a critical role in the failures of a malaria program.

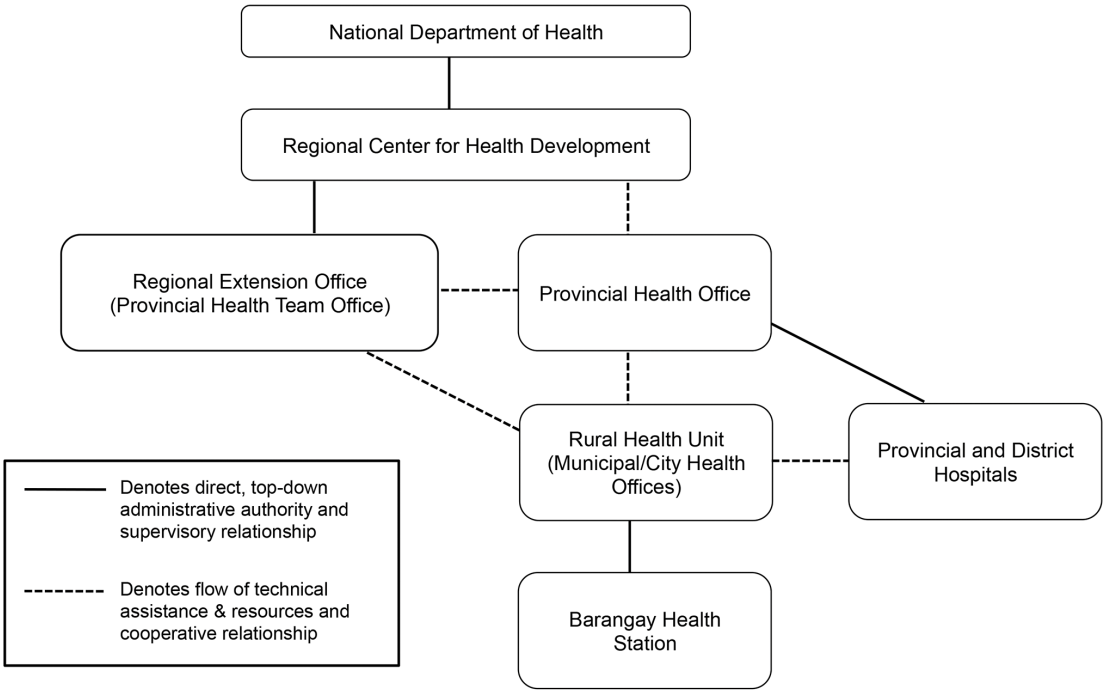
Structure of the malaria program

Due in part to its archipelagic geography, the health system in the Philippines is highly decentralized, characterized by a network of health facilities at the provincial, municipal, and barangay (village) levels, collectively known as local government units (LGUs). Malaria program policies, guidelines, technical training, treatment and vector control strategies, and logistics procurement are delivered by the national government through the NMCEP and the Department of Health's (DOH) regional offices, while services are delivered by LGUs (see Figure 1) [4, 6]. DOH regional offices were initiated to coordinate health programs and provide support to provinces. Surveillance systems including the Field Health Service Information System (FHSIS), the Philippine Malaria Information System (PhilMIS) established in 2005 in select regions, and the Philippine Integrated Surveillance and Response (PIDSR) implemented in 2009 in certain LGUs, allow for regular monitoring of program performance, but implementation of these systems is fractured largely due to decentralization.

Health system decentralization in the Philippines has generally posed a threat to malaria control efforts. In 1993, decentralization was enacted, resulting in a complete devolution of responsibilities to LGUs. Planning, financing, and health program implementation were transferred from the national DOH to the LGUs, many of which were lacking capacity and resources to effectively function without national support. This transfer of responsibility at the local level inherently contributed to gaps in malaria control efforts and slowed the pace of declining morbidity and mortality. Consequently, DOH regional offices were created to oversee and maintain service delivery at local levels.

Figure 1 illustrates the organization of the Philippines health system in regard to the malaria program. At the top, the national DOH disseminates policies and guidelines to the provinces via the regional offices. The provincial health offices supervise activities at the municipal and barangay levels. The stream of funding begins at the top with the National DOH, but all other levels generate their own funding at their respective levels of the government.

Figure 1. Organization of the health system in the Philippines [7]



The National Strategic Plan (NSP) for 2014–2020 aims to reduce the malaria incidence rate by 80% relative to a 2013 baseline and increase the number of malaria-free provinces from 27 to 50 by the year 2020 [4]. This target is within the elimination timeline set by the Asia Pacific Leaders Malaria Alliance (APLMA), which has committed to eliminate malaria in the Asia Pacific region by 2030 [8].

History of malaria control in the Philippines

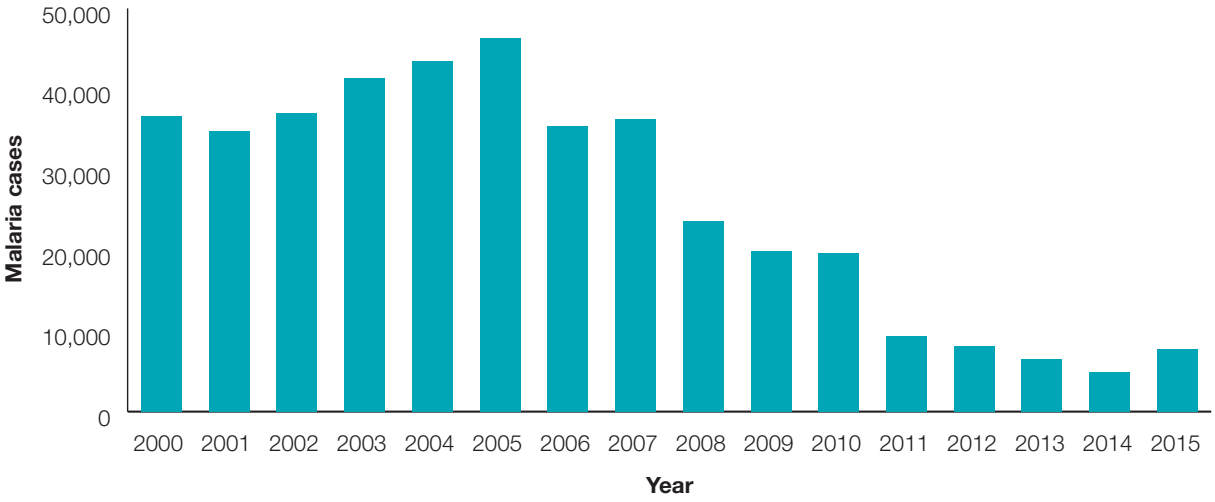
Reports of malaria in the Philippines date back to 1521, yet the first malaria control program was initiated in 1902 [9]. The principal vector is *Anopheles flavirostris*, which breeds in slow flowing water and shaded areas [10]. *An. flavirostris* is anthropophilic and zoophilic, feeds indoors and outdoors, and is considered a foothill and forest fringe species [11]. Less prominent vectors include *An. maculatus*, *An. litoralis*, *An. balabacensis*, and *An. mangyanus*. *Plasmodium falciparum* is the most common type of malaria found in the Philippines, contributing to 81% of cases in 2014, followed by *P. vivax*, which accounted for 17% of all cases [3].

The primary control interventions during the early 1900s included treatment with quinine, net distribution, and targeted educational campaigns. From 1967 to 1982, indoor residual spraying (IRS) with dichloro-diphenyl-trichloroethane (DDT) was the principal vector control strategy, coupled with intensified case investigation and treatment efforts [9, 11].

The malaria program benefited from logistical and financial support from the World Bank-funded Philippine Health Development Project (PHDP) from 1989 to 1993, which was dedicated to improving vector control and case finding in order to counter the malaria resurgence that occurred in the 1980s [12]. In 1992, the Philippines endorsed a novel global strategy for malaria control that included microscopy training for diagnosis, treatment of *P. falciparum* infections with chloroquine as the first-line drug, sulfadoxine-pyrimethamine as the second-line drug, and quinine for severe or complicated cases [13]. Malaria cases have been in decline ever since (Figure 2).

In 1999, the Health Sector Reform Agenda was established to address gaps in the existing health care delivery system [14]. System fragmentation was prioritized, eventually yielding fiscal autonomy at the local level. This restructuring produced several benefits, including the Philippines' Roll Back Malaria Project that was crucial in cultivating the new malaria control and elimination program.

Figure 2. Malaria incidence in the Philippines since 2000



Significance of the Study

This study was conducted in collaboration with the Philippines NMCEP and the Pilipinas Shell Foundation, Incorporated (PSFI) to build an investment case for malaria elimination. The findings of the investment case can be used by the NMCEP in its advocacy and resource mobilization efforts to ensure that sufficient financial resources and political commitment are maintained for malaria elimination. The findings can also inform malaria program budgeting and planning.

Objectives

The objective of this study is to estimate the costs and benefits of eliminating malaria from the Philippines. An investment case for malaria elimination involves estimating the costs of elimination activities over time and comparing that with the purported economic benefits of elimination. A return on investment (ROI) is calculated, which is the ratio of net benefits over total costs. In addition, the financial landscape for malaria elimination is assessed in order to determine any financial gaps and, if necessary, propose mechanisms to mobilize additional funding.

In building the investment case for the Philippines, this study set out to:

1. Estimate the current and future costs of malaria elimination and POR activities in the Philippines;
2. Understand the benefits of malaria elimination and POR, relative to an alternative scenario of resurgence; and
3. Estimate any funding gaps and explore potential sources of financing for malaria elimination.

Methods

This study estimated (1) the current costs of elimination and POR activities and (2) the cost of a resurgence. Under the cost of elimination and POR, we estimated the cost of current malaria activities in the Philippines and projected future costs of elimination activities over a five-year period. To estimate the cost of resurgence, we created a resurgence scenario based on incident cases and deaths from a resurgence in 2003–2008. The cost of resurgence, which represents the benefits of continued investments in malaria elimination and POR, was used to calculate an ROI. Resurgence cost is then compared to estimate the ROI of the current malaria program.

Study design

This study used a mixed-methods approach including a literature review, data extraction from existing reports and information systems, cost data collection and analysis, and key informant interviews. The time frame used for analysis in this study is six years (2015–2020). All costs were expressed in USD, using a mid-year exchange rate of 44.41 Philippine Pesos (PHP) per USD.

Literature review

We conducted a comprehensive literature review to gain an understanding of the current and historical structure and activities of the Philippines malaria program, as well as the financing landscape for malaria. Information was extracted from records at the national and regional levels and grey and published literature including those from Internet-based searches.

Key stakeholder interviews

Interviews were conducted with health staff involved in malaria activities at the national, regional, and LGU levels. Interviews provided insight into various malaria interventions employed, as well as the amount of time each individual allocated specifically to malaria. Regional malaria coordinators and other malaria staff were used as liaisons to document elimination-related activities and costs at LGUs. Table 1 outlines the number of individuals interviewed at each level.

Table 1. Total number of interviews conducted at each level of the healthcare system

Level	Total number interviewed
National	20
Regional	31
Provincial	16
Municipal	72
Total	139

Costing approach

Cost of elimination and POR

This study employed a micro-costing or ingredients-based approach. Key cost inputs (i.e., capital, consumables, personnel, and services) were identified and valued to produce cost estimates for all current malaria activities. We obtained cost data by reviewing expenditure records, financial reports, and budgets. When the most current cost was unavailable, past year average expenditures and program expense reports were used as estimates to fill in any gaps in information. This study was conducted from the perspective of the national government or public sector provider. Health worker time, donations, and in-kind contributions were all included.

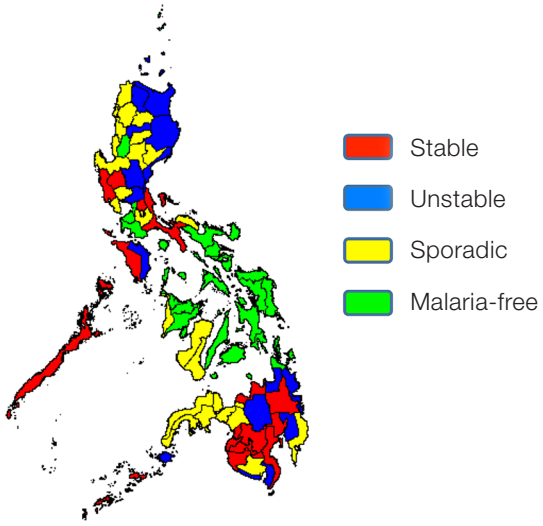
Cost of resurgence

The cost of resurgence was calculated based on the outcomes of a hypothetical resurgence scenario constructed using historical data and expert opinion from the NMCEP.

Study setting and sampling

Data collection on cost was done at the NMCEP and in five provinces across five separate regions, namely Rizal (Calabarzon Region), Oriental Mindoro (Mimaropa Region), Negros Oriental (Central Visayas Region), Abra (Cordillera Administrative Region), and Quirino (Cagayan Valley Region). These provinces were purposely sampled with the help of expert opinion from the NMCEP. These sampled provinces were understood to be representative of the remaining non-sampled provinces based on (1) population number and (2) elimination status. Figure 3 depicts the patterns of transmission across the country.

Figure 3. Patterns of transmission in the Philippines per province in 2013 [12]



Data collection

A data collection tool depicting relevant cost categories for activities and an interview guide were developed to facilitate data collection and entry, as seen in Annexes 2 and 3 respectively. Interviews were conducted in a semi-structured format with key malaria program personnel who were involved with program activities and knowledgeable about spending patterns and records. For staff whose responsibilities extended beyond the malaria program, participants were asked what percentage of their time was spent on malaria activities. Individual costs were extracted and aggregated according to pre-existing categories found in Table 2.

Data collection for the costing portion of this study took place between March and July 2015. Research assistants involved in the data collection process underwent training for the activity.

Ethical considerations

Ethical clearance from the University of California, San Francisco Committee on Human Research was not required. Written or verbal informed consent was obtained before each interview, after reminding subjects that they could decline to answer any question. A copy of the signed form was provided to each participant.

Data Analysis

Estimating costs of elimination and POR

Cost data was extracted, organized, and aggregated according to (1) funding source, (2) input type, and (3) activity (see Table 2).

Table 2. Organization of cost categories

Cost by source	Cost by input	Cost by activity
1. Domestic 2. External	1. Capital 2. Personnel 3. Consumables 4. Services	1. Prevention and vector control (PVC) 2. Diagnosis (D) 3. Treatment and prophylaxis (TP) 4. Surveillance and epidemic management (SEM) 5. Monitoring and evaluation (ME) 6. Information, education, and communication (IEC) 7. Program management (PM)

Specific activities within these categories are outlined in Annex 2.

Cost by source

Costs were disaggregated into external funding, predominantly the Global Fund to Fight AIDS, Tuberculosis and Malaria (Global Fund) and domestic funding (national DOH and LGUs).[A]

Cost by input

Costs were categorized based on four inputs of production: capital, personnel, consumables, and services. Capital costs consisted of all capital inputs including vehicles, buildings and office space, furniture, computers and other permanent supplies. Personnel costs included salaries, allowances, and benefits and any other compensation to staffs involved in malaria. Consumable costs included office and laboratory supplies, medicines, insecticides and other products. Services costs included utilities, transport (domestic and international), maintenance, security, and training.

A Health service delivery mechanisms in the Philippines can be best described as decentralized with high levels of fragmentation in the overall structure of the system. The national DOH provides a comprehensive health budget and disburses money to sub-national bodies for specific activities. Financing for malaria activities is thus seen as an extension from the regional DOH, feeding into provincial and municipal bodies, however LGUs are expected to secure their own funding as well.

Capital goods were annualized and discounted using common useful life years (ULYs) for capital goods and standard annuity factors (see Annex 5 for ULYs used). A standard 3% discount rate was used. Maintenance costs for equipment, vehicles or buildings were calculated using actual information on expenditures of maintaining these. Shared resources such as percentage of health workers time spent on each activity were determined through self-reporting. The cost of medicines was obtained using actual procurement costs from the DOH and its regional offices.

Cost by activity

Costs were analyzed across seven activity groups for malaria: prevention and vector control (PVC), diagnosis (D), treatment and prophylaxis (TP), surveillance and epidemic management (SEM), monitoring and evaluation (ME), information, education, communication (IEC), and program management (PM). Despite the potential integration of some of these activities, they were separated to facilitate analysis and to identify cost drivers. The detailed interventions and activities included under each of these categories are provided in Annex 2. Resources were apportioned across the activities based on self-reporting from interviewees on the time spent on each activity.

Estimating cost of elimination at the national level

To obtain national level estimates of the cost of elimination in the Philippines, we first calculated the cost per capita in each of our five sample provinces by dividing total program costs by each jurisdiction's total population. We then matched the 76 non-sampled provinces to our five sample districts based on malaria program phase (Annex 4).

We generated the total cost of malaria elimination for 2015 in the non-sampled provinces by multiplying their respective population figures by the average cost per capita of their matched provinces. For the non-sampled provinces in control, pre-elimination, and elimination phases, we used the average per capita cost of our three pre-elimination and elimination sample provinces (i.e., Rizal, Oriental Mindoro, and Negros Oriental). Similarly, we used the average cost per capita of our POR sample provinces on the non-sampled POR provinces. Costs across all 81 provinces were then added to the costs of the NMCEP to estimate the total cost of malaria activities for the entire country for 2015. We projected the cost of malaria elimination from 2016 to 2020 by adjusting for economic growth and accounting for modifications and introductions of activities as reported by the Regional Malaria Coordinators (RMCs).

Estimating cost of resurgence

We estimated the benefits of malaria elimination and POR of malaria in the Philippines by calculating the costs of a potential resurgence as a counterfactual scenario. The cost of resurgence is based on three broad dimensions of cost: (1) direct cost to the health system, (2) direct cost to individual households, and (3) indirect cost to society.

Direct costs to the health system were measured in terms of direct cost savings to the health system due to reduced utilization of health services related to malaria, leading to a reduction in the cost of delivering malaria services. The direct benefits to households include cost savings due to the reduced out-of-pocket (OOP) expenditure for preventing malaria and seeking care for malaria. The indirect benefits of malaria elimination to society included the increase in economic productivity, averted lost earnings to healthy life years, and longevity gained due to reduced malaria burden.

Table 3 illustrates the organization of categories used to calculate the cost of resurgence. The dimensions of the cost of resurgence are elaborated further in the results section. The parameters used to estimate the cost of resurgence and their data sources are listed in Table 5.

Table 3: Dimensions of cost of resurgence

Direct cost to the health system	Direct cost to individual households	Indirect cost to society
1. Cost due to increased health service utilization for malaria 2. Cost of increased vector control 3. Cost of treatment for population with special needs (children under 5) 4. Cost of increased diagnosis 5. Cost of human resource training and community education	1. Out-of-pocket expenditure incurred due to malaria	1. Cost due to loss of life due to malaria mortality 2. Cost due to loss of productivity due to malaria morbidity

Direct cost to the health system

Cost due to increased health service utilization

Delivering health care services to malaria patients was calculated separately for uncomplicated malaria (UM) and severe malaria (SM). Unit costs for UM and SM were multiplied by the number of potential cases to estimate the cost to the health system because of increased utilization of services.

Inpatient care for severe malaria

Inpatient care costs were unavailable because malaria services are not disaggregated from general health services. Therefore, the average cost of hospital admission was taken from the World Health Organization's Choosing Interventions that are Cost Effective Project (WHO-CHOICE) unit cost estimates for service delivery, adjusted for inflation, and adding the costs of drugs, diagnostics, and supply chain. [15]. In all cases the supply chain costs were estimated to be 25% of the acquisition cost of the product and added to the unit cost. The cost of an average course of malaria medicines as reported by the NMCEP was also added to obtain the total cost of an inpatient admission.

Outpatient care for uncomplicated malaria

Similar to the cost of inpatient care, the cost estimates were derived from WHO-CHOICE. The cost of an average course of antimalarials was added to the OP cost.

Cost of increased vector control to control a resurgence

The primary vector control strategies in the Philippines are long-lasting insecticide treated nets (LLINs) and indoor residual spraying (IRS) [16]. Under a resurgence scenario, we assumed that the NMCEP will mobilize to reach certain coverage targets for vector control in order to reduce the impact of the resurgence. For LLIN distribution and IRS coverage, we assumed the parameters in Table 4.

Table 4. Intervention coverage under a resurgence scenario

Year	IRS Coverage	LLIN Coverage
2016	59%	76.5%
2017	99%	76.5%
2018	72%	76.5%
2019	32%	76.5%
2020	12%	76.5%

Additionally, we assumed 1 net per 1.8 people, based on WHO recommendations in the provinces currently at risk [17]. Costs for procurement, distribution, and delivery of LLINs and IRS were obtained from the WHO and the Global Malaria Programme and were added to the cost of vector control.

Cost of treatment for a population with special needs
In this report, the special needs population refers to children under the age of five years, as they are at higher risk of malaria and one of the most vulnerable groups affected by this disease. In 2016, 23% of malaria cases were among children under 5. We estimated the number of children under 5 who would receive treatment and multiplied that by the cost of treatment for *P. falciparum*, *P. vivax*, and mixed infections.

Cost of increased diagnosis of fever cases for malaria
Under a resurgence scenario, we assume diagnostic testing (both rapid diagnostic tests [RDTs] and microscopy) will increase. Based on the slide positivity rate from 2014, we assumed 1.6% of suspected cases tested for malaria would be positive [3]. To calculate the cost of increased diagnosis, we multiplied the number of non-malarial fevers by the average cost of a test (average of RDT and microscopy slide) and the cost of administering the test.

Cost of human resource training and community education
Under a resurgence scenario, we assume an additional portion of human resources (personnel) will need to be trained, as well as supplementary costs associated with providing further IEC to the community. The cost for training and cost for IEC was taken from our analysis (1% and 6% of the malaria program costs, respectively) and assumed to be doubled their estimated costs in 2015.

Direct cost to the individual household

OOP expenditure incurred
The OOP expenditures incurred due to malaria included both direct and indirect costs incurred by households for preventing or seeking care for malaria. These included expenses for patients and their caretakers to access health facilities such as transportion costs as well as the expenditures on products for preventing malaria, such as bed nets, mosquito coils, and repellents. While these items are not costly, the fact that some of them are consumed on a regular basis could be a burden to the family budget.

Indirect cost to the society

Cost due to loss of life
To estimate the potential social value of life lost due to malaria, we employed the full income approach endorsed by the Lancet Commission on Investing in Health [18]. The full income approach combines growth in national income with the value individuals place on increased life expectancy—i.e. the value of their additional life years (VLYs). This approach accounts for people's willingness to trade off income, pleasure, or convenience for an increase in life expectancy. One VLY is the value in a particular country or region of a 1-year increase in life expectancy.

To estimate the cost of lives lost due to malaria mortality using the full income approach, we multiplied adult deaths attributed to malaria from UN Data estimates between 2005–2010 by the remaining life years at death and the VLYs. The average life expectancy at 40 years was used as the life years lost due to premature death.

Cost due to losses in productivity due to malaria
The lost earnings from an episode of illness due to malaria can have a significant impact on society. Cost due to productivity losses (loss in income/productivity) was estimated by multiplying potential malaria cases among adults, average days lost to a single episode of malaria, and the gross domestic product (GDP) per capita [19].

Other societal costs of resurgence
The costs of resurgence extend beyond health and these indirect costs likely account for the largest share of the societal burden of malaria. Frequent illness episodes due to malaria and associated school absenteeism have been shown to affect children's educational performance [20]. In addition to its debilitating physical impacts, malaria could affect the cognitive abilities of children imparting negative consequences on educational performance [21].

In addition to these effects, resurgence of malaria is likely to induce many other macro-economic consequences (for example via changes in demographic composition). Such societal costs are, however, very difficult to quantify.

Return on investment

The ROI of malaria was calculated as the ratio of net benefits over total cost. We recognize that computing the cost of a resurgence and the cost of elimination/POR uses marginally different methods. When computing the cost of elimination, we are using a public provider perspective by way of ingredients-based micro costing. Calculating the cost of resurgence uses a broader perspective to account for societal-level benefits via multiplying costs and quantities estimated under the resurgence scenario.

Uncertainty analysis

To compute the cost of elimination and the cost of resurgence, several underlying assumptions are in place. A sensitivity analysis was conducted using various levels of discount rates (1–7%) for costing capital resources to estimate the uncertainty of these costs estimates. We recognize that computing the cost of a resurgence and the cost of elimination/POR uses marginally different methods. When computing the cost of elimination, we are using a public provider perspective by way of ingredients-based micro costing.

Table 5. Parameters and values used

Parameter	Values	Reference
Population and economic inputs		
Population	Year 2010: 92,337,852 Year 2015: 101,109,948 Year 2016: 102,768,151	[19]
GDP per capita (in current USD)	Year 2015: USD 2,904.20	[19]
GDP growth rate	Year 2014: 6.1%	[19]
Malaria epidemiology		
Number of cases	Year 2015: 48,441 Year 2016: 50,850 Year 2017: 46,342 Year 2018: 35,405 Year 2019: 36,235 Year 2020: 23,655	Cases projected to calculate a resurgence
Distribution of cases by gender	Year 2014: Male 58%, Female 42%	NMCEP
Distribution of cases by age	Year 2014: <18 years: 65%, >18 years 35%	NMCEP
Number of deaths	Year 2016: 15 Year 2017: 23 Year 2018: 34 Year 2019: 51 Year 2020: 24	Deaths projected to calculate a resurgence scenario
Proportion of uncomplicated cases	72%	[3]
Proportion of severe cases	28%	[3]
Proportion of *P. vivax* cases	17%	[3]
Proportion of *P. falciparum* cases	81%	[3]
Slide positivity rate	16.72%	[3]
Total blood films	1,582,111	[3]
Proportion of population protected by IRS	Population covered Year 2016: 59% Year 2017: 99% Year 2018: 72% Year 2019: 32% Year 2020: 12%	Projections based off report from malaria program
Number of LLINs needed	1 LLIN per 1.8 population; coverage at 76.5%	NMCEP
Costs		
Number days lost due to a malaria illness	9.3 days	NMCEP
Cost of OP illness	USD 1.68	NMCEP
Cost of IP admittance	USD 24.49	NMCEP
Cost of malaria medicines (OP)	USD 1.00	NMCEP
Cost of malaria medicines (IP)	USD 8.50	NMCEP
Cost of IRS per person protected	USD 4.37	NMCEP
Cost of LLIN distributed	USD 5.49	NMCEP
Cost of testing non-malaria fevers	USD 1.12 per RDT USD 0.86 per microscopy slide	NMCEP
Out-of-pocket expenditure incurred to the household due to malaria (per episode)	USD 21.84	PQR Database

Children under five years of age (U5)		
Proportion of cases among children under five	Year 2015: 23%	NMCEP
Cost of treatment for *P. falciparum* Cost of treatment for *P. vivax* Cost of treatment for mixed infection	USD 0.59 USD 0.90 USD 0.61	NMCEP
Average treatment cost	USD 0.63	NMCEP

Results

Cost of elimination and POR

The total cost of the malaria program in the Philippines in 2015 was estimated to be USD 103,754,568 or USD 1.03 per capita (ranging from USD 0.13 to USD 2.47 across all provinces).

We also calculated the total cost of the program, excluding capital costs and personnel that are not included in program expenditure. This cost was estimated to be USD 20.15 million in 2015.

Cost by source

Based on the data collected from our five sample provinces and at the national level, roughly 83% of funding was from a domestic source (national or local) and the remaining 18% of funding was from an external source, namely, the Global Fund. The highest proportion of cost was found at the national level (58%), followed by the municipal level (21%), the Global Fund (18%), and provincial at 4% (Figure 4).

Figure 4. Distribution of cost by source

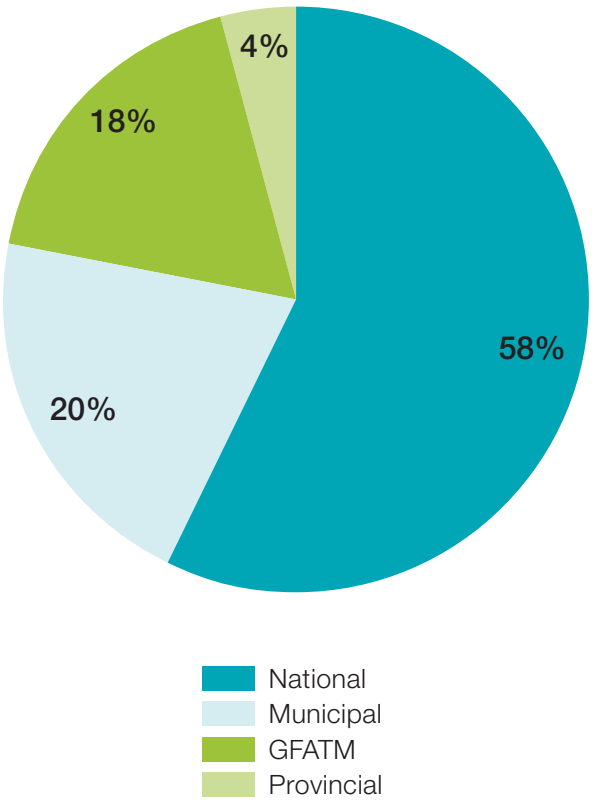
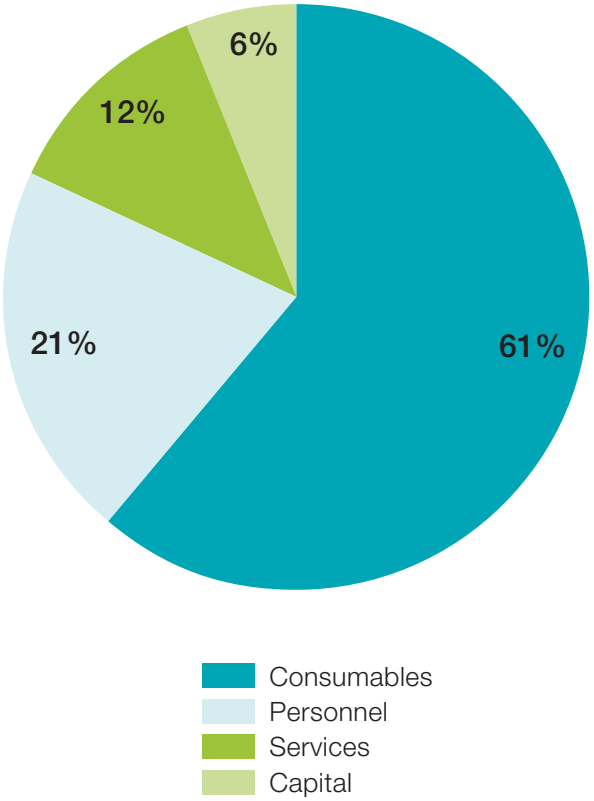


Figure 5. Distribution of total cost by input



Cost by inputs

Consumables (health commodities, including drugs, diagnostics, and insecticides) constituted the largest cost share at 62%, followed personnel at 21%, services at 12% and lastly, capital at 6% (Figure 5).

The input costs varied by sample region as seen in Table 6. For the five sample provinces, the distribution varies slightly, with consumables accounting for the majority of cost in Rizal, Oriental Mindoro, and Negros Oriental. In Abra, capital and personnel had similar proportions, whereas in Quirino consumables and personnel had similar proportions. Capital costs ranged from 2–44%, consumables ranged from 13–76%, personnel ranged from 15–42% and services ranged from 2–27%.

Table 6. Distribution of input costs across sample provinces

Provinces	Capital	Consumables	Personnel	Services
National	3%	74%	15%	9%
Rizal	6%	76%	16%	2%
Oriental Mindoro	2%	68%	21%	9%
Negros Oriental	3%	49%	22%	27%
Abra	43%	13%	42%	1%
Quirino	5%	42%	39%	13%

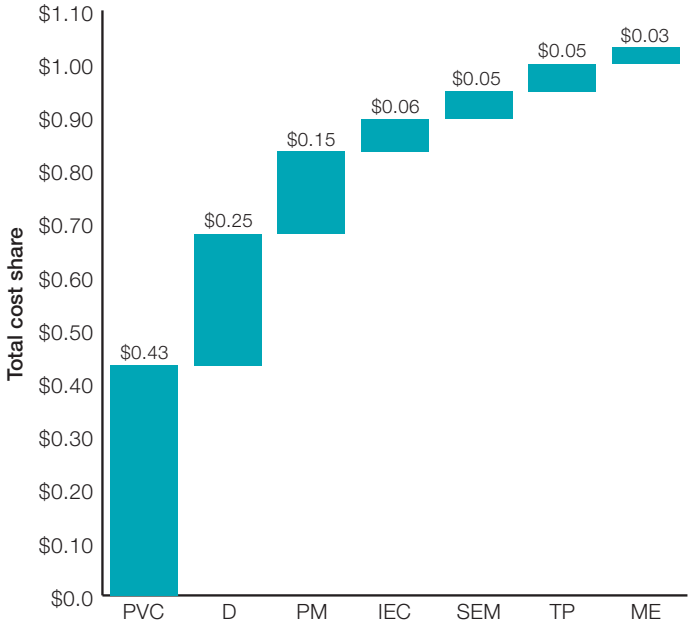
Cost share by activities

The major cost drivers at all levels were PVC, D, and PM. PVC constituted USD 0.43 per capita, followed by D at USD 0.25 per capita, and PM at USD 0.15 per capita. (Figure 6).[B]

The cost of activities varied across our sample provinces, as shown in Figure 7. The majority of cost at the NMCEP (70%) is incurred in PVC activities. At the provincial level, D constitutes a major fraction of cost for most provinces, with the exception of Rizal and Quirino, where PVC is the cost driver.

B PVC: Prevention and Vector Control; D: Diagnosis; PM: Project Management; IEC: Information, Education, Communication; SEM: Surveillance and Epidemic Management; TP: Treatment and Prophylaxis; ME: Monitoring and Evaluation.

Figure 6. Total cost per capita per activity*



*May not add to USD 1.03 due to rounding.

Distribution of input cost across activities

The differences of distribution of input costs across activities are depicted in figure 8, with D accounting for more than half of the capital distribution. PVC costs assumed 54% of consumables, IEC and PM shared nearly 25% of personnel costs, and PM accounted for the large majority in services costs.

Figure 7: Distribution of cost by activity across sample provinces

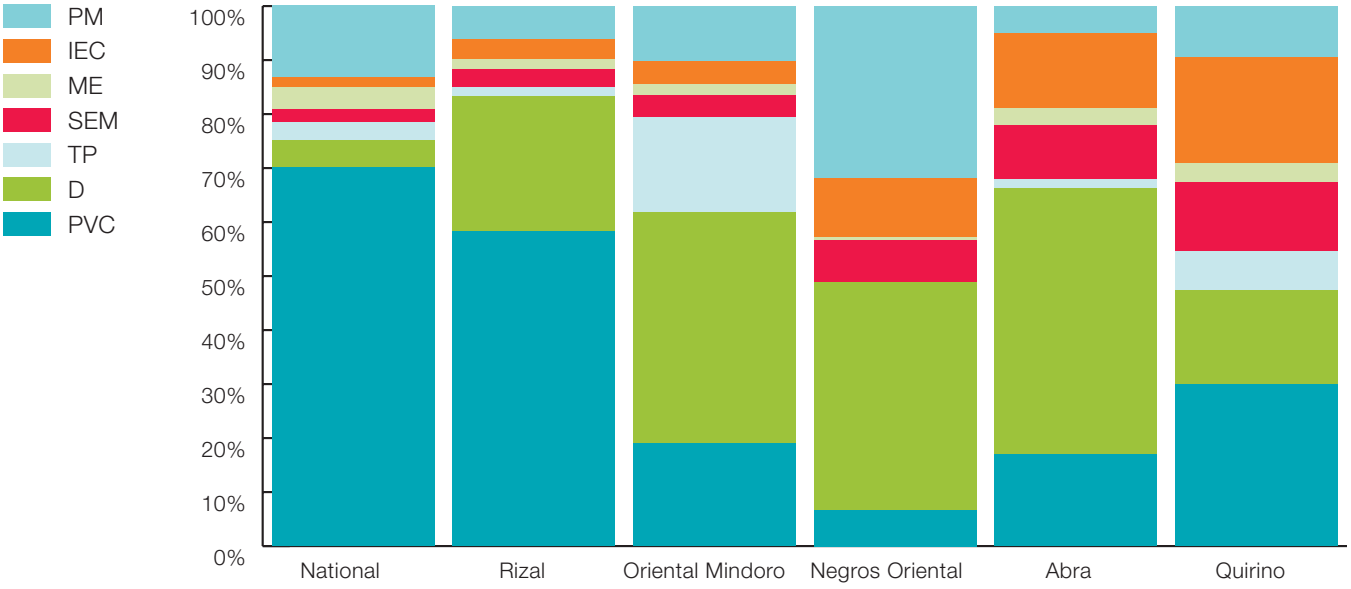
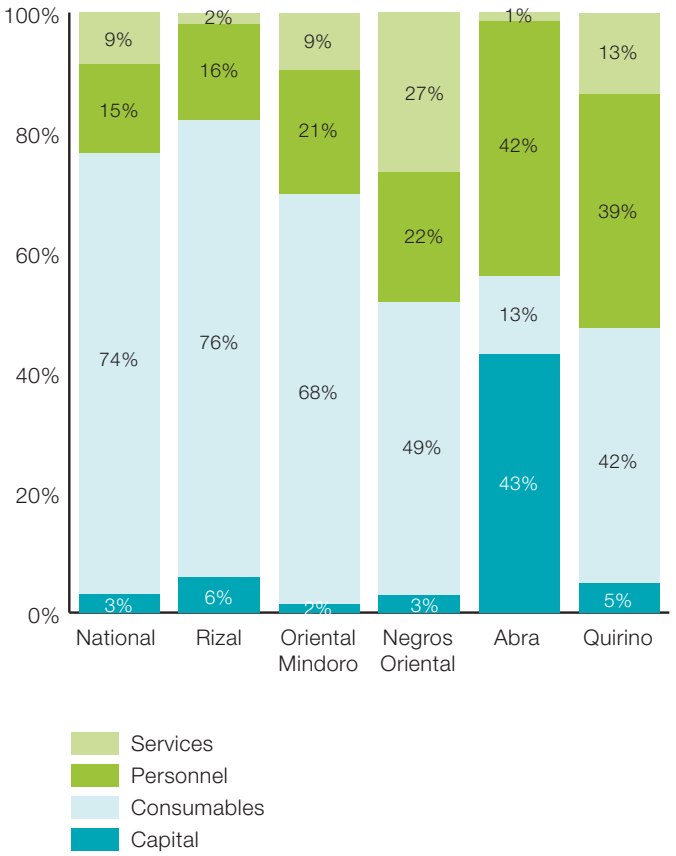


Figure 8: Distribution of input cost across interventions



Cost of future activities to prevent reintroduction

Future activities and associated costs were collected by each region in the Philippines from 2016–2020. Activities were categorized along the following dimensions: (1) surveillance; (2) diagnostics and treatment; (3) vector control; (4) monitoring and evaluation; and (5) community involvement.

This costing exercise illustrates the strategic planning for elimination done at the regional level only. Regions can increase budgetary allocations to assist LGUs in their elimination initiatives and decrease their reliance on central DOH sub-allotments.

Figure 9. Estimated cost of future activities for elimination at the regional level

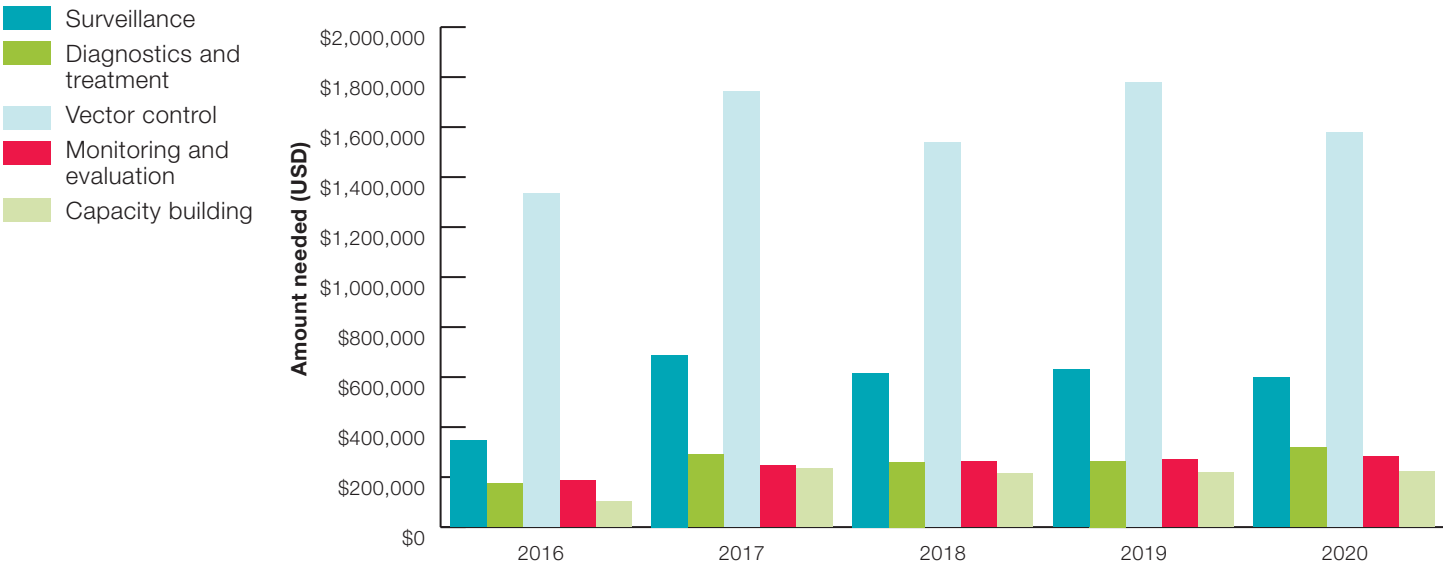
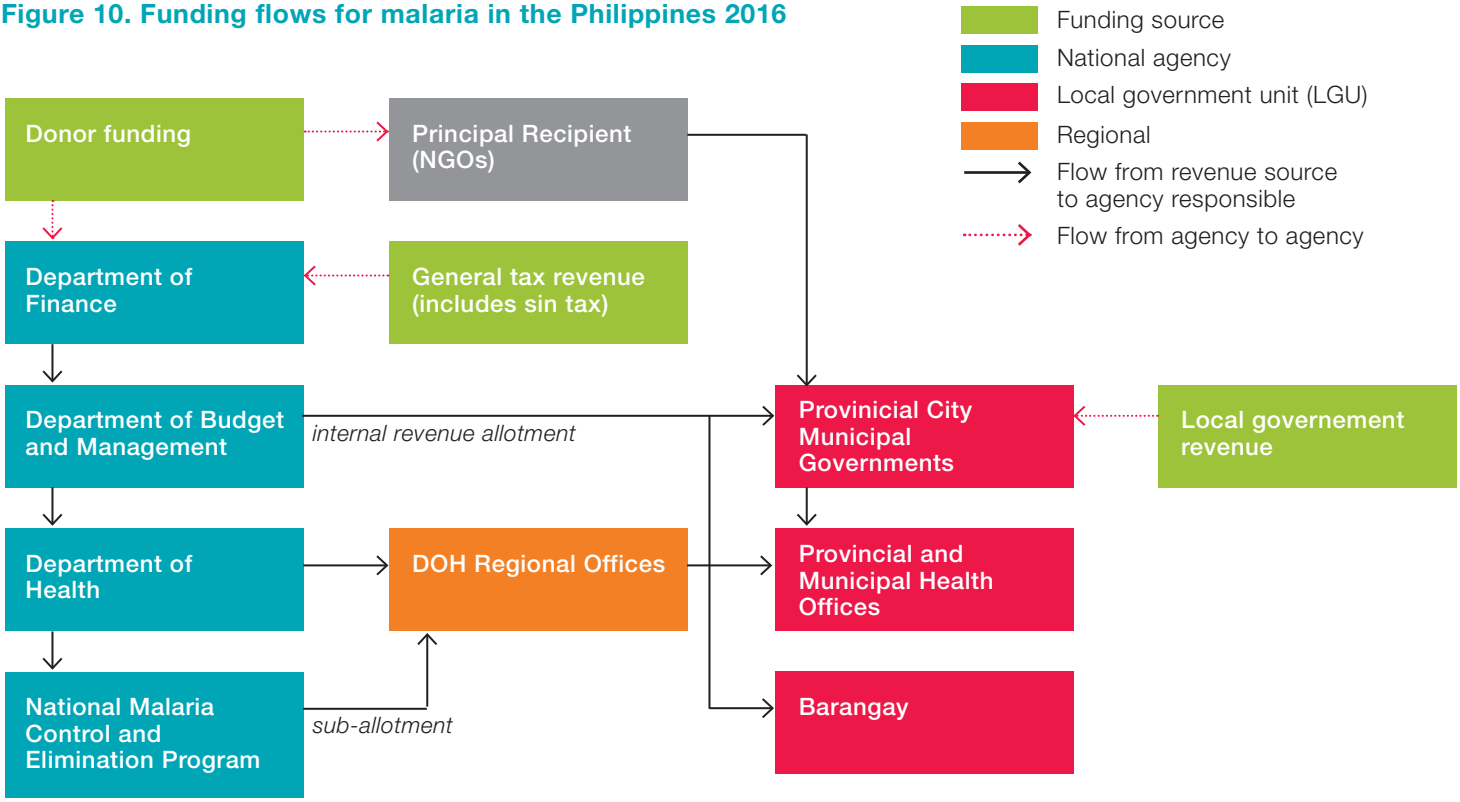


Figure 10. Funding flows for malaria in the Philippines 2016



Financing for malaria in the Philippines

Domestic financing for malaria activities in the Philippines in 2016 accounted for less than 0.3% of overall financing for health, at USD 6.88 million.[C] This amount includes a portion of funds that are sub-allotted to other programs (USD 3.1 million to the regional offices, USD 86,000 in performance grants to areas recently declared malaria-free, and USD 1.07 million in research support to partners). Figure 9 illustrates the funding flows in the Philippines. From the DOH, the money goes straight to the NMCEP, who sends sub-allotments to the DOH Regional offices. to the DOH Regional Offices. These sub-allotments have historically been requested because allocations from the national DOH are insufficient.[D] As indicated below, the NMCEP does not generally allocate funding directly to provinces or municipalities (i.e., LGUs). LGU financing for malaria is typically lacking and not systematically tracked (i.e. the NMCEP is not aware how much each province or municipality is spending specifically for malaria).

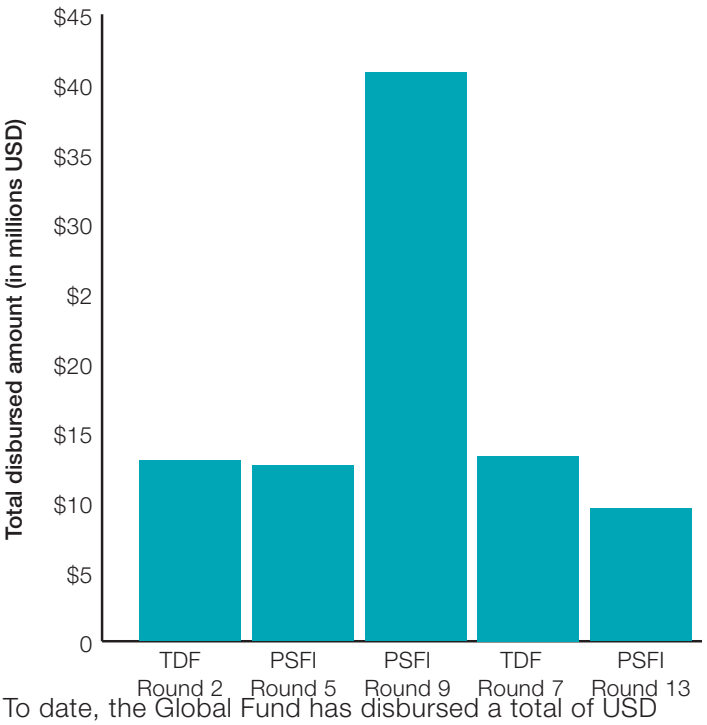
C From interview with Dr. Raffy Deray, NMCEP Program Manager, May 4, 2016.

D From 2010 to 2013, the annual sub-allotment proportion ranged from 11% to 33% of the NMCEP budget.

Table 7: Malaria program contributions in the Philippines 2014

Source of Funding	Actual funds spent (USD)		
	2012	2013	2014
Domestic spending [3]	3,939,519	5,235,686	5,861,758
Global Fund support [3]	7,224,199	8,612,874	7,395,343
Others [3]	-	337,546	-
Total budget for malaria control	11,163,718	14,186,106	13,257,101
Total domestic spending on health [19]	10,760,332,364	11,970,932,693	12,521,609,017
% of domestic health budget allocated for malaria	0.10	0.12	0.11

Figure 11. Global Fund disbursements to the Philippines for malaria



To date, the Global Fund has disbursed a total of USD 84.5 million for malaria in the Philippines since its first malaria grant in 2003 (Figure 11).[E] [22]

The Global Fund has been the only external funder for the malaria program since 2013 and most recently has allocated USD 10.66 million for the period of 2017 to 2019. [4, 22]. Under the Global Fund's current allocation model rolled out in 2012, funding is awarded based on disease burden and national income level [23]. In 2014, under this model, PSFI signed for USD 22.1 million as the Principal Recipient of malaria funding for the period of January 2014 to December 2017. The average annual allocation for the period 2014–2017 is USD 5.5 million – a 36% decline from previous Global Fund support [24]. The current Global Fund grant covers 47 municipalities in 13 provinces Ninety-seven percent of cases from 2011–2013 were found in these municipalities. While the NMCEP is applying for additional funding beyond 2018, the only available source of funding identified for elimination will be from central and local governments.[F]

Gaps in malaria financing

We calculated the amount of additional funding needed to maintain current malaria program activities, and cover the introduction of future ones, by comparing the projected costs of elimination to the amount of resources available (current and expected financing levels). The funding gap reflects our cost projections with several underlying assumptions. We measured the funding gap by comparing our cost projections to the planned influx of financing, provided by the NSP, RMC cost projections, and conversations with the NMCEP.

The projected cost requirements of malaria activities in the Philippines between 2016 and 2020 is illustrated in Table 8. The NSP 2014–2020 has budgeted an average of approximately USD 9.6 million per year between 2015 and 2020 for the maintenance of elimination and POR activities[G] [4].

E Tropical Disease Foundation, Inc. (TDF) Round 2: "Accelerating the Response to Malaria"; Pilipinas Shell Foundation, Inc. (PSFI) Round 2: Advancing Malaria Control Towards Elimination by 2020"; PSFI Round 5: Bolstering & Sustaining Proven and Innovative Malaria Control through Corporate-public partnerships"; TDF Round 6: An intensified strengthening of local response and health systems to consolidate gains in malaria control in rural Philippines through public-private partnership"; PSFI Round 13: "Philippines Malaria."

F In January 2015, Philippines signed for a grant amount of USD 15,205,724, which is less than their allocation of about USD 22 million, a 41% decrease from previous funding.

G The NSP budget and activities are currently being revised as of March 2017 to reflect projected costs of elimination activities for the period 2017–2022.

Table 8: Gaps in financing malaria (USD)

Category	2016	2017	2018	2019	2020
Total need	9,134,018	13,618,153	12,310,725	13,451,753	12,759,312
Domestic resources	7,205,584	7,497,707	5,504,834	6,517,934	6,973,304
Donor funding	5,030,355	3,554,272	3,554,272	3,554,272	-
Financial gap	(3,101,921)	2,566,174	3,251,619	3,379,547	5,786,008

*The NMCEP underspent their budget in 2016.

Cost of resurgence

Under a hypothetical scenario, we used incidence data from 2003–2008 in the Philippines to project the magnitude of a potential resurgence from 2015–2020. The total cost of resurgence in 2015 under a hypothetical scenario was estimated to be USD 1.55 billion in 2015 (Figure 12).

Return on investment

The total cost of the malaria program in 2015 was estimated to be USD 103 million and the total cost of re-surgence for the corresponding year was estimated to be USD 1.54 billion, yielding an ROI of over 13 to 1, as seen in Figure 13.

The total cost of the malaria program in 2015 when capital and personnel costs are removed* was estimated to be USD 20.14 million, yielding an ROI of 75 to 1.

Uncertainty analysis

For 2015, the cost difference between various discount rates was less than USD $24,000 (data not shown). Our best estimates used a discount rate of 3%.

We performed a sensitivity analysis of cost of resurgence estimates based on +/- 25% of the cases. Scenario 1 reflects the median estimates of the cost of resurgence. Scenario 2 represents a 25% increase in cases from the median and Scenario 3 represents a 25% decrease in malaria cases from the median. The estimates of ROI under different scenarios are illustrated in Figure 13.

Table 9. Cost of resurgence in 2015

Cost of resurgence	Best estimate (in USD)
Direct cost to the health system	
Cost due to increased health service utilization	4.48 million
Cost of vector control to control resurgence	1.52 billion
Cost of treatment for population with special needs (under 5 years old)	7,019
Cost of increased diagnosis	295,843
Cost of training human resources and educating community	2.47 million
Direct cost to the individual household	
Out-of-pocket expenditure due to malaria	1 million
Indirect cost to the society	
Cost due to loss of life to malaria	12.29 million
Cost due to loss of productivity to malaria morbidity	884,120
Total benefits in 2015 (in USD)	1.54 billion

*These costs are removed because they are financed through integrated national and provincial health budgets that are not specific to the malaria program.

Figure 12. Cost of resurgence of malaria in the Philippines

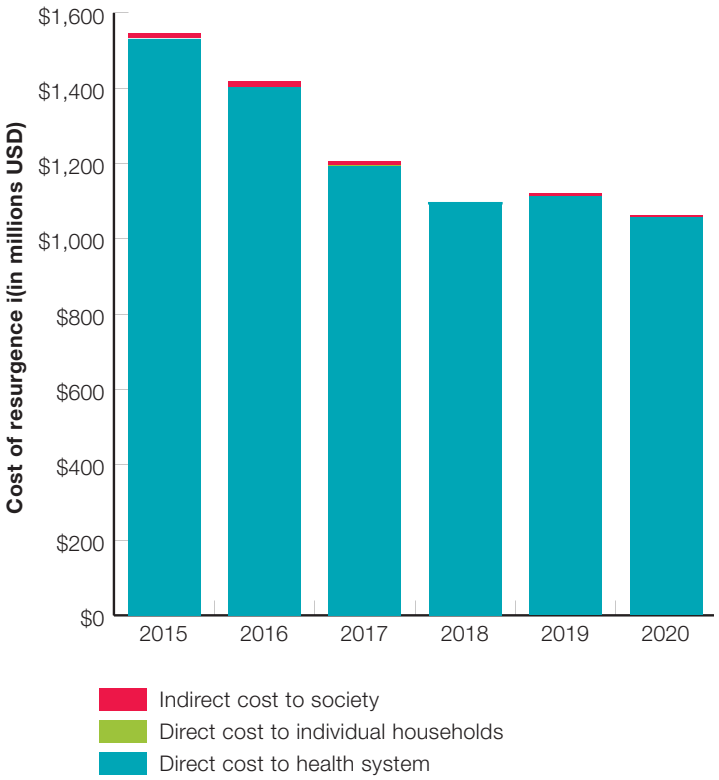
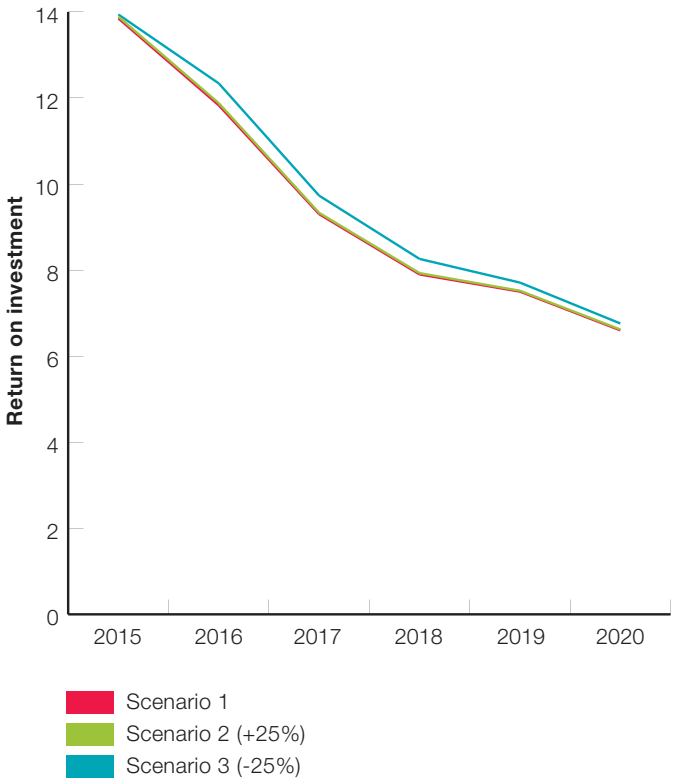


Figure 13. Sensitivity analysis of the estimates of returns on investment in malaria



Opportunities for resource mobilization

This analysis suggests a financial gap beginning in 2018, when Global Fund money is uncertain and may taper or disappear. The magnitude of this gap poses a serious threat on the progress that the Philippines has made, as well as its goal of being malaria-free by 2030. With just one year remaining on the latest grant from the Global Fund,[H] securing much higher levels of domestic financing is a priority. In 2015, the NMCEP reported an increase in cases due to outbreaks in Palawan, Sultan Kudarat, and Maguindanao provinces. Confirmed malaria cases for the entire country increased by 40% between 2014 and 2015, evidence of how unstable case declines are in some provinces. Given this increase, reliable funding is needed more than ever. The absence of domestic resource mobilization is a major bottleneck to an effective and efficient health system, particularly for the malaria program.

In 2014, health expenditure as a percentage of GDP in the Philippines was 4.4%, an allocation of roughly USD 12.5 billion [19]. A large share of health expenditure goes to the private sector (about 60%), employing over 70% of health professionals in the country and providing services to 30% of the population [25]. Low levels of public health expenditure have coincided with increasing OOP spending, which constitutes roughly 83% of total health expenditure in the country [19]. OOP health spending places greater pressure on poorer households. Our analysis suggests that in 2014 the Philippines allocated only 0.11% of their total domestic spending on health to malaria. Funding for malaria is largely provided by the government (central and local), constituting 82% of total malaria spending. To bridge the financial gap, domestic financing for malaria will need to increase. In the past, the Philippines has benefited greatly from external financing. The majority of this financing is focused in higher endemic districts. Subsequently, LGU financing for control and elimination is fundamentally insufficient in many areas.

Historically, the Universal Health Care (UHC) program in the Philippines had lacked resources to fund insurance premiums to reach remote and vulnerable populations, recruit health workers, and expand infrastructure. However, in December of 2012, the Sin Tax Reform Bill was passed in an effort to finance UHC, increasing taxes on all tobacco and alcohol products, eliciting major positive results for the health budget. The law has generated additional revenues, where 85% of the additional revenue is allocated for health and within that piece, 33% is earmarked for the attainment of Millennium Development Goals and other UHC programs and activities. Within the first two years of its existence, the 'sin tax' generated USD 2.3 billion in incremental revenue, increased the DOH budget by 63% in 2015 compared to a 2013 baseline, increased funding for elimination of four endemic diseases – including malaria – by 39% in 2016, and subsidized health insurance premiums for 14.7 million members of PhilHealth, the national health insurance program [27]. Incremental revenue collections are projected to increase to USD 1.28 billion in 2016 and USD 1.45 billion in 2017 [28]. Despite this growth, only a fraction of the DOH budget is directed to the elimination of diseases portfolio (USD 17 million out of a USD 2.64 billion budget in 2016). The sin tax is viewed as a "win for fiscal and public health" [26], signifying an important shift in health financing and creating an opportunity for additional sustainable financing, if used appropriately and effectively.

While the sin tax has resulted in gains across the board for public health, the malaria program could benefit from earmarked funds from the sin tax revenue. Another mechanism to increase domestic funding is to levy a tax on mobile phone companies. The telecommunication sector in the Philippines is vast and rapidly expanding. Given that the Philippines is considered the "texting capital of the world" and the "most social nation," there is opportunity to leverage the mobile market for positive health outcomes. As an example from Africa, Gabon finances extensive healthcare coverage via a "mandatory health insurance levy" through a 10% tax on mobile phone companies' turnover and a 1.5% tax on money transfers outside of the country [29,30].

Other innovative financing mechanisms to increase funding for malaria elimination should also be considered. The APLMA Regional Malaria Financing Task Force advocates for sustainable and higher impact financing through the establishment of a regional fund [31]. The regional trust fund would serve as a catalyst for cross-border collaboration and a means to direct shared resources from higher-performing countries to those with waning or limited financial resources.

H The Global Fund grant has a three year implementation period from 2015–2017. Forty-three percent of funding is allocated for vector control, 26% to program management, 22% to health information systems and M&E, and 9% to case management.

Discussion

This investment case indicates that the cost of malaria elimination activities in the Philippines in 2015 was just USD 1.03 per capita. If elimination was halted, however, the cost of resurgence will greatly outweigh the costs of elimination. The ROI in malaria was estimated to be over 13:1, exceeding the threshold on returns considered to be high-impact investments [32]. The ROI is likely to be even higher if the indirect effects of malaria on society were included, such as the effect on education, cognitive development or tourism which were found to be important factors in other studies.

The key cost drivers of malaria elimination in the Philippines were PVC, D, and PM. In low-burden settings, targeted detection and response (i.e., surveillance) is critical to achieving zero cases, promoting efficiency rather than aiming to achieve universal coverage. In 2015, the Philippines allocated just 3% of their total spend on surveillance. It will be essential to increase and enhance the surveillance systems in the country if elimination is to be realized. In pre-elimination and eliminating provinces, qualified personnel coupled with improved reporting and responding will be crucial in filling the current surveillance gaps. For provinces in the control phase, targeted vector control during outbreaks is recommended. Beginning in 2017, the Philippines will be adopting a "1-3-5" surveillance and response strategy. This strategy has been modified from China's 1-3-7 strategy, where cases are reported within one day, confirmed and investigated within 3 days and the appropriate response is undertaken to this case within 7 days [33]. This endeavor requires immediate capacity building, which is already underway through the construction of more elimination hubs (which provide technical expertise and rapid response capabilities) and regional collaboration centers for these hubs.

There are some limitations to the methods for data collection and analysis employed in this study. Costs were apportioned across activities by staff self-reporting specific time allocations per malaria intervention/activity. A time-in-motion study would be the ideal methodology for estimating the time and resources spent on each activity. However, the time and resource available for this research did not allow for this methodology.

Generating estimates of cost of resurgence were reliant on a hypothetical scenario. While it is impossible to know the likelihood and/or degree of a resurgence, historical evidence from a number of countries suggest that waning funding and dwindling attention is likely to result in malaria resurgence [34].

By employing the "bottom-up" financing approach via the decentralized health system, the Philippines is attempting to achieve inclusive growth throughout the country. Success will be largely dependent on the increase in public expenditure as a whole and for malaria, equitable distribution of finances, and fortifying political will of relevant stakeholders to maintain these gains.

In the absence of an investment case, it is difficult for a country to assess its performance and for decision-makers to accurately advocate for the utilization of specific resources. It is critical to address the current and projected financial gap in the Philippines to maintain progress towards malaria elimination. Under current conditions, the country is at risk of not meeting its elimination target. Securing support from the government, stakeholders, and communities across the Philippines is essential to the success of the malaria program.

This study provides the malaria program with an analysis of the costs and benefits of elimination. We demonstrate that while there are substantial benefits to elimination, it is a resource-intensive undertaking and one that requires long term commitment at all levels of the government, especially within the decentralized health system in the Philippines. This investment case should be used as a vehicle for advocacy in the Philippines as well as evidence for the global malaria community on the conditions to which elimination can be achieved.

Annex 1. NSP Budget 2015–2020 by Year and Funding Source (PHP)

Government of the Philippines: GOP
Global Fund: GF

		Objective 1	Objective 2	Objective 3	Objective 4	Total
2014	GOP	307,788,815	19,408,500	3,808,200	38,662,585	369,668,100
	GF	189,760,468	15,266,671	72,209,945	70,025,422	347,262,506
	TOTAL	497,549,283	34,675,171	76,018,145	108,688,007	716,930,606
2015	GOP & Others	232,133,257	76,829,200	18,086,300	34,767,228	361,815,985
	GF	102,319,145	18,033,204	40,266,170	62,779,558	223,398,077
	TOTAL	334,452,402	94,862,404	58,352,470	97,546,786	585,214,062
2016	GOP & Others	201,917,997	53,924,800	13,239,100	60,684,254	329,766,151
	GF	99,564,308	17,484,924	39,597,132	44,569,610	201,215,974
	TOTAL	301,482,305	71,409,724	52,836,232	105,253,864	530,982,125
2017	GOP & Others	201,207,561	54,701,000	11,455,000	65,609,599	332,973,160
	GF	151,382,305	22,081,959	45,669,535	55,779,769	274,913,568
	TOTAL	352,589,866	76,782,959	57,124,535	121,389,368	607,886,728
2018	GOP & Others	143,729,988	56,662,400	621,500	43,455,778	244,469,666
	GF	-	-	-	-	-
	TOTAL	143,729,988	56,662,400	621,500	43,455,778	244,469,666
2019	GOP & Others	182,390,736	58,001,000	621,500	48,448,226	289,461,462
	GF	-	-	-	-	-
	TOTAL	182,390,736	58,001,000	621,500	48,448,226	289,461,462
2020	GOP & Others	138,635,592	91,473,900	2,374,000	77,200,931	309,684,423
	GF	-	-	-	-	-
	TOTAL	138,635,592	91,473,900	2,374,000	77,200,931	309,684,423
Total	GOP & Others	1,407,803,946	411,000,800	50,205,600	368,828,601	2,237,838,947
	GF	543,026,226	72,866,758	197,742,782	233,154,360	1,046,790,125
	TOTAL	1,950,830,172	483,867,558	247,948,382	601,982,961	3,284,629,072

Annex 2. Cost Categories

Interventions	
Prevention and vector control (PVC)	IRS
	LLIN Distribution
	Personal Protective measures
	Bioassay Testing
	Insecticide Susceptibility testing
Diagnosis (D)	Microscopy
	Rapid Diagnostic Test (RDT)
	PhilHealth Accreditation
	Training
Treatment and prophylaxis (TP)	Treatment and case management
	Polymerase Chain Reaction (PCR) for treatment failure
	Drug importation
	Drug supply chain and distribution
	Training
Surveillance and epidemic management (SEM)	Active case detection (ACD)
	Passive case detection (PCD)
	Vector (Entomological) surveillance
	Case investigation and response
	PhilMIS
	FHSIS
	PIDSR
	Training
Monitoring and evaluation (ME)	Inspection and evaluation
	Monitoring and evaluation task force
	Routine surveys
	Training
Information, education, and communication (IEC)	Stakeholder advocacy
	Policy advocacy
	Community and stakeholder education
	Provider training
	Behavior change communication (BCC) programs
Program management (PM)	Coordination of meetings
	Staff retooling plan
	General administration
	Staff supervision
	Donor advocacy for external funding
	Staff hiring and recruitment
	Policy and guidelines development
	Operational research

Code	Category	Definition
PVC	Prevention and Vector Control	Measures that prevent human contact to mosquitoes or limit the ability of mosquitoes to transmit the disease
D	Diagnosis	Detection and identification of malaria infection due to *Plasmodium* species
TP	Treatment and Prophylaxis	Use of antimalarial drugs to treat or prevent malaria infections
SEM	Surveillance and Epidemic Management	In elimination and POR settings, the part of a program designed for identification, investigation, and elimination of continuing transmission, the prevention and cure of infections, and the final substantiation of claimed elimination
ME	Monitoring and Evaluation	Routine and episodic efforts to determine the relevance, effectiveness, and impact of malaria activities
IEC	Information, Education, and Communication	Combination of communication strategies, approaches, and methods that provide knowledge to enable individuals, families, groups, organizations, and communities to play active roles in achieving, protecting, and sustaining their own health
PM	Program Management	Oversight of malaria POR efforts including operations, human resource management, financing, training, and performance improvement for both individual components and the overall program
Code	Category	Working Definition
PVC	IRS	Indoor residual spraying or IRS is the use of insecticides to reduce transmission of malaria from mosquitoes
	LLIN Distribution	Distribution of long-lasting insecticide nets (LLINs) to reduce malaria transmission from mosquitoes
	Personal Protective Measures	Use window screens, repellants (such as DEET) and other personal effects for reduction of malaria transmission (i.e. wearing light-colored clothing, long pants and long sleeved shirts)
	Bioassay Testing	Conducting bioassay tests on used LLINs and IRS to test for chemical toxicity
	Insecticide Susceptibility Testing	Detecting insecticide resistance against *Anopheles* mosquitoes
	Training	Provided training on measures that prevent human contact to mosquitoes or limit the ability of mosquitoes to transmit the disease (i.e. the use or distribution of LLINs, personal protective measures, bioassay testing)
D	Microscopy	Identification of malaria infection using microscopic examination of Giesma-stained blood sample
	Rapid diagnostic test	Identification of malaria infection through the impregnation of a test strip in an RDT cassette, strip, or card with a small sample of blood, allowing for the detection of plasmodial antigens using immunochromatographic assay
	PhilHealth Accreditation	Assisting malaria diagnostic and treatment center achieve PhilHealth accreditation through capacity building and technical support
	Giemsa Production Centers	Developing and financing any of the 4 zonal Giemsa Production Centers
	Training	Training of health staff on relevant microscopy courses
TP	Treatment and Case Management	Treatment and tracking of progress in treatment among suspected and confirmed malaria cases
	Polymerase Chain Reaction (PCR) for Treatment Failure	Using genetic amplification methods (i.e. PCR) to detect drug resistance in malaria patients
	Drug Importation	Coordinating and financing the procurement of anti-malaria drugs from pharmaceutical companies or international organizations (i.e. UNICEF)
	Drug Supply Chain and Distribution	Coordinating/planning the storage and delivery on anti-malaria drugs in health facilities
	Training	Training on treatment and case management of malaria cases or relevant drug supply coordination and distribution
SEM	Active case detection (ACD)	Detection by health workers of malaria infections at community and household level in population groups that are considered to be at high risk (such as arriving travelers from malaria-endemic regions, laborers, OFWs) through fever screening followed by parasitological examination of all febrile patients or as parasitological examination of the target population without prior fever screening
	Passive case detection (PCD)	Detection of malaria cases among patients who, on their own initiative, go to a health post for treatment, usually for febrile disease

	Vector (Entomological) Surveillance	Use of surveillance techniques to understand the spatial, geographic distribution, and density of vector species, temporal changes in vector populations, and the efficacy and effectiveness of vector control measures employed for malaria vector control in order to facilitate appropriate and timely decisions regarding interventions
	Case investigation and response	Case investigation refers to the collection of information to allow classification of a malaria case by origin of infection (i.e., imported, introduced, indigenous or induced) via the administration of a standardized questionnaire to a person in whom a malaria infection is diagnosed while response refers to the screening of households or individuals and use of vector control strategies within a specified area, typically a pre-determined radius around a locally acquired case, with the goal of preventing further malaria transmission by identifying additional infections, symptomatic or asymptomatic
	PhilMIS	Data management on malaria-related information in the Philippine Malaria Information System (PhilMIS)
	FHSIS	Data management on service coverage and utilization for malaria activities in the Field Health Service Information System (FHSIS)
	PIDSR	Data management of malaria-related information for surveillance in the Philippine Integrated Disease Surveillance and Response system
	Training	Training of staff on data management (i.e. PhilMIS, FHSIS, PIDSR), case investigation of malaria cases using standardized questionnaires
ME	Inspection and Evaluation	Routine or periodical checking/inspection of health facilities, assessment of staff performance and results of malaria interventions (i.e. site visits from provincial health officers to regional/municipal/barangay levels)
	Monitoring and Evaluation Task Force	Has an organized ME Task Force that conducts regular meetings on monitoring and evaluation systems, formulate malaria program monitoring and evaluation (ME) plans, develop ME guidelines and tools or organize annual technical conference to disseminate ME results
	Routine Surveys	Bed net utilization surveys (i.e. spatial distribution net mapping in provinces or barangays where ITNs and LLINs are distributed), KAP surveys, facility surveys on diagnosis and treatment protocols and other periodical surveys done for malaria activities
	Training	Orient LGUs and other offices concerned with the Malaria Monitoring and Evaluation Plan or dissemination of surveys for malaria activities and diagnosis/treatment protocols
IEC	Stakeholder Advocacy	Undertake advocacy activities to increase participation of stakeholders in sustaining malaria-free status in each province/city or deliberate attempts to develop official partnerships or agreements between local health entities (e.g., RMO, provincial health services) and relevant partners to improve malaria diagnostic and treatment capacity or awareness among providers or the public
	Policy advocacy	Attempts to promote, raise awareness, or push for the adoption and implementation of a specific agenda or procedure in order to achieve a particular outcome
	Community and Stakeholder Education	Organizing and coordinating health promotion activities for malaria prevention (i.e. going into the barangays or communities increasing awareness or prevention of malaria transmission)
	Provider Training	Organizing and implementing a class, module, or activity to teach, impart, or disseminate information about malaria treatment, diagnostic, and case management processes, tools or policies to public or private health providers
	Behavior change communication (BCC) programs	Dissemination of targeted messages to communities that aim to improve health behaviors and reduce malaria transmission risk
PM	Coordination Meetings	Onetime or routine gatherings for administrative or policy discussions or consensus-building
	Staff Retooling Plan	Train/Retool of LGU personnel involved in malaria program implementation
	General Administration	Tasks related to day-to-day operations and administrative duties in the national, regional, provincial or municipal malaria office
	Staff Supervision	Routine oversight of staff and organizational outputs
	Donor Advocacy for External Funding	Requesting and applying for donor aid for malaria
	Financial Administration	Accounting, budgeting and overseeing annual reports for malaria activities
	Staff Hiring and Recruitment	Tasks related to seeking, recruiting, hiring, and assigning staff members to vacancies in the national/ regional/provincial/municipal offices or other public health facilities
	Policy and Guide-lines Development	Designing policy and guidelines for malaria activities
	Operational research	Conducting research, testing new approaches and assessing new technologies to strengthen the delivery of effective interventions based on evidence and experience

Annex 3. Interview Guide: Malaria Costing

Respondent ID: ❑ - ❑ ❑ ❑ - ❑ ❑ - ❑
Team Number Letter Location Office

Interviewer Initials: _____ Note Taker Initials: _____

Date of Interview: ____ /____ /2017 (mo/dy/yr)

Start Time: ____:____ AM/PM End Time: ____:____ AM/PM

Recording number: _____

Introduction *(Please cover the following content in your own words.)*

We are conducting a study of malaria elimination and prevention of re-introduction in Bhutan. This study has three main aims:

1. Estimate the costs of current and future malaria elimination activities in Bhutan
    - Costs of current elimination efforts
    - Costs of future activities to prevent reintroduction and resurgence
    - Potential cost savings from optimization of strategies for preventing reintroduction
2. Understand the benefits of malaria elimination, relative to the alternative of resurgence.
3. Identify the mechanisms being used to finance the malaria control program.

As part of this study, we're interviewing individuals who are currently involved in the malaria elimination activities. Your participation is very important because it will give us a better understanding of the costs of the elimination program and will contribute to efforts aimed at improved resources for and efficiencies of the program.

In this interview, we'd like to ask you specifically about expenditures related to malaria activities. You may not know about everything that we ask you so please let us know if you cannot answer any question and we will go to the next question. Any kind of information you can share with us about what types of expenditures were made and where this information can be found will be very useful.

We understand that the information that you will be sharing with us can be sensitive. Everything you tell me will be completely confidential and we will also ensure that the records that you share with us are kept privately and only used among our study researchers. I may make some notes as we talk. If at any time you wish to end the interview or take a break, please let me know.

Consent Procedures and Confidentiality
I am going to read through the informed consent with you and answer any of your questions. Then I would like you to sign and date two copies of the consent form, one copy will be for you to take with you, the other will be kept in a locked filing cabinet at our University offices.

[Show respondent consent form]

Please cover the following main points in the consent in your own words:

- This is a research study conducted in collaboration between the National Malaria Control Programme and the University of California, San Francisco.
- The purpose of this study is to learn about the background factors, strategies, activities, and costs of the malaria elimination program and any gaps in financing.
- If you agree to participate, we will conduct an interview with you, which may last up to two hours, depending on your experiences.
- We will keep all your personal information confidential and anything you say will not be directly associated with you identity.

- If at any time you wish to stop the interview, please also let me know. There are no consequences to you if you do not wish to participate. You decision will not affect your employment.
- You will not be paid for taking part in this study as it is completely voluntary.
- If you have any questions or concerns about the study, you can contact any one of our study leads. Each of their contact details is provided for you.

Do you have any questions?

Please sign this form. This copy is for you to keep.

Okay, let's begin.

I. Malaria control and elimination strategies

1. Let's review the main malaria-related activities that you or your offices are involved in over the years. Can you please tell me briefly about the following types of activities and what you do in each one? [For A–C, Probe for any participation in quality assurance systems.]
    a. Diagnosis and treatment/case management
        i. Diagnosis and treatment of cases at health facilities
        ii. Active case detection in high-risk areas or high-risk populations
        iii. Reactive case detection and treatment around existing cases
    b. Prevention & vector control
        i. LLIN distribution to high-risk populations
        ii. IRS in high-risk areas
        iii. Reactive IRS in response to cases or outbreaks
    c. Surveillance and epidemic management (in instances of epidemics)
        i. Case investigation
    d. Information, education, and communication activities
    e. Program management or administration
    f. Monitoring and evaluation
    g. Staff training
2. Let's review the past costs of malaria control. Can you please tell me about the costs of malaria control in past years [Ask about each sampled year. For A–C, Probe for any participation in quality assurance systems.]
    a. Diagnosis and treatment/case management
    b. Prevention & vector Control
    c. Surveillance and epidemic management (in instances of epidemics)
    d. Information, education, and communication activities
    e. Program management or administration
    f. Monitoring and evaluation
    g. Staff training

II. Funding sources

3. Now can you tell me how your program has been funded over these years? [Probe: Did you get funding from the national government? Provincial? External sources?]
4. Based on your experiences from the previous years, to what extent is the budget allocated for malaria actually being spent on malaria-specific activities (versus cross-cutting vector-borne diseases)? [Probe: In what cases is the malaria budget spent for activities indirectly related to malaria? Why?]

5. *For each activity mentioned, ask*: I'd like to go into more detail about this. Can you tell me which of these sources provides funding for [insert activity]? Can you show me any records of these resources or any reports that may have these resources documented? [Probe: Are these budgeted amounts or actual expenditures? Are actual expenditures available? If so, where?]

III. Major cost categories

6. We would like to ask about spending in the following categories: (1) personnel, (2) capital equipment, (3) commodities, and (3) services.

For each category, review the summary of costs already captured, who paid for them, and what activities were involved. Are these costs correct? Can you provide me a copy of where these costs may be recorded?

For costs not already captured: Can you tell us about any of these costs? What are the expenses used for? Are there specific records of what is being purchased and what amounts are paid?

7. Can you think of any events that could impact these costs in the immediate future? An example could be the cost of gas in transportation costs.

IV. Further contacts

8. Are there other key informants I should speak to who would know about some of the program costs that we've talked about today? What kind of information or records might they have? Could you provide me with their contact information?

Winding down the interview

1. Briefly review interview topics. Ask for clarification of anything you may have missed.
2. Ask if there is anything else he would like to say, questions he thought we should have asked, and information he needs.
3. Thank the participant again for their time and explain that their experience and expertise is essential for the success of the case study.

Write down any interview comments in the notebook [e.g., any documents or people that were mentioned that need to be followed up, etc.]

Annex 4. Province Matching for Extrapolation

Province	Income classification	Population (2010)		Population (2015)	Elimination status (2015)	Elimination status	Population	Price per capita (PHP)	Cost per capita (USD)	Total cost (PHP)	Total Cost (USD)
Bulacan	1st	2,924,433	2.73	3,323,618.10	CLM	2	1	PHP 38.91	$ 0.88	PHP 129,305,703.90	$ 2,911,634.85
Nueva Ecija	1st	1,955,373	1.65	2,116,691.27	CLM	2	1	PHP 38.91	$ 0.88	PHP 82,350,091.47	$ 1,854,314.15
Quezon	1st	1,740,638	1.61	1,880,759.36	CLM	2	1	PHP 38.91	$ 0.88	PHP 73,171,136.13	$ 1,647,627.47
Isabela	1st	1,489,645	1.47	1,599,133.91	CLM	2	1	PHP 38.91	$ 0.88	PHP 62,214,469.00	$ 1,400,911.26
Cagayan	1st	1,124,773	1.25	1,195,071.31	CLM	2	1	PHP 38.91	$ 0.88	PHP 46,494,372.22	$ 1,046,934.75
Zamboanga del Sur	1st	959,685	1.39	1,026,383.11	CLM	2	1	PHP 38.91	$ 0.88	PHP 39,931,540.27	$ 899,156.50
Maguindanao	1st	944,718	1.66	1,023,129.59	CLM	2	1	PHP 38.91	$ 0.88	PHP 39,804,961.99	$ 896,306.28
Palawan	1st	771,667	2.66	874,298.71	CLM	2	1	PHP 38.91	$ 0.88	PHP 34,014,681.20	$ 765,923.92
Sultan Kudarat	1st	747,087	2.45	838,605.16	CLM	2	1	PHP 38.91	$ 0.88	PHP 32,626,019.83	$ 734,654.80
Sulu	2nd	718,290	1.49	771,802.61	CLM	2	1	PHP 38.91	$ 0.88	PHP 30,027,059.66	$ 676,132.85
Zamboanga Sibugay	2nd	584,685	1.63	632,336.83	CLM	2	1	PHP 38.91	$ 0.88	PHP 24,601,129.25	$ 553,954.72
Zambales	2nd	534,443	2.11	590,826.74	CLM	2	1	PHP 38.91	$ 0.88	PHP 22,986,174.90	$ 517,590.07
Occidental Mindoro	2nd	452,971	1.76	492,832.45	CLM	2	1	PHP 38.91	$ 0.88	PHP 19,173,697.03	$ 431,742.78
Tawi-Tawi	3rd	366,550	1.29	390,192.48	CLM	2	1	PHP 38.91	$ 0.88	PHP 15,180,478.34	$ 341,825.68
Tarlac	1st	1,273,240	1.76	1,385,285.12	Pre-elimination	2	2	PHP 38.91	$ 0.88	PHP 53,894,659.95	$ 1,213,570.37
Cotabato (North Cotabato)	1st	1,226,508	2.49	1,379,208.25	Pre-elimination	2	2	PHP 38.91	$ 0.88	PHP 53,658,238.54	$ 1,208,246.76
Zamboanga del Norte	1st	957,997	1.53	1,031,283.77	Pre-elimination	2	2	PHP 38.91	$ 0.88	PHP 40,122,201.07	$ 903,449.70
Davao del Norte	1st	945,764	2.43	1,060,674.33	Pre-elimination	2	2	PHP 38.91	$ 0.88	PHP 41,265,643.65	$ 929,197.11
South Cotabato	1st	827,200	1.82	902,475.20	Pre-elimination	2	3	PHP 38.91	$ 0.88	PHP 35,110,890.40	$ 790,607.75
Bataan	1st	687,482	2.11	760,011.35	Pre-elimination	2	3	PHP 38.91	$ 0.88	PHP 29,568,319.71	$ 665,803.19
Davao del Sur	1st	574,910	1.36	614,003.88	Pre-elimination	2	3	PHP 38.91	$ 0.88	PHP 23,887,884.05	$ 537,894.26
Basilan	3rd	293,322	1.22	311,214.64	Pre-elimination	2	3	PHP 38.91	$ 0.88	PHP 12,107,837.63	$ 272,637.64
Aurora	3rd	201,233	1.48	216,124.24	Pre-elimination	2	3	PHP 38.91	$ 0.88	PHP 8,408,335.84	$ 189,334.29
Agusan del Norte	3rd	332,487	1.53	357,922.26	Elimination	1	3	PHP 38.91	$ 0.88	PHP 13,925,002.13	$ 313,555.55
Davao Occidental		293,780	1.36	313,757.04	Elimination	1	3	PHP 38.91	$ 0.88	PHP 12,206,749.88	$ 274,864.89
Ifuago	3rd	191,078	1.69	207,224.09	Elimination	1	3	PHP 38.91	$ 0.88	PHP 8,062,074.55	$ 181,537.37
Mountain Province	4th	154,187	0.92	161,279.60	Elimination	1	3	PHP 38.91	$ 0.88	PHP 6,274,599.49	$ 141,287.99
Pangasinan	1st	2,779,862	1.34	2,966,112.75	Elimination	1	2	PHP 38.91	$ 0.88	PHP 115,396,921.50	$ 2,598,444.53
Laguna	1st	2,669,847	3.11	3,085,008.21	Elimination	1	2	PHP 38.91	$ 0.88	PHP 120,022,561.37	$ 2,702,602.15
Negros Occidental	1st	2,396,039	1.15	2,533,811.24	Elimination	1	2	PHP 38.91	$ 0.88	PHP 98,578,186.77	$ 2,219,729.49
Pampanga	1st	2,014,019	2.21	2,236,568.10	Elimination	1	2	PHP 38.91	$ 0.88	PHP 87,013,911.74	$ 1,959,331.50

Bukidnon	1st	1,299,192	2.05	1,432,359.18	Elimination	1	2	PHP 38.91	$ 0.88	PHP 55,726,081.09	$ 1,254,809.30
Lanao del Sur	1st	933,260	1.55	1,005,587.65	Elimination	1	2	PHP 38.91	$ 0.88	PHP 39,122,490.86	$ 880,938.77
Misamis Oriental	1st	813,856	2.05	897,276.24	Elimination	1	3	PHP 38.91	$ 0.88	PHP 34,908,624.32	$ 786,053.24
La Union	1st	741,906	1.21	786,791.31	Elimination	1	3	PHP 38.91	$ 0.88	PHP 30,610,196.88	$ 689,263.61
Compostella Valley	1st	687,195	1.71	745,950.17	Elimination	1	3	PHP 38.91	$ 0.88	PHP 29,021,268.12	$ 653,484.98
Illocos Sur	1st	658,587	1.03	692,504.23	Elimination	1	3	PHP 38.91	$ 0.88	PHP 26,941,948.25	$ 606,664.00
Agusan del Sur	1st	656,418	1.61	709,259.65	Elimination	1	3	PHP 38.91	$ 0.88	PHP 27,593,819.53	$ 621,342.48
Illocos Norte	1st	568,017	1.00	596,417.85	Elimination	1	3	PHP 38.91	$ 0.88	PHP 23,203,697.74	$ 522,488.13
Surigao del Sur	1st	561,219	1.12	592,647.26	Elimination	1	3	PHP 38.91	$ 0.88	PHP 23,057,002.71	$ 519,184.93
Antique	2nd	546,031	1.45	585,618.25	Elimination	1	3	PHP 38.91	$ 0.88	PHP 22,783,538.10	$ 513,027.20
Camarines Norte	2nd	542,915	1.44	582,004.88	Elimination	1	3	PHP 38.91	$ 0.88	PHP 22,642,959.66	$ 509,861.74
Sarangani	2nd	498,904	1.97	548,046.04	Elimination	1	3	PHP 38.91	$ 0.88	PHP 21,321,787.66	$ 480,112.31
Nueva Vizcaya	2nd	421,355	1.39	450,639.17	Elimination	1	3	PHP 38.91	$ 0.88	PHP 17,532,163.31	$ 394,779.63
Kalinga	3rd	201,613	1.48	216,532.36	Elimination	1	3	PHP 38.91	$ 0.88	PHP 8,424,213.79	$ 189,691.82
Apayao	3rd	112,636	1.49	121,027.38	Elimination	1	3	PHP 38.91	$ 0.88	PHP 4,708,582.73	$ 106,025.28
Lanao del Norte	2nd	607,917	2.54	685,122.46	POR	1	4	PHP 91.13	$ 2.05	PHP 62,436,050.34	$ 1,405,900.71
Misamis Occidental	2nd	567,642	1.55	611,634.26	POR	1	4	PHP 91.13	$ 2.05	PHP 55,738,980.14	$ 1,255,099.76
Davao Oriental	1st	517,618	1.50	556,439.35	POR	1	4	PHP 91.13	$ 2.05	PHP 50,709,000.72	$ 1,141,837.44
Cavite	1st	3,090,691	4.12	3,727,373.35	POR	1	4	PHP 91.13	$ 2.05	PHP 339,680,106.56	$ 7,648,730.16
Cebu	1st	2,619,362	1.94	2,873,440.11	POR	1	4	PHP 91.13	$ 2.05	PHP 261,860,123.34	$ 5,896,422.50
Batangas	1st	2,377,395	2.24	2,643,663.24	POR	1	4	PHP 91.13	$ 2.05	PHP 240,920,274.88	$ 5,424,910.49
Camarines Sur	1st	1,822,371	1.62	1,969,983.05	POR	1	4	PHP 91.13	$ 2.05	PHP 179,526,972.64	$ 4,042,489.81
Iloilo	1st	1,805,576	1.48	1,939,188.62	POR	1	4	PHP 91.13	$ 2.05	PHP 176,720,638.72	$ 3,979,298.33
Northern Leyte (Leyte)	1st	1,567,984	1.04	1,649,519.17	POR	1	4	PHP 91.13	$ 2.05	PHP 150,322,705.76	$ 3,384,884.16
Bohol	1st	1,255,128	0.97	1,316,001.71	POR	1	4	PHP 91.13	$ 2.05	PHP 119,928,850.40	$ 2,700,492.02
Albay	1st	1,233,432	1.23	1,309,288.07	POR	1	4	PHP 91.13	$ 2.05	PHP 119,317,028.15	$ 2,686,715.34
Masbate	1st	834,650	1.66	903,925.95	POR	1	4	PHP 91.13	$ 2.05	PHP 82,375,880.95	$ 1,854,894.86
Sorsogon	2nd	740,743	1.31	789,261.67	POR	1	4	PHP 91.13	$ 2.05	PHP 71,926,384.10	$ 1,619,598.83
Western Samar (Samar)	1st	733,377	1.35	782,879.95	POR	1	4	PHP 91.13	$ 2.05	PHP 71,344,810.22	$ 1,606,503.27
Capiz	1st	719,685	0.96	754,229.88	POR	1	4	PHP 91.13	$ 2.05	PHP 68,733,894.42	$ 1,547,712.10
Northern Samar	2nd	589,013	1.64	637,312.07	POR	1	4	PHP 91.13	$ 2.05	PHP 58,079,030.57	$ 1,307,791.73
Aklan	2nd	535,725	1.73	582,065.21	POR	1	4	PHP 91.13	$ 2.05	PHP 53,044,317.02	$ 1,194,422.81
Surigao del Norte	2nd	442,855	1.68	480,054.82	POR	1	4	PHP 91.13	$ 2.05	PHP 43,747,984.78	$ 985,093.10
Eastern Samar	2nd	428,877	1.33	457,397.32	POR	1	4	PHP 91.13	$ 2.05	PHP 41,683,179.05	$ 938,598.94
Benguet	2nd	403,944	2.04	445,146.29	POR	1	4	PHP 91.13	$ 2.05	PHP 40,566,727.43	$ 913,459.30
Southern Leyte	3rd	399,137	1.03	419,692.56	POR	1	4	PHP 91.13	$ 2.05	PHP 38,247,097.55	$ 861,227.15
Romblon	3rd	283,930	0.72	294,151.48	POR	1	4	PHP 91.13	$ 2.05	PHP 26,806,385.30	$ 603,611.47
Catanduanes	3rd	246,300	1.35	262,925.25	POR	1	4	PHP 91.13	$ 2.05	PHP 23,960,700.65	$ 539,533.90

Marinduque	4th	227,828	0.47	233,181.96	POR	1	4	PHP 91.13	$ 2.05	PHP 21,250,157.95	$ 478,499.39
Guimaras	4th	162,943	1.42	174,511.95	POR	1	4	PHP 91.13	$ 2.05	PHP 15,903,488.41	$ 358,106.02
Biliran	4th	161,760	1.43	173,325.84	POR	1	4	PHP 91.13	$ 2.05	PHP 15,795,396.47	$ 355,672.07
Dinagat Islands	2nd	126,803	1.72	137,708.06	POR	1	4	PHP 91.13	$ 2.05	PHP 12,549,504.30	$ 282,582.85
Siquijor	5th	91,066	1.1	96,074.63	POR	1	4	PHP 91.13	$ 2.05	PHP 8,755,398.92	$ 197,149.27
Camiguin	5th	83,807	1.22	88,919.23	POR	1	4	PHP 91.13	$ 2.05	PHP 8,103,318.26	$ 182,466.07
Batanes Islands	5th	16,604	0.08	16,670.42	POR	1	4	PHP 91.13	$ 2.05	PHP 1,519,195.46	$ 34,208.41
Abra	3rd	234,733	1.14	248,112.78	POR	1	5	PHP 109.81	$ 2.47	PHP 27,244,085.21	$ 613,467.35
Rizal	1st	2,484,840	3.82	2,959,444.44	CLM	2	1	PHP 5.66	$ 0.13	PHP 16,759,726.19	$ 377,386.31
Negros Oriental	1st	1,286,666	1.31	1,370,942.62	CLM	2	2	PHP 58.68	$ 1.32	PHP 80,443,102.52	$ 1,811,373.62
Oriental Mindoro	1st	785,602	1.43	841,772.54	CLM	2	3	PHP 52.37	$ 1.18	PHP 44,087,799.28	$ 992,744.86
Quirino	3rd	176,786	1.75	192,254.78	POR	1	4	PHP 72.46	$ 1.63	PHP 13,930,244.03	$ 313,673.59
NMCEP costs				101,109,948.00	NA	NA	NA	PHP 1.63	$ 0.04	PHP 164,737,910.84	$ 3,709,477.84
								Total cost	Total Cost	PHP 4,607,740,359.75	$ 103,754,567.88
								Cost per capita (PHP)	Cost per capita	PHP 45.57	$ 1.03

Annex 5. List of Assumptions

Population numbers

We used 2014 mid-year population estimates by provinces via the Philippines Statistics Authority.

Personnel time

Personnel times were all self-reported. We interviewed one person or staff member from each position to determine his or her time allocations by malaria intervention category and activity. We then applied the time allocation of the staff member interviewed to all staff members with the same designation. For certain positions where multiple people shared the same designation, but conducted very different work activities (e.g., Anti-Malaria Campaign [AMC] medical officers), each person's time allocation was determined separately and used in the costing.

When a particular Regional Malaria Coordinator (RMC) staff member was not available, the regional malaria officer was interviewed instead.

Cars and other motor vehicles

We used the unit costs and year of purchase found in Global Fund records for the costing of cars and other motor vehicles.

For time allocations of cars and other motor vehicles, we used the time allocations reported by the personnel who use them or are in-charge of the vehicles' maintenance and care.

Computers, printers, photocopiers, and other equipment

We asked the RMOs to provide us a list of all their functioning computers and computer equipment. We asked them to provide time allotments for all the computers and computer equipment. When no time allotments were provided, we used the average of the self-reported time allotments of all the staff that use the computers or computer equipment. We used the unit costs and year of purchase found in Global Fund records for the costing of computers and computer equipment.

Buildings

We did not include the costs of buildings, office spaces, and laboratory space in the costing because no records of construction costs were available. However, building maintenance costs (e.g., elevator maintenance, building repairs, etc.) were included.

Treatment costs

Provided for by the Philippines NMCEP

Depreciation

To calculate the depreciated value of capital goods and equipment, we divided the original total cost of the good by an annualization factor based on a 3% discount rate and the good's useful life years (ULYs), and multiplying that value by the remaining ULYs.

Depreciated value = (Original Total Cost/Annualization Factor)*Remaining ULYs

Remaining ULYs = ULYs – (2014 – Year of Purchase)

The table below shows the annualization factors used:

Useful Life Years	Annualization Factor (3% discount rate)
1	0.971
2	1.913
3	2.829
4	3.717
5	4.580
6	5.417
7	6.230
8	7.020
9	7.786
10	8.530

Useful Life Years for Capital Costs Used	
Capital Goods	Useful Years of Life
Motorcycles	5
Vehicles	10
Computers	5
Microscopes	10
Buildings	20

The ULYs we used are based on the recommendations in the Bill & Melinda Gates Foundation's "Guidance for Estimating Cost for Malaria Elimination Projects."

Global parameters							
Variables	**Year**						
	2010	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Population	92,337,852	102,768,151	104,453,549	106,166,587	107,907,719	109,677,406	111,476,115
Incident cases		48,441	50,850	46,342	35,405	36,235	23,655
Deaths due to malaria		162	167	145	124	73	56

Population growth rate	**Years**	**Value**
	2000–2005	2.05
	2005–2010	1.95
	2010–2015	1.82
	2015–2020	1.64

GDP growth rate	**Year**	**Value**
	2008	4.2
	2009	1.1
	2010	7.6
	2011	3.7
	2012	6.8
	2013	7.2
	2014	6.1
	Avg.	5.24

Conservative scenario	25%
Optimistic scenario	–25%
Supply chain cost for drugs (as a % of drug cost)	25%

National parameters		
A. Direct cost to the health system		
A.1. Cost due to increased health service utilization	**OP**	**IP**
Proportion of cases	72%	28%
Average length of episode in days	6.5	10
Unit cost of drug (without supply chain)	3.22	2.21
Unit cost per visit (hostel cost)	8.51	23.17
Cost of RDT	1.05	
A.2. Cost of vector control	**IRS (Projections based off report from NMCEP)**	**LLIN (Projections based off report from NMCEP)**
2015	59%	76.50%
2016	99%	76.50%
2017	72%	76.50%
2018	32%	76.50%
2019	12%	76.50%
2020	12%	76.50%

Cost per person (in USD)	4.37	6.83
Unit cost of distribution	1.09	1.71
A.3. Population with special needs: Children under five years of age (U5)	**Value**	**Source**
Birth rate per 1000 population	24	World Bank
Cost per dose of drug ($)	0.35	Malaria in Pregnancy Consortium
Loaded cost ($)	0.5	Malaria in Pregnancy Consortium
Per person protected ($)	1.5	Malaria in Pregnancy Consortium
A.4. Cost of increased diagnosis	**Value**	**Source**
Slide positivity rate	1.60%	WMR 2015
Number of slides tested	314,820	WMR 2015
Number of non-malaria fever tested	309,783	WMR 2015
Unit cost per test (Slide)	0.86	NMCEP
Unit cost per test (RDT)	1.05	NMCEP
A.5. Cost of training human resources and IEC	**Year**	**Amount ($)**
Total estimated cost of the program	2015	17,666,596
Total estimated cost of the program	2016	18,797,258
Total estimated cost of the program	2017	20,000,282
Total estimated cost of the program	2018	21,280,300
Total estimated cost of the program	2019	22,642,240
Total estimated cost of the program	2020	24,091,343
Proportion	**IEC**	**Training**
	12%	2%
B. Direct cost to the individual households		
B.1. Out-of-pocket expenditure incurred due to malaria	**Value**	**Source**
HH OOP cost per episode (in $)	21.84	PQR Database
C. Indirect cost to the society		
C.1. Cost due to loss of life to malaria mortality	**Value**	**Source**
Case distribution by gender (Male)	58%	NMCEP
Case distribution by age (<18 years)	65%	NMCEP
Deaths distribution among 18 plus ages (male)	35%	NMCEP
Deaths distribution among 18 plus ages (female)	65%	NMCEP
Life expectancy at age 40 Male	29.99	UN
Life expectancy at age 40 Female	34.94	UN
GDP in year 2014	284,582,023,121	World Bank
GDP growth rate	6.1%	World Bank
Coefficient (Full income)	2.3	World Bank
C.2. Cost due to loss of productivity due to malaria morbidity	**Value**	**Source**
Average length of episode in days	6.5	Personal Communication: Antonio Bautista, PSFI

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