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Costing Dengue Fever Cases and Outbreaks: Recommendations from a Costing Dengue Working Group in the Americas

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ABSTRACT

Objectives: The overall aim of this article was to present a step-by-step guideline for determining the costs associated with dengue in dengue-endemic countries of the Latin American and the Caribbean region and to illustrate how each of these steps can be applied in dengue costing studies. **Methods:** An expert panel was convened to develop standards for costing dengue so that over the next decade, decision makers will have access to improved information on the true cost of dengue in endemic countries of the Latin American and the Caribbean region. We described the outcome of the expert panel meeting, which resulted in the provision of a step-by-step dengue costing guideline that aims to provide direction to planners and program managers on how to estimate dengue economic burden studies, and provide a discussion forum of the methods used to cost dengue fever cases and outbreaks in a manner that should be accessible to persons with some familiarity

with a cost study. **Results:** The guideline includes nine sequential steps: 1) definition of the scope of the study; 2) identification of the target population; 3) description of the study perspective; 4) definition of the time horizon; 5) calculation of the sample size; 6) definition of the unit of analysis; 7) identification of the cost items; 8) measurement and valuation of the cost items; and 9) handling of uncertainty. The trade-off between accurate, patient-level cost estimates and data availability constraints is discussed. **Conclusions:** The current guideline is the result of constructive collaboration among a multidisciplinary research team to better ascertain the true economic burden of dengue across countries of the region.

Keywords: costing, dengue fever cases, dengue outbreaks.

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Background

Dengue is the vector-borne viral infection most widely and further spread in the world, representing a severe public health problem. Dengue is caused by one of four serotypes (Denv1, Denv2, Denv3, and Denv4), transmitted by several species of mosquito within the genus *Aedes aegypti*. This disease has no boundaries or limits, affecting populations of all ages and socio-economic levels. It is estimated that 390 million dengue infections are reported every year, with 70% of the 96 million clinical dengue infections reported occurring in Asia, followed by 16% in Africa and 14% in the region of Latin America and the Caribbean

[1]. The dramatic increase in dengue cases is due to a number of factors, including population growth, urbanization, and increased international travel. Dengue has a high social and economic impact, affecting not just the patient but also the family and the community in which those affected by dengue live. The true economic cost of the disease is unknown; however, it is believed to range from US \$13.5 million (Nicaragua) to US \$56 million (Malaysia) [2].

Limited research has been done to estimate the costs of dengue in the Latin American and Caribbean region. In a recent review of the literature, only a handful of economic studies were found in the region [2]. The studies reviewed indicated an

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important variation in dengue cost estimates due to differences in case classification, definition of cost categories, sampling, data sources, and other methodological challenges. In addition, the published literature shows that studies looking at dengue cost estimates are not of sufficient quantity and quality. It is not always clear from these economic studies which form of treatment associated with dengue is costed, what is included in the total cost estimation of dengue, and how these estimates are calculated. Moreover, cost estimates from these studies are of heterogeneous (mixed) quality, not generalizable to other populations, and not representative of the total economic consequences of dengue.

These methodological issues are compounded by the absence of well-established guidelines for costing diseases such as dengue. Efforts by governments and health care systems in the United States, Europe, Asia, Latin America, and the Caribbean to harmonize approaches to economic evaluation are ongoing, but the task is challenging. With governments and health care systems continuing to take an independent line on evaluation, the scientific community is left in a difficult position, given the international basis of its research activities [3]. The impetus of conducting dengue cost studies is that they can be used as inputs into cost-effectiveness analyses to provide important information about efficient resource allocation and health care financing [4–6].

Cost studies can be performed across various delivery settings, such as hospitals or primary care centers; in different geographic areas, from urban to rural hospitals and primary care centers; and in different socioeconomic settings, from high-income households to low-income households [2]. Because of the limited research that has been done to estimate dengue costs across various health care delivery settings, geographic areas, and socioeconomic settings, and to estimate the consequences of dengue in settings outside the health care system (e.g., tourism), there is little development of the necessary underlying theory of economic costs of dengue and limited data systematically collected for this purpose are available.

Many guidelines have been developed to direct the design and conduct of economic studies, comprising an analysis of the costs and effects of an intervention. Most of the guidelines are from developed countries [6–9], where data are more readily available, and are not disease-specific. From preliminary discussions with experts in the region, we found a few country-specific economic evaluation guidelines in dengue-endemic countries of the region [10–12]. The overriding constraint when costs are estimated in these settings is the lack of financial records and incomplete patient disease registers, as well as the limited expertise in conducting costing studies. These issues are compounded by the fact that there is little consensus on which guidelines to adopt to estimate the true costs of disease.

In response to the growing need for dengue cost estimates to inform future vaccine introduction, an expert panel was convened on March 6–8, 2012 to discuss and develop a standardized methodology for estimating costs of dengue in the Americas [13].

Aim and Objectives

The overall aim of this article was to present a step-by-step guideline for determining the costs associated with dengue in dengue-endemic countries of the region and to illustrate how each of these steps can be applied in dengue costing studies. The guideline is regional in scope and includes nine sequential steps: 1) definition of the scope of the study; 2) identification of the target population; 3) description of the study perspective; 4) definition of the time horizon; 5) calculation of the sample size; 6) definition of the unit of analysis; 7) identification of the cost

items; 8) measurement and valuation of the cost items; and 9) handling uncertainty. Because a cost study has many different methodological components built from extensive theoretical and operational evidence of their comprising disciplines, it is not possible to cover all the diverse dengue-related costing issues. Only areas of priority to the expert panel are highlighted in this article [13].

Methods

On the basis of a systematic review of the literature and an expert survey described elsewhere [2], we developed a framework to cost dengue cases and outbreaks in the Americas. Two key elements were central to the development of this framework: 1) the type of standard methods needed to capture the true economic cost of dengue, and 2) the type of cost information that is most useful to making public health policies to counter dengue infections. We convened a panel of experts to identify methodological gaps in this area and discuss recommendations to measure the true cost of dengue. The overall approach used to develop the guideline is discussed elsewhere [13].

In brief, the guideline was developed using a stepwise approach starting with a provisional guideline developed by a multidisciplinary group of experts who attended a workshop in 2012. The guideline was based on existing evidence and extensive small and large group discussions and formal didactic sessions. A working group was then formed to review recommendations from the guideline, address common methodological issues when costing dengue, and assess the scientific validity of the guideline. Much like the original expert panel convened for the workshop, the working group was composed of health economists from various countries in the Americas, including epidemiologists, entomologists, program managers, and policymakers with background or expertise in dengue or dengue economics.

Defining Dengue

The lack of accuracy around dengue cost estimates is in large part due to the uncertainty of what to measure. There is considerable uncertainty surrounding the case and outbreak definitions, and what definitions are known vary across countries and regions. Experts agreed about the need to be explicit and consistent about the use of the dengue case definition and to distinguish where these cases are being reported (e.g., ambulatory vs. hospitalized dengue cases) because the costs differ across settings, and to characterize how these cases are being reported (e.g., suspected dengue cases, probable dengue cases, and confirmed dengue cases). In this section, we discuss dengue case and outbreak definitions based on in-depth expert discussions and address some of the key challenges of defining dengue.

Dengue Cases

Measurement of the local burden of disease is an essential component of dengue cost evaluations. When data on disease burden are lacking, policymakers may perceive that the disease is not important and the benefits of prevention and control strategies (e.g., vector control and vaccines) will not be appreciated. To estimate the burden of dengue, key outcomes of infection need to be identified. Difficulties arise because of inconsistencies in case definitions for dengue, overlapping clinical features with other illnesses, nonspecific and/or expensive diagnostic tools, and reliance on verbal autopsy to estimate mortality figures.

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