The Economic Burden of Illness caused by the Globally Spreading Chikungunya Virus: A Systematic and Targeted Literature Review

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Introduction

Disease background

Chikungunya (CHIK) is an arboviral disease transmitted to humans by chikungunya virus (CHIKV)-infected mosquitoes. with infection characterized by an acute phase, commonly presenting with fever, polyarthralgia, and myalgia (1,2). Climate change has facilitated the geographic spread of the vector species *Aedes albopictus* and *Aedes aegypti*, and recent decades have seen a rapid increase in CHIKV distribution and outbreak frequency (3,4,5). CHIKV is identified as a global health concern (6), but its economic impact remains unclear.

Disease management and prevention

No specific antiviral treatments or effective vaccines are currently licensed for CHIKV. Treatment for CHIK is mainly supportive and involves rest, pain and fever relief, and adequate hydration. Acetaminophen is a first-line treatment for fever. Non-steroidal anti-inflammatory drugs (NSAIDs) are recommended for articular symptoms, but only once dengue fever has been ruled out. Prevention and control rely heavily on reducing the number of water-filled habitats that allow mosquitoes to breed. During outbreaks, insecticides may be sprayed to kill flying mosquitoes, applied to surfaces where the mosquitoes land. Also, clothing which minimizes skin exposure to day-biting mosquitoes is advised (7).

Objectives

The economic review aimed to collect and analyze recent evidence on the global economic burden of CHIKV. The objective of the additional burden of illness (BOI) TLR was to put the results from the economic SLR in perspective. It is important to understand the economic burden of CHIK to be able to contextualize potential future interventional costs to prevent disease.

Methods

Systematic literature reviews

Three SLRs of economic evidence were conducted following Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines: one for modelling studies, one for costs and resource studies, and one for utilities and/or health-related quality of life studies. Medline and Embase were searched without date restriction, and congress abstract repositories were searched (2019–2021). Inclusion and exclusion was based on PICOS criteria, which were specified per SLR.

Grey literature search

A grey literature search was conducted to help identify the most recent abstracts, posters, and podium presentations that may not have been indexed in the medical literature databases. These searches were limited to the last two years (2019–2021) to capture the most recent unpublished or ongoing trials. Bibliographic searches of identified key systematic review and meta-analysis (including network meta-analysis) articles were also conducted to ensure that the initial searches captured all relevant economic studies.

Burden of illness targeted literature review

A TLR on BOI studies was also performed. The Medline database was searched for this TLR. The search strategy included search terms relating to CHIK for economic, humanistic, and epidemiologic outcomes. To determine the final set of studies eligible for review, explicit inclusion and/or exclusion criteria were applied to the literature search results. Primary and secondary screening to determine eligibility according to the inclusion and exclusion criteria were performed by one researcher.

Results

Studies identified

Of 3,146 records identified in the SLRs, 65 studies were included: 3 economic modelling studies, 28 cost and resource use studies, and 34 utility studies. The TLR yielded 17 studies. Reported diagnostic and treatment-related costs attributed to CHIKV infection varied widely by region, patient population, and duration and severity of illness. Substantial resource burden was associated with CHIKV outbreaks, including direct costs, indirect costs, and out-of-pocket (OOP) expenditure on healthcare and vector control interventions, with significant implications for low-income households and the impact of CHIKV on poverty.

Figure 1 summarizes the global distribution of CHIKV and the populations at risk for their continued spread. These are countries having transmission of chikungunya. The gradient indicates the average number of reported cases per year from 2010 to 2019 (8).

Figure 1. Global distribution of CHIKV (8)

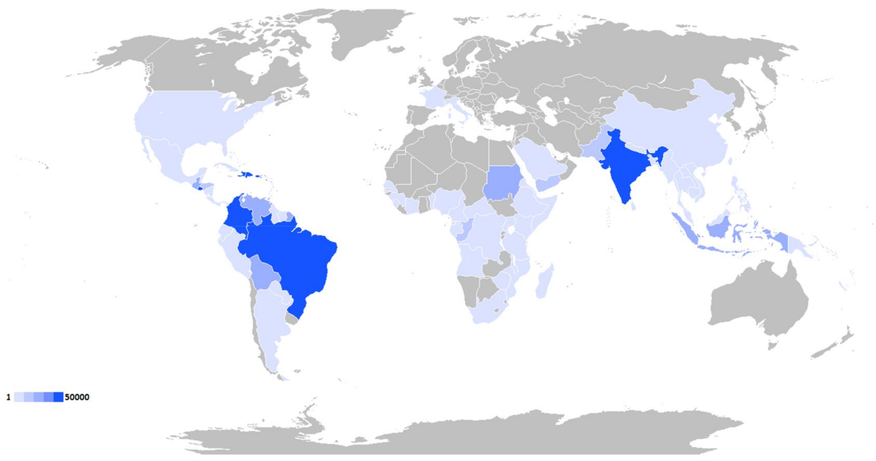

Figure 2. Cost CHIKV outbreak US Virgin Islands (9)

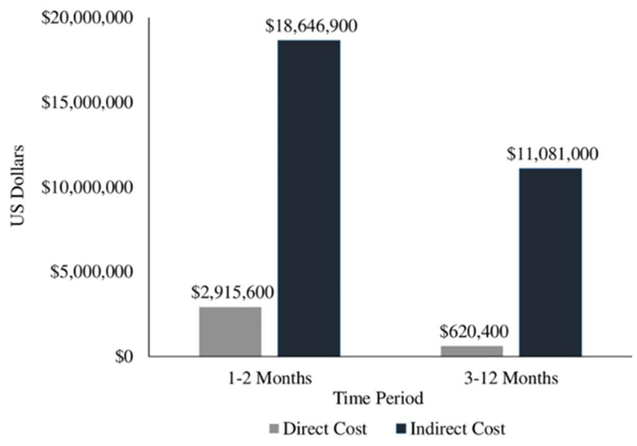

Figure 2 shows the economic burden of chikungunya associated with the 2014–2015 CHIKV outbreak in the US Virgin Islands by estimating direct medical costs, indirect cost of lost productivity due to absenteeism, and YLDs associated with long-term sequelae of the outbreak. This study is exemplary for the large proportion indirect costs make up for the total costs acquired during an outbreak (9).

Economic burden

- As the outbreak frequency of CHIKV has increased in past decades and the spread of the virus continues, it comes with a substantial health-economic impact on societies and healthcare systems. A CHIKV outbreak comes with a high economic burden. In a cost-of-illness study during the La Réunion epidemic, the medical costs were estimated to be €43.9 million (at 2006 values) — 60% (€26.5 million) of which was due to direct medical costs, and 40% (€17.4 million) to indirect costs (10)
- OOP expenditure includes all costs paid directly by private households, such as health services, self-medication, and other healthcare expenditure. OOP healthcare expenditure has significant implications for poverty in many developing countries. Several studies report on chikungunya as a noticeable percentage of monthly household income and income foregone due to loss of productive time (11,12).
- The spread of CHIKV in the Americas also has an impact on the tourism industry. As an important source of income and employment for the region, this will substantially contribute to the economic burden of CHIKV (13).
- The total estimated cost associated with the 2014-2015 outbreak in the US Virgin Islands ranged from $14.8 to $33.4 million (approximately 1% of gross domestic product), depending on the proportion of the population infected with symptomatic disease, the degree of underreporting, and the proportion of cases who were employed (9).
- A major factor in the economic burden of chikungunya is productivity loss, as the disease causes disability in acute and chronic illness due to CHIKV infection. Most studies investigating the indirect costs of CHIKV reported costs associated with productivity loss (14,15,16,17).

Conclusion

- This SLR identified a limited number of modelling and utility studies. This shows a clear data gap. More evidence is desirable.
- The costs of CHIKV prevention and treatment vary widely, depending on duration of illness and severity. Persistent CHIKV symptoms are also associated with an increased burden on healthcare systems, resulting in increased use of resources and subsequent medical costs.
- The wide range of values from the same cost-categories over the studies makes it difficult to draw conclusions about the actual costs related to CHIK
- Productivity loss is a major factor in the economic burden of chikungunya, as the disease causes disability in the acute and chronic phases.
- The indirect costs of CHIKV infection include the value of the economic resources lost due to productivity loss or incapability, lost wages, employee replacement, or premature mortality. Indirect costs also include insurance costs, home care, childcare, tourism, and other costs that are not directly related to direct patient care.
- The clinical symptoms of CHIKV infection affect HRQoL and can cause loss of productivity and incapacitation for work, which has a substantial health economic impact. With a higher duration of illness from the acute to chronic phase, the workdays and workhours lost increase.

CHIKV infection presents a considerable economic and healthcare burden to society and healthcare systems globally, highlighting the unmet need for effective preventive measures

Incorrect treatment and misdiagnosis of chikungunya as similar arboviral diseases was identified as a possible confounder in measuring disease burden

Productivity loss due to acute and chronic chikungunya symptoms was identified as a major contributor to the economic burden of CHIKV

The heterogeneity of evidence highlights the unpredictability of the disease and shows further research is required to estimate the true economic burden of CHIKV

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