Economic Costs of Chikungunya Virus in Colombia

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ABSTRACT

Objective: The aim of the present study was to estimate the economic impact of chikungunya virus (CHIKV) infection in Colombia from a societal perspective. Methods: We conducted a retrospective, bottom-up cost-of-illness study in clinically confirmed cases during the first chikungunya (CHIK) outbreak in Colombia in 2014. Direct and indirect costs were estimated per patient. Economic costs were calculated by the addition of direct costs (direct medical costs and out-of-pocket health expenditures) and indirect cost as a result of loss of productivity. Results: A total of 126 patients (67 children and 59 adults) with CHIK were included. The median of the direct medical cost in children was US$257.9 (interquartile range [IQR] 121.7–563.8), and US$66.6 (IQR 26.5–317.3) per adult patient. The productivity loss median expenditures reached US$81.3 (IQR 72.2–203.2) per adult patient. The median economic cost in adults as a result of CHIK was US$152.9 (IQR 101.0–539.6), of which 53.2% was a result of indirect costs. Out-of-pocket expenditures comprised 3.3% of all economic costs. Conclusions: Our study can help health decision makers to properly assess the burden of disease caused by CHIK in Colombia, an endemic tropical country. We recommend to strength the health information systems and to continue investing in public health measures to prevent CHIK.

Keywords: chikungunya virus, Colombia, economic cost, cost, disease outbreak.

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Methods

Study Design
We conducted a retrospective, bottom-up cost-of-illness study, to estimate the economic costs related to CHIK in the Colombian population. To estimate direct medical costs, we selected patients consulting from August 2014 to February 2015, when the Colombian CHIKV outbreak was peaking [13]. Costing was performed in four medical institutions purposely selected. Data were obtained from clinical records of patients with CHIK attending two private hospitals (Clinica Crecer [CC] and Hospital Infantil Nepaleón Franco Pareja [HINFP], both located in Cartagena de Indias, Bolívar) and two public hospitals (Hospital Universitario del Caribe [HUC] located in Cartagena, Bolívar, and Hospital Local de Mahates [HLM] from Mahates, Bolívar). Patients were enrolled following simple random sampling for HINFP and HLM and convenience sampling for CC and HUC.

Bolívar, located in the Caribbean region of Colombia, is one of the 32 Colombian departments (states) and has a population of 2.1 million people (4.3% of the 2014 Colombian population) [19]. The first autochthonous case in Colombia had place in Mahates (Bolívar), a Colombian municipality with a high CHIK burden [14]. Following the guidelines on clinical management of CHIK released by the Colombian health ministry, there are no differences among departments in CHIK treatment [20].

We selected a population with clinical signs and indicators of CHIK for our sample. These patients were selected from the early peak of the epidemic, where cases were most likely to be CHIK. Besides that, the INS requires mandatory notification of acute cases with fever of greater than 38°C, arthritis, arthralgia, and rash, when no other condition can explain the symptoms. Because of the overwhelming nature of approximately 500,000 notified cases in the country so far and because of the novelty of the epidemic (CHIK was not present before in the country), we could not perform laboratory confirmation of these cases. Despite that, in a related clinical study from HINFP, the authors found that around 92% of children with suggestive symptoms were positive for CHIKV [21]. Data were collected in Microsoft Excel 2013 (Microsoft Corp., Redmond, WA) and analyzed in R Project for Statistical Computing, and STATA 12 (Stata Corporation, College Station, TX). According to the Resolution 8430 of 1993 of the Ministry of Health, this research presented no risks to patients [22].

Cost Assessment

Direct costs per patient
We retrospectively extracted information from clinical records of patients with clinically confirmed CHIK of use and frequencies of consultations, drugs, laboratory and images, bed costs, and procedures performed in each selected patient. We included patients with clinically diagnosed CHIK with a positive epidemiologic link, in the inpatient and outpatient settings.

Direct medical costs were analyzed from the third-party payer perspective. Costs in pediatric and adult patients were estimated by using billing and price information and the official national prices health services databases, such as the official Colombian Tariff Manual (abbreviation SOAT for the Spanish name), which standardize the maximum price of medical, surgical, and hospital prices. Drugs costs were estimated using the national official drugs database (abbreviation SISMED for the Spanish name), which contains estimated median and range prices for drugs in the country. These Colombian official national tariff manuals are recommended for estimating costs from the Colombian health system perspective [23]. Direct medical costs per patient were estimated as follows:

\[ Vi \in K : \text{Total item cost per patient} = h_i \times P_i \]

\[ K = \{ \text{drugs, lab, & images, hospital stay, consults, procedures} \} \]

Where K stands for the health services set; h stands for use frequencies of health services, and P stands for price per item.

Direct costs per patient = \( \sum_{i=1}^{k} \text{Costs}_i \)

Out-of-pocket health expenditures and indirect costs per patient
We selected adult patients in the emergency room of HLM on March 18–19, 2017, with history of CHIK in the last 2 months to avoid memory bias. Patients selected for the survey of out-of-pocket and indirect costs were different to those which were selected to review their clinical records to estimate direct medical costs. A questionnaire was used to prospectively collect data on CHIKV testing, inpatient (US$518–US $777), and above three minimum wages (> US$777). Loss of income was calculated by using the following formula:

\[ \text{Loss of income} = \frac{\text{Mean monthly income}}{30 \text{ days}} \times \text{days with CHIKV} \]

Estimation of the economic cost per patient
Economic costs were calculated by the addition of direct costs (direct medical costs and out-of-pocket health expenditures) and indirect cost incurred because of loss of productivity. All costs were reported in 2014 US dollars (US$) [at exchange rate of 1 US$ per $2378.6 Colombian pesos (COP)] [24].

Data Analysis and Reporting
For reporting, median costs per patient and interquartile ranges (IQR) were shown. We also reported median costs and 95% confidence interval computed via bootstrapping (10,000 iterations), because costs per pediatric or adult patient do not follow a normal distribution, these were estimated by following a Gamma distribution [25]. Item costs were presented as a proportion of the median direct medical cost per patient, considering the average of the proportions of per-item costs. The median direct costs were stratified by pediatric (age <18 years) or adult cases (age >18 years), and hospitalization status (inpatient or outpatient).

Results
We included 126 patients with CHIK symptoms in the Colombian endemic outbreak. We collected 67 pediatric clinical records, of which 34 (51.0%) were those of males, 42 (62.7%) were less than 1 year old, 10 (14.9%) were 1 to 5 years old, and 15 (22.4%) were 6 to
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