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Dengue in Argentina: an economic analysis of the impact of the 2009 epidemic

Dengue en la Argentina: un análisis económico del impacto de la epidemia de 2009

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ABSTRACT The present study estimates the economic burden associated with the cases of dengue recorded during the 2009 Argentine epidemic. Among the costs considered are the medical costs necessary for the treatment of those affected and the opportunity costs for those who stopped working or studying because of the disease. In order to assess the costs of the disease, at the end of 2009 an ad-hoc survey was carried out in 201 households where people that had contracted dengue during the 2009 epidemic lived. The results allow us to estimate between 26 to 40 million Argentine pesos (6 to 9 million US dollars) as the total cost of the recorded cases. The regions in the north of Argentina bore the highest economic burden of the disease (more than 90% of the total burden). For all regions, the social cost of one dengue case accounts for more than 40% of the average monthly net individual income.
KEY WORDS Dengue; Cost of Illness; Argentina.

RESUMEN El presente estudio estima la carga económica de los casos notificados de dengue durante la epidemia argentina de 2009. Entre los costos considerados, se encuentran los costos médicos para el tratamiento de las personas afectadas y los costos de oportunidad de aquellas personas que dejaron de trabajar o estudiar a causa de la enfermedad. Para la determinación de los costos, a fines de 2009 se llevó a cabo una encuesta ad hoc a 201 hogares en los que habitaban personas que habían padecido la enfermedad durante la epidemia. Los resultados obtenidos permiten estimar entre los 26 y los 40 millones de pesos (entre 6 y 9 millones de dólares) el costo total de los casos notificados. Las regiones del norte argentino son las que habrían soportado la mayor carga económica (más del 90% de la carga total). Para todas las regiones, el costo social de un caso de dengue representaría más del 40% de la remuneración neta mensual promedio de los individuos.
PALABRAS CLAVES Dengue; Costo de Enfermedad; Argentina.

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INTRODUCTION

In recent decades, the incidence of dengue has increased dramatically around the world, and it is estimated that 2.5 billion people (approximately two-fifths of the world population) are at risk. The Pan American Health Organization estimates that each year 50 million dengue-related infections are reported worldwide (1).

This disease is endemic in more than 100 countries in Africa, the Americas, Southeast Asia and the Western Pacific. At present, there is not only a rise in the number of cases, but explosive outbreaks are also becoming more frequent (2). The most affected countries in the region are: Brazil, Ecuador, Colombia, Paraguay and Venezuela (3).

The outbreak that Argentina faced in 2009 was considered the worst dengue epidemic in the history of the country, due to both the number of people affected and the geographic distribution of the indigenous cases that exceeded the traditional endemic channels. According to official figures, more than 27,000 cases were recorded, and the most affected provinces were Chaco (42% of cases), Catamarca (33%), Salta (11%), Jujuy (5%), Santa Fe (4%), and Tucumán (2%), although there were also indigenous cases recorded in Misiones, Entre Ríos, and the city of Buenos Aires. The northern provinces of Argentina were at the highest risk: the provinces of Chaco, Catamarca, and Salta alone accounted for almost 86% of the indigenous cases of dengue recorded during the first half of 2009 (4).

The aim of this study is to estimate the aggregate economic burden associated with the cases of dengue that occurred during the Argentine epidemic throughout the first half of the year 2009. In this estimate, the cost of the medical services needed for the treatment of those affected by the disease, as well as the opportunity cost for those individuals that discontinued their regular activities (like working or attending school) as a result of the disease are included. For the cost estimate, a social perspective was adopted, in terms of the costs to society as a whole, with no distinction between the different actors responsible for those costs (patients, the State, families, etc.).

Cost estimates of the measures taken to prevent new cases that were implemented after the outbreak of the epidemic (as well as those implemented during or before it) are not included. The losses that the epidemic could have caused to specific economic activities (such as tourism) or to the aggregate economic growth of the region or country affected – which could both be topics of further research – are also not included.

MATERIALS

Quantities

The cost estimate was carried out taking into account the information regarding "quantities" of goods and services consumed. This information was taken from an *ad hoc* survey carried out during October and November of 2009 in the affected zones. This survey allowed for the detection of the average duration of the disease (differentiating between outpatient and inpatient cases), the frequencies of use of medical goods and services, and the frequencies related to opportunity costs (school days and workdays lost) for a sample of the dengue cases that took place during the first half of 2009. The target population of this analysis was made up of those affected by the disease during the epidemic of 2009 in Argentina. However, given the difficulties of carrying out a survey covering the whole country and the absence of a register of cases, the selection of the sample was based on the population of one endemic region of Argentina, critical in terms of the presence of dengue cases during the epidemic, and where a thorough register including records of the domiciles of the affected people which allowed subsequent contact was also kept. In light of these considerations, the city selected was Orán, in the province of Salta, one of the cities with the highest number of cases in the province and one of the most affected in the country, and which has a distribution by age groups similar to the age distribution of the country as a whole. The sample was composed of all the notified cases of dengue that were registered in the city of Orán during the epidemic. It is worth mentioning that this city had precise information about the place of residence of all the notified cases (which was not true for all cases throughout the country). Two hundred and one cases of dengue were officially notified

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in the city of Orán during the period of analysis. The people affected were visited, and information was gathered by means of a structured questionnaire. To determine the proportions and quantities of the services and inputs used, it is assumed that in all cases treated by public health care providers the clinical protocols recommended by the national health authority were closely followed. This allows for the assumption that there would not be significant variations regarding the health care provided in other areas of the country.

Prices

With the aim of minimizing the problems of valuation associated with the existence of subsidies, the prices of medical goods and services (drugs, laboratory procedures, medical fees, and hospitalization) of the private market were used whenever possible. Given the differences in prices and salaries throughout Argentina, an attempt was made to gather information representative for each of the affected regions.

In the case of drugs (paracetamol and ibuprofen) the prices taken into consideration include both the suggested retail prices valid at a nationwide scale (that match market prices), according to the information in the Pharmaceutical Manual [*Manual Farmacéutico*] (5), and the average prices of bids accepted by the National Ministry of Health for the drugs distributed as part of *Programa Remediar,* Argentina's largest public drug provision program. Since the proportion of the population treated in the public sector in relation to those that received drugs from the private sector is unknown, two extreme scenarios are used: one in which all the drugs used are from private sources (at retail price) and one in which all the drugs used are from public sources (at public bid prices). In practice, neither the prices paid by the State nor the retail prices present significant differences between regions and/or provinces and, therefore, a single average price is considered for all the national territory. At the same time, given that the unit prices for paracetamol and ibuprofen show considerable variation, depending on the commercial brand, the presentation of the product, the quantity of units per package in the case of retail prices, as well as valuations in the public bid prices, average unit prices were used in this study.

For laboratory practices, the researchers took into consideration the prices that the subsystem of Social Security uses, based on the information of the Unified Biochemical Confederation of the Argentine Republic [*Confederación Unificada Bioquímica de la República Argentina*] as well as information provided by private laboratories.

The medical consultations and hospitalizations were valued according to the prices provided by different health centers that belong to the private sub-sector of the provinces of Chaco, Salta and Buenos Aires. In the case of hospitalizations, prices from different catalogs used by the provincial institutions of health insurance were also taken into account.

For the assignation of a value to the loss of school days, the methodology of similar studies is followed, and it is considered that the economic value of a school day is *at least equal to the cost of providing a school day in the public system* (6) and, being conservative, the value is estimated based on the spending per student of public schools. At the same time, spending per student is estimated taking into account the information included in provincial education budgets and the number of students enrolled in all educational levels in the provinces for the year 2008 (the latest information available) (7-13). To update the costs to the year 2009, these costs were adjusted taking into account the Consumer Price Index [*Índice de Precios al Consumidor*] (14). In turn, to calculate the average cost per student, consideration was given to the school months and workdays, considering that this period corresponds to the academic year. For this calculation, six jurisdictions were selected, because they constitute places of reference in the three regions studied and, at the same time, are the jurisdictions in which the majority of cases of dengue were notified during the year 2009. The selected jurisdictions are: Chaco (Northwest region), Salta and Catamarca (Northeast region), and Buenos Aires, Santa Fe, and the city of Buenos Aires (Central region).

Lastly, the opportunity cost of workdays lost is estimated taking into account the income information per jurisdiction (for Chaco, Salta, Catamarca, Buenos Aires, city of Buenos Aires and Santa Fe) for the year 2009, according to the

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figures of the Ministry of Economy and Public Finances (15).

METHODS

For the purposes of estimating the economic burden of the disease, average equations of individual costs are approximated for different regions of Argentina, which, in turn, are combined with official information of recorded dengue cases in order to obtain the total costs for each region and for the entire country.

The estimate of the average individual medical cost for each region is the result of the following expression:

$$CM_i = \left(P_i^M \times F^M \times \Pr^M\right) + \left(P_i^V \times F^V \times \Pr^V\right) + \left(P_i^I \times F^I \times \Pr^I\right) + \left(P_i^L \times F^L \times \Pr^L\right)$$

Where:

CM_i is the average medical cost for an individual infected with the disease in region *i*; P_i^M is the daily price of the drug for region *i* (unit price of drug multiplied by the average daily dosage); F^M is the average frequency of use of drugs (in days), among the cases in which drugs were administered, according to the information obtained from the *ad hoc* survey; Pr^M is the proportion of the cases in which drugs were administered for treatment, according to the *ad hoc* survey; P_i^V is the average price of a medical consultation for region *i*; F^V is the average frequency of medical visits, among the people that visited a physician, according to the *ad hoc* survey; Pr^V is the proportion of patients that visited a physician, according to the *ad hoc* survey; P_i^I is the average price per day in cases of hospital admission for region *i*; F^I is the average length of hospital stay (in days), according to the *ad hoc* survey; Pr^I is the proportion of the cases of hospital admission, according to the *ad hoc* survey; P_i^L is the average price of the laboratory studies for region *i*; F^L is the average frequency of laboratory studies according to medical standards (measured in quantity of standard studies for a case of dengue); and Pr^L is the proportion of cases with symptoms of the disease among those that were part of laboratory analysis.

For the estimate of average opportunity costs for an individual affected by the disease in each region, the following equation applies:

$$CO_i = \left(P_i^S \times F^S \times \Pr^S\right) + \left(P_i^E \times F^E \times \Pr^E\right)$$

Where:

CO_i is the average opportunity cost in region *i*; P_i^S is the average salary per day for region *i* (and according to the distribution by age, sex and level of education of the cases of dengue in each region); F^S is the frequency of workdays lost as a result of the disease, according to the *ad hoc* survey (both the days lost by the patient and by caregivers are included); Pr^S is the proportion of patients with dengue and caregivers that had to miss work, according to the *ad hoc* survey (adjusted by the unemployment rate of each region); P_i^E is the unit price of a school day lost in region *i*; F^E is the frequency of school days lost as a result of the disease, according to the *ad hoc* survey; and Pr^E is the proportion of patients diagnosed with dengue that had to miss school, according to the *ad hoc* survey (adjusted for the age structure of the cases recorded in each region).

RESULTS

Survey

According to the results of the survey, 91% of the notified cases of dengue were outpatients and 9% required hospitalization. Among the outpatient cases, the average duration of the disease was 10 days, while the average duration of the hospitalized cases was almost 18 days. Inpatients indicated that on average they were hospitalized more than five days.

Eighty-three percent of the outpatient cases indicated having taken medication and 85% reported having visited a doctor at least once. The 83% of the patients that took medication indicated that they did so for an average span of seven days, and the 85% of patients that indicated having visited a doctor did so on average three times.

The analysis of the loss of workdays and school days was carried out for the people that indicated at the beginning of the survey that they worked

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and/or were in school. Among the people that said they worked at the beginning of the survey, 82% (of those who answered) indicated they had to miss work during the period of the disease. Among those that missed work, on average eight days were lost. On the other hand, 80% of the people that were in school (of those who answered) indicated they had to be absent, with the average number of school days lost being almost nine among these respondents.

Costs

The estimate of medical costs was carried out taking into account three scenarios according to the type of service used. The first scenario assumes the use of the least costly medical alternatives, while the third scenario assumes the use of the most expensive.

Given that the cost of drugs represents between 0.2% and 1% of the total individual average cost for each scenario (according to whether the price paid by the State or the retail price is used), only the results obtained when the drugs used were valued at the price paid by the State are presented in this article. The comparison with the retail price can be found in the tables included in this section. It should be noted that the equivalences in US dollars included in this text correspond to the official exchange rate of July 2009 (4.55 Argentine pesos per US dollar).

The first scenario assumes that the individuals that used drugs took paracetamol. The inpatient cases assume the admissions took place in a general hospital ward, and that the laboratory test used for the detection of dengue was the IgM or the IgG. According to this scenario, the individual medical costs, on average, would be 592 Argentine pesos (130 USD) for the Central region (city of Buenos Aires and provinces of Buenos Aires, Córdoba, Entre Ríos, La Pampa, and Santa Fe); 409 Argentine pesos (90 USD) for the regions of Northwest Argentina (NOA, from the Spanish *noroeste argentino*) and Cuyo (Catamarca, La Rioja, Jujuy, Salta, Santiago del Estero, Tucumán, Mendoza, San Juan, and San Luis); and 466 Argentine pesos (102 USD) for the region of Northeast Argentina (NEA, from the Spanish *noreste argentino*) (Chaco, Corrientes, Formosa, and Misiones).

The second scenario assumes that the drug used was ibuprofen, that the cases of hospital admission took place in a special care unit and that the test used for the confirmation of dengue was obtained utilizing PCR. According to this scenario, the average individual costs would be 864 Argentine pesos (190 USD) in the Central region, 600 Argentine pesos (132 USD) in the NOA and Cuyo regions, and 680 Argentine pesos (149 USD) in the NEA region.

The third scenario is different from the second only in the type of admission: instead of a special care unit, this scenario implies the use of an intensive care unit. In this case, the average individual costs would amount to 1473 Argentine pesos (324 USD) in the Central region, 714 Argentine pesos (157 USD) in the NOA and Cuyo regions, and 1138 Argentine pesos (250 USD) in the NEA region.

For the estimate of the proportion of people affected by the loss of workdays (as a result of the disease), the values obtained from the survey (the proportion of people that had to stop working) were adjusted according to the proportion of the people affected in each region in economically active age groups and to the unemployment rate of each region in the year 2009 according to the official information (4,16), considering that a person affected by the disease, who does not work voluntarily or because he/she is unemployed, does not suffer an opportunity cost attributable to the disease.

The estimates of the opportunity costs due to loss of work indicate that, on average, an individual in the Central region stopped receiving (or generating) 542 Argentine pesos (119 USD) as a result of the disease. That figure would be 499 Argentine pesos (110 USD) for individuals in the NOA and Cuyo regions, and 468 Argentine pesos (103 USD) for individuals in the NEA region.

For the estimate of the proportion of the population that suffered an opportunity cost due to lost school days, the results obtained from the survey (people that studied and were forced to miss school due to the disease) were adjusted taking into account the information about the age group to which the people affected in each region belong (4), assuming that lost school days can take place between 5 to 24 years of age.

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The estimates of opportunity costs (individuals on average) for loss of schooling produced the following values: 57 Argentine pesos (13 USD) for the Central region, 40 Argentine pesos (9 USD) for the NOA and Cuyo regions, and 52 Argentine pesos (11 USD) for the NEA region.

The average individual costs used as the basis for the calculation of medical costs, opportunity costs, and total individual costs are presented in Table 1. The information about the prices and quantities used to estimate the average individual costs is also included in the text below:

a. The different items that make up the costs are presented in the first column. In the case of medical costs, the different alternatives of drugs and services for each of the scenarios previously mentioned are presented.
b. The second, third and fourth columns show the information regarding "quantities," that is to say, the proportion of the population to which each item is applied, the frequency of use of each good or service, or days of school or work lost in the case of opportunity costs. In relation to drugs and medical consultations, the items apply exclusively to the outpatient cases (the daily cost contemplates these items in the hospitalization costs for inpatients). Outpatient cases accounted for 91% of the cases in the sample (proportion 1). This is multiplied by the proportion of the patients that used drugs and had medical consultations (proportion 2) and the number of days drugs were administered and the number of medical consultations (frequencies), according to the results of the survey. The cases of hospitalizations and laboratory tests were treated in a similar fashion. For the calculation of the opportunity costs for workdays lost, proportion 2 – corresponding to the ratio of individuals surveyed that answered that they had to miss work due to the disease (to the total number of people that worked) – is multiplied by the proportion 1 which, in turn, is the product of: i) the population affected by the disease of economically active age groups in each region (according to official information), and ii) (1- unemployment rate/100) of each region (according to official information). Therefore, in this case, proportion 1 is used to adjust for the differentials between the age composition of the affected population and unemployment rate of each region. For the opportunity costs linked to the loss of school days, proportion 1 – corresponding to the ratio of the number of affected people in the age group 5 to 25 years to the total number of affected individuals in each region (according to official information) – is multiplied by the second proportion, which corresponds to the surveyed individuals that answered they had missed school days among those that said they attended school at the beginning of the survey.
c. The fifth, sixth and seventh columns show the unit prices of medical goods and services, and work and school days for each region. It is worth mentioning that the price of drugs is expressed in days (where the daily dosage is three 500mg paracetamol tablets or three 400mg ibuprofen tablets).
d. Finally, the eighth, ninth, and tenth columns show the average individual cost for each item, including the subtotals for the medical cost, the opportunity cost, and the total average individual cost (which are the sum of the two subtotals).

It is worth noting that the individual costs estimated in this manner are the sum of weighted averages, where the weight of each item is given by the profile of the affected people in the sample, in terms of the severity of the case (outpatient or inpatient), the type of medical good or service used, and the age and activity of the affected individual. That is to say, although the model of estimation is based on average cost (applied to all the officially notified cases of dengue), the relative weight of the different "profiles" or types of cases and the costs associated with those profiles are taken into consideration in the calculation, which allows us to account for the fact that the cost for one group of patients does not necessarily follow a normal distribution (because a small number of cases can represent a very high cost in terms of medical treatment or the duration of the needed treatment, while the majority of the cases can be patients with much lower cost of treatment).

With the aim of evaluating the ways in which the loss of earnings and the treatment expenses would imply a significant economical burden for families (when the families are responsible for said expenses), the relation between the average individual cost of the disease in each region

Table 1. Average individual costs. Central region, Argentine Northwest (NOA) and Cuyo regions, and Argentine Northeast (NEA) region, in Argentine pesos, 2009 value.

Concept	Proportion 1	Proportion 2	Frequency	Prices			Average Cost		
				Central	NOA + Cuyo	NEA	Central	NOA + Cuyo	NEA
Medical costs									
Drugs 1: Paracetamol (outpatient)*	0.91	0.83	7.00	0.04 (1.02)	0.04 (1.02)	0.04 (1.02)	0.22 (5.39)	0.22 (5.39)	0.22 (5.39)
Drugs 2: Ibuprofen (outpatient)	0.91	0.83	7.00	0.24 (1.68)	0.24 (1.68)	0.24 (1.68)	1.27 (8.88)	1.27 (8.88)	1.27 (8.88)
Medical consultation (outpatient)	0.91	0.83	3.30	71.50	47.80	56.60	182.51	122.01	144.47
Admission 1: General room (inpatient)	0.09	-	5.28	750.10	490.70	564.00	356.45	233.18	268.01
Admission 2: Special care (inpatient)	0.09	-	5.28	1,234.10	807.30	927.90	586.44	383.63	440.94
Admission 3: Intensive care (inpatient)	0.09	-	5.28	2,516.60	1,046.20	1,892.20	1,195.89	497.15	899.17
General laboratory (outpatient)	0.91	-	1.00	17.50	17.50	17.50	15.93	15.93	15.93
Dengue test 1: IgM or IgG (all)	1.00	0.31	1.00	120.00	120.00	120.00	37.20	37.20	37.20
Dengue test 2: PCR (all)	1.00	0.31	1.00	250.00	250.00	250.00	77.50	77.50	77.50
Average individual medical cost Scenario 1							592.30 (597.47)	408.54 (413.71)	465.83 (471.00)
Average individual medical cost Scenario 2							863.65 (871.26)	600.33 (607.95)	680.11 (687.72)
Average individual cost Scenario 3							1,473.09 (1,480.07)	713.86 (721.47)	1,138.34 (1,145.96)
Opportunity costs									
Work (18 to 64) Central2	0.56	0.82	8.21	142.94	-	-	542.20	-	-
Work (18 to 64) NOA2	0.60	0.82	8.21	-	122.06	-	-	499.17	-
Work (18 to 64) NEA2	0.67	0.82	8.21	-	-	103.00	-	-	468.25
Education (5 to 24) Centro3	0.25	0.80	8.80	32.13	-	-	56.55	-	-
Education (5 to 24) NOA3	0.33	0.80	8.80	-	17.39	-	-	40.40	-
Education (5 to 24) NEA3	0.34	0.80	8.80	-	-	21.80	-	-	52.18
							598.75	539.58	520.43
Total average individual cost Scenario 1							1,191.05 (1,196.22)	948.12 (953.29)	986.26 (991.43)
Total average individual cost Scenario 2							1,462.39 (1,470.01)	1,139.91 (1,147.53)	1,200.54 (1,208.15)
Total average individual cost Scenario 3							2,071.84 (2,079.45)	1,253.44 (1,261.05)	1,658.77 (1,666.38)

Source: Own elaboration.

Note: The official exchange rate during July 2009 was 4.55 Argentine pesos per US dollar.
*The values presented correspond to the average price of drugs purchased by the State for the Remediar program. The value in parentheses is the average retail price.

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(medical and opportunity costs) and the average monthly net income in the same regions was estimated (15).

The results of estimating this quotient are represented in Figure 1, which shows that the cost of a case of dengue, for every region and under the three scenarios of medical attention considered, accounts for more than 40% of the average monthly net individual income. The region with the highest monthly net cost/income relation is the NEA region, followed by the Central and the NOA and Cuyo regions.

Table 2 presents the results of the total cost for each region and for the whole country for the three evaluated scenarios. According to those results, the dengue epidemic that took place in Argentina in 2009 implied a cost for the Argentine economy as a whole somewhere between 26 and 40 million Argentine pesos (between 6 and 9 million USD, according to the exchange rate for the year 2009).

DISCUSSION

This study approximated, for the first time in Argentina, the economic burden associated with the officially notified cases of dengue during the epidemic of 2009.

The estimate of the total cost showed that the dengue epidemic of 2009 implied an economic burden to Argentina somewhere between 26 and 40 million Argentine pesos at current values (between 6 and 9 million USD), according to the health care scenario considered.

The relative importance of the medical and opportunity costs would be similar, although these vary depending on the health care scenario considered. In the first scenario (which assumes the use of the least costly medical services), the medical costs account for 43% to 50% of the total economic burden, depending on the region (Central, Northeast, or Northwest and Cuyo). In

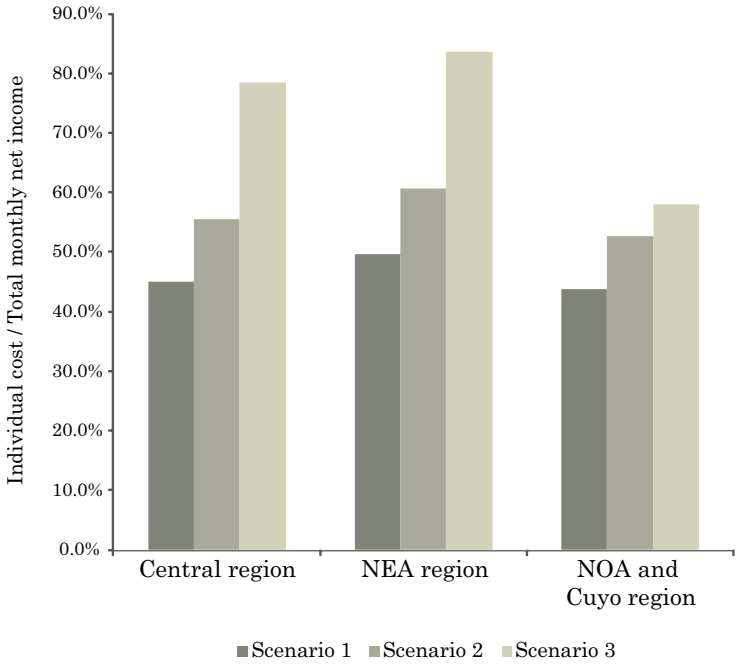

Figure 1. Impact of the individual cost of dengue in the monthly net income for the Central region, the Argentine Northeast (NEA) region and the Argentine Northwest (NOA) and Cuyo regions. 2009.

Source: Own elaboration.

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Table 2. Economic cost of dengue for the Central region, the Argentine Northwest (NOA) and Cuyo regions, the Argentine Northeast (NEA) region, and the country as a whole.

Region	Affected provinces of the region	Total cases	Total cost Scenario 1 (in ARS)	Total cost Scenario 2 (in ARS)	Total cost Scenario 3 (in ARS)
Central	Autonomous city of Buenos Aires, Province of Buenos Aires, Córdoba, Entre Ríos, Santa Fe	1,625	1,935,458 (1,943,861)	2,376,392 (2,388,763)	3,366,738 (3,379,110)
NOA & Cuyo	Catamarca, La Rioja, Jujuy, Salta, Santiago del Estero and Tucumán. Mendoza and San Luis	14,238	13,499,290 (13,572,912)	16,230,070 (16,338,469)	17,846,442 (17,954,842)
NEA	Chaco, Corrientes and Misiones	11,180	11,026,428 (11,084,237)	13,421,990 (13,507,108)	18,545,062 (18,630,180)
Whole country		27,043	26,461,176 (26,601,010)	32,028,451 (32,234,341)	39,758,242 (39,964,132)

Source: Own elaboration.

Note: The values presented correspond to the average purchase price of drugs by the State for the Remediar program, and the value in parantheses is the average retail price. Both values are expressed in Argentine pesos. The official exchange rate during July of the year 2009 was 4.55 Argentine pesos per US dollar.

the second scenario, the relative importance fluctuates between 53% and 59%, while in the third scenario it fluctuates between 57% and 71%, depending on the region.

The regions in the north of Argentina bore the highest economic burden of the disease (more than 90% of the total burden of the country), despite the lower unit cost of medical services and lower opportunity costs. Although the number of cases in the Central region increased during the last epidemic, almost 94% of the cases took place in the north of the country, which explains the high economic burden for the region.

For all regions, and considering all three scenarios of medical attention, the cost of a case of dengue accounts for more than 40% of the average monthly net individual income. The region with the highest monthly net cost/income relation is the NEA region, followed by the Central and the NOA and Cuyo regions.

One of the limitations of this study is the lack of information needed to estimate non-medical costs such as those related to transportation and those associated with being far from one's place of residence as a result of the disease. Losses that the dengue epidemic may have caused in specific economic activities (such as tourism) or to the aggregate economic growth of the affected region were also not taken into account.

On the other hand, since the initial aim of the study was to estimate the economic burden of the disease specifically associated with the number dengue cases that took place during the epidemic of 2009, and not the economic burden of the dengue fever in a broader sense, the cost of preventive measures for the disease was not included.

The estimates of quantities (frequency of use of services and school or workdays lost) are based on the information for a sample of a specific group of citizens (the population of the city of Orán, in the province of Salta). For the estimates of costs, estimated average frequencies based on the sample were used, and it is assumed that those frequencies are representative of the average frequencies of the affected population in the whole country. Therefore, the extrapolation implies assuming that the averages of disease duration, frequency of the use of medical goods and services, and number of school and workdays lost are relatively constant among all regions. While this may appear to be a strong assumption, the existing evidence for some of those quantities indicates that they are relatively constant, even in groups of citizens with considerable differences between them. According to the estimations of Suaya *et al*. (15), the average duration of the disease among the outpatient cases fluctuates between 9 and 12 days (only one country of the eight Latin American and Asian countries analyzed in the study showed a longer average duration: 19.6 days for Panama), which is very similar to the estimations of this study based on the sample information (which showed an average duration of 10 days). For the inpatient cases of dengue, Suaya *et al*. show that

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the average duration of the disease, in general, fluctuates between 10 and 19 days, while the estimates based on the sample for Orán show an average duration of almost 18 days.

Lastly, the methodology used by Suaya *et al*. (15) was employed to estimate the value of a school day lost, where spending per student is considered. This estimation of the value of student enrollment can be seen as an indirect approximation of the economic (opportunity) cost of the resources already invested that are then not used, but does not approximate the present value of the salaries that could be affected if the loss of school days would have an impact, to some extent, on the future productivity of the affected students.

In all countries that have outbreaks of dengue, there is evidence indicating that the official figures underestimate the true number of cases, which highlights the necessity of considering expansion factors that allow for the realization of more accurate estimates (17). According to previous studies, it is estimated that for each inpatient dengue case there are 1.6 to 3.2 more cases that should have received such care but did not. For the outpatient cases of dengue, it is estimated that for each case diagnosed, there are between 10 to 27 undiagnosed cases (18-20). For the total number of cases it is estimated that, on average, for each recorded case there are six cases that were not detected by the official health statistics (21). Consequently, the results obtained in this study are indeed conservative, since only the cases that were officially reported were taken into account. In effect, if for each recorded case three non-recorded cases were contemplated, the estimation would show an economic burden that would fluctuate between 78 and 120 million Argentine pesos (17 to 26 million USD), and if the aforementioned studies were to be considered, these figures would amount to between160 and 240 million Argentine pesos (35 to 53 million USD).

The results obtained show how great the burden related to the dengue epidemic that took place in Argentina in the year 2009 was for the health system and for the society as a whole.

There is currently an increase in the number of cases and in the frequency of the outbreaks in the world and in the region. In the early 1990s, 250,000 cases were recorded in the region of the Americas. At the beginning of the present decade, 600,000 cases were reported, while in the year 2007 alone more than 890,000 cases were notified, 26,000 of which were cases of hemorrhagic dengue (2).

Given the current tendency, and considering the lack of effective prevention campaigns, it is possible that dengue fever will continue to pose a problem in Argentina. It is known that the risk of death for individuals infected with a particular strain of dengue increases if they later contract a different strain. In light of this situation, the lack of effective prevention campaigns would not only imply an increase in the number of potential cases, but also an increase in the probability of more severe cases. This would not only increase the economic burden of the disease, but would also increase the risk of disability and mortality of the affected population.

The results show, additionally, that studies of economic burden should contemplate a broad spectrum of costs generated by the disease. While the medical cost related to the treatment of the affected population accounts for an important fraction of the total burden of dengue, this portion is not necessarily the most important. The opportunity cost associated with the loss of school and workdays accounts forms another important fraction of the economic burden of disease.

ACKNOWLEDGEMENTS

We would like to thank the team of primary care agents of the locality of Orán for their invaluable collaboration in the implementation of the surveys. We would like to give special thanks to Dr. Luis Mario Arias, Director at the Hospital San Vicente de Paul de San Ramón de la Nueva Orán and to Dr. Pedro Cortada, Director of Epidemiology of the same institution. This study was possible due to the financial support and the initiative of Fundación Mundo Sano. We would also like to thank the feedback and suggestions received from the editors of the journal *Salud Colectiva* who greatly helped us to enhance the original draft.

BIBLIOGRAPHIC REFERENCES

1. San Martín JL, Brathwaite O, Zambrano B, Solórzano JO, Bouckenooghe A, Dayan GH, Guzmán MG. The epidemiology of dengue in the Americas over the last three decades: A worrisome reality. American Journal of Tropical Medicine and Hygiene. 2006;82(1):128-135.

2. WHO. Dengue and severe dengue: Fact sheet N°117. [Internet] WHO; 2012 [cited 8 Mar 2012]. Available from: http://www.who.int/mediacentre/factsheets/fs117/en.

3. Torres J. El dengue en América Latina: ¿una situación única? [Internet] Universidad Central de Venezuela; 2002 [cited 6 Apr 2010]. Available from: http://caibco.ucv.ve/caibco/vitae/VitaeDieciocho/Articulos/Infectologia/ArchivosHTML/dengue.pdf.

4. Ministerio de Salud de la Nación. Planilla de Notificación de Casos de Dengue, 1 de junio de 2009. Buenos Aires: MSAL; 2009.

5. Alfabeta. Informes de precios online a octubre 2009 [Internet]. 2009 [cited 15 Feb 2010]. Available from: http://www.alfabeta.net/home/.

6. Suaya JA, Shepard DS, Siqueira JB, Martelli CT, Lum LSC, Tan LH, et al. Cost of dengue cases in eight countries in the Americas and Asia: A prospective study. American Journal of Tropical Medicine and Hygiene. 2009;80(5):846-855.

7. Gobierno de la Provincia de Catamarca. Ley de Presupuesto 2008 [Internet]. Catamarca: Ministerio de Hacienda y Finanzas; 2008 [cited 5 Feb 2010]. Available from: http://www.hacienda.catamarca.gov.ar/normativas/Ley%20de%20presupuesto%202008.pdf.

8. Gobierno de la Provincia de Salta. Ley Nº 7.486, Ley de Presupuesto de la Provincia de Salta, Ejercicio 2008 [Internet]. Salta: Ministerio de Finanzas y Obras Públicas; 2008 [cited 5 Feb 2010]. Available from: http://presupuesto.salta.gov.ar/Leyes/Textos/2008/2008%20-%20Ley%207.486.pdf.

9. Gobierno de la Provincia de Chaco. Ley Nº 6.089 [Internet]. Chaco: Ministerio de Economía, Producción y Empleo; 2008 [cited 5 Feb 2010]. Available from: http://economia.chaco.gov.ar/index.php?option=com_wrapper&view=wrapper&Itemid=201.

10. Gobierno de la Ciudad de Buenos Aires. Ley Nº 2.571, Presupuesto para el año 2008 [Internet]. Ciudad Autónoma de Buenos Aires: Hacienda; 2008 [cited 5 Feb 2010]. Available from: http://estatico.buenosaires.gov.ar/areas/hacienda/presupuesto2008/pdf/ley2571/ley2571.pdf.

11. Gobierno de la Provincia de Buenos Aires. Ley 13.786, Presupuesto General [Internet]. Provincia de Buenos Aires: Ministerio de Economía; 2008 [cited 5 Feb 2010]. Available from: http://www.ec.gba.gov.ar/areas/hacienda/Presupuesto/Presupuestos/2008/php/ejercicio2008.php.

12. Gobierno de Santa Fe. Ley Nº 12.850 [Internet]. Santa Fe: Sistema de Información Normativa; 2007 [cited 5 Feb 2010]. Available from: http://gobierno.santafe.gov.ar/sin/mitemplate.php?tiponorma=ley&anio_norma=2007&nro_ley=12850&fecha_norma=27/12/2007.

13. Dirección Nacional de Información y Evaluación de la Calidad Educativa. Anuario Estadístico Educativo 2009 [Internet]. Ministerio de Educación de la Nación [cited 10 Feb 2010]. Available from: http://diniece.me.gov.ar/index.php?option=com_content&task=category&sectionid=2&id=8&Itemid=19.

14. Instituto Nacional de Estadística y Censos. Serie histórica del Índice de Precios al Consumidor (IPC) en el Gran Buenos Aires [Internet]. INDEC [cited 12 Feb 2010]. Available from: http://www.indec.mecon.ar/nuevaweb/cuadros/10/sh_ipc_2008.xls.

15. Dirección Nacional de Política Macroeconómica. Información económica al día [Internet]. Ministerio de Economía y Finanzas Públicas [cited 5 Feb 2010]. Available from: http://www.mecon.gov.ar/peconomica/basehome/infoeco.html.

16. Instituto Nacional de Estadística y Censos. Tasa de actividad, empleo, desocupación y subocupación por regiones y aglomerados urbanos desde el primer trimestre de 2003 en adelante [Internet]. INDEC [cited 10 Feb 2010]. Available from: http://www.indec.mecon.ar/nuevaweb/cuadros/4/sh_eph_continuatrimestral.xls.

17. Suaya JA, Shepard DS, Beatty ME. Dengue burden of disease and cost of illness: TDR/SWG/08. Geneva: World Health Organization on behalf of the Special Programme for Research and Training in Tropical Diseases; 2007.

18. Duarte HH, Franca EB. Data quality of dengue epidemiological surveillance in Belo Horizonte, Southeastern Brazil. Revista de Saúde Pública. 2006;40:134-142.

19. Rigau-Pérez JG. Surveillance for an emerging disease: dengue hemorrhagic fever in Puerto

Rico, 1988-1997. Puerto Rico Health Science Journal. 1999;18:337-345.

20. Meltzer MI, Rigau-Pérez JG, Clark GG, Reiter P, Gubler DJ. Using disability-adjusted life years to assess the economic impact of dengue in Puerto Rico: 1984-1994. American Journal of Tropical Medicine and Hygiene. 1998;59:265-271.

21. Armien B, Suaya JA, Quiroz E, Sah BK, Bayard V, Marchena L, Campos C, Shepard DS. Clinical characteristics and national economic cost of the 2005 dengue epidemic in Panama. American Journal of Tropical Medicine and Hygiene. 2008;79:364-371.

CITATION
Tarragona S, Monteverde M, Marchioni S, Caporale J, Pereiro AC, Palacios JM. Dengue in Argentina: an economic analysis of the impact of the 2009 epidemic. Salud Colectiva. 2012;8(2):151-162.

Received: 13 February 2012 | Revised: 23 April 2012 | Accepted: 16 May 2012

The translation of this article is part of an interdepartmental collaboration between the Undergraduate Program in Sworn Translation Studies (English < > Spanish) and the Institute of Collective Health at the Universidad Nacional de Lanús. This article was translated by Darío Damián Di Franco y Mariano Germán Saab, reviewed by Pamela Vietri and modified for publication by Joseph Palumbo.