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Economic Costs of Water-related Health Problems in Mexico: Deficiencies in Potable Water Services and the Costs of Treatment of Diarrhoeas

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ABSTRACT *The paper provides a quantitative estimate of the economic costs of the health problems, especially diarrhoea, attributable to deficiencies in potable water services in Mexico. It is argued that more financial resources should be allocated to improving and extending potable water and sanitation, lack of which are the principal causes of diarrhoeas.*

Introduction

Infectious diarrhoeas are the principal causes of the morbidity rate caused by water-transmitted illnesses and those that relate to the lack of water for personal hygiene (OMS, 2004a, 2004b). From the health viewpoint, greater access to potable water supply and sanitation services, together with improved hygiene, constitute a prophylactic intervention whose principal result is a reduction in the number of episodes of diarrhoea and, in consequence, proportionally in the number of deaths. Throughout the world, US$16 billion a year is invested in water-supply and sanitation works, although approximately US$24 billion is needed in order to meet the Millennium Goal of halving the number of people who lack such services (ONU, 2006).

Potential benefits from an improvement in water and sanitation services would be very substantial. On the one hand, 2.6 billion people would benefit if the goal were achieved according to World Health Organization (OMS, 2004a). On the other hand, investments would provide very favourable results in cost-benefit terms, with an average ratio of US$8.1 worldwide and US$35.9 in Latin America (Hutton *et al.*, 2006). Such action would generate savings (1) of treatment costs borne by the public-health sector or the patients themselves; (2) of costs incurred by patients in seeking assistance and transportation, including the opportunity costs, in terms of the time spent in doing so; (3) the number of days lost at work, in productive domestic activities, and in attendance at school (OMS, 2004a).

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In the case of Mexico, how high are these costs? What do they consist of? How are they distributed between the state and society, and among the various urban and rural social sectors? Are these monetary costs relevant? If they are, would it not be more convenient to devote these resources to resolving the cause of the problem—the lack of access to adequate water and sanitation services? That would mean users having water of sufficient quality and quantity in their homes, together with adequate sewage and sanitation, so that they can meet their basic needs as a necessary condition for the enjoyment of life.

In order to analyse the previous issues, a study was carried out attempting to determine the monetary costs of the treatment of diarrhoeas that are caused by shortcomings in the potable water service. This has led to a critical evaluation of the existing statistics on morbidity and mortality, as well as of the methodologies used to estimate monetary costs.

The findings of the study show that there are serious problems of under-reporting in terms of both morbidity and mortality, and that the information that is available lacks an adequate breakdown by municipality and type of location (urban or rural). It was also found that the economic costs of diarrhoeic illnesses, despite their great importance (4266 deaths and 5.9 million cases in 2005) have not been rigorously analysed by the health-related institutions in the country, and do not take into account the wide range of inherent costs: those of the public sector and the patients, the days lost at work and in education, and the loss of life. This is largely due to the growing importance of cardiovascular and cancerous ailments, as well as diabetes and hepatitis, as a result of the population's epidemiological transition. For political reasons, this latter group of diseases has received more attention in terms of resources and estimates of the economic costs involved.

A proposal is made to develop some methodological criteria that could lead to a representative estimate of the costs associated with diarrhoea, both direct and indirect, including the need to take account of social, demographic and economic heterogeneity, as well as that of the basic services of the country.

Deficiencies in the Provision of Potable Water and Sanitation Services

Potable water supplies have been the responsibility of municipalities in Mexico since 1981, as have the treatment and disposal of wastewater since 1989. The services are the responsibility of municipal operators. Mexico is estimated to have about 1200 municipal operators, of whom the 389 most important attend to the needs of localities with more than 20 000 inhabitants (CNA, 2006). One of the most evident problems of potable water and sanitation services is the low coverage (CNA, 2006). According to information from INEGI (National Institute of Statistics and Geography) (INEGI, 2006a) major advances were made between 2001 and 2005; by the end of the period, 85.5% of the population at the national level had potable water and 85.8% had drainage. However, geographical distribution of the services is heavily weighted against the most socially backward states, those with a substantial indigenous presence (Chiapas, Guerrero and Oaxaca).

Among the part of the population that has potable water supplies, many only have an irregular service. According to official estimates (INEGI, 2006a) based on 20% of the homes registered in the 2000 National Census, only 44.7% of the total population has an uninterrupted potable water supply. The rest receive potable water intermittently, in some cases for part of the day, in others every third day or once or twice a week. In urban areas, 46.6% of the population has water all day long, but the proportion drops to 35.7% in the

Table 1. Percentage distribution of inhabited private dwellings that have piped water, by type of locality, frequency of service and timetable of supply, 2000

	Urban (%)	Rural (%)
Daily		
All day	46.6	35.7
Part of the day	34.0	37.5
At some point each week	16.3	20.8
From time to time	3.1	6.0
National total	100.0	100.0

Notes: Tables based on census sample. Available at http://www.inegi.gob.mx/inegi/contenidos/espanol/prensa/Contenidos/estadisticas/2004/agua04.pdf (accessed 12 December 2006).
Source: INEGI. XII *Censo General de Población y Vivienda, 2000.*

countryside. Meanwhile, 16.3% of the urban population and 20.8% in the countryside receives water only once a week (see Table 1).

It is important to note that the provision of water services does not necessarily relate to the natural presence of water, but rather to its access, many times due to political reasons. Mexico is a country of great contrasts among regions (Arzoz & Knaul, 2003). In those places where water is most naturally abundant, coverage of water services tends to be more deficient, and vice-versa. In the states of southern and south eastern Mexico, where nature can provide as much as 14 000 cubic metres (m^3) per habitant per year, a very high proportion of the population has no service, while in some regions of the north—with natural availability that can be lower than 2000 m^3 per inhabitant per year—the figures for coverage are the highest in the country (Carabias *et al.*, 2005).

Inadequate sanitation coverage also has serious consequences in terms of the proliferation of infectious diseases, and others. According to official figures, in December 2005, a total of 1433 water treatment plants were in operation. Their combined capacity was 95.8 m^3/s, and they were processing 71.8 m^3/s, or about 35% of the total sewage generated and collected in municipal systems, estimated at 205 m^3/s (National Water Commission [CNA], 2006; IMTA, 2006).

The Mexican government's efforts to expand coverage and improve the quality of potable water and sanitation services are significant. Its initiatives include the Programme for the Sustainability of Potable Water and Sanitation Services in Rural Communities; the Potable Water, Sewage and Sanitation Programme for Urban Areas; the Royalties Refund Programme, and the Programme for the Modernization of Water Operators (CNA, 2006). Measures taken to fight diarrhoea include chlorination of municipal water supplies, promotion of breast-feeding, training for new mothers emphasizing warning signs and oral hydration therapy, vitamin A mega-doses for children aged from 6 months to 4 years in extremely poor communities, and timely and good quality treatment for patients (Santos Preciado & Ignacio, 2001). However, despite all these government initiatives, the incidence of diarrhoeic diseases remains very significant.

Diarrhoeic Diseases in Mexico

According to the Pan American Health Organization (PAHO), the term 'infectious intestinal diseases' covers a wide range of ailments that includes cholera, typhoid and

paratyphoid fever, salmonellosis, shigelosis, amebiasis and other forms of diarrhoea. The persistence of diarrhoeic infections (together with respiratory ailments and malnutrition) is a clear indication of serious social deprivation in Mexico (Table 2).

In 2005, some 5.8 million new cases of diarrhoeic diseases were recorded, and the group headed 'other ill-defined intestinal infectious illnesses' represented three-quarters of the total (4.7 million cases). For that reason, this sub-group is the focus of the present investigation.

By age group, morbidity is heavily concentrated in the under-15s (52.2%). Some of the states where morbidity is highest are relatively well off (the State of Mexico, or Mexico City, Jalisco, Nuevo León, Guanajuato, Chihuahua) while others include those with a high proportion of extremely poor inhabitants (Veracruz, Oaxaca, Guerrero and Chiapas). Some 84.2% of new cases in 2005 were treated in government health institutions. No breakdown is available of statistics at municipal level or in accordance with zone of residence (urban or rural) that would enable a more accurate measurement of the impact of diarrhoea in geographical and social terms.

Diarrhoeic diseases of all types caused 4266 deaths throughout the nation in 2005, the equivalent of 4.1 per 1000 inhabitants. Mortality was particularly high among infants and the elderly, as well as in the states of Chiapas (14.7%), Oaxaca (11.1%) and Guerrero (6%). Indeed, these three states alone accounted for 28.2% of the national total of deaths from diarrhoea (INEGI, 2006b). Despite the progress made in the 1980s and 1990s in reducing mortality, particularly in the case of children, much remains to be done, given that deaths continue to occur when they could have been avoided. A Health Ministry study (Secretaría de Salud, 2006) estimated the number of deaths from diarrhoea between 2000 and 2004 at 11 305, of which 79.6% were avoidable.

The quality of epidemiological statistics has improved over the last decade thanks to the establishment of a National System of Health Information based on close cooperation among the federal institutions that offer health services in Mexico: the Social Security Institute (IMSS), Health Ministry, State Employees' Institute (ISSSTE), the armed forces (Sedena and Semar), Family Development Institute (DIF), the state oil company (Pemex), as well as those of the states, and the government's statistical organizations, INEGI and the National Population Council (Conapo). Together, they have produced a single format and database on which to register epidemiological information.

However, there are considerable shortcomings. Reliable and opportune information is seldom available from private hospitals and clinics, and many patients rely on self-medication. The Federal Commission for Health Protection (Cofepris) has estimated (Mayén & Luna/Cofepris, 2005) that for every case of diarrhoea that is registered, 19 are

Table 2. Mexico: principal diseases, 2005

Type of disease	Cases (millions)	Percentage
1. Respiratory	25.6	59.7
2. Intestinal	5.9	13.8
3. Urinary	3.3	7.7
4. Others	8.2	19.1
Total	42.9	100.0

Source: DGEPI, Secretaría de Salud 'Anuario de Morbilidad', 2005. Available at www.dgepi.salud.gob.mx (accessed 18 December 2006).

not. Moreover, the statistics that are available lack breakdowns by municipality and in accordance with whether the place of residence is urban or rural.

Two problems are relevant with respect to the mortality statistics. One is the difficulty of obtaining updated information on diarrhoeas, whether in printed form or on the Internet, on rates and their structure by age groups and states. The other is the deficiency in record keeping, particularly of deaths in infancy, although INEGI has taken measures that include the approval of a single format to be used nationally and the use of a copy of the death certificate as a primary source of information. Transcription from death certificates has become a source of frequent errors (Corona Treviño, 2006).

Differentiation measures indicate the contribution of any one factor in producing an illness among those that are exposed to it. Their use is based on the supposition that the factor in question is responsible for the appearance of the illness and on the postulate that, in its absence, the risk would be the same for both groups. As a synonym, the term 'attributable risk' is employed (Moreno Altamirano *et al.*, 2000). Therefore, a key aspect is the quantitative approximation of the fraction attributable in cases of diarrhoea to poor quality in water services, an issue that is complex because of the number of factors involved—sanitation; water quality at source, during distribution and while in storage in homes; and hygiene). Prûs *et al.* (2002) state that, in a WHO study (OMS, 2004b) that covered almost 90% of the world's population, the proportion attributable to the consumption of unsafe water (inadequate potable water supply, sanitation and hygiene) amounted to 60% in developed countries and 85–90% in the developing world. Another study (PAHO/Incap, 2006), maintains that in addition 70% of cases of diarrhoea are due to the consumption of contaminated food or water.

In Mexico, there are no precise studies on the proportion of cases of diarrhoea attributed to water. According to a Cofepris (2006) projection on the basis of international research, it is estimated that this figure could be about 50%. In the course of the present investigation, during an interdisciplinary workshop on the 'Economic costs of diarrhoea and its relation to water' a specialist from the Health Ministry's Epidemiology Department mentioned that it might be best to estimate the proportion as high as 60%.[1]

Principal Economic Costs of Diarrhoeic Infections in Mexico

The cost of a medical intervention can be defined as the cost of all the resources it requires if they had been assigned to a more valuable use. All costs imply a lost opportunity, thus corresponding with the economic concept of 'opportunity cost'. As a result, cost analysis calls for a profound understanding of the service that is being provided, how it is produced and to whom it is offered (Mendoza, 1994, 1995a, 1995b, Drummond *et al.*, 2001).[2] Economic valuations can be full or partial.[3] Cost analysis is common to both, and includes the stages of identification, measurement and valuation of the resources that are used (CCOHTA, 1996). The costs under consideration are of three types. Type 1 refers to health services, type 2 to those incurred by the patient and his or her family, and type 3 refers to costs incurred outside the ambits of the health services and their users (see Table 3).

Current institutional efforts in Mexico to achieve full or partial valuations have been directed towards other diseases that are becoming more common because of the country's epidemiological and demographic changes which require very expensive treatment and are more important causes of death (Mexican Ministry of Health-Harvard University, 2005). Meanwhile there have been few studies of diarrhoeic ailments because their

Table 3. Types of costs of utilized resources under consideration in the economic evaluation

Type 1 costs	**Health service resources**
Hospital resources	Labour Supplies Equipment Services Capital
Community services	Ambulance services, visits by nurses
Type 2 costs	**Costs incurred by users and their families** Direct: Contributions to treatment Direct payments Indirect: Lost working time Psychological costs
Type 3 costs	**Costs incurred outside the ambit of the health services and users** (Costs of social workers and visitors).

Source: Drummond *et al.* (2001).

mortality and morbidity rates have been in marked decline nationally, although they remain a serious problem in certain regions, especially in the countryside. However, political criteria that underlie the assignation of financial resources favour the treatment of certain types of illness, particularly in urban areas.

For this study, statistics produced by INEGI were consulted, especially the National Survey of Household Income and Spending (2004) which recorded both monetary and non-monetary spending by households under several headings (including spending on treatment of diarrhoea and on bottled water). Interviews were also held with specialists working in a wide range of public institutions and conversations were held with officials from the Health Ministry's Department of Epidemiology in order to establish how the statistics are generated. The investigation was carried out between August 2005 and May 2007.

A revision of the bibliography revealed seven partial economic evaluations, with quantitative estimates on the impact of diarrhoeas. The evaluations were made using differing objectives, methodologies and representations. They were the work of a variety of institutions, whose objectives were also various. The findings were systematized in accordance with the institution, the author of the study, its objective, coverage, methodology, units and perspectives of the analysis, and the types of costs taken into account (see Table 4).

Given the wide range of viewpoints, objectives and resources, the estimates of the costs of treatment vary widely by type of institution or type of treatment (see Tables 5 and 6).

These evaluations are mainly of type 1 costs—those incurred by the health sector—and exceptionally of type 2, which are incurred by the patients and their families. No study attempting to estimate type 3 costs was found.

Type One Costs

On type 1 costs, the studies fail to take full account of the representative costs of diarrhoeas by considering such variables as age structure (children, adults), zone

Table 4. Summary of estimates of type 1 costs of public-sector treatment of diarrhoeas

Author	Villarreal *et al.* (1996)	Arredondo & Damián (1997)	Margulis (1992)	Granados (2001)	CNA (2004)	Mayén & Luna/ Cofepris (2005)	Seguro Popular (2005)
Coverage: National, state, municipal	State. Nuevo León	National. Public and private sectors	National	Municipal. Cuernavaca, Morelos	National	Macro regional. South and South east Mexico	National
Regional Urban, rural	Urban, rural	NS	NS	Urban	NS	NS	NS
Type of medical unit	Metropolitan and Non-metropolitan	IMSS, ISSSTE, Health Ministry	NS	Metropolitan	NS	NS	
Type of treatment Ambulatory, hospitalization	NS	NS	NS	Ambulatory and hospitalisation	Ambulatory and hospitalisation	NS First and second level attention	Ambulatory
Type of patient Children, adults	NS	NS	Adults and children, aggregated	Children under 5 years	Adults and children, aggregated	Adults and children, with breakdown	Children under 5 years
Type of cost	1 Unitary direct	1 Unitary direct	1 Unitary direct. Methodology not explained	1. Micro costing	1 Unitary direct. Methodology not explained	1 Unitary direct	1. Micro-costing

Note: NS = not specified.
Source: Villarreal (1996), Arredondo (1997), Margulis (1992), Granados (2001), CNA-Fecic (2004), Mayén & Luna/Cofepris (2005), Seguro Popular (2005).

Table 5. Average real cost of public treatment of diarrhoea per patient, by author and treatment institution (in pesos as of December 2005)

	Villarreal *et al.* (1996)		Arredondo & Damián (1997)	
	IMSS	IMSS	ISSSTE	Health Ministry
Year	1996	1997	1997	1997
Cost	196.4	1332.5	1227.5	669.9

Notes: Average exchange rate 2005: 1 dollar = 10.89 pesos (Source: Bank of Mexico (2006). Available at www.banxico.gob.mx (accessed 12 December 2006).
Sources: Villareal (1996); Arredondo (1997).

of residence (urban, rural) or institution or type of treatment. Those that take most account of age are the Mayén & Luna/Cofepris (2005) and Seguro Popular studies (2005), while Arredondo & Damián (1997) show variations by specific organizational culture (public and private sector). The methodology used to estimate the costs also includes differences of criterion, among them the use of mean cost and micro-costing, as well as of statistical instruments (the estimation of parameters).

The study by the Seguro Popular (2001), a Health Ministry dependency that provides medical insurance to the poor, was one of the most useful for the present investigation. The Seguro Popular carried out an economic analysis with the aim of estimating the costs of the catalogue of medical benefits for the 78 procedures that make up the 'Family Package' and the 105 of the 'Complete Package'; diarrhoeal ailments were important elements of both. The study was carried out nationally and used micro-costing to estimate from an institutional perspective the direct costs of treatment, including treatment of diarrhoeas. Seguro Popular's costs were identified by means of a detailed description of the diagnostic and therapeutic measures involved, including decision trees for ailments that have various clinical options. Production functions were drawn up for each of the measures taken for all of the illnesses that were analysed. Fixed costs were considered to include staff salaries, services and annual capital costs, while variables included diagnostic studies and inputs. The valuations were achieved by referring to the annual average costs of the IMSS, the prices of bulk purchases of medicines and consumables, the prices of medical equipment, and the wage and salary scales of Health Ministry employees.

The average cost per procedure or intervention of Seguro Popular (2005), estimated for 2005 nationally, was 372.56 pesos in December 2005, of which fixed costs (consultations) accounted for 66%. Variable costs (studies) accounted for 33.5% (see Table 7).

Table 6. Average real cost of public treatment of diarrhoea per patient, by author and by treatment type (ambulatory or hospitalization) (in pesos of December 2005)

	Ambulatory treatment				Hospitalization		
Author	Granados	CAN-Fecic	Mayén & Luna/Cofepris	Seguro Popular	Granados	CNA-Fecic	Mayén & Luna/Cofepris
Year	2001	2004	2005	2005	2001	2004	2005
Cost	188.7	170.5	376.3	372.6	2,154.1	1219.7	2889.9

Sources: Margulis (1992); Villarreal (1996); Arredondo (1997); Granados (2001); CNA-Fecic (2004); Mayén and Luna/Cofepris (2005); Seguro Popular (2005).

Table 7. Seguro Popular: costs of ambulatory treatment of acute diarrhoea in five-year-old children, 2005 (in pesos as of December 2005)

	Amount	Percentage
Fixed costs	245.9	66.0
Consultation	82.4	66.0
Variable costs	126.7	34.0
Medicines	1.9	0.5
Studies	124.8	33.5
Total weighted cost	372.6	100.0

Source: Seguro Popular (2005).

The Seguro Popular study's major benefits were that it was carried out at national level, took account of various types of procedures, and used micro-costing. The quantification of fixed costs included estimates of depreciation and discount rates. However, it remains unclear whether cost sensibilities were analysed or whether parameters were estimated. Nor does it seem that the costs of hospitalization were included in estimates of the treatment of diarrhoeic illnesses.

Type 2 Costs

Type 2 costs include direct costs incurred by the patients and their families as well as indirect ones, especially days lost at the workplace or school. No evaluation has been made in Mexico of the type 2 direct costs incurred in cases of diarrhoea. The only available source of information at the national level is the National Survey of Household Income and Spending carried out every two years by INEGI. According to the 2004 survey (INEGI, 2004), 28.9% of households incur expenses in the treatment of diarrhoea, with or without a medical prescription. The total amount spent was 3.4 billion pesos, or 16.8% of the total health expenditure of the nation's families, and the poorest pay proportionately more than the well-off families. Diarrhoeas accounted for 26.2% of the total health spending of the poorest decile of households, but only 10.3% of the wealthiest (see Table 8). Unfortunately, there is no way of breaking down total spending on diarrhoea by states. The survey is at the national level, and at least 100 samples would have to be taken in each state in order to achieve such a breakdown. With regard to diarrhoea, only Nuevo León and the Federal District met that requirement.

Some estimates have been made of the indirect costs incurred by families. These include Mantilla *et al*. (2004), CNA-Fecic (2005) and Mayén & Luna/Cofepris (2005). Mantilla *et al.* (2004), specialists from the Mexican Institute of Water Technology, analysed the costs at a state level and in municipalities on the shores of Lake Pátzcuaro. They identified the incidence, in terms of morbidity, of acute diarrhoeal illnesses, according to age groups (older and younger than 15 years). Each case was estimated to have caused the loss of four workdays on average, which was multiplied by the region's daily minimum wage of 35.85 pesos in 2001. By that estimate, 395 820 working days were lost, equivalent to 14.7 million pesos as of December 2005. Although the study is a major effort that provides an approximation in local terms of the indirect costs of diarrhoeas, it has several limitations. On the one hand, there is no estimate of the direct costs. On the

Table 8. Annual household spending on treatment of diarrhoeas, with and without medical prescription, 2004 (pesos as of December 2005)

	Total	Decile 1	Decile 10
Average spending per household with prescription (pesos)	947.9	675.8	1581.9
Average spending per household without prescription (pesos)	288.1	307.1	610.1
Average total spending per household with or without prescription (pesos)	685.7	522.9	1236.6
Total annual spending (thousands of pesos)	3 418 358.7	164.6	698.0
Percentage of households that face expenses as a result of diarrhoea	28.9	23.2	27.3
Diarrhoea as a percentage of total household health spending	16.8	26.2	10.3

Source: National Survey of Household Income and Spending (2004).

other hand, the research does not question the quality of the epidemiological statistics, particularly in view of the problem of under-recording.

The National Water Commission (CNA) and the Federation of Mexican Civil Engineering Colleges (FECIC) produced an estimate of indirect costs of diarrhoeas on the basis of working days lost and compensation for deaths. These costs were evaluated in accordance with the number of medical house calls and the number of hospitalizations (3.193 days per patient). A monetary value of 45 pesos was placed on each working day lost, to produce a total of 5.8 million pesos as of December 2005. This study presented several limitations. The quality of the epidemiological statistics went unchallenged, nor was there any explanation of the criteria used to estimate the number of days lost per patient or the value attributed to each death.

Finally, Mayén & Luna/Cofepris (2005) tried to estimate the cost of working days lost by those legally able to work (more than 14 years old), in both ambulatory and hospitalization cases, counting not only the time lost by patients but also by those who accompany them. This evaluation was achieved by multiplying the days lost by the minimum daily wage in May 2005, to give a result of 113 million pesos for patients aged 14 and over in the 10 states that were studied. The differences in the estimates due to the variations in methodology and coverage are evident (see Table 9).

If we take, as a first approximation, the Seguro Popular's estimate of ambulatory treatment, total type 1 costs amount to 829.9 million pesos as of December 2005. In the case of type 2 costs, half of household spending (Mayén & Luna/Cofepris, 2005, estimate) in the treatment of diarrhoeas according to the National Household Survey (2004) is taken into account, as is an amount for lost working days (for patients aged more than 14 years, on the basis of a daily wage of 45.4 pesos in 2005). The result is very significant: the total

Table 9. Summary of type 2 cost estimates for diarrhoeic illnesses (pesos as of December 2005)

	Mantilla *et al.* (2004)	CNA-Fecic (2005)	Mayén & Luna/Cofepris (2005)[a]
Total cost (millions of pesos)	14.7	4.9	113.4

Note: [a]Campeche, Chiapas, Guerrero, Oaxaca, Puebla, Quintana Roo, Tabasco, Veracruz and Yucatán.

Table 10. Estimate of costs of treatment of diarrhoeas (pesos as of December 2005)

Costs	Millions of pesos	Percentage
Type 1 costs (public treatment of diarrhoeas)	829.9	30.9
Type 2 costs (incurred by patients)	1859.2	69.1
Medicines, National Household Survey (2004) (attributable proportion of 0.5)[a]	1709.2	63.6
Working days lost[b]	150.0	5.6
Total	2689.1	100.0

Notes: [a]Attributable fraction determined by Cofepris (2006).
[b]Morbidity in persons aged over 14, assuming an attributable proportion of 0.5 for deficiencies in potable water and sanitation services and a nominal daily wage of 45.4 pesos in 2005.
Source: Health Ministry's Epidemiology Department for epidemiological statistics and the Finance Ministry's Tax Administration Service (SAT) for the amount of the minimum wage. Available at www.sat.gob.mx (accessed 20 January 2007).

monetary cost of diarrhoeas in 2005 would have amounted to 2689 billion pesos, of which type 2 costs would be 69.1% and 30.9% type 1. Spending by households would be almost double that of the public health institutions, according to what families reported on their outgoings on medicines. The estimated monetary cost of lost working days amounts to 5.6% of the total (see Table 10).

The total preliminary economic cost of diarrhoeas is very significant when it is compared with the annual investment required to achieve total coverage of potable water and drainage: 776.9 million pesos as of December 2005, from 2005 to 2030. That is to say, according to Ramírez (2008), in order to mitigate the economic impact of diarrhoeas in the 13 states that account for 75% of the cases, 776.9 million pesos (as of December 2005) a year would have to be invested for 25 consecutive years in order to achieve total coverage of both services.

One issue that has not been raised in this study, but which ought to be mentioned, is the increasing consumption of bottled water due to concerns about health (the substitution of drinks with a high sugar content), lack of access of clean water or confidence in the quality of tap water, and the quest for a higher social standing. Mexico has the world's second highest per capita consumption of bottled water (Herraíz, 2006), although it is relatively expensive and of uncertain quality given the absence of any specific Health Ministry supervision of the production process. According to the National Household Survey (2004), however, the nation's households spent 9.3 billion pesos in 2004 (pesos as of December 2005) on bottled water, 47% of total spending on non-alcoholic beverages. Some 30.9% of all households bought bottled water and the average annual cost per household was 1249.2 pesos as of December of 2005.

Elements for a Proposal that would Lead to an Estimate of Economic Costs

This section presents some methodological criteria that could lead to a more representative estimate of the costs associated with diarrhoea, both direct and indirect, including the need to take account of social, demographic and economic heterogeneity, as well as that of the basic services at the national level. The central features of medical attention, and the costs associated with it, must also be taken into account.

Type 1 Costs: Health Services[4]

A full breakdown is needed of information on diarrhoeas in Mexico. The problem of under-reporting of outbreaks has to be considered, and clear criteria have to be established to define the elements of treatment costs. That means that the following elements have to be taken into consideration: (see Table 11):

- Information should be broken down by municipality or health jurisdiction. These should be classified in accordance with their place on the National Population Council's socio-economic scale.
- Ill-defined diarrhoeic ailments have to be taken into account because these are the most important.
- Two age groups should be established: under 14 and 14 and over.
- Three health service providers, IMSS, ISSSTE and Health Ministry, should be taken into account.
- Treatment types should be divided into ambulatory and hospitalization.
- Direct costs only should be estimated by treatment type.
- An attributable fraction of 0.6 should be assumed.

Type 2 Costs: Costs Incurred by Patients and their Families. These Could be of Two Types: Direct and Indirect

Direct costs (met by patients and their families). In this case, the fundamental deficiencies are in the lack of private-sector information and the ease with which medicines can be acquired in pharmacies without a medical prescription. Both factors contribute to under-reporting. If both aspects can be resolved—but above all, the former—by Health Ministry action, cases that are treated within the private sector could serve as a basis for cost estimates.

Table 11. Criteria for the estimation of direct treatment costs of diarrhoeas

Variable	Observation
Poverty index	Classification of 'poor' and 'not poor' municipalities as rated by the National Population Council
Pathology	Ill-defined diarrhoeal illnesses
Age	Under 14
	14 and over
Health service providers	IMSS
	ISSSTE
	Health Ministry
Treatment type	Ambulatory
	Hospitalization
Cost of treatment	Ambulatory: Equipment and human resources (nurses and doctors), in order to establish an average cost per consultation
	Hospitalization: Estimate of the daily cost
Attributable proportion	0.6

Source: Interdisciplinary workshop on 'The economic costs of diarrhoea and their relationship with water', 4 May 2007, UNAM, Mexico City.

Another mechanism that can provide more exact information on the costs of diarrhoeas is the National Survey of Household Income and Spending. As previously explained, the survey provides only national information, without a breakdown by state. Such a breakdown would need at least 100 case studies in each state, but the INEGI lacks the budget that would be needed to carry out such work. It would also be helpful to explore the possibility of the survey's information providing a relationship between the spending incurred in the treatment of diarrhoeas and socio-economic level, place of residence, and the educational level of the household member who incurred in the expense. This information would provide a profile, by state, of those affected by diarrhoeas.

Indirect costs (days lost). The number of working days lost in cases involving patients over 12 years old should be evaluated. In this case a breakdown should be included between those receiving ambulatory treatment and cases of hospitalization. Information on the number of days lost can be gleaned from the Health Ministry's annual reports, in the section on hospital expenses by service requirement.

A fundamental condition of this proposal is coordination among institutions, both horizontally and vertically, in order to provide the basic information that would lead to more precise and representative estimates of the various costs of diarrhoeas. Close coordination would be needed among the INEGI, the National Water Commission, and the Health Ministry, with its Department of Epidemiological Statistics. The aim is to have a more rigorous estimate of the economic costs of diarrhoeas as a basis for preventive measures that would improve the potable water service.

Conclusions

This paper has attempted to determine the monetary costs of the treatment of diarrhoeas that are caused by shortcomings in the potable water service. This has led to a critical evaluation of the existing statistics on morbidity and mortality, as well as of the methodologies used to estimate monetary costs.

The economic costs of diarrhoeic illnesses, despite their great importance (4266 deaths and 5.9 million cases in 2005, according to INEGI and the Health Ministry respectively) have not been rigorously analysed in Mexico, by taking account of the wide range of inherent costs: those of the public sector and the patients, the days lost at work and in education, and the loss of life. This is largely due to the growing importance of cardiovascular and cancerous ailments, as well as diabetes and hepatitis, as a result of the population's epidemiological transition. For political reasons, this latter group of diseases has received more attention in terms of resources and estimates of the economic costs involved.

There are serious problems of under-reporting in terms of both morbidity and mortality. The information that is available lacks an adequate breakdown by municipality and type of location (urban or rural).

The attributable percentage has not been the subject of rigorous analysis. Cofepris (2006) places it at 50%, but a Health Ministry specialist suggests that it should be raised to 60%.

Only a few economic studies have been carried out, and they have had differing objectives and methodologies, as well as varying representativity. Most of them refer to type 1 costs, health service resources. Only a few, and even then partially, refer to type 2 costs, those incurred by patients and their families. None refers to type 3 costs.

Type 1 costs are based on the Seguro Popular estimate of 829.9 million pesos as of December 2005 for ambulatory treatment. Type 2 cost estimates are based on halving the nation's household spending (attributable proportion 0.5) on the treatment of diarrhoeas as estimated by the National Household Survey, and also on an amount for working days lost (patients aged 14 and over, average daily wage 45.4 pesos (as in 2005).

The result is very significant. In 2005, the total monetary cost of diarrhoeas amounted to 2.689 billion pesos as of December 2005, of which type 2 accounted for 69.1% and type 1 for 30.9%. Household spending was almost double that of the public health services. Working days lost accounted for 5.6% of the total.

It is necessary to define certain methodological criteria that would lead to a representative estimate of the costs of diarrhoeas, including types 1 and 2. The criteria would have to take account of the heterogeneity in social, demographic and economic terms, as well as in the provision of basic services, at the national level.

According to a group of experts, the criteria for type 1 costs would imply the segmentation of municipalities in accordance with their poverty index; the inclusion of three health service providers (IMSS, ISSSTE and the Health Ministry); two types of treatment (ambulatory and hospitalization); definition of the cost elements to be taken into consideration for both types of treatment; and the establishment of an attributable proportion of 0.6.

Very few estimates appear to have been made of type 2 costs (those incurred by families in treatment and working days lost). The National Household Survey which is undertaken every two years, proved to be a valuable source of information. However, its usefulness is limited because it is representative only at a national level, and also because there is no way of relating spending on diarrhoeic ailments to socio-economic level, place of residence or the educational level of the household member who meets the cost.

Several institutions will have to coordinate their efforts closely in order to generate the information that is required to achieve a more rigorous and representative estimate of the costs of diarrhoeic illnesses. If, as preliminary estimates suggest, the amounts involved are substantial, much thought should be concentrated on the action that is needed to take preventive measures by improving the potable water service.

As a result of the nature of the research into this problem in Mexico, only partial answers can be given to the basic questions raised at the beginning of this study.

The total costs that have been estimated are very relevant in quantitative terms. Some 830 million pesos as of December 2005 a year for type 1 only, compared with the annual investment required to provide potable water and sanitation: 776.9 million pesos as of December 2005 between 2005 and 2030. That is the amount that Ramírez (2008) estimates would be required for the provision of total coverage under both headings to mitigate the economic costs of diarrhoeas in the 13 states where 75% of the cases occur.

The persistence of diarrhoeas, together with respiratory ailments and malnutrition, are clear indications of poverty. If the political will existed, morbidity and mortality would be greatly reduced. Given modern medical technology, most deaths due to diarrhoeas are regarded as avoidable. These are deaths that should not have occurred or should have been prevented.

Finally, for all the above reasons it would be much better to channel resources into attacking the principal cause of diarrhoeas: the lack of access to adequate services of potable water and sanitation. People should have water in their homes of sufficient quantity and quality, together with sewerage and water treatment facilities, so that they can meet their basic needs as a basic condition for the enjoyment of life.

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Notes

1. For more information on the workshop, see the note 4.
2. There are obvious differences in the calculation of the resources utilised in relation to their opportunity costs and, because the services are public, there could be objections to the valuation of health programmes on the basis of opportunity cost.
3. There are several types of economic valuation, which may be either partial or complete, depending on coverage. Partial valuations are those that analyse only the costs or the consequences. Those that might be considered within this group are the description of costs, the description of consequences, the description of costs and consequences, the evaluation of efficacy or effectiveness, and the analysis of costs. On the contrary, only studies that compare both costs and consequences of two or more measures are accepted as complete economic valuations (Warner & Luce, 1995; Brent, 2003; Drummond *et al.*, 2001). The description of costs gives an idea of the use of resources in accordance with several alternatives; however, since it does not take account of the consequences (the impact on health), it provides no more than the framework of a form of partial economic evaluation, since it fails to reflect efficiency.
4. This is a summary of views expressed by the participants at a workshop on 'Economic costs of diarrhoea and their relation to water', held on 4 May 2007 at the National Autonomous University of Mexico (UNAM).

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