FIELD REPORT

THE ECONOMIC IMPACT OF THE CHOLERA EPIDEMIC IN PERU: AN APPLICATION OF THE COST OF ILLNESS METHODOLOGY

WASH Field Report No. 415
July 1993

WATER AND SANITATION for HEALTH PROJECT

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Prepared for the Office of Health,
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by

Rubén Suárez
and
Bonnie Bradford

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Cost-Effective Approaches to the Control of Dracunculiasis. WASH Technical Report No. 38. September 1986.

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FOREWARD

This report is the product of a desk-top analysis of secondary data. The task was originally designed as a two-phase effort. During the first phase, data available in the United States about the cholera epidemic in Peru would be assessed using the cost of illness methodology to estimate the cost of the disease to Peru. The first phase was also intended to be a test of the cost of illness methodology. Results of the first phase, it was hoped would generate interest in USAID to warrant a follow-up or second phase application of the methodology in which first-hand data would be collected and analyzed to reflect a more true cost of cholera to Peru. The first phase was initially slated for completion in early 1992, but difficulties in obtaining fairly reliable secondary data and problems related to interpreting appropriate cost estimates delayed the effort.

Notwithstanding efforts to address the weaknesses found in the secondary data, some difficulties remain. For example, the direct costs of treatment of cholera cases in Peru, especially with regard to intervenous solution, would benefit from first-hand knowledge and data. Nonetheless, WASH believes this report represents an important contribution to the literature about the cost of illness. Moreover, apart from demonstrating the utility of the cost of illness methodology, the report underscores the paramount fact that cholera has a negative economic impact on a society both in terms of direct treatment costs and costs associated with productivity losses. Seen from this perspective, the control and prevention of disease has relevance for all segments of society and not just health agencies or ministries.

ABOUT THE AUTHORS

Rubén Suárez has an M.A. in economics from the University of Ottawa and has undertaken Ph.D. studies at the University of Western Ontario, Canada. Mr. Suárez has served as an economic adviser to the National Bank of Mexico and has been a professor of economics at the Catholic University of Peru and Anahuac University of Mexico. He has more than 10 years' experience as an economic and financial consultant in the area of human resources development. He has done extensive work for the World Bank, the Pan American Health Organization, and USAID. Mr. Suárez has assisted several countries in Latin America in formulating national health plans and policy reforms, and in assessing the feasibility of national health projects and programs. Currently, as a consultant for PAHO and the Economic Development Institute of the World Bank, he is actively involved in research and training on health care economics and financing.

Bonnie Bradford has an M.P.H. in international health from the John Hopkins School of Hygiene and Public Health. She has been active in public health for the past 13 years, and has participated in other WASH activities. Ms. Bradford is currently working as a consultant, specializing in water and sanitation, housing, and the environment, particularly in peri-urban areas. She lived in and worked as a public health consultant to various local and international organizations in Tegucigalpa, Honduras, from 1985 to 1991.

ACKNOWLEDGMENTS

WASH wishes to extend appreciation to several individuals from whom valuable assistance and guidance was received during the preparation of this report. Ms. Jane Walker, now of the World Bank and earlier of WASH, put together the scope of work for this task, and provided helpful commentary on shaping the report. Dr. Jo Mauskopf and Dr. John Paul both provided valuable expert opinion on the application of the cost of illness methodology in this report. An in-depth technical review of the final draft was provided by Dr. David C. Warner of the University of Texas at Austin, whose efforts improved the cost estimates of cholera in Peru and sharpened the narrative presentation of the findings.

ACRONYMS

ALOS	average length of stay
ARI	acute respiratory infection
GDP	gross domestic product
GNP	gross national product
LAC	Latin American and the Carribean region
MOH	Ministry of Health
ORT	oral rehydration therapy
PAHO	Pan American Health Organization
USAID	U. S. Agency for International Development

EXECUTIVE SUMMARY

The objective of this report is to provide preliminary estimates of the impact on Peru's economy of the cholera epidemic that began in January 1991. It is designed to be the first phase of a two-phase project that applies the cost of illness methodology developed by Dorothy Rice and elaborated by Paul and Moskopf to the direct and indirect costs generated in 1991 and the first three months of 1992 by the cholera epidemic in Peru.

The cost of illness methodology calculates losses to gross national product (GNP) for a period of time from a particular illness, group of illnesses, or even all illness (Paul and Mauskopf 1991; Rice et. al. 1985). The purpose of such studies is often to identify costs to society, which possibly could be averted or reduced if a policy change (i.e., requiring seat belts or lowering speed limits) were implemented or a program (diabetes research or clean drinking water) were initiated. Direct costs are the medical expenses incurred in treating those affected by or at risk of developing the disease. Indirect costs are the losses in productivity from the disabling effects and loss of productive years of life from premature deaths due to the disease.

Estimates are quite rough and depend on assumptions regarding costs of medicine, facilities, and professionals, in addition to assumptions regarding utilization of the medical care system and public health initiatives. Loss of future income estimates also depend on tenuous income, labor force participation, and productivity assumptions. Much of the assumed cost is lost production due to early death, but no adjustment is made for the reduction in consumption that such early deaths also generate.

In a sense, subject to these caveats, these costs may be looked at as benefits that would have been generated by water and sanitation projects. It should be noted that the study does not look at the costs in the other countries of Latin America of the cholera epidemic or of the loss of product. Also it is important to remember that most investment in ameliorating or treating disease is not undertaken for purely economic investment or GNP enhancement purposes. Rather it is to lengthen life, extend hope, and reduce pain and suffering. In addition to raising productivity, water and sanitation projects can reduce painful disease and premature death—not simply increase productivity and reduce treatment costs.

In addition to estimating direct and indirect costs, which total $149.666 million for 1991 and the first three months of 1992 using the cost of illness methodology, this report presents estimates of the impact of the cholera epidemic on tourism, exports, fisheries, and certain other activities. The estimate of $50.4 million is based on readily available international and in-country information.

In Chapter 1 we discuss the cost of illness methodology in more detail and describe the spread of the disease in Latin America and the evolution of the epidemic in Peru. Chapter 2 presents more detailed epidemiological information including the number of days of productive life lost, and morbidity and mortality by age groups. Chapter 3 of the report estimates the economic cost of cholera for 1991 and early 1992 in Peru. A number of early estimates are presented, followed by estimates of direct and indirect costs and the economic impact of the epidemic on tourism and other economic activities. Chapter 4 presents conclusions and recommendations for further research.

Chapter 1

INTRODUCTION

1.1 Cost of Illness Study

A cost of illness study starts with modeling the disease, its treatment, and its effect on mortality and morbidity. The aim is to estimate the economic cost of the disease and then to estimate the extent to which a particular intervention will reduce these costs. This reduction of the "cost of illness" can serve as an estimate of some of the benefits of an intervention. The intervention may reduce illness costs by reducing the number of persons suffering from the disease or by reducing the severity of the disease so that treatment periods are shorter or people return to work sooner, or the number of deaths is reduced. When a capital investment project is designed to improve water quality and thus as one of its goals reduce disease over a number of years, some of the benefits of the project can be estimated by taking the present value of the cost of illness reductions over time.

This study of the cholera epidemic in Peru differs from a usual cost of illness study in that the direct productivity losses of people working in industries affected by the disease are also taken into account. A usual cost of illness study looks at the cost for one year of a disease that exacts its toll on a continuing basis over the years. The cholera epidemic, although not strictly a one time occurrence, had significant direct impact in Peru in 1991 and 1992 and in addition to the direct cost of the disease on the medical care system and on the ability of those affected to work, cholera also struck directly at specific industries such as fishing and tourism. We are thus measuring many costs that could have been averted if the appropriate investments in water and sanitation infrastructure had been made.

Reintroduction of cholera into the Americas has had a number of other deleterious effects. At this writing, 20 other countries in the Western Hemisphere have had outbreaks of cholera (PAHO Bulletin, March 1993). Also, shellfish in a number of other regions, including Mexico and the U.S. Gulf, have become contaminated. These "costs" of the illness are not being examined in this paper.

Because of the secondary nature of the information used, a number of caveats must be entered at this point.

Table 1 summarizes a number of variables we have had to estimate and our basis and sources for these estimates. Clearly, further verification should be undertaken to establish the appropriate values for many of these variables. Also, it should be pointed out that even if these figures were absolutely accurate there could be legitimate debate as to the extent they represent economic costs. For instance, hospital costs may have a significant fixed cost component that would have been incurred even if the epidemic had not happened, or the existence of unemployment might invalidate our lost production assumptions. In this case the low wage we chose probably mitigates that problem, since, even if not in the formal labor market, most adults do work either in the home or in informal markets. And losses due to

Table 1
Estimates and Assumptions Used in Valuing the Cost of the Cholera Epidemic in Peru

VARIABLE	SOURCE	ASSUMPTIONS MADE
Total cases	Peruvian Ministry of Health Tables A3.2 and A3.3	Accurate count and breakdown between hospitalized, ambulatory and deaths.
Severity of hospitalized cases	PAHO 1991/1	That the experience at three hospitals represents total experience
Age distribution of cases and deaths	Based on age distribution of 2000 reported cases and confirmed by Ecuador hospital data	Assumes the sample represents the whole and that the hospital in Guayaquil is also representative
Drug expenditures	Based on optimum community treatment model developed in Buenos Aires and also on Peruvian, Ecuadoran and wholesale prices	That drug use approximated the ideal model and that the prices used are appropriate measures of cost; also, that the discount factor ultimately applied was appropriate
Variable hospital and ambulatory costs	Source, based on utilization assumptions and on cost estimates for hospitals of the IPSS, private clinics and medical offices	Assumptions made that these costs are representative of the extra cost due to the epidemic; there could be a fixed cost component that would be incurred anyway; or there may have been additional costs
Cost of additional community outreach and community education.	No data	Conservative estimate
Cost of direct treatment at home	No data except some national income data	Conservative wage rate and one day per case assumption
Lost days of work due to morbidity	Extrapolated from ambulatory and hospitalization data	One day per ambulatory case and four per hospitalization; wage rate conservatively estimated but assumed that all between 15 and 55 were working
Lost income due to premature mortality	Dates by age from prior assumption, income derived from rough estimates by IBRD	Conservative income estimates; discount rate, productivity gains, and labor force participation rates all reasonable guesses

premature deaths are somewhat suspect in economic terms, both because of the necessity to discount these earnings, back as much as 50 years in the case of children, and also due to the fact we have chosen not to net out their consumption from the estimates.

1.2 Background

The first cases of cholera were reported in Peru at the end of January 1991. By December 1991, the epidemic had spread to 14 countries of the Americas and the Caribbean (see Table 2). The number of reported cases in the region reached 366,017, of which 158,739 required hospitalization and 3,892 resulted in death. Excluding the United States, where only 24 cases were reported in 1991, the countries of the Latin American and Caribbean Region (LAC), where the cholera epidemic is already present, and likely to spread and become endemic, account for more than 80 percent of the total population of the region.

Peru, Ecuador, Colombia, Panama, and the poorest countries of the Central American region (Guatemala, El Salvador, Honduras, and Nicaragua) have been hardest hit. Nearly 99 percent of the reported cholera cases and cholera-related deaths in the region are from these countries. Peru has been most severely affected. With less than 5 percent of the population of the LAC region, more than 80 percent of the reported cases on the entire continent and more than 72 percent of the reported deaths have occurred in Peru.

The impact of the epidemic on the already strained budget of the Ministry of Health (MOH) was enormous, creating greatly increased demands for hospitalization and ambulatory treatment and medicines. In countries where the epidemic has not yet reached, domestic and foreign resources are being mobilized to prevent and control the spread of the disease (PAHO 1991). The epidemic has worsened the precarious and impoverished existence of those already suffering most from the economic crisis and adjustment programs. The loss of human life plus the financial losses due to premature death or days of disability have aggravated the burdens of poor families in low-income countries of the LAC region.

Table 2

Cholera Epidemic in the Americas—
Reported Cases to the End of December 1991

Country	Pop.1991[3] (millions)*	Cases	Accumulated Hospitalizations	Deaths
Peru	22.0	301,277	114,352	2,840
Ecuador	10.9	44,126	35,471	672
Colombia	33.7	11,218	5,136	202
USA[1]	248.8	24	11	0
Brazil	153.7	913	561	20
Chile	13.4	41	38	2
Mexico	90.6	2,605	836	34
Guatemala	9.5	3,530	1,470	47
El Salvador	5.3	921	478	34
Bolivia	7.5	175	94	12
Panama	2.5	1,152	272	28
Honduras	5.3	21	19	0
Nicaragua	4.0	1	1	0
Venezuela[2]	20.3	13	0	1
Total:	627.5	366,017	158,739	3,892

* Cases reported to PAHO through December 21, 1991.

[1] 16 cases related to trips to Latin America, 6 trips to other regions, 2 of undetermined origin, under investigation.

[2] 8 cases imported from Colombia.

[3] Mid-year estimates.

Source: From PAHO (1991/4), World Bank (1991), IDB (1991).

1.3 The Evolution of the Cholera Epidemic in Peru

The evolution of the epidemic is depicted in Figure 1. The disease was first detected at the end of January 1991 in Lima (the capital and largest urban area), and in Chimbote and Piura, the larger coastal cities approximately 200 miles and 700 miles to the north of Lima, respectively. A total of 300 cases were reported during the first week of the epidemic, rising steadily until the end of March 1991 (the end of the summer in the southern hemisphere).

By the end of February, the epidemic had spread to 22 of the 25 departments in the country, affecting the coastal, Andean, and Tropical regions.

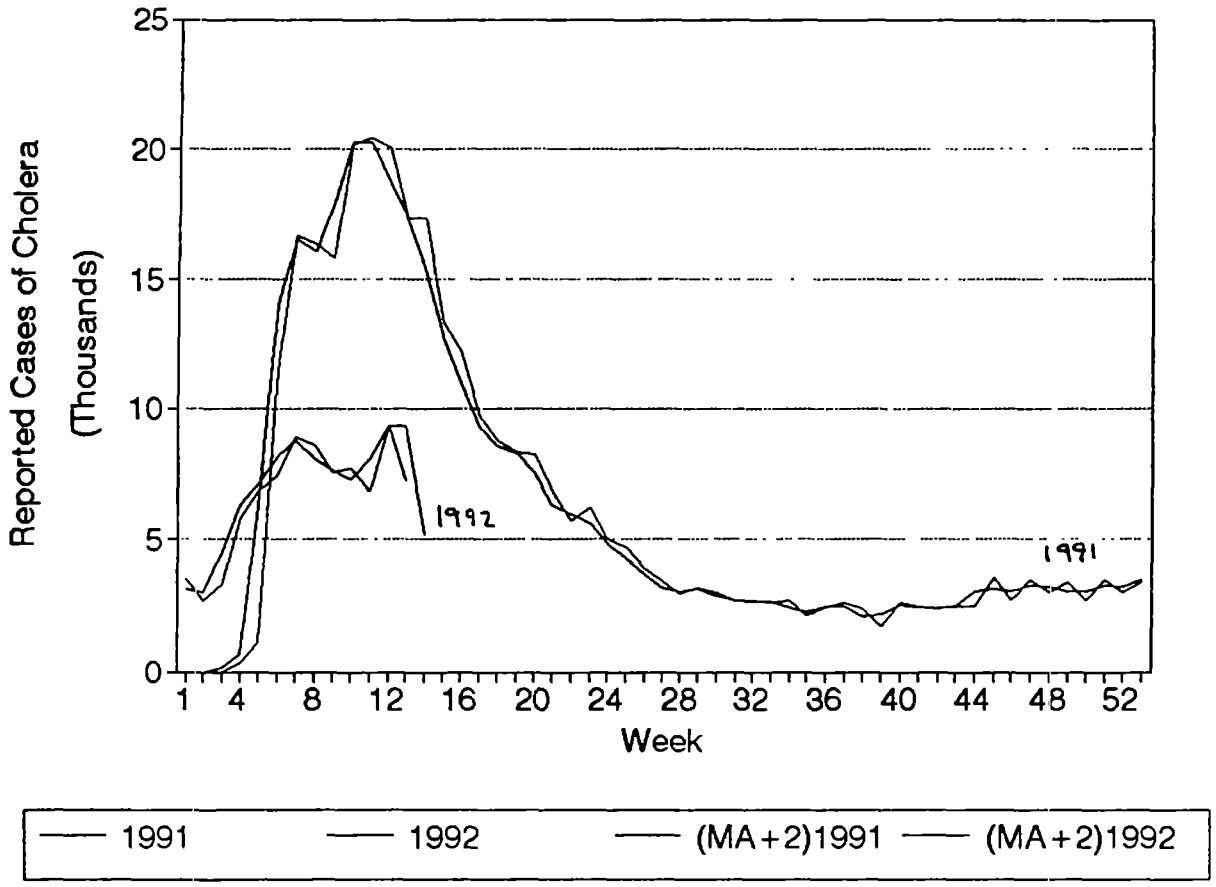
The number of reported cases per week increased from 10,000 in mid-February to 20,000 during the last three weeks of March. The number of hospitalizations per week rose to approximately 9,000 and about 200 cholera-related deaths were reported every week.[1] During the fall and winter months (April to August) of 1991, the number of cases per week declined consistently. From the beginning of May to the end of June, the average number of reported cases per week fell from around 7,000 to 3,600. By the end of the winter season (August), the number of reported cases dropped even further to around 2,500 cases per week and by mid-September to about 2,200.

From the end of September 1991 to the end of March 1992, the number of cases increased consistently, although at a much slower pace, rising from nearly 3,300 cases at the end of November to 8,000 by mid-January and 9,000 by the end of March (see Table A.3.3).

From the beginning of the epidemic in January 1991 to the end of March 1992, approximately 420,000 cases had been reported. During 1991, 322,562 cases were reported and the remainder were reported during the first three months of 1992. By the end of 1992 the number of reported cases exceeded a half million, i.e., 535,204. Estimates of the economic impact of the disease to be developed in this report are based on data from January 23, 1991 to the end of March 1992. However, for comparisons with major macroeconomic indicators, direct and indirect cost estimates will be presented on an annual basis.

The accuracy of these estimates of the total number of cases depends on the completeness and accuracy of the epidemiological surveillance system in Peru. There were no doubt a number of cases that went unreported. By the same token, there were probably a number of cases of diarrhea that would have gone unnoticed before the epidemic that were booked as cholera during 1991 and 1992. A Phase Two study would attempt to verify the accuracy of these estimates.

[1] See PAHO (1991\2 pp 1-2, Reyna, C and Zapata, A (1991) p 105



Source: See Annex Table A.3.2.

Figure 1

Cholera Cases Reported in Peru
January 1991–March 1992

Chapter 2

EPIDEMIOLOGICAL BASES FOR DETERMINING THE COST OF CHOLERA

2.1 Epidemiological Data

The epidemiological bases used to determine the economic impact of cholera in Peru are derived from data reported to the Ministry of Health's Epidemiology Department, from PAHO studies, and from records at hospitals, health centers, clinics, and health posts. Cholera cost estimates, detailed in Chapter 3 of this paper, are determined for different degrees of severity and length and type of treatment. Data on the distribution by age group of morbidity and mortality related to cholera are used to assess total income loss; however, there is said to be under-reporting in these categories.

2.2 Severity Estimates: Ambulatory Care, Hospitalizations, and Deaths

2.2.1 Ambulatory Care and Hospitalizations

The first major breakdown of data for deriving cost estimates is the proportion of cases that required hospitalization. In 1991, approximately 120,000 cholera-related hospitalizations were reported. The percent of those hospitalized fluctuated between 37 percent and 38 percent.

During the first three months of 1992, the number of hospitalizations as a proportion of reported cases where reported cases increased, 41,804 out of 93,411 reported cases, or 44.75 percent, required hospitalization (see Table 3).[2] These percentages will be used for deriving the cost estimates for different degrees of severity.

Table 3

Reported Cases, Cases Requiring Ambulatory Care and Hospitalization, 1991 and January–March 1992*

	1991		1992		Total	
Total Cases:	322,562	100%	93,411	100%	415,973	100%
Ambulatory	203,039	62.9%	51,607	55.2%	254,646	61.2%
Hospitalized	119,523	37.1%	41,804	44.8%	161,327	38.8%
Deaths:	2,909	0.9%	328	0.4%	3,237	0.8%

* Data reported to the Epidemiology Department of the Ministry of Health to the end of March, 1992 (MOH 1992). Note that the deaths are all included in either ambulatory or hospitalized cases.

[2] Data reported to the Epidemiology Department of the Ministry of Health to the end of March 1992 (MOH 1992).

2.2.2 Hospitalizations: Distribution of Cases by Severity and Average Length of Stay

The second breakdown of data is of hospitalized cases according to degree of severity. From February to March 1991, a sample of 2,115 hospitalized cases at major health care institutions (larger hospitals) in the metropolitan area of Lima was taken to assess this factor.

While 89.2 percent of the hospitalized cases required standard intravenous therapy followed by oral rehydration therapy (ORT), 10.8 percent developed complications related to acute renal insufficiency; and 25 percent of those with renal complications required hemodialysis (Table 4).[3]

Table 4
Severity of Cholera Cases

Degree of Severity	No. of Cases	% of Cases[1]	% of Cases[2]
Total Reported Cases		100.0	100.0
Ambulatory care		62.0	62.0
Hospitalization	2,115	38.0	38.0
No complications/standard treatment	1,886	89.2	33.9
Renal complications	229	10.8	4.1
Requiring hemodialysis	57	25.0[3]	1.0

[1] Composition of cases and composition of hospital cases by degree of severity.
[2] Composition of severity of total reported cases.
[3] Percentage of renal complications requiring hemodialysis.

Source: Elaborated from Table 3 and PAHO (1990/a).

For the purposes of cost estimates, this study will use the data on cases that required ambulatory care or hospitalization, shown in Table 3, and data from the referenced sample of hospitalized cases at the beginning of the epidemic. The breakdown of how reported cases were treated is illustrated in Figure 2.

[3] These estimates are derived from a sample taken in three major hospitals in metropolitan Lima during the months of February and March 1991 (Hospital Rebagliati, of the Social Security Institute, Cayetan Heredia, a University Hospital, and the Hospital Arzobispo Loayza of the Ministry of Health) See PAHO (1991/1)

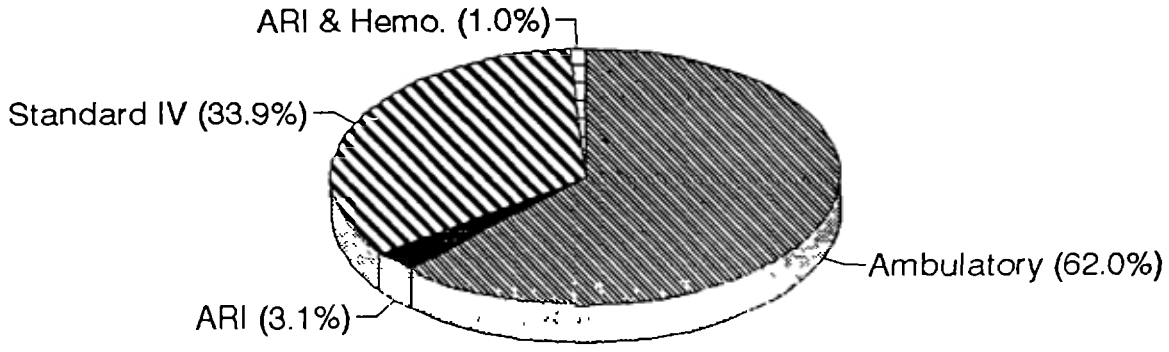


Figure 2

Cholera Cases by Degree of Severity

It is likely that in areas of the country with restricted health services the incidence of acute complications could have been higher than in Lima. However, if these cases could not be treated, they were probably not reported as complications but as deaths. In any case, the costs and economic impact estimates to be presented here will use the information in Figure 2.

Data on the disability caused by the disease suggest that from 1 to 2 days of work may have been lost because of mild cases of diarrhea identified as cholera. The average length of stay (ALOS) for hospitalized cholera cases was 4 days for patients at the major hospitals of social security institutions in Lima, and 3 days for those at Ministry of Health facilities. No data are available for those seeking treatment at private health facilities. The number of days of disability for uncomplicated hospitalized cases has been estimated at 4, which will be used in cost estimates of the productive life lost due to the epidemic.[4] For those with renal complications and those requiring hemodialysis days of disability have been estimated at 7 and 10 respectively.

[4] No systematic information is available on the days of disability attributable to the cholera epidemic This must be addressed in further studies of the economic impact of the disease

2.2.3 Days of Productive Life Lost: Morbidity and Mortality by Age Groups

Estimates of the distribution by age, number of cases, and deaths are needed to assess income loss including work days and productivity lost due to morbidity and current and expected income lost due to premature death.

The ratio of deaths per reported cases during the first three months of the epidemic was about 1.4 per hundred. After a sharp decline in the fatality rate in February 1991, the decrease in the number of cholera-related deaths was proportionately less than the decline in the number of reported cases. By the end of 1991, the cumulative number of deaths over the cumulative number of reported cases was 0.9 per 100. During the first three months of 1992, there were 328 cholera-related deaths, resulting in a ratio of 0.35 deaths per 100 reported cases.

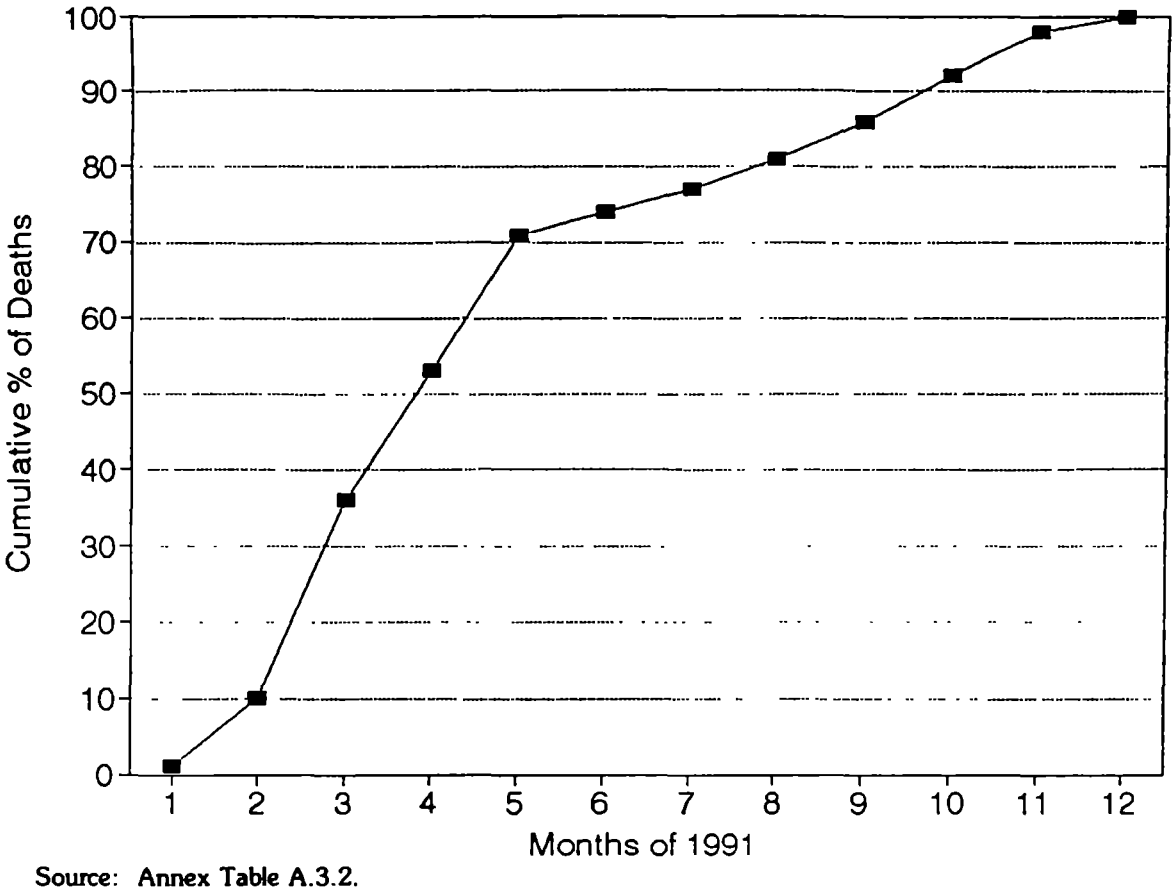
From January 1991 to March 1992, there were 3,237 cholera-related deaths among 415,973 reported cases, a fatality rate of 0.78 per 100. The immediate and aggressive campaign at the onset of the epidemic, initiated by the MOH in cooperation with international organizations, is said to be the main reason for the relatively low fatality rate.

Nearly one-third of the total reported deaths from January 1991 to March 1992 occurred during the first three months of the epidemic. Nearly three-fourths of the 2,909 deaths reported to the end of December 1991 had been reported by the end of June 1991 (See Figure 3). The rest were fairly evenly distributed at around 4 percent per month over the last six months of 1991. Estimates of the months of life lost to the cholera epidemic will be based on these figures (see Table A.3.3).

Although the MOH collects information on the ages of the reported cholera cases, this is not processed and published regularly. Data on age distribution are available for a limited number of cases reported to hospitals in Lima and a small town north of Lima, and from a sample of about 2,000 medical records of reported cases.[5]

No data were found on the age distribution of cholera-related deaths. Data on the age distribution of hospitalized cases, more likely to represent the age distribution of deaths, have been derived from confirmatory laboratory tests for cholera at different hospitals in Lima and Chancay. Most of these samples were taken during single weeks, in the months of February (Hospital Almenara) and May among people seeking attention at these hospitals, and are not intended to be representative of reported or hospitalized cases. The samples identify the proportion of cases that tested positive for vibrio cholera.

[5] These records are from hospitals, health centers, clinics, and health posts from January to June 1991 (Petrera, M [1992])



Source: Annex Table A.3.2.

Figure 3

Cholera-Related Deaths, 1991

The age distribution derived from these data reflects the nature of the reporting institutions. Two of the institutions, specializing in maternal and child care, reported that more than 45 percent of the positive cases were children under five years of age. In a general hospital, the proportion of children was less than 20 percent. While a breakdown by specific age groups was not possible, the adult population represented more than 50 percent of the total tested cases.

Looking at the experience in another country, a major hospital in Guayaquil, Ecuador, reported that a total of 1037 hospitalized cases occurring between March and June 1991, 90 percent were older than 15 years and 58 percent were between 15 and 45 years. Hospitalized cases of infants represented less than 1 percent of the total.[6]

Table 5 summarizes available data on the age distribution of reported and hospitalized cases. Approximately 60 percent of reported cases were from the working age population, between

[6] Data are from the Hospital of Infectology of Guayaquil, Ecuador's largest urban area (Fernandez, T [1991], p. 9).

Table 5

Age Distribution of Reported and Hospitalized Cases

Severity of Cases	Age Groups		[0 to 4]	[5 to 14]	[15 to 54] (E.A.P)[1]	[> than 54]	Estimated Average Days Disability (per case)	Estimated Total Days Disability 1991	Total Person-Year Equivalent Losses[2]
	Compo-sition (%)	= = > (%) Total Cases	10.7	11.9	61.2	16.2			
Total Cases (to March 1992)		415,973	44,509	49,501	254,575	67,388		601,562	2,005
Severity Composition:	100.0								
Ambulatory	62.0	257,903	27,596	30,690	157,837	41,780	1	157,837	526
Hospitalizations	38.0	158,070	16,913	18,810	96,739	25,607		443,725	1,479
Standard IV	33.9	141,015	15,089	16,781	86,301	22,844	4	345,204	1,151
ARI[3] Complications	4.1	17,055	1,825	2,030	10,438	2,763	7	73,063	244
ARI & Hemodialysis	1.0	4,160	445	495	2,546	674	10	25,458	85
Deaths	0.9	3,751	401	446	2,296	608			

[1] E.A.P : Economic Active Population

[2] A total of 25 working days per month has been used for the estimations.

[3] Acute respiratory infections (ARI)

Note that these numbers differ slightly from the breakdown in Table 3 due to rounding assumptions allocating cases between ambulatory and hospitalized.

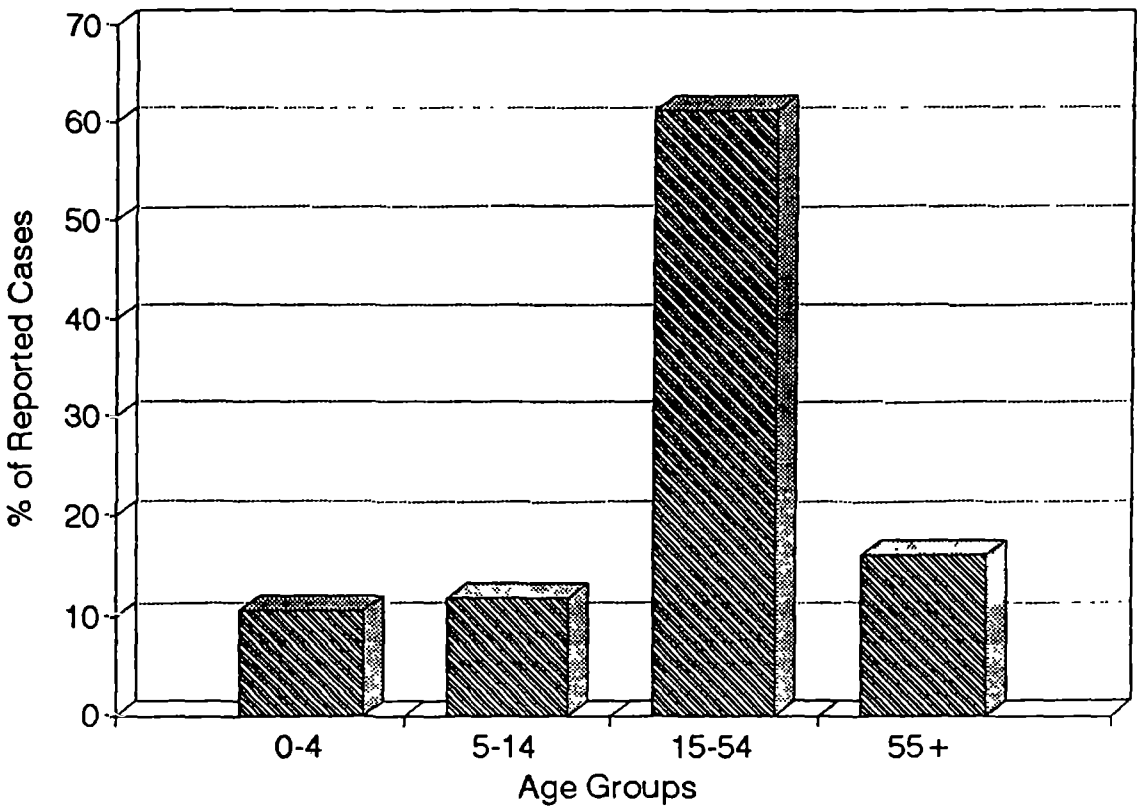


Figure 4

Age Distribution of Reported Cholera Cases

15 and 54 years of age, 22 percent were less than 15 years of age, and the rest over 54 years of age. A reliable estimation of the short- and long-term economic losses due to premature death will require a better knowledge of the age distribution of hospitalized cases and deaths (see Figure 4).

2.3 Under-reporting

The under-reporting by the national health surveillance system is high. Under-reporting of morbidity is said to be even higher than the under-reporting of mortality. A 1985-86 survey on health service utilization patterns found that while 43 percent of the population showed some symptoms of disease or had an accident during the 28 days prior to the interview, only 40 percent sought medical attention. Of those seeking medical attention, only 47 percent went to a public health institution—27 percent to a hospital and 20 percent to a health post or community health center. Approximately 27 percent went to a private clinic or medical office.

The rest went to the local pharmacy (10 percent), a health practitioner, a curandero (traditional healer), or a midwife, or were treated by a relative at home.

Since the national health surveillance system in Peru, as in most of the countries of the LAC region, captures information mainly on those seeking attention at public health facilities, the above illness and utilization patterns suggest that under-reporting may be extensive. Most diseases treated by private clinics, private physicians, and private medical offices go unreported and there are no mechanisms for reporting by informal sector health practitioners. In addition, During the 1980s, it was estimated that only 50 percent of actual deaths were reported.[7]

Utilization patterns suggest that a larger number of first outpatient consultations are with private providers. In Castilla and Piura, two cities in the north of Peru, 32 percent of 426 families recently interviewed said that they had a cholera-like case of diarrhea Only 45 percent of them sought attention at a health service institution. A similar study in Belen, a remote city in the Amazon region, found that while 26 percent of the families had a severe case of diarrhea, only 20 percent received attention at a health service institution.[8]

Data on morbidity from water-related diseases transmitted by fecal-oral contamination show that typhoid, dysentery, hepatitis, and salmonellosis have become endemic, and gastroenteritis and diarrheal diseases have become epidemic. (Table 6).

The upward trend in the reported incidence of diarrheal diseases may be explained by improvements in the surveillance system, by the increased utilization of public health services by low-income groups, and by a sharp increase in poverty and the population without access to basic water and sanitation services. The deterioration of sanitary conditions in urban slums could be a major factor explaining this trend. From 1985 to 1988, the total population without access to safe water increased from 9.3 to 9.5 million, and those without access to a sewage system, from 10.3 to 11.7 million. About half of those without access to basic sanitary services live in urban areas.[9]

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[7] See PAHO (1990) p 242

[8] Results from these two studies are reported in Petrera, M (1991) p 2

[9] Data reported in Elmore, E (1991), Tables 5 and 7

Table 6

Morbidity Rate of Diseases Transmitted by
Fecal-Oral Contamination (per 10,000 Inhabitants)

Disease	1971	1980	1989
Gastroenteritis and Diarrhea	13.6	35.4	127.9
Typhoid and Paratyphoid	6.5	11.7	7.5
Bacillary Dysentery	4.3	3.6	2.0
Hepatitis	3.3	3.5	3.2
Salmonellosis	2.7	4.0	2.3

Source: INE (1988) Compendio Estadistico; reported in Elmore (1991), p. 11.

Chapter 3

ESTIMATING THE ECONOMIC IMPACT OF CHOLERA IN PERU: COST OF ILLNESS ESTIMATES AND ECONOMIC IMPACT

3.1 Existing Estimates of the Economic Impact of Cholera in Peru

Several estimates of the economic impact of the cholera epidemic have been made, most of them related to export losses. Peru's estimated gross domestic product (GDP) for 1991 was US $49.2 billion. Annual exports in 1989 and 1990 were US $3.2 and US $3.4 billion, respectively. Initial estimates of losses for 1991, from import bans on Peruvian products likely to be contaminated and from a decline in tourism, range from low of US $350 million to a high of US $1 billion.

Estimates, based on the assumption that the epidemic is likely to spread and import bans on agricultural products from Peru will continue, placed the loss in income from exports and tourism as high as US $660 million for 1991, approximately 18 percent of the 1990 level of exports. If estimates of expenditures on health-related activities and losses in the domestic economy are included, these projections of the total cost of the cholera epidemic in Peru reach US $1,060 million. A total of US $60 to US $70 million has been attributed to losses in tourism income. While these estimates have been widely publicized and used by Peruvian officials and officials from international organizations, there is little information on the methodology used to derive them[10] (see Table 7).

According to revised estimates developed by the Ministry of Finance, in April 1991 overall economic activity would be severely affected for four months and exports for six months. It was estimated that loss of export earnings during the first six months of the epidemic could range between US $144 and $244 million (MOEF 1991). The tourism industry could lose up to US $30 million per month. Petrera estimated that total losses were estimated to amount to around US $424 million.[11] It was projected that unemployment would increase for 50,000 persons.

More recent and detailed estimates that include the direct and indirect costs of the disease, as defined on the COI methodology, have been developed in a WHO-sponsored study conducted by M. Petrera (1991, 1992). Total losses for 1991 amount to US $233 million, which increases to US $465 million when the present value of productivity losses due to

[10] These estimates were quoted in several newspapers by government officials and representatives of international organizations (see WHO, April 1991)

[11] Elaborated from Reyna, C and Zapata, A (1991) Table 7, Petrera, M (1992) pp. 53-56, Ministry of Health (1991), MEF (1991).

premature deaths among the working age population (COI indirect costs) are included (see Table 7).

The estimates in Table 7 are based on different assumptions about the activities or sector that would be affected by the epidemic. Very few of the estimates are backed by a clear definition of the methodology or estimation procedures used to derive them. The most comprehensive estimate are those of Petrera (1992).

3.2 Cost of Illness Estimates: Direct and Indirect Costs of Cholera

3.2.1 The Direct Costs

The direct costs of illness are those costs incurred to treat the disease. They include the physician, hospital, or drug costs in the formal medical care system for treating the disease. They also include the costs of community outreach, of community education programs specific to the disease, and of preventive prophylaxis administered to the contacts of sufferers. Finally, the direct cost of treatment includes production foregone by friends or relatives of the patients in order to care for them at home. Other direct costs such as transportation to health care providers, moving expenses, household costs to accommodate the needs of the affected person, and vocational, social and family counseling services are beyond the scope of this study.

Drugs and Medical Supplies

Direct cost estimates presented in this section are based on incidence rates and utilization patterns presented in Section 3 and treatment protocols defined by the Ministry of Health (MOH) (see MINSA 1991, ESL/February 1991). The treatment protocols specify the drugs and medical supplies required to treat moderate and severe cases of cholera in children and adults. Early estimates of the cost of treatment priced intravenous fluids at US $4.6 per case.[12] This estimate, reported by Tullock J. (1991), was derived from the current market price of US $5.7 million for the total IV units used to treat 126,000 patients. Approximately 50 percent of these supplies came from foreign donors. The total value of other drugs and supplies amounted to US $6.25 million, of which US $3.4 million came from donors.

Unit costs of medicines and medical supplies for this study have been estimated using the treatment protocols recommended by the Ministry of Health (MINSA 1991, ESL/February 1991), which are similar to those recommended by PAHO and WHO. It is assumed that these standard treatments were used for all reported cholera cases, regardless of who provided medical attention.

[12] A total of 108,000 tetracycline courses and 2 5 million liters of ORS were also provided by donors

Table 7

Estimates of the Economic Impact of Cholera

Institution/ Researcher	Date of Estimate	Est.(millions of $US)	Type of Losses
ADEX[1]	Feb. 19	400	Exports of food products
SNP[2]	Feb. 25	,350	Exports of fish and other seafood products
CCL[3]	Mar. 4	1,000	Export restrictions
Office of Pres.[4]	Mar. 15	1,000	Total economic losses due to cholera
MOH	Apr. 16	1,060	Exports, tourism, and domestic production (US $60 million)
MOEF[5]	Apr.	424	Exports (US $144 to 244 million) and tourism (US $30 million per month) during the first six months of the epidemic
Petrera	Nov. 30	268	Direct, indirect, and losses in exports, tourism and domestic production
Petrera	Feb. 1992		Total losses, including future losses from linked industries
		233	Total 1991 direct and direct net losses

Source: Elaborated from Reyna, C. and Zapata, A. (1991), Petrera, M. (1991) Table 7; Petrera, M. (1992) pp. 53-56; Ministry of Health (1991), MEF (1991).

[1] Estimates reported by Hugo Zapata from the Association of Exporters (ADEX) and estimates presented by M. Vega Alvear. No methodology available.

[2] Sociedad Nacional de Pesqueria-SNP (National Fisheries Society), estimates presented by Arturo Madueno, President of SNP.

[3] Estimates presented by Juan Alvaro Lira, President of the Chamber of Commerce of Lima (Camera de Comercio de Lima-CCL)

[4] Estimates reported by the head of the Cabinet of Ministries, Office of the Presidency, Government of Peru, Carlos Torres Lara.

[5] Ministry of Economics and Finance (MOEF, Government of Peru, preliminary estimates of the economic impact of cholera.

The three inputs included in estimates of the costs of drugs and medical supplies are venoclysis kits, including needles and "alitas," disposable syringes, and nasogastric tubes for children and adults with severe vomiting. Two alternative solutions, electrolytic and Ringer's lactate, were considered. Costs of oral rehydration salts for severe and moderate cases, and tetracycline, doxycycline, or furazolidone for severe cases, both adults and children, were also estimated (see Table A.4.1) Estimated costs of the treatment for the adults are summarized in Table 8 Since institutions can buy medical supplies and medicines at discounted prices, the cost of treatment at public health facilities would be lower than what is shown in Table 4.2. Given the heterogeneity of the Peruvian health system, there are larger variations in the prices charged by pharmacies in Lima.[13] To illustrate the large variations in cost that can result from using different sets of prices overall estimates using the prices of the same inputs in Ecuador and the UNIPAC costs of ORS are presented in the statistical annex.

Table 8
Unitary Costs of Medicines and Medical Supplies
for Treatment of Cholera Cases (in Millions of US Dollars)

	Adults		Children	
	Moderate	Severe	Moderate	Severe
Medical Supplies Materials				
Equipment		5.37		5.37
Solution		6.36		2.5
ORS	7.5	7.5	7.5	7.5
Antibiotics		8.76		0.14
Total Cost[1]	7.5	27.99	7.5	15.51
Total Cost[2]		28.7		22.5

Source: See Table A.4.2.

1 Standard treatment using market (pharmacy) prices.
2 Cases that require the use of nasogastric tubes.

The prices of medical supplies and medicines in Peru were used in a model to estimate the total cost of treatment, assuming the standard treatment protocols were applied to all reported cholera cases.[14] The model employs basic epidemiological data (population, and cholera attack and hospitalization rates) and the unit costs of the inputs required for the treatment of

[13] Margarita Petrera of the Catholic University of Peru, kindly helped in the gathering of data on the prices of medical drugs supplies, and hospital costs use for the estimates of this section.

[14] The model was developed by Santichi (1991) for the Pan American Health Organization to estimate the cost of national cholera control and prevention programs

ambulatory and hospitalized cases, and includes a provision of 20 percent for inventories and 30 percent to cover losses and expirations (see notes to Table A.4.5 in the annex). The resulting estimates are presented in Table 9. Note that this protocol assumes that for each cholera case there will be 10 ORS packets for that person and another 10 packets for community distribution. [The inventory and loss adjustments are then added to those totals.] Similarly, the dosage of tetracycline is a total of 12 tablets of 500 mg. each, and the treatment of 5 contacts per patient is assumed.

Table 9
Estimated Direct Costs of Cholera Cases:
Medical Supplies and Medicines, 1991 and 1992
(in Millions of U.S. Dollars)

	1991 Jan-Dec	1992 Jan-Mar	1991-1992 Jan-Mar
No. Cases	322,562	93,411	415,973
Hospitalization Rates	0.37	0.45	0.39
Venoclysis Kits	0.70	0.20	0.90
Ringer's Lactate	1.10	0.40	1.50
ORS Packets	7.30	2.10	9.40
Tetracycline	25.40	7.40	32.80
Total Cost of Medical Supplies	34.50	10.10	44.60

Source: See Annex Table A.4.a

The estimated cost of medical supplies and medicines used from the outbreak of the epidemic to March 1992 is US $44.9 million.

The results are highly sensitive to the price of antibiotics, which account for nearly three-fourths of the total costs. Also, the number of secondary contacts and community distribution is the idealized mix and was probably not achieved in Peru. Clearly, a Phase II study will have to determine the extent of treatment this group received. Also, an estimate of all medicines and medical supplies used should be possible with local data.

Cost of Outpatient Consultation, Hospitalizations and Medical Personnel (labor)

The other items included in estimating the direct cost of the epidemic are the costs of outpatient treatment at public and private clinics, and of hospitalization at health facilities of the Peruvian Institute of Social Security (IPSS) and at private clinics. This information, together with the average cost of medical supplies and medicines, has been used to estimate the costs of treating cholera cases by degree of severity. Table 10 summarizes the prices and costs of treatment by type of health service provider.

Table 10

Prices and Costs of Treatment of Cholera Cases, 1991
(in U.S. Dollars)

	Public Health Facilities[1]		Private Providers[2]	
	Low	High	Low	High
Ambulatory				
Consultation	3.0	10.0	10.0[5]	25.0[3]
Drugs (ORS)	8.2	8.2	7.5[6]	7.5[4]
Total Cost	11.2	18.2	17.5	32.5
Hospitalization				
Cost/day	38.0	54.0	20.0	88.5
No. of Days	4.0	4.0	4.0	4.0
Drugs, medical[3]	(28.0)	(28.0)	28.0	28.0
Supplies & Labor[4]	84.0	84.0	30.0	75.0
Total Cost	236.0	300.0	138.0	457.0

Source: See Table A.4.6

[1] Cost estimates at polyclinics and hospitals levels I and II of the Peruvian Institute of Social Security (IPSS).

[2] Cost per day of hospitalization in April, 1992 at private clinics in Lima.

[3] Cost of drugs and medical supplies are taken from Table A.4.2.

[4] Labor costs for private hospitals are based on three consultations per cholera episode.

[5] Costs of outpatient consultation at medical offices in metropolitan Lima.

[6] ORS costs for out-patient consultation from Table A.4.2

The estimates in Table 10 are based on informal investigations. There is no indication of how the cost studies of the IPSS were conducted nor of the statistical significance of the prices of inputs and hospital costs that were used. This cost component must be refined if a more reliable estimate of the economic impact of cholera is to be developed. Also, a breakdown of costs according to health service utilization patterns is needed. Empirical studies of the direct cost of treatment in endemic areas suggest that the cost of fluids is only a small component. A 1973 study of Calcutta estimated that fluids represented about 30 percent of the cost of treatment. Hospitalization, physicians, nurses, and auxiliary personnel accounted for the balance. The cost structure from these assumptions is 60 percent for hospital stay and 20 percent for drugs and medical supplies and labor, respectively (Verma 1975).[15]

Since the disease affects mainly the poor, who do not have access to the social security system or expensive private clinics, the low estimate of the costs in Table 11 has been used as the cost of hospitalization. Also, the average cost of treatment at public institutions has been assumed to be between the low costs at public and private institutions, respectively, that is, US $11 for

[15] The following cost structure was estimated by Grundy and Reinke (1973), reported in Verma O P (1975) p 60

ambulatory care and US $150 for hospitalization.[16] These estimates are lower than the estimates of US $18 for ambulatory treatment and US $167 for hospitalized cases reported by the MOH (PAHO 1991d). It is important to be conservative in estimating hospital and clinic costs since there is a fixed cost element and the costs we wish to measure are the additional costs generated by the cholera epidemic rather than the average charges that might be incurred or even overhead costs allocated.

Table 11
Average Cost of Treatment of Cholera Cases
by Degree of Severity (in U.S. Dollars)

Severity of Cases	Estimated Cost per Case (U.S. $)		
	Distribution of Cases by Degree of Severity (%)	Report Estimates[1]	MOH[2]
Total Estimated Ave. Cost	100.0	84.0	94.0
Average cost of:			
Ambulatory care	62.0	11.2	18.0
Hospitalizations	38.0	202.9	218.0
Standard IV	(33.9)	150.0	167.0
ARI complications	(4.1)	450.0	450.0
ARI & hemodialysis	(1.0)	779.0	779.0

[1] Derived from estimates presented in Table 10.
[2] Implied MOH estimates from reported costs of hospitalization and ambulatory care.

Total medicines and medical supplies are estimated in Table 9 at $44.6 million. More than two-thirds of those costs are to cover community distribution of oral rehydration salts treatment of contacts with tetracycline and to account for inventories, losses, and expirations that are not included in the estimate of direct costs of the cholera epidemic (see Table 12).

Accordingly, even though the $44.6 million figure appears inflated, it would appear to be reasonable to add $12 million to the $25 million estimate of Direct Costs in hospitals and clinics [as discussed above this needs verification].

[16] These estimates assume a US $3 cost ambulatory consultation (estimated for polyclinics of the IPSS) and US $3 18 for drugs and medical supplies. Hospital cost estimates assume an average of 3 days of hospitalization (at US $30 per day) US $28 for drugs and medical supplies, and US $30 services of medical personnel (US $148)

Table 12
Direct Costs of the Cholera Epidemic: Hospitals and Clinics
(in Millions of U.S. Dollars)

Degree of Severity	Total COI Direct Cost		
	Jan-Dec 1991	Jan-Mar 1992	Jan 1991-Mar 1992
Ambulatory care	2.2	0.6	2.9
Hospitalization	24.9	7.2	32.1
Standard IV	16.4	4.7	21.2
ARI Complications	6.0	1.7	7.7
ARI & Hemodialysis	2.5	0.7	3.2
Total Direct Cost	27.1	7.8	35.0

Source: See Annex, Table A.4.7.

Cost of Additional Community Outreach and Community Education

The government of Peru inaugurated a major health education campaign with active community participation (PAHO 1991/1). The cost of this campaign is not known but it should be factored into estimates of the cost of cholera. It would be surprising if the cost of this campaign and the labor costs of the delivery of oral rehydration salts and treatment of contacts with a course of tetracycline was less than $5 million. (There is no objective basis for this estimate. It obviously would have to be verified in Phase II or through further research).

Cost of Direct Treatment in the Home

For a disease such as cholera the care of even the ambulatory cases may require some help by friends or relatives in the home in obtaining and administering medication, in caring for the person, or in transporting them to the hospital. A conservative estimate would be that on average for each case a day's work at the minimum daily wage of approximately $3.00 was sacrificed by a care giver. In March 1991, the minimum monthly wage was $69.10, which was 40.5 percent of the minimum wage in 1988. (EIU, 1992). With a total of 415,973 cases this would yield an estimate of $1.25 million in direct care costs in households.

Total Direct Costs

Total direct costs are summarized in Table 13.

Table 13
Total Direct Costs of the Cholera Epidemic in Peru,
January 1991–March 1992 (in Millions of U.S. Dollars)

Category	1991	1992	Total
Costs incurred in hospitals & clinics	27.1	7.8	34.9
Costs of medications outside hospitals & clinics	9.3	2.7	12.0
Costs of public education and community outreach	3.9	1.1	5.0
Direct costs of treatment in the home	0.9	0.3	1.2
Total	41.2	11.9	53.1

It can be seen that total direct costs are estimated at $53.1 million. If the MOH estimates for ambulatory care (US $18) and hospitalization (US $1167) are used, the figure would be $57.3 million.

3.2.2 Indirect Cost Estimates

Two components in estimating the indirect cost of the disease are the total number of days of disability because of morbidity, and the number of years of productive life lost due to premature death during the period being examined. This data, in combination with labor force participation and earning assumptions, permits the estimation of losses to GNP due to the morbidity and mortality under examination.

Morbidity Losses

Table 14 summarizes the estimated lost days of work due to illness at 446,480 in 1991 and 144,281 in 1992.

Table 14

Distribution of Economically Active Population by Treatment Status and Estimated Days of Disability, 1991 and January–March 1992

Severity of Cases	Total Cases Age 15-54		Estimated Average Days of Disability per case	Total Days of Disability	
	1991	Jan-March 1992		1991	Jan-Mar 1992
Total	197,408	57,167		446,480	144,281
Ambulatory	124,260	31,583	1	124,260	31,583
Hospitalizations	73,148	25,584			
Standard IV	65,248	22,821	4	260,992	91,284
ARI complications	5,924	2,072	7	41,468	14,504
ARI & hemodialysis	1,976	691	10	19,760	6,910

Source: Tables 3 and 5

This table does not take into account the fact that a number of hospitalized patients might be laid up at home significantly longer or that their ability to work for a longer period might be attenuated by the disease. Clearly, although cholera itself is a short-term affliction, the complications can be severe and in an already weakened population there may be some reasonable long term disability. These are questions for a Phase II study. It should be noted that no days of disability are computed for the population below 15 or above 54 years of age. Quite clearly, there are persons in both age groups who are economically active, which makes the estimated days of disability further conservative.

Valuing lost income for days of disability is a tenuous exercise in the best of circumstances; in an economy such as Peru's in the early 1990's it is especially difficult. Peru during the last ten years has suffered from deteriorating economic conditions, including rapid inflation and declining gross domestic product (EIU, 1992). It is estimated that two percent of the population receives 18 percent of national income while 60.3 percent receives only 23.8 percent. PAHO estimates that approximately 60 percent of workers are employed in the informal sector outside the control of state standards and regulations. This includes street peddlers, some fishermen, small farmers, and others (PAHO 1991/1). If household workers are included, the number working in the informal sector increases even more. Consensus is that in constant 1988 dollars, per capita income has remained in the $1,000-$1,200 range or has declined (IDB 1991). In fact, due to inflation, the minimum monthly wage has declined.

It should be noted that illegal work, work outside the formal sector, and household work may not be counted in these estimates of GNP and per capita income. Indeed, by definition, household work is not included although estimates of its value must be made in cost of illness computations.

Labor force participation rates are estimated variously. For persons who only miss a day of work they can probably adjust but they do have a small loss. Similarly, there can be some adjustment inside the household if the homemaker is sick for a day or two. At the same time, when an epidemic hits a community whole work establishments can be idled if a significant number of workers are sick. For estimating morbidity costs we assume that the economically active population, 62 percent of the population, accounts for all labor income and that labor income is 60 percent of per capita income. In addition, we assume that including household workers would increase labor income in the economically active population by 25 percent if their work were included. Assuming a 300 day per year work year:

Per Capita Income	Labor Income & Per Capita Population	Per Capita Labor Income Economically Active	Adjusted for Household Work
$1200	X .6 = $720	$720 /.62 = $1161	$1161 x 1.25= $1451

The resulting estimate of $1,451 per year yields a daily wage of $4.84. This wage may seem low, but in light of economic trends and the disproportionate numbers of the poor who were afflicted with cholera, it is important not to overestimate income loss. Table 15 shows estimated income lost due to morbidity from cholera in Peru in 1991 and from January to March 1992.

Table 15
Estimated Income Lost Due to Morbidity from Cholera,
1991 and January–March 1992 (in U.S. Dollars)

	1991	Jan-March '92	Total
Total	$2,160,962	$698,319	$2,859,281
Ambulatory	601,418	152,862	$754,280
Standard IV	1,263,201	441,814	$1,705,015
ARI complications	200,705	70,199	$270,904
ARI and hemodialysis	95,638	33,444	$129,082

Mortality Costs

Mortality costs of an illness are commonly calculated by taking the discounted lifetime earnings that those who died of the illness during the year in question would have earned if their life expectancy, average earnings, and labor force participation rate had been that of the average person of their age, race and sex. Given the state of the data available for Peru we will make

some simplifying assumptions. We assume, as above, that the population over 55 in 1991 is not economically active. We further assume that the economically active population (15-54 years) had an average age of death of 36 years and that the average person would have had an average loss of productive life of 24 years from the end of 1991. For 1991, since most of the deaths took place early in the year, the average loss of productive life due to premature deaths in 1991 is estimated at 200 days. Similarly, for those who died in 1992, it is assumed that they would have had 280 days of productive economic life in 1992.

For those dying below the age of 15 it is assumed that for those who died between the ages of 0 and 4 that they died at an average age of 2 and that they would have had 13 years of no productivity and then could be anticipated to have had 40 years of productive life. For those between 5 and 14 at death it is assumed that they had an average age of 10 at death and that they would have had 43 years of productive life after reaching age 15. It is assumed that the youngest age group would have had a lower average work life since in Peru the death rates for causes other than cholera is quite high and rather more of this group could have been expected to die of other causes than the older age groups before the age of 15. This is especially true since persons dying of cholera can be expected to be at high risk of other diseases spread by fecal-oral contamination (Table 6).

Given these assumptions the discounted mortality costs due to cholera for persons dying of cholera in 1991 were $82,744,334, while for those dying in the first three months of 1992, the present value of potential lost lifetime production was $11,176,647 (Table 16). These estimates were made on the assumption that the average loss in 1991 or 1992 for persons between 15 and 55 was $1,451 per year. Furthermore, it is assumed that the appropriate net discount rate to use is 2 percent. This is the difference between a discount rate of about 4 percent and projected productivity increases of 2 percent annually. Several points should be made. This lost income goes nearly to the middle of the 21st century and as projections go so far into the future it becomes enormously difficult to make reliable estimates. Similarly, these calculations make no adjustment for the net consumption of the person whose income is foregone. It is likely that many of these lost workers would have consumed a substantial portion of their production. If maximizing GNP is our goal that is not significant. If our concern is with the rest of the society then perhaps we are overestimating the lost income due to cholera in this analysis.

Table 16

Present Value of Mortality Costs of the Cholera Epidemic,*
1991 and January–March 1992 (in U.S. Dollars)

	1991	Jan-March 1992	Total
Deaths, ages 15-54	2,026	270	2,296
Income lost, 1991 (valued in 1992)	$2,039,615		
Income lost, 1992		$365,904	
Annual loss 1992-2015	$2,939,726		
Annual loss 1993-2016		$391,770	
Present value of a 24-year income stream (discounted at 2%)	$55,601,684	$7,409,898	
Total	$57,641,299	$7,775,802	$65,417,101
Deaths, Ages 0-4	354	47	401
Present value of 40 years of income (discounted at 2% and then discounted back 13 more years)	$10,862,047	$1,442,136	$12,304,183
Deaths, Ages 5-14	394	52	446
Value of 43 years of income (discounted back 5 additional years)	$14,240,988	$1,958,709	$16,199,697
Grand Total	$82,744,334	$11,176,647	$93,920,981

*Assumes 1991 income of $1,451 per year or $4.84 per day (see above).

As can be seen in Table 17, total illness costs for 1991 and the first three months of 1992 amounted to $149.666 million with indirect costs almost double direct treatment costs.

Table 17

Direct and Indirect Costs of the Cholera Epidemic in Peru, 1991 and January–March 1992 (in Millions of U.S. Dollars)

	1991	Jan-Mar 1992	Total
Morbidity costs	$2.000	$0.646	$2.646
Mortality costs	$82.744	$11.176	$93.920
Total indirect costs	$84.744	$11.822	$96.566
Direct costs	$41.200	$11.900	$53.100
Total illness costs	$125.944	$23.722	$149.666

Source: Tables 13,15, and 16

3.3 Tourism and Other Economic Activities

3.3.1 The Impact on Exports and Tourism

Exports

The impact on export earnings was one of the major concerns at the outbreak of the epidemic. Initial estimates were that close to U.S. $1.0 billion of the US $3.2 billion earned from exports would be lost because of import restrictions imposed by Peru's main trading partners. By April these estimates were reduced to U.S. $240 million. The latest estimates of total export losses for 1991 are now only US $12.9 million. Similarly, losses in earnings from tourism initially estimated at around US $180 million have been reduced to US $84.4 million.[17]

Fish meal, canned and frozen fish, fruits, nuts, and fresh vegetables were the main products initially thought to be at high risk for cholera contamination. The main markets for these products are the United States, the EEC countries, and China. Data on actual exports of these products suggest that initial concerns were exaggerated. Import restrictions, when imposed, were not maintained for long.

In the case of the United States, an import alert issued by the Food and Drug Administration (FDA) on February 15, 1991, called for intensified testing of seafood and water-processed

[17] The total direct and indirect costs of the cholera epidemic from reduced exports and tourism are estimated at US $27 7 million and US $147.1 million, respectively (see Petrera, (1992) Table No. 37)

produce for vibrio cholera.[18] In the middle of March, an FDA team was sent to Peru to assist CERPER, the export certification agency, in assessing the control over potential contamination of fish products and produce exported to the United States. It was found that most plants had adequate quality control procedures, facilities, equipment, and personnel. No contamination by vibrio cholera was found at any of the processing plants visited.[19] As of April 1992, no contamination by V. cholera has been found in products imported into the United States and no import bans have been imposed.

On February 11, 1991 a ban on imports of Peruvian food products was imposed by the EEC countries. On February 14, France lifted restrictions on imports of fish meal and canned fish products but maintained restrictions on frozen fish. On March 19, the EEC agreed to ban only those imports without an official certificate of quality and sanitary standards issued by CERPER or Peru's Ministry of Health. Products excluded from the ban were processed fish and seafood products, fruits, and fresh vegetables. The ban on unprocessed sea shells and fresh fish continues.

On February 26, a meeting of representatives of the Ministries of Health of the Andean countries (Ecuador, Chile, Bolivia, Colombia, Venezuela, and Peru) agreed not to restrict tourism and imports of fish, seafood, and agricultural and agro industrial products unless there was proven evidence of contamination. Only a ban on fresh, unprocessed seafood products was adopted.[20] Restrictions on exports of products among Andean counties were lifted on March 21 (table 18).

Table 18 shows that Peruvian exports of fish meal, the main item in the list of products with risk of contamination, increased substantially between 1990 and 1991, proving that initial concerns about the impact of cholera were excessive. The only export losses of any magnitude were perishable products in transit during the first weeks after the outbreak of the epidemic. These losses were estimated at US $8.1 million. The initial estimate of US $4.6 million was attributed to a decline in the international prices of Peruvian exports.

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[18] Import Alert # 99-07 issued by the FDA on information provided by the Center for Disease Control (CDC) and the Peruvian Embassy called for 100 percent sampling of seafood and water processed produce imported from Peru From Zuazua, L and DepPaolo, A (1991)

[19] Because of the high temperatures involved in processing fish meal and canned goods, these products were excluded from the list of cholera risk products The FDA mission concentrated on inspecting the fruit and vegetable processing plants (4), seafood processing plants (6), and a shrimp hatchery and one shrimp farm They also assessed two of the CERPER quality control laboratories and recommended improvements in CERPER quality control laboratories and recommended improvements in CERPER testing capabilities [See Zuazua, L and DePaolo, A (1991)]

[20] Despite this agreement a short-lived ban on tourism and imports of Peruvian products was imposed by Ecuador when the first case of cholera occurred in that country (February 28, 1991).

Table 18 shows that in 1991 there was a significant increase in the price of fish meal exports.[21] The fish catch between the months of January and March of 1990 and 1991 declined by 6 percent. But this is explained by enforcement of stricter controls on anchovy fishing. The catch of sardines for fish meal increased substantially (IEU 1992).

Table 18

Total Exports, Fishmeal End Product Exports, and Tourism, 1988-1991

	1988	1989	1990	1991
Total Exports (millions of US$)	2701	3488	3276	(a) 2481
Fishmeal End Products	357.2	409.7	340	482
Prices (Index 1980 = 100)	192	163	135	174
% of Total Exports	13.2	11.7	10.3	
Tourism	448	382	275	197
% of Exports	16.6	10.9	8.4	
# of Visitors (000)	355.9			
Average Expenditure per visitor (US$)	1261			
Fishmeal Exports (TM)		116		
U.K.			2465	3108
Germ.			101.9	36.6
Tropical Fruits and Citrus				
Germ.		1.2	1.5	(b) 1

Sources: IMF (1992b); EIU (1992, 1992Q); IMF (1992a); Petrera (1992)

Tourism

The losses from tourism were estimated at U.S. $40 million per month,[22] and for 1991 at U.S. $180 million. Preliminary estimates to the end of 1991 suggest that overall tourism earnings may have declined by U.S. $77 million, or 28 percent. This decline could be attributed to several factors: an increase in terrorist activities, reduced tourist travel because of economic conditions in the more developed countries, a deterioration in the tourism infrastructure, extreme overvaluation of the domestic currency that has made Peru one of the most expensive countries of the region, and the cholera epidemic. In addition to these factors,

[21] Estimates of export losses were made by the Peruvian Association of Exporters (ADEX). Total losses amounted to US $12.9 million. Other losses not included are the additional costs of quality certificates estimated US $1 1 million (reported in Petrera, M (1992) table 17) These certificates may help boost the demand for some exports

[22] Cusco, Peru's main tourist center, was one of the last areas affected by the cholera epidemic The first case was reported in April 1991 Weather conditions and a decline in the flow of tourists even before the first reported case may explain the late arrival of the disease

the relatively rapid development of competing tourist centers in other countries of the region could explain the sharp decline of the tourism industry in the last few years.

Considering all these factors and the seasonal nature of the tourist industry, with peaks in the months of December-January and June-September, it is likely that the impact of the cholera epidemic has been marginal. It is assumed that no more than 20 percent of the decline in foreign exchange earnings, or US $15.4 million, can be attributed to the cholera epidemic. Terrorist activities, together with the decline in the competitiveness of the Peruvian tourist industry, seem to be the main factors explaining the overall declining trend observed since 1988. However, a more detailed analysis of these losses is necessary.

The estimate of US $15.4 million is lower than the estimate of U.S. $84.8 million derived from the assumption that close to 80 percent of the decline in foreign exchange earning can be attributed to the cholera epidemic (see Petrera, M. (1992)).

3.3.2 The Impact of Cholera on Domestic Production of Fish, Seafood, and Fresh Produce

Early in February 1991, two weeks after the outbreak of the epidemic, the MOH issued a warning about the risk of cholera from consuming fresh fruits, seafood, and uncooked fish (ceviche). At the same time, the mayor of Lima announced a ban on the sale of food by street vendors. On March 17, the Ministry of Fisheries declared that thousands of fisherman had lost their jobs because of the drastic reduction in the consumption of fresh fish.[23]

Contaminated seafood and raw vegetables irrigated with untreated sewage water from metropolitan areas were identified as the main sources of cholera. Warning against consuming these had a noticeable impact on demand during the first eight months of the epidemic. The production and prices of these products dropped, adversely affecting the incomes of small farmers and artisan fishermen, the main suppliers of these products. Unemployment among fishermen increased substantially during the months of February and March 1991, and intermediaries like the owners of seafood restaurants and street vendors also suffered.

The lack of recent data precludes reliable estimates of the impact of cholera on the domestic market for fresh fish, fresh produce, and food service activities. The only available estimates are a loss of US $17.8 million for fresh fish and US $9.1 million for sales of food by street vendors.[24] The first estimate was based on an estimated decline in consumption of 33.6 percent reported by the Ministry of Fisheries, which seems out of line with a decline of only 6 percent in the fish catch during the first six months of 1991. The methodology used to derive the reported losses of street vendors also needs to be examined. In a sense these

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[23] At the same time, it was announced that the production of fish meal had increased due to an increase in the demand from China and Italy. This is consistent with our estimates that the impact of cholera on exports of fishmeal has not been significant.

[24] Estimates developed by Petrera, M. (1992) p. 27-30.

estimates stand in for other losses due to reductions in consumption, possible increases in the price of other goods, and lost income. Counting all of these things can lead to double counting, and reliable data are not available to begin to disentangle these issues. Although these estimates may be exaggerated, they will be used in estimating the overall impact of the cholera epidemic.

3.4 The Overall Estimate of the Economic Impact of the Cholera Epidemic

The preliminary estimates of the overall economic impact of the cholera epidemic developed in this paper suggest that early estimates (presented in Table 7) have inflated losses. The total economic impact for 1991 (excluding the present value of mortality costs) amounts to $93.6 million, while if mortality costs are included it increases to $176.9 million. For the first three months of 1992 the direct and indirect costs of illness due to the epidemic are estimated at $23.7 million (the macroeconomic impact was not calculated for the 3 months of 1992 because of the lack of data). Thus, the total impact for 1991 and 1992 is estimated at $200 million (see Table 19 below).

Table 19

Economic Impact of the Cholera Epidemic (in Millions of U.S. Dollars)

	1991	Jan-Mar 1992	Total
Direct cost	$41.2	$11.9	$53.1
Indirect costs			
Morbidity	$2.0	$0.6	$2.6
Mortality	$82.7	$11.2	$93.9
Macroeconomic Impact			
Exports	$8.1		$8.1
Tourism	$15.4		$15.4
Domestic Production	$26.9		$26.9
Overall economic impact (excluding mortality costs)	$93.6	$12.5	$106.1
Total economic impact	$176.9	$23.7	$200

Chapter 4

CONCLUDING REMARKS

The objective of this paper has been to develop some initial estimates of the economic cost of the cholera epidemic in Peru. The methodology has been to apply the cost of illness methodology first developed by Rice in the 1960s, and then to apply it with the help of techniques described by Paul and Mauskopf in 1991. To these cost of illness estimates, we added some estimates of the direct impact on the economy of the cholera epidemic in 1991 and early 1992.

Although such estimates may legitimately be incorporated in the benefits that would potentially be derived from water and sanitation projects, several issues should be raised explicitly:

- Most investment in ameliorating or treating disease is not undertaken for purely economic investment or GNP enhancement purposes. Rather it is to lengthen life, extend hope, and reduce pain and suffering. In addition to raising productivity, water and sanitation projects can reduce painful disease and premature death—outputs with a value beyond increased productivity.
- Direct costs look like hard savings, but to count them in full one has to believe that if cholera had not come to Peru, for instance, that direct costs would have gone down by the total cost of the epidemic that we projected—a strong assumption.
- Other considerations include the difficulty in evaluating the impact of one of several shocks on a country that has been in the process of disintegration. The political and economic environment in which the cholera epidemic has played itself out have been so destabilized that it is very difficult to evaluate its impacts by trying to hold everything else constant.

In conclusion, while cost of illness analysis may yield interesting and useful estimates, the real strengths of the technique may be its ability to force an explicit examination of the underlying epidemiological and economic processes. As such, cost of illness analysis should be a technique used frequently in development economics and water and sanitation studies.

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ANNEX

Cholera Cases, Hospitalizations and Deaths

Table A.3.1

Accumulated Cholera Cases, Hospitalizations, and Deaths Nationwide Through Dec. 21, 1991

A	B	C	D	E	F	G	H	I
			Accumulated					
Country	Pop.1990(p) (millions)	Pop.1991(p) (millions)*	Cases	Hospitalizations	Deaths	Attack Rate	Hosp. Rate	Death Rate
Peru	21.6	22.0	301277	114352	2840	0.0137	0.3796	0.0094
Ecuador	10.6	10.9	44126	35471	672	0.0041	0.8039	0.0152
Colombia	33.0	33.7	11218	5136	202	0.0003	0.4578	0.0180
EUA (a)	248.8	245.8	24	11	0	0.0000	0.4583	0.0000
Brazil	150.4	153.7	913	561	20	0.0000	0.6145	0.0219
Chile	13.2	13.4	41	38	2	0.0000	0.9268	0.0488
Mexico	88.6	90.6	2605	836	34	0.0000	0.3209	0.0131
Guatemala	9.2	9.5	3530	1470	47	0.0004	0.4164	0.0133
El Salvador	5.3	5.3	921	478	34	0.0002	0.5190	0.0369
Bolivia	7.3	7.5	175	94	12	0.0000	0.5371	0.0686
Panama	2.4	2.5	1152	272	28	0.0005	0.2361	0.0243
Honduras	5.1	5.3	21	19	0	0.0000	0.9048	0.0000
Nicaragua	3.9	4.0	1	1	0	0.0000	1.0000	0.0000
Venezuela (b)	19.7	20.3	13	0	1	0.0000	0.0000	0.0769
Total:	619.0	627.5	366017	158739	3892	0.0014	0.5411	0.0247

(a) 16 cases related to trips to Latin America, 6 to trips to other regions, 2 of undetermined origin, under investigation.
(b) 8 cases imported from Colombia.

Source: Elaborated from PAHO (1991/4), World Bank (1991), IDB (1991).

Table A.3.2

Peru: Reported Cholera Cases by Calendar Weeks, January 1991 - March 1992

Year	Calendar Week	No.of Reported Cases	Cumulative No. of Cases
1991			
January	1	0	0
	2	0	0
	3	0	0
	4	299	299
February	5	1040	1339
	6	11462	12801
	7	16643	29444
	8	16344	45788
	9	15759	61547
March	10	20124	81671
	11	20393	102064
	12	20052	122116
	13	17324	139440
April	14	17347	156787
	15	13319	170106
	16	12239	182345
	17	9754	192099
	18	8776	200875
May	19	8365	209240
	20	8244	217484
	21	6888	224372
	22	5700	230072
June	23	6221	236293
	24	5007	241300
	25	4694	245994
	26	3897	249891
	27	3402	253293
July	28	2925	256218
	29	3149	259367
	30	2998	262365
	31	2675	265040
August	32	2680	267720
	33	2581	270301
	34	2702	273003
	35	2125	275128
September	36	2402	277530
	37	2580	280110
	38	2388	282498
	39	1695	284193
	40	2591	286784
October	41	2486	289270
	42	2374	291644
	43	2472	294116
	44	2480	296596
November	45	3557	300153
	46	2660	302813
	47	3462	306275
	48	3003	309278
December	49	3375	312653
	50	2660	315313
	51	3462	318775
	52	3003	321778
	53	3375	325153
1992			
January	54	3534	328687
	55	2698	331385
	56	3287	334672
	57	5773	340445
February	58	6852	347297
	59	7456	354753
	60	8894	363647
	61	8625	372272
	62	7585	379857
March	63	7728	387585
	64	6846	394431
	65	9341	403772
	66	9341	413113
	67	5176	418289

Cumulative to January, 1991: 340445
Cumulative to March, 1992: 418289

Table A.3.3

Cumulative Data: Cholera Cases, Hospitalizations, and Deaths

Dates (to end of month)	No. of Reported Cases (Cumulative)	No. of Hospitalized Cases (Cumulative)	% Hospitalized	% of Total Hospitalized Cases in 1991	No. of Deaths (Cumulative)	Death/Case Ratio	% of Deaths Reported in 1991
1991							
January	1041	265	25%	0%	15	1.44	1%
February	60283	16034	27%	13%	287	0.48	10%
March	135953	48845	36%	41%	1039	0.76	36%
April	186934	72298	39%	60%	1549	0.83	53%
May	216548	84603	39%	71%	2077	0.95	71%
June	223564	86954	39%	73%	2163	0.97	74%
November	331277	114352	38%	96%	2840	0.94	98%
December	322562	119523	37%	100%	2909	0.90	100%
1992							
March	415973	161327	39%		3237	0.78	

Source: Elaborated from Ministry of Health (1991), Ministry of Health (1991), Informes Epidemiologicos, Oficina General de Epidemiologia, Reyna and Zapata (1991), p. 107.

Table A.3.4

Epidemiological Data: Reported Number of Cases, Hospitalizations, Deaths, Number of Laboratory Tests Performed and Results

INSTITUTION	(a) DATE	NO. OF CASES	HOSP.	DEATHS	LAB TESTS TOTAL	% CASES TESTED	(+) V. CHOL.	(-) V. CHOL.	% POSITIVE
Hosp. TOTAL:	02/06-	3900	1360	10	1280	33%	792	488	62%
Arzobispo MALE:	05/08				550		373	177	68%
Loaiza FEMALE:					730		419	311	57%
Hosp. TOTAL:	02-05				210		130	80	62%
Almenara MALE:					133		82	51	62%
FEMALE:					77		48	29	62%
Hosp. Nacional Materno Infantil San Bartolome					104		47	57	45%
Hosp. Emergencias Pediatricas	02/10- 05/10	2204	705	5	263	13%	69	214	24%
Hosp. Militar Central					24		7	17	29%
Hosp. Central Sanidad Policia Nacional del Peru	02/06- 05				156		110	46	71%
Hosp. Maternidad de Lima	02/09- 04/24				67		24	43	36%
Hosp. Victor Larco Herrera	05/10				276		49	227	18%
Hosp. General 2 de mayo	05	3200			154	5%	72	82	47%
Hosp. de Apoyo Santa Rosa					350		175	175	50%
Hosp. de Huaral	01/05- 04/05				40		14	26	35%
Hosp. Sergio E. Bernales					600		500	100	83%
Hosp. de TOTAL:	02/21-				130		82	48	63%
Apoyo de MALE:	05				81		51	30	63%
Chancay FEMALE:					49		31	18	63%

Table A.3.4 (continued)
Epidemiological Data

INSTITUTION	(a) DATE	Number of Reported: CASES	HOSP.	DEATHS	LAB TESTS TOTAL	% CASES TESTED	(+) V. CHOL.	(-) V. CHOL.	% POSI-TIVE
Hosp. Apoyo Nat.-Inf. Jose Agurto-Tello-Chosica		1245							
Hosp. Emergencia Jose Casmuro Ulloa		650	(280)		57	9%	21	36	37%
Hosp. Nacional Edgardo Rebagliati		(200) (e)			531		271	260	51%
Municipalidad Villa el Salvador					524		441	83	84%
I.N.S.N.					524		441	83	84%
UDES Lima		7813	4021		1244	16%	890	354	72%
Hosp. Belen (Trujillo)(b)		150			136	91%	106	30	78%
TOTAL: (c)		19162			6690	35%	4241	2449	63%
TOTAL: (d)		17917			3154	18%	1950	1204	62%

(a) reference period
( ) average number of reported or hospitalized cases
(b) from Swerdlow (1991)
(c) total reported cases and laboratory tests
(d) only those reporting both number of cases and lab tests done

Source: Elaborated from INS (1991), Swerdlow (1991).

Drugs, Medicines and Supplies

Table A.4.1
Prices of Medicines and Supplies in Ecuador and Peru

Medicines and Supplies	Unit	(a) Ecuador Domestic Price	(b) Ecuador UNIPAC Price	(c) Peru Pharmacy Price	(d) Peru Instit. Price
ORS packets	packet	0.33	0.17	0.75	0.45
NaCl solution	liter				
Electrolitic solution	liter				
Ringer's Lactate solution	liter	3.21		1.06	0.64
Venoclisis kits (e)	kit	0.45		1.90	1.14
Tetracycline	500 mg.	0.16		0.73	0.44
Furazolidona	150 mg.			0.14	
Docycycline	100 mg.	0.21			

(a) based on domestic prices in Ecuador
(b) based on UNIPAC prices quoted for Ecuador
(c) based on pharmacy prices in Peru
(d) based on prices for Institutions in Peru, estimated at 60% of pharmacy prices
(e) we are not including the unit price of alitas or needles, 0.6 and 0.06 of U.S.$

file: pricegen

:ble A.4.2
-otocol and Costs for Treatment of Cholera Cases, According to Severity

Materials & Equipment	Units	Unit Cost(a)	Severe Adult (q)	Cost	Severe Child (q)	Cost	Mod. Adult (q)	Cost	Mod. Child (q)	Cost
I. Equipment:										
-venoclisis kits	kit	1.9	2	3.8	2	3.8				
-alitas	set	0.6	2	1.2	2	1.2				
-needles	unit	0.06	2	0.12	2	0.12				
-disposable syringe	unit	0.25	1	0.25	1	0.25				
-nasogastric tube #16	unit	0.71	(b)		(b)					
II. Materials:										
A.) Solutions:										
-NaCl	liter	3.12/l	2-6	18.72 (c)						
-Electrolitic					(d)0.8	2.50				
-Ringer's Lactate	liter	1.06/l	6	6.36						
B.) ORS										
-In-patient Use	packet	0.75/p	10	7.5	10	7.5	10	7.5	10	7.5
-Out-patient Use	packet	0.75/p	Plan B		Plan B					
C.) Antibiotics: (e)										
-Tetracycline (f)	500 mg	0.73	6000 mg	8.76						
-Furazolidona (g)	150 mg	0.14			150 mg.	0.14				
TOTAL: (h)				40.35		15.51		7.50		7.50
TOTAL: (i)				27.99		15.51		7.50		7.50
TOTAL: (j)				41.06		15.51		7.50		15.00
TOTAL: (k)				28.70		15.51		7.50		22.50

(a) market prices in Peru
(b) only for cases with severe vomiting
(c) based on use of 6 total liters of NaCl and Electrolitic solutions
(d) using averge weight of 10 kg for children less than 2 yrs. old
(e) medical discretion
(f) 500 mg; 4 times/day; for 3 days
(g) 5 mg/kg/day; for 3 days (ave. weight 10 kg.)
(h) using NaCl and Electro. solutions for adults
(i) using Ringer's Lactate solution for adults
(j) using NaCl and Electro. solution and nasogastric tube
(k) using Ringer's Lactate and nasogastric tube

Source: Elaborated from MINSA (1991, ESL/February 8, 1991).

Table A.4.4a

Cost of Medicines and Supplies in Peru Based on Various Scenarios

	Peru Jan.91-Dec.91		Peru Jan.92-Mar.92		Peru Jan.91-Jan.92	
Parameters:						
Number of Cases	322562	322562	93411	93411	351537	351537
Attack Rates	0.015	0.015	0.004	0.004	0.016	0.016
Hosp. Rates	0.37	0.37	0.45	0.45	0.38	0.38
Unit Prices	Pharmacy (a)	Instit. (b)	Pharmacy (a)	Instit. (b)	Pharmacy (a)	Instit. (b)
Total Costs:(US$)						
ORS packets	7257645	4354587	2101748	1261049	7909583	4745750
Ringer's Lactate	1140249	684149	398810	239286	1274392	764635
Venoclisis kits	681281	408769	238283	142970	761429	456857
Tetracycline	25430787	15258472	7364523	4418714	27715178	16629107
TOTAL:	34509962	20705977	10103364	6062018	37660582	22596349
UNIT COST/CASE:	107	64	108	65	107	64

(a) based on pharmacy prices in Peru
(b) based on prices for Institutions in Peru, estimated at 60% of pharmacy prices

Table A.4.4b

Cost of Medicines and Supplies in Peru Based on Various Scenarios

	Peru (a) Jan.91-Dec.91		Peru (a) Jan.92-Mar.92		Peru (a) Jan.91-Jan.92	
Parameters:						
Number of Cases	322562	322562	93411	93411	351537	351537
Attack Rates	0.015	0.015	0.004	0.004	0.016	0.016
Hosp. Rates	0.37	0.37	0.45	0.45	0.38	0.38
Unit Prices	Domestic (b)	UNIPAC (c)	Domestic (b)	UNIPAC (c)	Domestic (b)	UNIPAC (c)
Total Costs:(US$)						
ORS packets	3193364	1645066	924769	476396	3480216	1792839
Ringer's Lactate	3453019	3453019	1207718	1207718	3859244	3859244
Venoclisis kits	161356	161356	56435	56435	180338	180338
Tetracycline	5633094	5633094	1631292	1631292	6139102	6139102
Doxycycline	1889891	1889891	547295	547295	2059655	2059655
TOTAL: (d)	12440833	10892535	3820214	3371841	13658900	11971523
TOTAL: (e)	8697630	7149332	2736217	2287844	9579453	7892076
UNIT COST/CASE:(f)	39	34	41	36	39	34
UNIT COST/CASE:(g)	27	22	29	24	27	22

(a) using number of cases, attack rates, hosp. rates from Peru and unit prices from Ecuador
(b) based on domestic prices in Ecuador
(c) based on UNIPAC prices quoted for Ecuador
(d) using tetracycline
(e) using doxycycline
(f) using tetracycline
(e) using doxycycline

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Table A.4.5

COSTS OF MEDICAL EQUIPMENT AND SUPPLIES FOR TREATMENT OF CHOLERA CASES
FROM JANUARY 1991 THROUGH DECEMBER 1991
PRICES FROM PHARMACIES IN PERU

ESTIMATION OF ORS NEEDED AND COSTS (a)

Attack rate	0.015
Hospitalized patients	10
Outpatients	10
Community distribution	10

A	B	C	D	E	F	G	H	I	J	K
	POPULATION(b)	No. of cases Bx0.015	Packets hosp.+out Cx10	Community distrib. Cx10	Total packets D+E	Reserve inventory Fx0.2	Losses Fx0.3	TOTAL PACKETS F+G+H	TOTAL COST(c) Ix0.75	
TOTAL	21677100	322562	3225620	3225620	6451240	1290248	1935372	9676860	7257645	

ESTIMATION OF RINGER-LACTATE/1.000 ml SOLUTION NEEDED

Attack rate	0.01488
Hospitalization rate	0.370543
Liters (l) Ringer-lactate	61

A	B	C	D	E	F	G	H	I
	POPULATION(b)	No. of cases Bx0.01488	Hosp. cases Cx0.3705	Liters of solution Dx6	Reserve inventory Ex0.2	Losses Ex0.3	TOTAL LITERS E+F+G	TOTAL(c) COST Hx1.06
TOTAL	21677100	322562	119523	717138	143428	215141	1075707	1140249

ESTIMATION OF VENOCLISIS KITS USING NEEDLE #18 NEEDED

Attack rate	0.01488
Hospitalized patients (%)	0.370543
No. of Sets	2 per patient (or 2 for 6 l)

A	B	C	D	E	F	G	H	I
	POPULATION(b)	No. of cases Bx0.0148	Hosp. cases Cx0.37054	No. of Kits Dx2	Reserve inventory Ex0.2	Losses Ex0.3	TOTAL KITS E+F+G	TOTAL(c) COST Hx1.9
TOTAL	21677100	322562	119523	239046	47809	71714	358569	681281

COSTS OF MEDICAL EQUIPMENT AND SUPPLIES FOR TREATMENT OF CHOLERA CASES
FROM JANUARY 1991 THROUGH DECEMBER 1991
PRICES FROM PHARMACIES IN PERU (continued)

ESTIMATION OF TETRACYCLINE NEEDED (d)	
Attack rate	0.01488
Patients (hosp. and out)	12 tab.x 500 mg
Contacts (5)	60 tab.x 500 mg

A	B	C	D	E	F	G	H	I	J
	POPULATION(b)	No. of cases Bx0.0148	No. of contacts Cx5	No. of pat+cont C+D	No. of Tab.500mg Ex12	Reserve inventory Fx0.2	Losses Fx0.3	TOTAL Tetra 500m F+G+H	TOTAL(c) COST Ix0.73
TOTAL	21677100	322562	1612810	1935372	23224463	4644893	6967339	34836695	25430787

TABLE OF CONSOLIDATED DATA (based on use of Tetracycline) pharmacy prices										
A	B	C	D	E	F	G	H	I	J	K
RATE	% HOSP.	TOTAL PACKETS	COSTS (c)	LITERS RINGER	COST (c)	TOTAL KITS	COST (c)	TOTAL TETRA-500m	COST (c)	TOTAL COST
0.014880311	0.370542717	9676860	7257645	1075707	1140249	358569	681281	34836695	25430787	34509962

(a) Estimates for the number of ORS packets needed is determined by the attack rate only, not on the percentage of hospitalized or ambulatory patients, even though both groups receive 10 packets each.
(b) for population data, see Table ()
(c) local price in U S.$
(f) The estimated number of tablets of tetracycline or doxycycline needed is determined only by the attack rate and the number of contacts estimated to be treated by chemophrophylaxis.

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Notes on Table A.4.5

Methodological Notes on Estimating Costs of Medicines and Supplies in Peru using PAHO Computer Program

Cost estimates for medicines and supplies in Peru were calculated using a computer model developed by PAHO for the National Commission for the Prevention and Control of Cholera, Buenos Aires, Argentina, in December 1991. This model uses Quatro Pro to generate columns and tables which estimate the amount of medicine and supplies needed according to the size of the population, the attack rate, and hospitalization rate. Costs are calculated according to unit prices for medicines and supplies.

The computer model assumes a standard treatment plan for ambulatory and hospitalized patients and their contacts, and the use of either Tetracycline or Doxycycline. It uses a fixed rate of 20% for reserve inventory and 30% to cover losses. Variables which can be adjusted are the population, attack rate, hospitalization rate, and costs per unit doses for each medicine or supply.

Assumptions are made for each type of medicine or supply. The total number of ORS packets includes 10 packets for hospitalized patients, outpatients, and for community distribution per cholera case. Six liters of Ringer's Lactate solution are estimated per case. Two venoclysis kits are needed per patient, or two for every 6 liters of Ringer's Lactate solution. The dosage of Tetracycline is a total of 12 tablets of 500 mg. each, and treatment of 5 contacts per patient is assumed. The dosage of Doxycycline is a total of 3 tablets of 100 mg. each, and treatment of 5 contacts per patient is also assumed.

The program calculates costs based on unit prices. In the case of Ecuador (which is the basis of the computer model), comparisons can be made between using ORS produced locally, or imported (CIF-UNIPAK). Number of cases, attack rates, and hospitalization rates for Peru were used together with prices given for Ecuador to produce hypothetical estimates of the costs of medicines and supplies using this data. Estimates of the cost of medicines and supplies for Peru are based on number of cases, attack rates, and hospitalization rates for Peru based on price information from Peru.

Source: Santich, I. (1991).

ble A.4.6

sts of Cholera Cases (Outpatient and Hospitals) at Different Institutions

	OUTPATIENT			HOSPITALIZATION			
nstitution	Consult	Drugs (ORS)	Total Cost	Hosp. Cost/Day	(Days)	Drugs & Supplies	Total Cost
Estimated Costs by Levels:							
Level I:							
Hosp. Almenara	10.00	8.16	18.16	54.00	4	84.00	300
Hosp. Rebagliati	10.00	8.16	18.16	54.00	4	84.00	300
MOH Hospitals				?	3		
Level II:	4.25	8.16	12.41	20.00	4		
Level III:				38.00	4	84.00	236
(Regional Hospitals)							
Polyclinic	6.00	8.16	14.16				
	3.00	8.16	11.16				
Clinic San Felipe				88.50			
Clinic San Vicente				20.00			
Clinic Santa Cecelia				20.00			
Clinic Melgar				70.00			

Source: Personal communication, Petrera (1992)

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Table A.4.8

Unit Cost per Treatment: Summary of Available Estimates

	Our Estimates	Petrera (19: MOH	IPSS (a)	PAHO (1991) : MOH
Ambulatory	11.1	12	14	18
Hospitalization				
-Standard IV	150	159	198	167
-IRA Complications	450	na (b)	na (b)	na (b)
-IRA & Hemodialisis	767	na (b)	na (b)	na (b)

(a) IPSS is the Social Security Institute of Peru
(b) information not available

Sources: Table A.4.7; Petrera (1992), Table 28; PAHO (1991)

Table A.4.9

Indirect Costs Estimates: Days of Productive Life Lost and Average Productivity per Day

Estimation Parameters:	1990	1991
GDP (current prices) (thousands of new soles)	6799.0	38101.0
Exchange Rate	187.9	772.5
GPD (in billions of US$)	36.2	49.3
Population	22.3	22.8
Per Capita GDP (in US$)	1622.6	2162.0
EAP % of Population	31.8	31.8
Total EAP	7.1	7.3
Productivity per EAP (actual) (in thousands of US$)	5.1	6.8
Daily Productivity (in US$) @ 300 days per annum)	17.0	22.7
Productivity EAP per age group	11	14.1
Equivalent person-year loss	3169	4222.8
Life Expectancy	65	65.0
Average Age of EAP Deaths		36.0
Yearly loss per death case, 1991		29.0
Productivity Life time Loss; (Growth 1% p.a.)		146896.6
Net P.V of Losses (at r: 3% p.a.)		93899.3
Total Present Value of Losses due to 1991 deaths (millions of U.S.$)		167.1

Severity of Cases	Age Groups: Composition (%)	Total Cases	[15 to 54] (E.A.P) a/ 61.2	Estimated Average No. Days of Disability (per case)	Estimated Total Days Disability 1991	Total Person-Year Equivalent Losses b/	Total Losses (Daily Loss of US$ $14.00)
Total Cases 1991		322,562	197,408		782,430	2,608	11.0
Severity Composition:	100.0						
Ambulatory	62.0	199,988	122,393	1	122,393	408	1.7
						0	0.0
Hospitalizations	38.0	122,574	75,015		344,082	1,147	4.8
Standard IV	33.9	109,349	66,921	4	267,685	892	3.7
ARI Complications	4.1	13,225	8,094	7	56,656	189	0.8
ARI & Hemodialisis	1.0	3,226	1,974	10	19,741	66	0.3
							0.0
Deaths	0.9	2,909	1,780	178	315,955	1,053	4.4

a/ E.A.P : Economic Active Population
b/ A total of 25 working days per month has been used for the estimations.

Sources: IMF (1992), UNDP (1991)

Camp Dresser & McKee International Inc.
Associates in Rural Development, Inc.
International Science and Technology Institute
Research Triangle Institute
University Research Corporation
Training Resources Group
University of North Carolina at Chapel Hill

WASH Operations Center
1611 N. Kent St., Room 1001
Arlington, VA 22209-2111
Phone: (703) 243-8200
Fax: (703) 243-9004
Telex: WUI 64552
Cable Address: WASHAID

THE WASH PROJECT

With the launching of the United Nations International Drinking Water Supply and Sanitation Decade in 1979, the United States Agency for International Development (A.I D) decided to augment and streamline its technical assistance capability in water and sanitation and, in 1980, funded the Water and Sanitation for Health Project (WASH). The funding mechanism was a multi-year, multi-million dollar contract, secured through competitive bidding. The first WASH contract was awarded to a consortium of organizations headed by Camp Dresser & McKee International Inc. (CDM), an international consulting firm specializing in environmental engineering services Through two other bid proceedings since then, CDM has continued as the prime contractor.

Working under the close direction of A.I D.'s Bureau for Science and Technology, Office of Health, the WASH Project provides technical assistance to A I.D. missions or bureaus, other U.S. agencies (such as the Peace Corps), host governments, and non-governmental organizations to provide a wide range of technical assistance that includes the design, implementation, and evaluation of water and sanitation projects, to troubleshoot on-going projects, and to assist in disaster relief operations. WASH technical assistance is multi-disciplinary, drawing on experts in public health, training, financing, epidemiology, anthropology, management, engineering, community organization, environmental protection, and other subspecialties.

The WASH Information Center serves as a clearinghouse in water and sanitation, providing networking on guinea worm disease, rainwater harvesting, and peri-urban issues as well as technical information backstopping for most WASH assignments.

The WASH Project issues about thirty or forty reports a year. WASH *Field Reports* relate to specific assignments in specific countries; they articulate the findings of the consultancy. The more widely applicable *Technical Reports* consist of guidelines or "how-to" manuals on topics such as pump selection, detailed training workshop designs, and state-of-the-art information on finance, community organization, and many other topics of vital interest to the water and sanitation sector. In addition, WASH occasionally publishes special reports to synthesize the lessons it has learned from its wide field experience

For more information about the WASH Project or to request a WASH report; contact the WASH Operations Center at the above address.