THE COST OF HOSPITAL CHOLERA TREATMENT IN ECUADOR

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Number of tables and figures: 4

Keywords: cholera, Ecuador, treatment costs

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ABSTRACT

Objective: Analyze the efficiency of cholera treatment in three hospitals, representative of the Ecuadorian public health system. Method: Calculate total and excess cholera treatment costs through hospital files and statistics and an intrahospital surveillance system of the cholera cases, which allowed to know the type and quantity of each input used for each treatment as well as the hospitalization days according to the level of severity. In this way, it was possible to determine the excess costs in relation to the treatment norm incurred for each patient in terms of inputs and hospital stay. Results: 45% of cholera treatment costs were excessive. The most important contributor to these excess costs was excess recurrent costs (90%), while excess capital costs represented 10%. The principal causes of this waste of resources were extended hospital stays, disproportionate use of intravenous rehydration solutions, and unnecessary laboratory exams. No significant relationship was found between treatment costs and the severity of the illness, nor between costs and a patient's age. A patient's sex appeared to be an important variable, with the cost of treating women being notably higher than for men. An inverse relationship, albeit with variations, was found to exist between treatment costs and the complexity of the hospital. Conclusion: There is an inefficient use of resources in the treatment of cholera in the hospitals in which the research was carried out.

1. Introduction

The Latin American cholera epidemic spread rapidly in Ecuador after its arrival in 1991. In this first year the number of cases totaled 46,284, with another 31,870 registered in 1992. After this there was a sustained fall, with only 6,833 cases in 1993, although there have been subsequent outbreaks, especially in the first half of 1995 (1, 2, 3). Cholera treatment in the country has been principally carried out within hospitals: in 1991, 81% of registered cholera patients were hospitalized; with the figures for 1992, 1993 and the first six months of 1994 being 89%, 80% and 69% respectively (1). Nevertheless, experiences in other countries show that a significant proportion of cholera cases can be successfully treated as out-patients or in community rehydration centers (4).

In Ecuador there have been very few cost studies in the health sector. Of those that exist, it is perhaps worth mentioning the work of Robertson *et al* (5), in which the costs of several important services in the system managed by the Ministry of Public Health were found to be considerably lower than those in the Rural Social Security Program. Shephard *et al* (6) compared, using cost-efficacy analysis, the national mass vaccination programs with the ordinary vaccination services offered by the public health system. With regard to cholera, in Ecuador no research into the cost of the epidemic has been carried out. An exploratory study in Ecuador calculated the treatment costs in two Sierra hospitals during the height of the epidemic (2,459 cases in Ibarra and Otavalo), giving a total of approximately US$ 65,000 (7). These figures suggest that, taking the nation as a whole, cholera treatment during the epidemic would have constituted a significant item in the Public Health Ministry (MSP) budget. This conclusion is particularly worrying if one takes into account the fact that public health expenditure has fallen in recent years, not only as a percentage of the national budget, but also in absolute terms. This reduction has been of the order of 54% since 1992 until 1994 (8, 9).

The little research done on cholera treatment in Ecuador reveals that intravenous rehydration is far more widely used than oral rehydration therapy (ORT), and that hospital stays are often unnecessarily long (7, 10, 11). This, in turn, has raised treatment costs. Similar results have been found in other Latin American countries (12, 13). Equally, in several developing countries it has been found that ORT is both highly effective

and can significantly reduce treatment costs. Examples include a WHO study in Lesotho (14), and research in carried out in India (15, 16).

2. Methodology

The principal objective of the present study was to calculate the level of total and excess cholera treatment costs in selected Ecuadorian Public Health Ministry hospitals. Once the excess costs had been identified, their determinant factors were investigated. These excess costs were calculated by subtracting the "ideal" treatment cost - based on a preestablished treatment norm determined for each case - from the total cost. Given that it was possible that conditions specific to each hospital could lead to higher costs, regardless of whether the norm was strictly applied, the project also sought to analyze the underlying cost structures in each unit and their effect on the cost of cholera treatment.

During the period of field research, the project team sought to answer the following questions:

1. Are cholera treatment costs in MSP hospitals significantly excessive when compared to an ideal treatment based on a diagnosis of the degree of dehydration of each patient?
2. If treatment costs are found to be excessive, is overuse of intravenous rehydration therapy a significant determinant of these excess costs?
3. Do treatment costs vary proportionately with the severity of each case?
4. Does the variation in treatment costs bear any relationship to the complexity of the hospital into which a patient is admitted?
5. Do a patient's sex and/or age affect cholera treatment costs?

Considering the fact that all the patients in the study left hospital fully cured, it can be assumed that oral and intravenous rehydration therapy are equally effective. This renders a cost-effectiveness analysis redundant - treatment effectiveness in all cases is the same - such that the analysis effectively becomes one of cost-minimization. The research presented here centered on the analysis of the capital and recurrent costs incurred in each type of treatment - oral (ORT) and intravenous (IV) - taking into account the severity of each case (mild, moderate and severe), the complexity of the hospitals, and the age and sex of the patients.

The study population was made up of patients who were admitted to hospital with a cholera diagnosis. Criteria for exclusion included the presence of blood in feces, fever and any other associated acute or chronic illness. Patients below the age of five were also excluded because they were thought to run greater risk of complications; hence the result of this research can not be directly extrapolated to the whole population. The population was grouped in the following way: 5 - 19 years, 20 - 39 years, 40 - 59 years and equal or more than 60 years.

The choice of the hospitals to be included in the study was based on three criteria:

a) location in a zone of high cholera incidence during the research period;

b) previous admission of large numbers of cholera patients;

c) differing levels of complexity.

This last characteristic enabled the results of the study to be extrapolated tentatively to other similar hospitals in the public health system. The following hospitals were selected: the "Dr. José Daniel Rodríguez Maridueña" Infectious Diseases Hospital in Guayaquil, a specialized national reference hospital with 107 beds; the Chimborazo Polyclinic Hospital in Riobamba, a provincial level hospital with 173 beds, which from the onset of the epidemic, received a large number of the cases in the central Sierra; and the “León Becerra" Hospital in Milagro, a primary-level canton hospital with 74 beds which, at the beginning of the study, had received the greatest number of cases nationally for a hospital of its complexity (17).

For the purpose of the analysis, costs were divided into recurrent and capital costs (see appendix 1). Recurrent costs included:

i) the costs of medicines (including antibiotics and other medication) and rehydration salts (oral and parenteral), the equipment used for their administration, and laboratory tests;

ii) personnel and administration costs: wages, salaries and social benefits, food, cleaning, electricity, fuel and water; and other administrative costs.

Capital costs were determined on the basis of the present value of hospital buildings, land and medical and other equipment.

It is worth remembering at this point that the research concentrated on the factors that affected the efficiency of intra-hospital cholera treatment from the point of the view of the providers of the service, in this

case the MSP and the hospitals. For this reason, other costs caused by the disease, such as lost incomes, reduced productivity and effects on patients' families, or other savings generated by treating patients out of hospital, while undoubtedly important, are not taken into account.

An essential element of the analysis was the definition of a treatment norm, in particular for the initial rehydration requirement and for the prescription of antibiotics, in order to be able to specify an "ideal treatment" and the required hospital stay for each patient. This norm was based on criteria established by Barua and Greenough III (4) and the guidelines laid down by the World and Pan-American Health Organizations (18).

Evaluation of the initial rehydration requirement was based on an assessment made by the research team of each patient's degree of dehydration at the moment of admission. The maintenance rehydration requirement was not estimated given the difficulty in ensuring an accurate monitoring of the ingestion and elimination of liquids. For this reason, the total volume of liquids administered to each patient was assumed to be correct and only the need for ORT or IV treatment was assessed. Additionally the appropriate length of hospital stay was calculated on the basis of the treatment norm, estimating the values of necessary variables from a patient's clinical history.

During three months (April – June 1994), an intrahospital surveillance system of the cholera cases was implemented in the selected hospitals, which allowed to know the type and quantity of each input used for each treatment as well as the hospitalization days according to the level of severity. Nurses hired by the project and trained by members of the research team collected this information. An instruction manual was also prepared and distributed to the nurses. Prior to the data-collection itself, the survey and its application by the nurses were subjected to a dry run and any problems that arose were corrected. In this way, it was possible to determine the excess costs in relation to the treatment norm incurred for each patient in terms of inputs and hospital stay (see appendix 2).

The costs of medicines and rehydration inputs were calculated by multiplying the average price of each item - in three pharmacies and laboratories in the area, including those in the hospitals themselves - by the quantity used. The information on the recurrent costs in the personnel and administrative category was obtained from MSP and hospital files and interviews with key staff in each institution.

The capital cost imputable to land and buildings was based on data from municipal property valuation departments, while the cost of hospital equipment was calculated from information in hospital inventories, balance sheets and receipts for purchases (19). Calculations were made on the basis of the percentage of the hospital area occupied by cholera patients. The percentage of general services (administration, food, cleaning services, electricity, water and fuel) attributable to these areas was calculated according to the ratio of cholera patient-days to the total number of patient-days for the hospital during the study period. This proportion, multiplied by the total cost for each item and then divided by the number of cholera patient-days, gave the personnel, administration and capital costs per cholera patient-day. The results are presented in terms of excess costs and the ratio of excess to total costs for each cost category.

On the basis of these values, multiple regression analyses using dummy variables were run in order to identify correlations between the independent variables (severity of the illness, hospital type, sex and age) and the results of the fieldwork (excess total, capital and recurrent costs and excess use of oral and intravenous rehydration salts). The results of the regressions showed that there was no significant relationship between excess treatment costs and the age or severity of patient's illness. The relationship between hospital type and a patient's sex was not included because its regression coefficients were not statistically significant.

Further details on the calculation of recurrent and capital costs and estimation of correct cholera treatment is available on request.

3. Results

Table 1 shows that, on average, 45% of the observed cholera treatment costs in the three hospitals studied can be considered excessive. Of the average treatment cost of US$ 101.62 per patient, excess costs totaled US$ 45.50 (US$1 = 2,200 sucres). The most important contributor to these excess costs was personnel and administration costs (61%), which corroborates the results found in various studies of immunization programs in other countries, and the treatment of diarrheal diseases (20, 21, 22). However, the individual cost category with the highest ratio of excess to total costs was laboratory tests and medical supplies (53%). Within this category, 63% of the total spent on intravenous rehydration salts was excessive.

This suggests that intravenous rehydration therapy requires greater use of equipment and other supplies than oral therapy (Tables 1 and 2). Correspondingly the observed expenditure of oral rehydration salts was lower than would have been the case if the treatment norm had been adhered to.

TABLES 1 AND 2

With respect to the severity of the case being treated, in the three categories (mild, moderate and severe), excessive use of intravenous rehydration salts accounts for between 60% and 69% of the excess expenditure on lab tests and medical supplies (Table 2), while of the total excess costs in each group, recurrent expenditure takes up between 87% and 91% and capital costs accounts for between 9% and 13% (Table 1). No significant differences were found between total treatment costs for cases of differing severity. It is worth pointing out that, in absolute terms, the group with the highest excess costs was that of moderate cases (US$ 50.6), followed by the mild (US$ 43.50) and, finally, the severe patients (US$ 35.80).

An inverse relationship was found to exist between hospital complexity and average total, recurrent, and capital costs. The excess costs occurred in the treatment of the average patient in the least complex hospital, in Milagro, totaled US$ 63.6, while in Riobamba this value was reduced to US$ 52 and in the most complex hospital, in Guayaquil, excess treatment costs were “only” US $36 (Table 1). The ratio personnel to patient-day was greater in the more complex hospitals, due to the higher proportion of specialized staff in these institutions (Table 3). In the case of the administration of intravenous rehydration salts no clear pattern emerged: the percentage of excess costs in the total spent was 86% in Milagro, 72% in Guayaquil, and 40 % in Riobamba (Table 2).

TABLE 3

The differences in costs related to a patient’s sex are evident in the average treatment cost, which is US$ 117.40 for women (50% excessive), while for men it is US$ 86.90 (38%). There is little difference between the two groups in terms of expenditures on laboratory tests and medical supplies, but for capital,

and personnel and administration, the excess-to-total cost ratios are 49% in both categories for women patients and 35% and 33% for men (Table 1). These variations are largely a result of the longer time spent in hospital by women patients, whose average stay was more than double that of men, although there was no significant difference between the groups in terms of the distribution of cases by severity (Table 3).

The population shows an U curve for total average excess costs: the group between 5 and 19 years has an average total excess costs of US $ 59; these costs are reduced to US $ 40 and to US $ 45 for the group between 20 and 39 years and for the group between 40 and 59 years respectively; these costs increase to US $ 53 for the group equal or above 60 years.

The variance analysis showed the following differences between the hospitals to be statistically significant: the least complex hospital, in Milagro, has significantly higher excess capital, recurrent, intravenous rehydration salts and total costs than the more complex hospital in Guayaquil (p-value 0.00, 0.02, 0.05 and 0.01 respectively). Similarly, the excess capital costs and intravenous and oral rehydration salt costs in Riobamba are significantly higher than in Guayaquil (p-value 0.00, 0.03 and 0.00 respectively). Finally, the excess capital, recurrent and total costs (p-value is 0.00 in all cases) of treating women are significantly higher than for men (Table 4).

TABLE 4

4. Discussion

The results show that the overuse of intravenous rehydration is an important source of inefficiency, occasioning much higher treatment costs than oral methods. All the patients with vomiting among their symptoms were given intravenous treatment, but the switch to oral therapy was never made soon enough, just one example of a clear pattern of indiscriminate use of intravenous rehydration therapy, regardless of the severity of the disease. This could be due to:

?? the absence of clear, adequately disseminated treatment norms coupled with poor diagnoses, leading to excess demand for laboratory tests and over-cautious treatment. This is aggravated by the lack of supervision and well-defined communications channels, both within hospitals and between hospitals and

the Ministry of Health. In the case of cholera, the ministry prepared and distributed a treatment manual, yet when asked, many hospital staff members responded that they were unaware of it;

?? the little training given to junior residents, who are largely responsible for attending to cholera patients. Senior doctors, on the other hand, tend to eschew the treatment of "less prestigious" ailments. During the early stages of the epidemic in 1991, nurses and auxiliary staff were given training, while many doctors in the hospitals most affected did not attend the programs, giving as reasons their lack of time and the little status afforded by receiving basic training (11).

According to the norm, treatment of mild cases should be cheaper than the treatment of more severe patients. Nevertheless, the results of this research show that excess costs are highest in the case of the moderate patients, followed by the mild cases and, finally, the most severe cases. This would appear to suggest that all the patients attended were treated similarly, regardless of the severity of their illness as indicated by their symptoms.

The inverse relationship between hospital complexity and excess treatment costs, however, could be the result of the more qualified staff working in the more specialized hospitals, which in turn contributes to a more efficient use of resources (Tables 1 and 4). This would be enhanced by their greater cholera treatment demand.

The high excess to total cost ratio in the personnel and administration category in the least complex Milagro hospital is possibly due to the low staff-patient ratio in comparison with the other hospitals (Table 3), while the high "land, buildings and equipment costs" per patient day of US$ 6.20 (against US$ 2.30 in Guayaquil and US $3.00 in Riobamba) are, at least in part, the result of the remodeling carried out in Milagro during the last five years (23). Thus it could be argued that the Milagro hospital suffers from lower occupancy rates or excess capacity, in terms of staff and installations, which results in excess treatment costs. For this reason, in the future it will be important to analyze carefully the value of expanding the canton-level hospitals if patients can be more efficiently treated in the larger hospitals where economies of scale can be achieved, thereby reducing costs and increasing efficiency.

In the case of Riobamba, the greater proportion of severe cases received by the hospital (45%), coupled with the previously noted tendency to treat all patients similarly, regardless of their severity, at least partly explains its relatively lower excess expenditure on laboratory tests and medical supplies, especially intravenous rehydration salts (Table 2); although in absolute terms the excess days of hospitalization are higher than in the other hospitals (Table 3). This suggests that, in spite of having a greater proportion of severe cases, the hospital was more efficient than the hospitals in Guayaquil and Milagro, in terms of the degree of excess use of intravenous rehydration therapy; although the lack of discrimination between patients on the basis of the severity of their illness meant that having more severe patients reduced the effects of this distortion.

The Guayaquil hospital, the busiest and most complex in the sample, had the lowest recurrent, capital and total costs (Table 1). Although its excess to observed cost ratio was lower than in Milagro, it had a higher per-patient expenditure on IV therapy (Table 2) which, in view of the fact that it received a particularly large number of cholera patients, would have made a significant contribution to the hospital's overall costs. This would be especially worrying if there were a new epidemic, since the Hospital Infectológico would be the major recipient of cases in the Guayaquil region.

The high level of excess costs incurred in cholera treatment in all three of the hospitals studied raises the question as to the reasons why trained medical staff prescribe treatments that are inefficient and often not recommended for cholera patients. One important factor would appear to be the fact that MSP hospital budgets are established on the basis of the previous year's occupancy rate (the ratio of occupied bed-days to total available bed-days). This provides an incentive to hospitalize patients unnecessarily, and extend a patient's stay once admitted, so as to raise the occupancy rate. Additionally, hospitals have been known to close wards with the same aim of securing more funds in the subsequent year's budget. In this regard it is worth underlining the fact that the hospitals could have saved money in two ways: by administering the correct treatment, and by avoiding unnecessary and overlong periods of hospitalization. An example of these savings can be found in the Babahoyo provincial hospital where, through the implementation of a management system based on continuous improvement in patient care, the costs of cholera treatment have been significantly reduced (11). Another possible solution would be to be adopt the

budget system found in many countries, where funds are assigned on the basis of the income and specific diagnosis of each patient, such that hospitals receive more funding the greater the number of patients treated, thus providing a disincentive to prolonging hospital stays and opting for unnecessary and expensive treatments

In general, it can be said that if the US Institute of Medicine cholera treatment guidelines were observed (24), 29% of the total excess costs corresponding to medical supplies and exams would be automatically reduced. The reduction of the rest of the excess costs (personnel, administration and capital costs) would require measures other than the correct application of treatment guidelines, such as the elimination of excess hospital beds and staff.

The higher treatment costs observed amongst women patients is related to their longer periods of stay in hospital - excess periods of hospitalization more than double those of men - which directly raises the capital and personnel and administration costs of their treatment (Table 1). Although the treatment norm specified a slightly longer treatment period for women, this is not enough to explain the differences found. Nor do differences in the severity of the cases account for the variation since the majority of the female patients were among the mild cases (Table 3).

The little influence of a patient's age on excess costs is not surprising when one takes into account that around 70% of the sample population were in the 20-59 age range, and that children under five were excluded from the study. Both the very young and the old would have been more likely to suffer complications. The exclusion of the former contributed to select a more homogenous population, and to reduce the potential impact of the "U" curve observed in the excess average total costs of the different population groups on the results.

The results of this study could, with due caution about the homogeneity of the treatment facilities in the Ecuadorian public health system, be extrapolated to other similar hospitals. Nevertheless, to corroborate the results found here and have a larger sample from which to extrapolate, further research is required in which the methodology is varied with the focus of the study. This research analyzed treatment costs from the perspective of each individual hospital, specifically highlighting the impact of different factors in the generation of excess treatment costs, in order to provide hospital directors and administrators and health

service policy-makers with the information necessary for planning responses to future epidemics and to reduce the costs of cholera treatment in general. If, for example, the objective was to identify priorities for cost reductions in the public health system as a whole, it would be necessary to analyze the real demand for health-care, focusing investment in those areas where demand is highest and where economies of scale can be achieved.

The research did not attempt to predict the excess costs of cholera treatment or project them on a nationwide basis: this would require a different research methodology with factors not considered in the present analysis. Likewise, no attempt was made to estimate the social cost of the cholera epidemic, for which information on the real or imputed income foregone by each patient and the opportunity costs of their treatment would have been necessary.

Finally, it is worth mentioning that a new cholera strain has been identified (*Vibrio cholerae* 0139) in Bangladesh and other parts of South Asia, to which immunity is not acquired through previous exposure to the disease (25). If this strain were to arrive in Latin America, the resultant epidemic could be as serious as the one studied in the research reported here. For this reason, and to prevent a severe drain on the resources of the Ecuadorian health system, it is vital that training programs be developed for medical staff in which diagnostic and prescription procedures are strengthened and the relative efficiency of different treatments are taken into account. Emphasis should also be put on the use of oral rehydration whenever possible. As part of this process, hospital communication and information systems need to be improved so that policies and procedures can be monitored and evaluated and treatment norms adequately disseminated, following recommendations formulated by the US Institute of Medicine to increase treatment effectiveness (24).

Acknowledgements

Financial support for this research was provided by the Harvard University Project for Applied Research into Diarrheal Diseases, by way of a Cooperation Agreement sponsored by the United States Agency for International Development.

The authors are also grateful for the comments and technical suggestions provided by four anonymous referees, Robert Robertson, John Rapoport, Robert Gilman, Carlos Campillo, Davidson Hamer and James Trostle, the last of whom also helped the research through the Harvard Institute for International Development (HIID).

The authors would also like to thank Carmen Escobar, who coordinated the intra-hospital surveillance, and the nurses Patricia Pillajo, Isabel Pinza, Rosa Villao, Patricia Silva, Carlota Velasco, Italia Castro, Mayra Garófalo, Patricia Fuenmayor, Betty Pomboza, Laura Quinzo and Luz María Cóndor. Likewise we are indebted to Dr. Alberto Narváez, National Director of Epidemiology at the Ministry of Public Health, Dr. Ricardo Cañizares, regional Epidemiology Chief in the Region II Health Undersecretariat, Dr. Telmo Fernández, Director of the Hospital Infectológico de Guayaquil "Dr. José Daniel Rodríguez Maridueña", Dr. Eduardo Chafla, Director of the Hospital Policlínico de Chimborazo and Dr. Roberto Del Salto, Director of the Hospital "León Becerra" de Milagro, as well as the collaboration of the administrative staff, doctors and nurses in the three hospitals and in the Ministry of Public Health who participated in the workshop held in Guayaquil in March 1995, without whom this research would have been impossible, and, finally, Mariana Naranjo who participated in the preparatory stages of the project.

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Table 1. Ecuador: Recurrent and Capital Average Costs (per patient) by Severity, Hospital and Sex (Dollars)

	No.	Recurrent Costs						Capital Cost		Total	
		Medical Supplies and Exams		Personnel and administrative		Total					
	Patients	Excess	Exc/Obs %	Excess	Exc/Obs.%	Excess	Exc/Obs.%	Excess	Exc/Obs.%	Excess	Exc/Obs.%
By Severity:											
Low	37	14	62	25.6	42	39.6	47	4	43	43.5	47
Category/Total %		32		59		91		9		100	
Moderate	35	14.5	56	31	43	45.5	46	5.2	44	50.6	46
Category/Total %		29		61		90		10		100	
Grave	11	4.9	18	26.3	41	31.2	34	4.6	42	35.8	35
Category/Total %		14		74		87		13		100	
By Hospital:											
Guayaquil	46	16.4	61	17.4	33	33.8	43	2.2	33	36	42
Category/Total %		46		48		94		6		100	
Riobamba	20	6.2	27	39	53	45.2	47	6.9	53	52.1	47
Category/Total %		12		75		87		13		100	
Milagro	17	11.7	57	43.5	45	55.2	47	8.3	45	63.6	47
Category/Total %		18		68		87		13		100	
By Sex:											
Female:	40	13.4	55	38.8	49	52.2	50	6.4	49	58.5	50
Category/Total %		23		66		89		11		100	
Male:	43	12.6	51	17.9	33	30.5	39	2.9	35	33.4	38
Category/Total %		38		54		91		9		100	
Total	83	13	53	28	42	41	45	4.6	43	45.5	45
Category/Total %		29		61		90		10		100	

Table 2. Ecuador: Oral and Intravenous Rehydration Solutions and other Medical Supplies Average Costs by Severity, Hospitals and Sex (Dollars)

	No. Patients	Oral Rehydration Salts		Intravenous Hydration Solutions		Other Medical Supplies		Total	
		Excess	Exc/Obs %	Excess	Exc/Obs.%	Excess	Exc/Obs.%	Excess	Exc/Obs.%
By Severity:									
Low	37	-0.6	-119	8.4	81	6.2	53	14	62
Category/Total %		-4		60		44		100	
Moderate	35	-0.8	-93	9.5	70	5.8	51	14.5	56
Category/Total %		-5		65		40		100	
Grave	11	-0.1	-7	3.4	22	1.6	15	4.9	18
Category/Total %		-2		69		32		100	
By Hospital:									
Guayaquil	46	-0.8	-667	10.4	72	6.8	56	16.4	61
Category/Total %		-5		64		41		100	
Riobamba	20	0.0	2	4.8	40	1.3	14	6.2	27
Category/Total %		0		78		22		100	
Milagro	17	-0.8	-47	6.1	86	6.4	54	11.7	57
Category/Total %		-7		52		55		100	
By Sex:									
Female:	40	-0.5	-62	8.3	72	5.6	46	13.4	55
Category/Total %		-4		62		42		100	
Male:	43	-0.7	-108	8.1	62	5.2	48	12.6	51
Category/Total %		-5		64		41		100	
Total	83	-0.6	-83	8.2	66	5.4	47	13	53
Category/Total %		-5		63		42		100	

Table 3. Ecuador: Patient Days by Sex, Hospital and Severity								
	Low	*Moderate*	*Grave*	*Patient-Day / Personnel*	*Excess Days*	*Ideal Days*	*Average Excess Days*	*%Excess / Observed Days*
By Severity:								
Low					45	64	1.2	41.3
Moderate					51	69	1.5	42.9
Grave					17	24	1.5	41.5
By Hospital:								
Guayaquil	23	21	2	14.5	44	88	1.0	33.3
Riobamba	5	6	9	9.7	46	41	2.3	52.9
Milagro	9	8	0	3.6	23	28	1.4	45.1
By Sex:								
Female	20	15	5		76	80	1.9	48.7
Male	17	20	6		37	77	0.9	32.5
Total	37	35	11		113	157	1.4	41.9

Table 4. Ecuador: Determinants of Cholera Treatment Cost
Multiple Regression Analysis Results (With Intercept)
Dependent Variables

	Excessive Capital Cost			*Excessive Recurrent Cost*			*Excessive Total Cost*		
	Coefficient	***EE***	***P-value***	***Coefficient***	***EE***	***P-value***	***Coefficient***	***EE***	***P-value***
Sex: Female	6,004.31	2,018.72	0.00	44,451.10	13,399.50	0.00	50,455.45	15,300.54	0.00
Age: 5-19	-3,084.82	3,716.47	0.41	-5,206.19	24,668.49	0.83	-8,290.91	28,168.29	0.77
40-59	904.10	2,366.18	0.70	4,896.14	15,705.76	0.76	5,800.49	17,934.00	0.75
60 +	2,422.80	3,032.37	0.43	20,245.43	20,127.69	0.32	22,668.36	22,983.28	0.33
Gravenesss: Low	1,948.31	3,648.40	0.60	18,640.45	24,216.64	0.44	20,588.58	27,652.34	0.46
Moderate	4,608.00	3,658.70	0.21	33,707.03	24,285.04	0.17	38,314.89	27,730.44	0.17
Hospital: Milagro	14,238.33	2,876.44	0.00	45,178.30	19,092.70	0.02	59,417.20	21,801.45	0.01
Riobamba	9,725.30	2,939.31	0.00	20,496.59	19,509.97	0.30	30,222.36	22,277.93	0.18
	R Square (not adjusted)	***F***	***Significance F***	***R Square (not adjusted)***	***F***	***Significance F***	***R Square (not adjusted)***	***F***	***Significance F***
	0.41	6.53	0.00	0.25	3.11	0.00	0.27	3.44	0.00

Rehydration Solution Excessive Costs

	Intravenous				*Oral*		
	Coefficient	***EE***	***P-value***		***Coefficient***	***EE***	***P-value***
Sex	2,662.17	3,399.96	0.44		65.04	285.78	0.82
Age: 5-19	-291.96	6,259.32	0.96		-283.31	526.12	0.59
40-59	-2,497.88	3,985.14	0.53		334.39	334.97	0.32
60 +	3,651.72	5,107.15	0.48		93.58	429.28	0.83
Gravenesss: Low	5,389.06	6,144.67	0.38		123.95	516.49	0.81
Moderate	7,948.65	6,162.02	0.20		-373.72	517.95	0.47
Hospital:Milagro	-9,562.63	4,844.53	0.05		201.71	407.21	0.62
Riobamba	-10,809.86	4,950.41	0.03		1,793.22	416.11	0.00
	R Square (not adjusted)	***F***	***Significance F***		***R Square (not adjusted)***	***F***	***Significance F***
	0.18	2.07	0.05		0.34	4.71	0.00
No. of Observations:	83						

Appendix No. 1

Methodology Used to Calculate Recurrent (personnel and administrative) and Capital Costs

I. Recurrent Costs

1) Personnel Costs

i) From payrolls and staff distributions, personnel were divided into three groups: [A] those whose work was exclusively confined to the pediatrics or clinical departments (Riobamba and Milagro) or infectious diseases (Guayaquil); [B] those who worked exclusively in other areas; and [C] those who worked in the hospitals' general services departments (e.g. administration, kitchens, etc.).

ii) In calculating the staff costs associated with cholera treatment, the total wage bill of the workers in group A was included, none of group B and that part of the wages of the workers in group C corresponding to the proportion of clinical, pediatric and infectious diseases patient-days to total patient-days in each hospital.

iii) Having summed the relevant wages for the first six months of 1994, this total was divided by the daily average of clinical, pediatrics and infectious diseases patient-days in the same period, thus obtaining the per patient-day staff cost.

2) Other Recurrent Costs

For the remaining recurrent costs (administration, food, cleaning, electricity, fuel and water), the total expenditure on each item recorded in the hospital accounts were summed for the first six months of 1994, and later divided by total number of patient-days on the period, giving the average cost per patient-day.

3) Total Recurrent Costs

To obtain the total recurrent cost per patient-day, the totals from 1 and 2 above were added to the expenditure on the medicines and other materials necessary for the administration of rehydration salts. The ideal, excess and total costs per patient were obtained by multiplying this figure by the number of days each patient spent under treatment.

II. Capital Costs: land, buildings and hospital equipment

a) Land and Buildings

i) The cost per patient-day of hospital land and buildings was calculated on the basis of the commercial value used for taxation purposes by the municipal valuation and property registry office in each city.

b) Hospital Equipment

i) In order to calculate the value of hospital equipment, information was taken from hospital inventories, the items referring to equipment investments in budget balances and details of purchases made directly by the Ministry of Public Health (MSP).

ii) The estimation of the value of the equipment whose use was associated to cholera treatment followed a procedure similar to that used to calculate staff costs. First, the total inventory was divided into three groups: those pieces of equipment used exclusively in the clinical, pediatrics and infectious diseases departments [A], those not used in cholera treatment [B], and those of general usage (e.g. computers, beds, desks) [C].

iii] In the case of the equipment registered in hospital inventories, its value was actualized taking the value recorded in the inventory as the initial value (this assumption, despite its obvious imprecision, being used due to the lack of data available on purchase prices and dates) and then depreciating at a rate of 14% a year, equivalent to a total depreciation of 70% over a period of five years. These values were then converted into April 1994 (the start date of the project) sucres on the basis of the cumulative inflation rates in each of the cities between the date of the inventory and the beginning of the project. The total value of the equipment in group A, none of group B, and the value of equipment in group C multiplied by the ratio of clinical, pediatrics and infectious diseases patient-days to total patient-days, were used to calculate the total equipment costs.

iv) To these totals were added the value of the equipment recorded in hospital budgets. However, since there was no mention of the type or use of the equipment registered, the value used was the actualized value multiplied by the ratio of clinical, pediatrics and infectious diseases patient-days to total patient-days.

v) Finally, of the list of equipment bought directly by the MSP (principally four contracts with overseas supplier that together account for around 90% of the total equipment purchases made in the last five years), those pieces that were not used at all in cholera treatment and those presumably already included in the hospital inventories were discarded. The valuation of the remaining equipment involved four stages. First, the prices in each contract were converted into sucres at the date of delivery to the receiving hospital, using national price indexes. Second, each piece of equipment was depreciated, using the formula described earlier, from this delivery date to the beginning of the project. Third, these values were converted into April 1994 sucres using the respective inflation rates in each of the three cities. Finally, the value corresponding to cholera treatment was calculated in the same way as in the other cost categories already described.

vi) The values obtained above were then added together to give the total value of equipment associated with cholera treatment in each hospital.

c) Total Land, Building and Equipment Costs per Patient-Day

Adding the values of land and buildings to those of hospital equipment, the total actualized value of the hospital was obtained. Assuming an annual rental value equal to 10% of the total value - and thus 5% for the six months covering the study - the cost per patient-day was calculated by dividing this value by the total number of patient-days during the period.

NOTES:

a) Since inflation data was not available for Milagro, figures corresponding to Guayaquil, the nearest large city, were used.
b) In calculating the value of buildings, the value of those areas totally unconnected to cholera treatment was not deducted from the total, thus leading to an over-estimation of the costs per patient-day in this expenditure category.
c) With regard to personnel costs, in the case of Guayaquil the payroll for June 1994 alone was used, due to the lack of information on the other months covered by the study.
d) In the calculations based on budget balances, it should be noted that in Guayaquil patient information was only available for the first five months of 1994, in Milagro there was only data on budgets and patients for the period January-May, and in Riobamba, in the absence of consolidated budget statements, other documents from the accounts department were used.

Appendix No. 2.

Norm Used for Estimating Correct Cholera Treatment.

1. Estimate loss of liquids using the following formula:

(Weight /Kg) * (Degree of dehydration expressed as a proportion) = Liters of liquid lost.

2. Evaluation of the initial rehydration requirement:

- Severe cases: IV - 50% during the first hour; the rest during the subsequent 2-4 hours.
- Moderate cases with uncontrollable vomiting: treatment as per severe cases followed by oral rehydration.
- Mild cases with uncontrollable vomiting: IV until the vomiting has passed, followed by oral rehydration. When vomiting is not present and liquids are tolerated: oral rehydration from the outset.

3. Maintenance rehydration therapy should at all times be administered orally, except when uncontrollable vomiting is present. As soon as the vomiting has passed oral therapy should be adopted.

4. Quantity of liquids administered as part of the maintenance rehydration: it is to be assumed that the amount administered by the relevant health unit is correct

5. Type of liquid administered:

For the initial rehydration only hypertonic liquids (lactates, Dx in water plus electrolytes and oral rehydration salts) are taken into account. For the subsequent maintenance therapy, to counteract losses due to diarrhea and vomiting only hypertonic solutions are considered; in the case of other losses other hypotonic liquids, such as mineral water are accepted. Due to the impossibility of precisely controlling ingestion and excretion, it is assumed that while diarrhea or vomiting are present, both hypertonic and hypotonic liquids should be administered. Once these symptoms have been controlled, only hypotonic liquids should be used.

When a patient stays less than one day in hospital and the initial rehydration has not been completed, the remaining rehydration salts should be given to the patient for oral administration at home.

When a patient has spent more than one complete day in hospital and is sent home with oral rehydration salts, even if the initial rehydration is deemed adequate, these additional salts are considered appropriate but not obligatory.

When a patient receives less than the required initial rehydration therapy, the initial rehydration administered is considered to be equal to the ideal treatment.

6. Hospital Stay:

Mild cases without uncontrollable vomiting should not be admitted to hospital.

Mild cases with uncontrollable vomiting should be admitted while they receive intravenous therapy, and then until they have less than three diarrhoeal depositions.

Moderate and severe cases should remain in hospital during the initial rehydration, and until they have less than three diarrhoeal depositions, are not vomiting and their vital signs are stable.

7. Antibiotics:

Tetracycline	adults: 500mg every 6 hours for three days.
Eritromicine	adults: 250mg every 6 hours for three days.
	children: 30mg/kg/day three times a day for three days.
Sulfas	adults: 160mg/kg TM and 800mg/kg SMT twice a day for three days.
	children: 5mg/kg TM and 25mg/Kg SMT twice a day for three days.

8. Laboratory exams: the test considered appropriate is a *gramm* exam to identify *Vibrión Cholerae*, although it is not considered necessary for diagnosis. All other tests are considered excessive.

9. All other medication is considered excessive, with the exception of those necessary for the treatment of passing symptoms, such as migraine.

In the case of anti-parasite treatment, these medications are not taken into account.