

## Environmental Health Conditions and Cholera Vulnerability in Latin America and the Caribbean

Deficient environmental health conditions in the countries of the Americas have concerned health authorities over the years. The fact that contaminated water played a mayor role in the transmission of cholera and that it could be controlled, was demonstrated in 1854 by John Snow in London. This knowledge, together with the later discovery of *Vibrio cholerae* by Robert Koch in 1884, prompted the improvement of sanitation services to prevent the spread of the disease. Deficient environmental health conditions increase a country's vulnerability to cholera and, conversely, environmental health barriers remain the most effective measures to control and prevent cholera epidemics. This is unlikely to change in the future.

The Latin American and Caribbean countries have been making significant efforts to increase population coverage with drinking water supply, excreta and sewage collection and disposal, food sanitation, and solid waste disposal, among other public health measures taken to improve health conditions.

In 1961, the Governments of the Region committed themselves in the Charter of Punta del Este to provide water and sewerage to 70% of the urban population and to 50% of the rural habitants by 1971. In the main, in terms of coverage, the urban goals were met but in the rural areas progress was much slower than expected. In 1972, the Ministers of Health adjusted the recommended goals, urging faster progress in all aspects and particularly emphasizing that urgent attention be given to squatter settlements, which already represented about 25% of the urban population.

The coverage goals for the 1970s were met in the established urban areas but with significant deficiencies in the urban peripheries and rural areas. Although the provision of good quality water and sanitary excreta disposal services had been intended, the results in these aspects were less than satisfactory. The International

Drinking Water and Sanitation Decade, 1981-1990, further prompted the countries to take more dramatic action and resolve once and for all the deficiencies of these services.

The evaluation report on *The Situation of Drinking Water Supply and Sanitation in the American Region at the End of the Decade 1981-1990, and Prospects for the Future (1)*, provides information on the status of these services and is the main source of information for what follows. Table 1 summarizes the water supply and sanitation situation in 25 countries of Latin America and the Caribbean, including population served and not served, by different types of service.

By the end of 1988, the latest year for which information is available, urban water supply services with household connections reached 79% of the population; when including the population served by public sources (access within 200 meters of dwelling), coverage came to 88%. Urban sanitary sewerage services covered 49% of the population; if other methods of excreta disposal are included, coverage came to 80%.

At the end of 1988 coverage with house connections and standposts in the rural areas was 55%, while coverage with sanitary excreta disposal services was 32%.

There has been a considerable longstanding imbalance between drinking water and sanitation coverage, due to greater priority afforded water supply than sanitation. In addition to coverage, Table 1 shows the deficit in the services. By late 1988, 89 million people (about 34 million in urban areas and 55 million in rural areas), comprising 21% of the population still lacked access to water supply, and almost 141 million (57 million in the urban areas and 84 million in the rural areas), i.e. 34% of the population lacked adequate wastewater and excreta disposal services. In 1988 there

Table 1. Drinking water supply and sanitation coverage in 25 countries of Latin America and the Caribbean, by the end of 1988.

Service	Population in millions			Percentage served
	Total	Served	Not served	
Urban water	291.6	257.8	33.8	88.4
Rural water	124.0	68.5	55.5	55.3
Urban sanitation	291.6	234.7	56.9	80.5
Rural sanitation	124.0	39.8	84.2	32.1

were about 52 million more inhabitants with water supply services than with sewerage or alternative systems for excreta disposal (23 million in the urban areas and 29 million in the rural areas). The disparity is increasing.

### **Quality of Water and Sanitation Services**

From the public health point of view, providing safe water and sanitation implies adequate quantities and guaranteed quality, on a permanent, continuous basis (24 hours a day) at a cost people can afford, as well as commensurate sanitary collection, treatment and disposal of wastewater, and excreta. The coverage figures shown above do not necessarily mean that the services provided meet the minimum standards of drinking water and sanitation. In fact, large deficiencies exist in practically all countries of Latin America and the Caribbean.

Almost all countries reported having water quality control programs in urban and rural areas but with few notable exceptions these are only partially or inefficiently implemented. Control measures are usually the responsibility of the water supply institutions themselves. Health authorities seldom incorporate sufficient water quality surveillance in their programs. Furthermore, they are not oriented toward corrective action and have not allocated sufficient financial resources, materials, and personnel duly trained to do this work effectively (1).

Water supply programs have focused primarily on expanding services or building new ones, with less attention to the quality of water distributed. Access to a public source or even a household connection do not guarantee the quality of the water supplied. Evidence of this was found in the results of inquiries carried out in the workshops organized by PAHO to present and promote the new WHO Guidelines for Drinking Water Quality (1984), and in later studies that indicated that 75% or more of the water supply systems did not disinfect at all or had serious operational problems that interfered with effective and continuous disinfection. Several subsequent national studies indicate a somewhat larger percentage of failure.

National quality standards are generally not met in the peripheral urban areas, where water services are intermittent, nor in the small and medium size systems, particularly in remote areas. With losses as high as 60% of the water produced, water use is very inefficient. Frequently even major cities have intermittent services, at least in certain areas, with high levels of water loss. Seventeen of the 25 countries indicate that they have intermittent services; eleven consider the situation to be serious. Even countries with very high coverage, such as Costa Rica, report that they have some intermittent water supply services that do not meet the minimum standards of quality (1). Lack of system integrity makes it impossible to maintain water quality, especially without disinfection.

### **Drinking Water Quality in the Cholera Affected Areas**

Various studies exemplify the deteriorated situation of drinking water supplies in the cholera affected areas. Between 1984 and 1985 a study of 60 water supply systems, complemented by 40 more at a later date, was conducted in the central highland and jungle areas of Peru(2). The systems comprised different configurations and included wells, and slow and rapid sand filter plants, but the majority had springs as their sources. Most of the treatment plants produced water of poor bacteriological quality; only two of the 40 rural systems claiming to practice chlorination showed chlorine residuals. Among the simple gravity systems, none of 20 claiming to practice this treatment showed chlorine residuals.

In 1991 the USA Centers for Disease Control conducted an epidemiological investigation of cholera in Piura and Trujillo, Peru. It concluded that "the principal route of transmission in both cities was via municipal drinking water, with potential points of contamination in wells, distribution systems and houses", the principal risk being intermittent non-disinfected supplies (Dr. Robert Tauxe, personal communication). The study also implicated contaminated ice, beverages, contaminated food, locally raised vegetables and fruits and shellfish eaten raw. In Piura and Trujillo water samples were found to contain cholera organisms and in the Lima-Callao area the distribution system water contained fecal coliforms (3). Data from the treatment plant of Lima, La Atarjea, showed a Total Coliform content of less than 1/100 ml in the finished water, a Fecal Coliform content of less than 1/100 ml, and an Heterotrophic Plate Count of less than 1-11/100 ml, after post chlorination, from March 4-9, 1991, even though the raw water contained up to 130,000 Fecal Coliform/100 ml.

Although the examples above refer specifically to cases in Peru, this water quality situation is representative of many countries of Latin America and the Caribbean.

As stated by PAHO, ensuring the supply of adequate quality water, both to those who already have services and to those who will receive new services, poses one of the greatest challenges that most of the countries of the Region will have to face in coming years (1).

### **Wastewater Disposal and Water Pollution**

The discharge of untreated municipal wastewater is a rapidly growing problem in all countries and water pollution has already reached crisis proportions, especially from the enormous discharges originating in the metropolitan areas and large cities.

Information on wastewater treatment facilities in Latin America and the Caribbean is limited. Based on the coverage data (1988) and assuming a daily per capita generation of 200 liters of wastewater for the population served with water connections and sewerage, it is estimated that 142 million inhabitants would produce

**Table 2. Pollution caused by domestic wastewater in 25 countries of Latin America and the Caribbean, by the end of 1988.**

Service	Population served (millions)	Flow m <sup>3</sup> /sec.	Contamination
With sewerage and water	142.0	328.7	
- Sewerage with complete or partial treatment (10% of the total)	(14.2)	(32.9)	Partial contamination depending on the extent of treatment
- Sewerage without treatment	(127.8)	(295.8)	Contamination from raw sewage
With house water connections, without sewerage	88.4	51.2	Partial and indirect contamination
Total with house water connections	230.4	379.9	

328.7 m<sup>3</sup>/sec, of which only 16.3 m<sup>3</sup>/sec to 32.6 m<sup>3</sup>/sec is receiving some treatment. The urban inhabitants who have water in their residences without sewerage connections, at a daily rate of 50 liters per capita, would produce some 51.2 m<sup>3</sup>/sec more of wastewater. The contribution of the 61.2 million urban population without access to public sources of drinking water is negligible. The total urban population, estimated at 291.6 million, would thus produce about 379.9 m<sup>3</sup>/sec of wastewater (Table 2). These figures should be considered only as indicators of the order of magnitude of current demand for wastewater treatment. Future volumes will increase significantly.

The contribution to water pollution by wastewater from smaller communities is also important. Although they do not pose the mega-problems of large cities, in their limited milieux they cause damages to watercourses, including groundwater, which is the source of water supply for both large and small communities.

The treatment of urban wastewater poses a major challenge both to decision makers and administrators and to the technical personnel in the countries, because of the related problems connected to natural resources, water supply, and other uses, the high cost of treatment facilities, and the lack of appropriate policies and technologies for the special characteristics and situations of the countries of the Region (1).

In relation to the foregoing, it is important to bear in mind that municipal wastewater, if properly treated, can be a valuable resource and play an important part in the management of water resources. There is a considerable economic value attached to reusing such waters for irrigation, aquaculture; and other activities, especially in arid regions. However, the uncontrolled use of untreated wastewater for irrigation, which is reported by several countries of the Region, and for other uses, poses high risk from pathogenic microorganisms and possibly toxic substances. A few countries have initiated actions in this respect, but in general the countries must yet

adopt the necessary measures to guarantee that water reuse is carried out in accordance with appropriate sanitary standards.

Another important factor that contributes to the pollution of surface waters and groundwater is municipal solid waste, especially when it is disposed of with no controls, in open dumps or directly into bodies of water and even "landfills" that are not well-designed, well-built, or properly operated.

#### **Future Requirements of Water Supply and Wastewater Collection, Treatment and Disposal**

In the future, the first consideration of the countries will continue to be extending coverage of water supply and sanitation services that are adequate in quantity and quality to the population without services and those poorly served. Table 3 illustrates the population projected to the year 2000 and the population served as of the end of 1988.

The difference between the population served in 1988 and the population projected for the year 2000 is the population that should receive services in the course of the 12-year period in order to achieve 100% coverage. The following are the figures: urban water, 122.8 million; rural water, 59.2 million; urban sanitation, 145.9 million; and rural sanitation, 87.9 million.

In Latin America the increase in the urban population is particularly noteworthy. The annual increase from 1990 to the year 2000 is projected to be 2.5%, and is expected to happen primarily in marginal urban areas. In 1970 it had been estimated that on average 25% of the population lived in the urban marginal areas, in precarious conditions (4). Although there is no recent thorough information, it is estimated that this situation continues to prevail, and may have worsened in the marginal areas of the larger cities, where according to a definition of low-income population, this category comprised 40% of the population of urban human settlements in 1981, in some cases accounting for more

**Table 3. Unsatisfied and potential demand for services in 25 countries of Latin America and the Caribbean, 1988-2000 (Population in millions).**

Service	Total year 2000	Served year 1988	To be served year 2000
Urban water	380.6	257.8	122.8
Rural water	127.7	68.5	59.2
Urban sanitation	380.6	234.7	145.9
Rural sanitation	127.7	39.8	87.9

than 60% of the urban population. Moreover, it has been calculated that from 1984 to 1995 the low-income population may increase by an additional 40 million (5), further overtaxing the already inadequate water supply and sanitation services.

The population growth in the larger cities is especially significant, given the rapid increase and concentration. In 1990 there were 14 cities with over two million people and a total population of 99.7 million (32% of the urban population). By the year 2000 the 14 cities mentioned will have a combined population of 123.7 million, to which 16 million will be added from 8 additional cities of two million each, for a total of 22 cities making a total of some 140 million (34% of the urban population) in these cities. These data give an idea of the enormous quantities of water that will be required and also of the volumes of wastewater that will be produced, which will require collection, treatment and disposal in an appropriate manner.

In the next decade the greatest demand for water supply and sanitation services will be in the marginal urban areas, where at least 40% of the population, mostly poor, will reside. The rural population without services will still be numerous, including the scattered population, which will also require attention.

Meeting the coverage goals implies not only extending services to the entire population, but also providing safe water in sufficient quantity on a permanent basis. This means that the services must be reliable, operate 24 hours a day, and use appropriate technologies that people can afford. In addition, excreta and wastewater disposal will have to be sanitary so as not to present health or environmental hazards.

Degradation of water resources caused by pollution from major discharges of wastewater and solid wastes produced by the population, as well as those resulting from rapid industrial and agricultural development, are affecting the availability of water suitable for drinking water supply, crop irrigation, and aquatic products for

human consumption, to such an extent that the authorities of several countries have expressed great concern.

This situation is making it necessary to use increasingly distant water resources or resources requiring complex treatment processes, which makes the services less reliable and drives up economic and ecological costs to unmanageable levels, especially in the metropolitan areas and larger cities. One notable characteristic of the second half of the 20th century has been the emergence and rapid advance of water pollution in Latin America; this is a major problem, as it impacts not only on water supply and sanitation services and thus on health, but also on the social and economic development.

Of the countries that reported in 1988, 15 expressed concern about the situation of water resources, and three of these considered the situation serious. In addition, 16 countries indicated that knowledge of the condition of water resources was not complete, and four considered that the situation was critical.

In several countries pertinent and in some cases extensive legislation on water resources has been approved, but actions for prevention and control of pollution are mostly not sufficient.

An important related aspect the countries will have to face decisively is the disposal of increasing quantities of urban wastewater. The prediction of how much municipal waste water will be produced in addition to what is already discharged, and require treatment to avoid pollution of water courses, is difficult to make as it will depend on many factors such as the number of people that will get sewers, increased consumption of water, introduction of new household fixtures, waste water control, quality of the new sewers, and others. In Table 4 a very rough estimate is shown, made on the assumption that, as a minimum, the proportion of population with different levels of service by the year

2000 will be the same as that estimated at the end of 1988 (Table 2).

The 185.4 million urban inhabitants expected to have sewers will contribute 429.2 m<sup>3</sup>/sec of sewage. In addition 115 million with water but no sewers in their homes will contribute 66.7 m<sup>3</sup>/sec, for a total of 495.9 m<sup>3</sup>/sec. To prevent extreme health and gross environmental degradation these discharges will have to receive some degree of treatment.

The urgency of putting in place comprehensive policies for the management of water resources can be appreciated in the degradation of important rivers such as the Mapocho in Chile, as well as the Bogota, the Cauca, and the Magdalena in Colombia, the Mantaro in Peru, and those of the River Plate system in Argentina (6). In general, the Latin American situation is worsening in relation to rivers and smaller bodies of surface water, as well as to groundwater, which is a major source of water supply for small and large communities, including metropolitan areas such as Mexico City, Lima, Buenos Aires, Santiago, and others.

Some rivers have become so contaminated that they are virtually open sewers and introduce a health threat when used for water supply or for irrigation. In water deficient areas the recycling of wastewater for agricultural purposes without adequate sanitary standards is a major cause for concern. Preliminary information suggests this practice to be associated with a high incidence of gastro-intestinal infectious diseases.

#### Hygiene and Environmental Health Education

Past experience has confirmed that one of the conditions for attaining the greatest health benefits from the provision of water supply and sanitation services is that these be accompanied by adequate and pertinent health education.

As of late 1988, 18 countries of the Region reported that hygiene education activities in the water supply and sanitation sector were in general insufficient, and eight of these considered this to be a serious shortcoming. The subject was taught in school in nine countries and five

of these reported that it was part of the normal curriculum. The type of activities as well as their intensity and frequency varied considerably among countries; in some, notable efforts have been made, while in others they have yet to be initiated. In several countries the water supply and sewerage institutions, on occasions with the collaboration of the local authorities, have taken innovative initiatives and organized ad-hoc campaigns and activities in related aspects. However, the great majority of the countries consider that efforts in this regard are still insufficient.

#### Future Outlook and Conclusions

Although considerable efforts have been mounted to increase water supply and sanitation coverage in Latin America and the Caribbean, large segments of the population, especially those economically disadvantaged, remain without adequate service. Additionally, in many cases the dependability and quality of water supply has deteriorated and there is widespread failure to adequately treat municipal sewage or human excreta before their discharge into the environment. This situation greatly increases the vulnerability of the population to diseases of public health significance such as gastro-intestinal infections, and cholera in particular. In reviewing the areas adversely affected by cholera it can be seen that there is a direct correlation between the prevalence and speed of propagation of this disease and deteriorated environmental health conditions.

To prevent the propagation of cholera it is absolutely necessary to establish environmental health barriers. Without them other interventions to control cholera epidemics will not be effective. This is especially important since after a number of months a cholera epidemic will diminish of itself, after it has taken its toll of susceptible people. The resulting reduction in the number of new cases can induce a false sense of security, and diminish the incentive for mounting the necessary environmental barriers on a permanent basis. This lull in the epidemic is a critical period of time, for

Table 4. Estimated pollution caused by domestic wastewater discharges in 25 countries of Latin America and the Caribbean, year 2000.

Service	Population served (millions)	Flow m <sup>3</sup> /sec.	Contamination
With sewerage and water	185.4	429.2	
- Sewerage with complete or partial treatment (10% of the total)	(18.5)	(42.9)	Partial contamination depending on the extent of treatment
- Sewerage without treatment	(166.9)	(386.3)	Contamination from raw sewage
With house water connections, without sewerage	115.3	66.7	Partial and indirect contamination
Total	300.7	495.9	

if the necessary interventions do not continue to be implemented the chances that cholera will become endemic are greatly increased. This would entail regular seasonal outbreaks that would become a source for the introduction of the disease and subsequent epidemics in other countries.

Adequate supplies of clean water are essential for health and wellbeing as well as for life itself. All development, whether economic, social, agricultural or industrial, is totally dependent upon adequate water resources. Although on a per capita basis Latin America and the Caribbean enjoy the most abundant fresh water resources in the world, negligence in protecting these resources from pollution currently threatens both the health and the economy of the countries. Presently, this is being clearly manifested in the cholera epidemic. However, cholera is only one of more than 20 serious water related diseases, each of which will become more prevalent without sufficient investment in environmental health. The countries of the Region have little choice: either they make the necessary investments in environmental health interventions, including pollution control, or they pay the consequences in terms of economic loss as well as suffering, disease and death.

### References

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(Source: Environmental Health Program, PAHO.)

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## Epidemiology Meeting in the Dominican Republic

From 19 to 22 November 1991 the II National Scientific Meeting on Epidemiology will be held in Santo Domingo, to consider "Epidemiology and Crisis: Impact on the Quality of Life." The objectives of the meeting will be:

- To generate a favorable environment for a discussion of the health problems that have been accentuated by the crisis, with a view to proposing urgent reforms of the health care system.
- To promote the research necessary to obtain information regarding the impact of the crisis and of different models of development on the population's quality of life.
- To promote the development of epidemiology, both in its methodological aspects and in its areas of application, as a basic discipline for public health decision-making.

- To contribute to the development of the scientific community active in the health field.

In the meeting there will participate international guests, and various group techniques will be used to discuss the challenge of attempting to deal with the social differentials of health, in order to provide the opportunity for intervention and open analysis by all those interested in the problems of the sector from an epidemiological perspective.

For further information, contact the Office of the II Meeting on Epidemiology, Dr. Pineyro # 41, Santo Domingo, Dominican Republic.