Introduction

Latin America and the Caribbean have been severely affected in the past by natural disasters. Almost every year, catastrophic events cause deaths, injuries and enormous losses to property and to the economy. In the second half of the 1980's, Chile, Mexico, Ecuador, Peru, Panama and Costa Rica were affected by earthquakes. Among these, the earthquake in Mexico brought devastating effects causing 10,000 deaths and the destruction of thousands of buildings. When the Nevado del Ruiz volcano erupted in Colombia in 1985, the city of Armero was buried beneath a mudslide; 23,000 people were killed. Hurricanes Gilbert and Joan in 1988, and Hugo in 1989, left a path of destruction in the Caribbean, Mexico, Colombia and Nicaragua.[1]

Every year, floods affect almost every country in this Region. During 1982 - 1983, the "El Niño" phenomenon, characterized by a combination of flood and drought, severely affected more than 3.7 million people in Bolivia, Ecuador and Perú.

The consequences of the major natural disasters of the last two decades translated into 150,000 deaths, 500,000 injuries and property losses that affected almost 8 million people. These figures rely heavily on official sources. It is quite difficult to obtain accurate information in sudden-onset disasters, because there are multiple sources of information and a lack of a standardized information system. The Economic Council for Latin America (ECLA) estimates that 6,000 lives and more than 1.5 billion dollars are lost each year in Latin America and the Caribbean to disasters.

Table 1 illustrates the major events that have affected countries in Latin America and the Caribbean during the last two decades. It should be noted that slow-onset disasters, such as drought and floods, are not included.

Table 1. Major disasters in Latin America and the Caribbean, 1970-1990*

Year	Country	Type of disaster	Deaths	Affected
1970	Peru	Earthquake	66,797	3,139,000
1972	Nicaragua	Earthquake	10,000	400,000
1976	Guatemala	Earthquake	23,000	1,200,000
1980	Haiti	Hurricane (Allen)	220	330,000
1982	Mexico	Volcanic eruption	3,000	60,000
1985	Mexico	Earthquake	10,000	60,000
1985	Colombia	Volcanic eruption	23,000	200,000
1986	El Salvador	Earthquake	1,100	500,000
1988	Jamaica	Hurricane (Gilbert)	45	500,000
1988	Mexico	Hurricane (Gilbert)	250	200,000
1988	Nicaragua	Hurricane (Joan)	116	185,000
1989	Monserrat, Dominica	Hurricane (Hugo)	56	220,000
1990	Peru	Earthquake	21	130,000

*Source: PAHO / OFDA / UNDRO

The economic impact

During the last decades, ECLA carried out extensive research on the social and economic impact of disasters. The direct correlation between disasters and the negative repercussions on social and economic development in developing countries has been clearly demonstrated.

The amount of money lost to disasters often exceeds the total annual gross income of an affected country. In countries with weak economies, it can exceed the total gross income plus a portion of the foreign debt. This can paralyze many affected countries and lead to outbreaks of political and social turmoil.

The economic impact affects three main areas:

- Direct effects on the affected population's property.

- Indirect effects caused by losses in economic production and the provision of services.

- Secondary effects which become apparent after the disaster. These can include a reduction in the national income, an increase in the inflation rate, problems with foreign trade, higher financial expenses and a resulting fiscal deficit, a decrease in monetary reserves, etc.[2]

The following table presents the economic effects of certain natural disasters:

Table 2. Losses due to natural disasters

DISASTER	LOCATION	DATE	TOTAL LOSSES (millions)
Earthquakes	Mexico	1985	US$ 4,337
	El Salvador	1986	US$ 937
	Ecuador	1987	US$ 1,001
Volcanic eruption	Nevado del Ruiz	1985	US$ 224
Floods - Drought	"El Niño" Peru Ecuador, Bolivia	1982-1983	US$ 3,970
Hurricane Joan	Central America	1988	US$ 870

These figures may be insignificant for developed or industrialized countries with stable economies, but this is not the case for developing countries, where disasters have a serious, lasting impact on already deteriorated economies. Some examples include:

- The oceanographic phenomenum, "El Niño," caused a reduction in the internal per capita income of 10%, while food prices rose up to 50% for consumers.

- Losses from the Mexico earthquake totaled only 2.7% of the Gross National Product (GNP); but the urgent financial expenditures for reconstruction and restoration of services increased the demand for public funds at a time when Mexico was implementing a fiscal austerity policy.

- In El Salvador, the earthquake brought social consequences in the form of housing shortages, an unemployment rate of 26 to 35%, and reduced public health facilities. The side effects to the economy were aggravated by guerrilla warfare.

- Hurricane Joan, which severely affected the Atlantic coast of Nicaragua in 1988, aggravated the economy which was already deteriorating from internal and external factors during a difficult political period.

The effects on the health infrastructure

In any major emergency caused by natural or manmade disasters, the first priority is to save lives and provide immediate emergency care to the injured. Among the emergency medical services that are mobilized, hospitals play a key role.

In most developed countries there is a standardized system for emergency response in which emergency medical services, paramedics, firemen, and others play an important role in the response. In most developing countries no such system exists. Thus the emergency medical response relies heavily on Red Cross volunteers or on the deployment of medical personnel sent by the closest hospitals to the disaster site.

In addition, hospital disaster plans for internal and external emergencies have not been well established. However, today, many countries are beginning to take seriously the need to organize an emergency response, especially after the lessons learned during recent disasters which caused important losses to the health infrastructure.

Structurally, many hospitals in Latin America are old; some date from Spanish colonial times. Others are contemporary, modern facilities with attractive architectural design, but lax application of anti-seismic building codes makes their ability to support earthquakes questionable.

In addition to the above factors, according to the information published by the Pan American Health Organization, there seems to be a shortage of health service facilities in Latin America and the Caribbean. In 1987, the average ratio of hospital beds per 1,000 population was 2.5, while in the U.S., the average rate for the same year was estimated at 4.4 per thousand.[3]

A survey in Central America and the Andean countries between 1986 and 1987 revealed that 35 - 53% of the hospital equipment was out of order. The equipment was 10 to 25 years old.[3]

The above indicators increase the risk of the population living in disaster-prone areas should the existing health services facilities, many of them already inefficient to provide appropriate medical care, are affected by the disaster.

Health care facilities are particularly vulnerable to the effects of earthquakes and hurricanes. The following table offers a partial inventory of the destruction.

Table 3. Hospitals damaged or destroyed by natural disasters.(*)

TYPE OF DISASTER	NUMBER OF HOSPITALS	NUMBER OF BEDS
Earthquake, Mexico (Federal District, September 1985)	13	4,387
Earthquake, El Salvador (San Salvador, October 1986)	4	1,860
Hurricane Gilbert (Jamaica, September 1988)	22	5,085
TOTAL	39	11,332

(*) PAHO and other sources.

The estimated cost for each hospital bed in Latin America is approximately US$ 100,000 for modest hospitals, and higher for highly specialized facilities. The number of hospitals damaged and beds lost gives us a gross idea of the financial implications of restoring them, bringing into consideration the high cost of construction and the expensive equipment necessary to furnish hospitals.

It is not only the damage to hospitals that counts. The loss of human life, including the loss of highly qualified professionals with promising futures for their countries, is just as important.

Selected Cases

The following summary of selected cases illustrates the effects caused by disasters to the health services:

The Mexico Earthquake: September 19, 1985

The epicenter of this 8.1 magnitude earthquake was located off the Pacific coast of the state of Michoacan. It destroyed or severely affected 49 hospitals of which 13 were high-complex establishments. As a consequence, a total of 4,389 hospital beds were lost. This earthquake killed 10,000 people; 30,000 injured received emergency medical care during the first days. Regarding the mortality associated with the destruction of health infrastructures, 879 died trapped in two main hospitals in Mexico City (Hospitals Juárez and General).[4]

Table 5. Hospitals and available beds in the metropolitan area following the 1985 earthquake in Mexico City

	HEALTH CARE CENTERS						
RESOURCES	**Health Secretary**	**Social Security**	**Gov. Empl. Soc.Sec.**	**Family Development**	**Others**	**Private Sector**	**TOTAL**
Hospitals Type II & III							
Before	17	37	9	24	8	23	118
After	15	28	7	24	8	23	105
Lost	2	9	2	0	0	0	13
Available beds							
Before	4,975	8,197	2,427	1,807	1,383	760	19549
After	4,230	5,422	1,560	1,807	1,383	760	15162
Lost	745	2,775	867	0	0	0	4387

Source: Secretary of Health, Mexico. Office of Epidemiology.

Table 6. Victims of the collapse of the General Hospital

	COLLAPSED HOSPITALS			
	General		Juárez	
	Number	%	Number	%
Fatalities	295	62.6	561	76.0
Rescued	129	27.4	179	24.0
Missing	47	10.0	-	-
TOTAL	**471**	**100%**	**740**	**100%**

Source: **Crónicas de Desastre. Terremoto en México**, PAHO, 1987.

The 1986 El Salvador earthquake

In October 1986 a moderate earthquake hit El Salvador. It severely affected four hospitals and destroyed several health centers. Initial estimates for urgently-needed repairs were calculated at US$ 120 million. This earthquake caused 1,500 deaths and approximately 10,000 injuries.[5]

Table 7. Health sector investment following the El Salvador earthquake

PROJECT	REQUIRED INVESTMENT (Thousands of dollars)
Reconstruction and equipment - General Hospital	16,000
Reconstruction and equipment - Children's Hospital	19,000
Reconstruction and equipment - Social Security Hospital	24,000
Reconstruction and equipment for four health care centers	2,600
Rehabilitation - Maternity Hospital	200
Rehabilitation of seven health care centers	1,920
Rehabilitation and construction of both Military Hospitals	13,000
Rehabilitation of nine private health care centers	2,000
Construction - Pediatric Hospital	200
TOTAL	102,920

Source: CEPAL, 1986

The 1985 Chile Earthquake

A 7.8 magnitude earthquake struck Chile in March, 1985, causing structural damage to 22 of the 79 existing hospitals in the affected area. As a consequence, 3,271 hospital beds were lost, 20.7% of them in the Santiago metropolitan area. This earthquake caused 180 deaths and some 2,500 injuries.[6]

The following table illustrates the impact of the earthquake on hospitals.

Table 8. Impact on Hospitals of the Earthquake in Chile

REGION	NUMBER OF HOSPITAL	NUMBER OF BEDS	NUMBER OF LOSS BEDS	
Metropolitan Area (Santiago)	26	11,464	2,373	20.7
Region # 5 (Viña del Mar, Valparaíso, San Antonio)	23	4,573	622	13.6
Region # 6 (Rancagua)	15	1,413	212	15.0
Region # 7 (Ralca, Meula)	15	2,286	64	2.8
TOTAL	79	19,736	3,271	16.6

Source: L. Wyllie, M. Durkin, et al. Earthquake Spectra, Volume 2, No. 2, February 1986.

Hurricane Gilbert, Jamaica 1988

Hurricanes affecting the Caribbean have also caused severe damage to the health infrastructure. When hurricane-strength winds have ripped the roofs off hospitals, the heavy rains have flooded the facilities, causing permanent damage to expensive hospital equipment and furnishings.

After Hurricane Gilbert, only two of the 25 public hospitals escaped with minimal damage. Two hospitals were completely destroyed and eleven others suffered severe damages. The losses were estimated at US$ 4 billion.[7]

Risk Factors

Among sudden-onset natural disasters, earthquakes are, by far, the most damaging to the hospital infrastructure. According to seismologists, each earthquake has its own characteristics depending on the epicenter, the type of seismic waves, the geological

consistency of the soil, etc. Studies have revealed common factors that cause death and injuries. These include the structural failure of buildings, aggravated by non-structural factors related to equipment, furnishings and other items inside the buildings.

Hoping to make better recommendations and norms on building and organizing hospitals in highly vulnerable areas, scholars and planners are paying special attention to identifying risk factors associated with the hospital infrastructure, and with non-structural and behavioral factors.

From the health point of view, there is particular interest in identifying the risk factors associated with structural, non-structural and behavioral aspects which are summarized in the following table:

Table 9. Risk Factors

STRUCTURAL	NON-STRUCTURAL	BEHAVIORAL
Design	Medical equipment	Public information
Quality of construction	Laboratory equipment	Motivation
Materials	Office equipment	Plans
Soil conditions	Cabinets, shelves	Educational programs
Seismic characteristics	Stoves, refrigerators, heaters	Health care staff training
Time of the event	X-Ray machines	
Population density	Reactive materials	

These risk factors, particularly those related to the structural aspects of the construction, were observed during the earthquakes in Armenia in December 1988, in which 377 schools, 560 health facilities and 324 community and cultural centers were destroyed or seriously damaged. Official estimates place deaths at 25,000, with 1,100,000 persons affected.[8]

A similar situation happened in June, 1990, when an earthquake hit Iran. In the most affected area, 60 to 90% of the houses collapsed, 40,000 people died, 60,000 were injured and 500,000 became homeless.[9]

To address these issues, an international seminar was held in Lima, Peru in 1989 on planning designing, repairing and managing hospitals in seismic areas. The seminar, under the sponsorship of Peru's National University of Engineering, the Peruvian-Japanese Center

for Seismic Research (CISMID) and the Pan American Health Organization (PAHO), gathered architects, engineers and hospital administrators to study the issues of health facilities located in these areas. The seminar approved a core of technical recommendations and commitments to carry out vulnerability analysis of hospital infrastructures, improve the designing of new facilities, and establish safety measures in existing hospitals, with emphasis on those located in high risk earthquake areas.[10]

Costa Rica is among the countries that have dedicated financial resources to reinforce their hospital infrastructure. After their experiences with earthquakes in the last decade, this nation has paid special attention to prevention activities in public hospitals, in spite of the difficult economic situation affecting the country during this period.[11]

PAHO recommendations on hospital disaster preparedness

Hospital disaster preparedness constitutes an important component of PAHO's Emergency Preparedness and Disaster Relief and Coordination Program. Over the last ten years, member countries have been encouraged to develop or improve their preparedness at the hospital level. Countries that have placed priority on hospital preparedness are carrying out the following activities:

- Classifying hospitals according with their risk factors and vulnerability to disasters.
- Developing internal and external hospital response plans and training personnel.
- Developing contingency plans and establishing safety measures for the professional and technical hospital staff.
- Strengthening lifeline backup systems that allow hospitals to function during emergency situations.

We hope that the International Decade for Natural Disaster Reduction (IDNDR) will attract the motivation and commitment of national health authorities and policy decision makers worldwide to strengthen the health services and reduce the existing vulnerability of less developed countries.

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