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Principles of Disaster Mitigation in Health Facilities

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Preface

This book presents key principles of disaster mitigation that can be of value to health facilities throughout the Americas. By compiling this information the Pan American Health Organization, the Regional Office for the Americas of the World Health Organization (PAHO/WHO) hopes to reach national and local authorities, hospital administrators, officials and staff, and other human resources connected in significant ways to health facilities. The book is aimed at health professionals, personnel responsible for health facility operations and maintenance, educators, architects and engineers, and members of the construction industry.

During its first meeting, held in July 1997, the PAHO/WHO International Hospital Mitigation Advisory Committee recommended that publications dealing with hospital mitigation have a multidisciplinary approach and include experiences and case studies from throughout Latin America and the Caribbean. Based on this recommendation, the PAHO Emergency Preparedness and Disaster Relief Coordination Program decided to produce a new and extensively revised edition of Disaster Mitigation in Health Facilities, originally comprised of four volumes: General Issues, Administrative Issues, Architectural Issues, and Engineering Issues. As the titles imply, each volume examined a different facet of disaster mitigation in hospitals, and had a different target audience.

Since the Advisory Group recommended a multidisciplinary approach, the four volumes have been condensed into one. Some of the chapters and sections have been simplified and rewritten for a more general audience, and other graphical elements have been introduced to illustrate key concepts, particularly the factors that increase hospital vulnerability to natural disasters. Case studies from countries in the region describe the methodology employed in various mitigation projects and processes, as well as the results of such initiatives, showing that hospital mitigation is indeed practical and feasible.

One of the most relevant success stories in Latin America and the Caribbean has been the inclusion of disaster mitigation issues in the sectoral reforms underway in a majority of countries, thanks to awareness-raising efforts at the political level. Sectoral authorities can therefore proudly point to the positive results, in terms of cost effectiveness, of incorporating mitigation measures into any process aimed at upgrading health facilities, and health care in general.

This book examines the potential problems that can arise when disasters strike health facilities, and offers specific mitigation measures, emphasizing the key components that have to be in place for health establishments to continue providing vital services during and in the immediate aftermath of a major emergency.

Health facilities can be affected by natural phenomena such as earthquakes, hurricanes, landslides, volcanic eruptions, and floods. They can also be damaged by anthropic (i.e., man-made) events such as fires, gas leaks or explosions. However, the emphasis here will be on seismic events, for two reasons. The first is that no other natural disaster affects health facilities as severely as earthquakes do. The second is that in reducing both the direct and indirect effects of seismic events, practically all other hazards are reduced.

Introduction

The planning, design and construction of health facilities in high-risk areas provide multiple challenges to the professionals involved in these efforts, given the importance of such buildings to the everyday life of a city—particularly when disaster strikes. A community's recovery after a major event depends to a significant extent on the ability of health facilities to function without interruption and to provide the extra care needed during an emergency. Many issues must be considered, ranging from the site chosen for construction to the installation of nonstructural equipment, not to mention the architectural design and structural integrity of the buildings.

Many health facilities have suffered severe damage as a result of natural disasters (particularly high-intensity earthquakes and hurricanes), leading to the partial or total collapse of the structures and the interruption of the health services urgently needed by the victims of the event.

It is in this context that existing regulations on the design and construction of health facilities must be revised. They must be reoriented towards disaster mitigation, with the ultimate goal, not only of protecting the lives of their occupants, but of ensuring that these facilities can continue to function after a disaster strikes.

This book compiles information previously published by PAHO/WHO, covering topics related to potential problems generated by natural events as well as the mitigation measures necessary to ensure that a facility will continue to function during and immediately following an event. It aims to encourage the reader to reflect on the planning, design, construction, operational and maintenance criteria governing health infrastructure. It presents techniques for the identification and assessment of hospital vulnerability. Risk mitigation solutions are presented that will protect both the population and the investments made in building or improving health facilities. The book is not intended to cover in detail technical aspects that have been the subject of academic publications, although the necessary references are included for the benefit of the reader who wishes to study these topics more in depth.

Chapter 1 reviews cases of health facilities affected by disasters in the Americas, including descriptions of the types of damage and, more generally, the losses suffered by health facilities as a result of earthquakes in recent years. Other topics include the role of health facilities in disaster situations, the demand for their services in such situations, and the economic and social costs of not having access to them at such a critical moment. Finally, the types of physical vulnerability found in health facilities are enumerated.

Chapter 2 focuses on structural vulnerability. When vulnerability is high, the essential operations of a health facility may be compromised, lives may be lost, and the facility's assets may be destroyed. The chapter discusses architectural practices that augment structural vulnerability, and provides guidelines on how to perform a vulnerability assessment based on the most widely accepted engineering methods. Additional guidelines explain how the facility's infrastructure can be reinforced through retrofitting or rehabilitation.

The vulnerability of nonstructural elements is the subject of Chapter 3, which discusses the behavior of architectural finishes and of medical and support equipment and installations. Steps are outlined for inventorying and assessing nonstructural vulnerability and carrying out the interventions needed for risk mitigation.

Chapter 4 deals with administrative and organizational vulnerability issues that can interrupt or degrade hospital services after a major event. Key concepts are outlined, including sectoral modernization, decentralization and quality control. These concepts provide the framework for the implementation of sectoral guidelines for disaster mitigation.The wrong administrative and organizational procedures can increase this type of vulnerability; recommendations are made on how to prevent or modify them.

One of the most important topics in this chapter is how to use the various vulnerability assessments of the facilities to perfect disaster preparedness activities until the resources are in place for an intervention. However, the connection between disaster preparedness, on the one hand, and functional and nonstructural aspects on the other, can only be explored here superficially, and readers are encouraged to consult the specialized publications produced by PAHO that are included in the references,[1] and which detail the methodologies required to formulate, test and update hospital emergency plans.

The annex outlines current methods used to analyze the structural vulnerability of hospitals.

[1] An extensive bibliography on safer hospitals, including relevant publications on hospitals and disaster preparedness, can be found in Bibliodes # 22, September 1995. Bibliodes is published by the Regional Disaster Information Center (CRID), a resource center for disaster mitigation for Latin America and the Caribbean that is partly sponsored by PAHO/WHO and the Secretariat of the International Decade for Natural Disaster Reduction (IDNDR).

Executive Sumary

Hospitals, and health facilities in general, are exposed systems that can suffer severe damage as a result of intense natural phenomena. Given the seriousness of the risk, new health facilities must be built to standards that can help them to withstand the natural hazards that surround them. It is also necessary to assess the vulnerability of existing buildings with a view to identifying their weaknesses, and to plan, design, and carry out the physical interventions or retrofitting needed.

Between 1981 and 1996, a total of 93 hospitals and 538 health centers were significantly damaged as a result of natural disasters in Latin America and the Caribbean. Some collapsed. Others were so weakened that they had to be evacuated. According to the Economic Commission for Latin America and the Caribbean (ECLAC), direct losses in the Region as a result of such events reached US$ 3.12 billion over that period. To visualize such an impact, it helps to imagine 20 countries in the region each suffering the collapse of 6 major hospitals and 25 health centers. This underscores the urgency of reviewing design strategies and construction practices of health facilities located in disaster-prone regions.

When it comes to disaster mitigation, hospitals require special attention due to the vital functions they perform, their high level of occupaancy, and the role they play during a disaster situation.

At any given moment, hospitals can have a large population of resident patients, outpatients, staff members and visitors. In the event of a disaster, they must continue to treat the patients who were already in their care, while tending to the needs of the injured. For this to happen, the staff must be in place and must know how to respond to the situation. It is just as important, however, for the infrastructure and equipment to remain functional after disaster impact.

The systematic organization and easy mobilization of the staff, equipment and supplies in a safe environment are crucial if disaster response is to be prompt and effective. Buildings, technology and processes are both interdependent and critical. Deficiencies in any of the functional aspects of a hospital can plunge the institution into a crisis.

Moreover, due to the high cost of health facilities and the vital services they provide, major damage can have a severe impact on public finances and the production capacity of a country due to the high costs of repair and reconstruction.

Hospital facilities include clinical services, diagnostic support services and general services, all of which have specific functions and yet must interact for the hospital to operate effectively. The relationship between administration, intermediate or outpatient services, general services, outpatient consultation, emergencies, and inpatient services is critical, and when designing the facilities attention must be paid to their operations and physical distribution in the event that a massive number of patients must be assisted. The areas surrounding the hospital and hospital access routes play a particularly important role in disaster response. A hospital can be the victim of a functional collapse, a danger that is often detected only in the middle of an emergency.

A building may remain standing after a disaster yet be rendered incapable of providing medical care due to nonstructural damage. In most buildings the cost of nonstructural components is considerably higher than that of structural components. This is particularly true of hospitals, where between 85% and 90% of the value of the facilities lies in the architectural elements, the mechanical and electrical systems, and the medical equipment. A seismic event of lesser magnitude, which is far more common than a major earthquake, can damage nonstructural elements. These key components of a hospital, those most directly linked to its purpose and function, are the ones most likely to be affected or destroyed by earthquakes. On the other hand, it is easier and less costly to retrofit them and prevent their destruction or severe degradation.

Many of the problems mentioned above originate in structural and nonstructural safety of the building. The structural components should be considered during the design and construction phase of a new building or during the repair, remodeling, or maintenance of existing buildings. Good structural design is key to a building's survival in an earthquake. Damage may occur, but collapse is unlikely.

Unfortunately, in many countries in Latin America and the Caribbean codes for seismic-resistant buildings have not been followed or have not taken into account the special specifications required by health facilities. Little wonder, then, that every time a major earthquake shakes the region, the most severely damaged buildings will include some hospitals. Hospital vulnerability is high and this must be corrected in order to prevent economic, social and human losses, particularly in developing countries that can ill afford such losses.

Disaster mitigation through the adoption of preventive measures makes economic sense in areas prone to recurring events. For each dollar invested in mitigation before a disaster strikes, enormous savings will be made in losses prevented. Mitigation is ultimately cost-free, since it pays for itself in lives and money saved.

The various mitigation measures have different implementation methods and costs. The simplest and most economical have to do with nonstructural and administrative and organizational aspects; the most complex and costly are the structural measures. If an integrated hospital mitigation plan is carried out in stages, the use of resources can be spaced out over time, making it easier to keep the additional expenses within a reasonable margin of ongoing maintenance costs.

A vulnerability analysis begins with a visual inspection of the facilities and the preparation of a preliminary report. This inspection makes it possible to identify the areas that require attention. The report will be discussed with consultants and hospital authorities in order to set priorities and a timetable for undertaking the work.

In every documented case, cost/benefit analysis has shown the economic and social sense of upgrading the structural and nonstructural behavior of vulnerable hospital buildings. The cost may seem high, but it is always significantly lower than that of repairing or replacing damaged facilities. It is useful to ask questions such as this: how many CT scanners could be bought with the cost of retrofitting the building? And how many of them does the hospital now have? The answer can be surprising, without even considering the other equipment and assets currently housed by the facilities, much less the human lives directly or indirectly at risk due to the current deficiencies and the social cost of losing the services provided by the hospital.

Risk reduction in hospital design is a responsibility shared by architects, engineers, physicians and administrators. The link between architecture and resistant structural systems must be clear to all involved in the design process in disaster-prone areas.

The loss of life and property as a result of an earthquake can be prevented by applying available technology and without great expense. The only thing needed is the will to proceed. With the current understanding of the construction requirements for buildings that can resist earthquakes, hurricanes, and other natural hazards and damage can be minimized as long as the right preventive measures are taken in the design, construction and maintenance of new health facilities.

Recommendations

1. All buildings where health services operate in disaster-prone areas must carry out vulnerability and risk assessments of the structures and essential hospital services.
2. Appropriate mitigation measures must be taken in the design and construction of new health facilities or the remodeling and expansion of existing establishments in accordance with an integrated disaster mitigation plan.
3. Nonstructural mitigation or intervention measures must be included in plans for maintenance, inspection, remodeling, and upgrading existing hospitals.
4. Risk reduction specifications must be met as part of the procedures for acquiring, operating, and maintaining hospital equipment and systems.
5. Hospital disaster preparedness plans must be reviewed to take into account hospital vulnerability.
6. Design and building codes must be enforced in the design and construction of health facilities. They must aim not just to protect the lives of their occupants but also to ensure the uninterrupted operations of the facility after a disaster has struck.
7. Health care administrators, medical staff, builders and maintenance personnel must be made aware of the standards to be met for buildings entrusted to withstand the impact of potential natural disasters.
8. Hospitals must keep up-to-date information and floor plans of their buildings' architectural, engineering and technical design in a safe and accessible place.

This book, ***Principles of Disaster Mitigation in Health Facilities***, has been prepared by the Pan American Health Organization (PAHO) for national and local authorities, building owners, administrators, health professionals, officials, engineers, architects and other personnel involved in the planning, operations, and management of health services. After describing the kinds of damage that may be expected in the event of a natural disaster, guidelines are provided to incorporate seismic risk mitigation procedures in the inspection of existing establishments and the planning, design, and construction of new structures.