Good Practice

St. Kitts & Nevis

Ensuring design, construction standards for a paediatrics unit

The event that prompted action

Citizens of the small Caribbean nation of St. Kitts and Nevis in the Eastern Caribbean had a sense of déjà vu as they awoke on 21 September 1998 to survey damage caused overnight by Hurricane Georges. Roofs were lost and other buildings seriously affected at Joseph N. France Hospital. The laboratory roof was gone and support services such as storage facilities, laundry and the central sterile supplies department all had sustained damage. An estimated 90 per cent of the hospital could not function. With its 174 beds, Joseph N. France Hospital is the only referral hospital on the island, serving a population of 33,000 people on St. Kitts and 9,000 on Nevis.

Three years earlier, almost to the day, Hurricane Luis had ripped through the island, damaging the same hospital severely. In fact, JN France Hospital has suffered moderate to severe damage from hurricanes on no less than 10 separate occasions since it opened in 1966.

Action taken

A phased redevelopment plan of the Joseph N. France Hospital, which called for incorporating disaster mitigation measures into the building of a new accident and emergency and outpatient department, operating theatres, a laboratory and radiology unit, medical records and a pharmacy, was already on the drawing board.

In the phased redevelopment plan, the paediatrics ward was slated to be replaced by a new building at a later date. In the interim, certain disaster mitigation measures, such as strengthening the roof and reinforcing the walls, were taken and equipment was replaced. Yet some key items of equipment continued to deteriorate due, in large part, to the longer-term effects of water damage.

The arrival of Hurricane Georges (1998) forced the Ministry of Health and Environment to step up its plans for the JN France paediatrics ward and, within the framework of the larger development project, work was completed in 2001 to:

- Construct a new 24-bed paediatrics unit, using appropriately modified design standards and incorporating disaster mitigation and risk reduction measures with respect to natural hazards;
- Procure and install equipment for the JN France and Alexandra hospitals to support paediatric service at these institutions; and
- Provide training in post-disaster stress management for up to 25 persons, disaster management training for 20 persons, and training on equipment maintenance for up to five people.

A key step to building a safer hospital

Building standards to protect facilities have been around for years, but unfortunately, simply incorporating risk reduction (prevention, mitigation and preparedness) measures into the design is no guarantee that they will be followed during construction. Cost restrictions and time constraints can lead to shortcuts to meet deadlines. However, in the rebuilding of the JN France paediatrics ward, one important measure was taken to ensure that design standards were adhered to. A bureau de contrôle (quality control firm) was hired. A bureau de contrôle is an independent firm, licensed by the state to check designs and make site visits during construction. Certification by a bureau de contrôle determines whether or not insurance coverage and a mortgage may be obtained for a building. The earlier Hurricane Luis (1995) revealed an important lesson about this concept.

In addition to St. Kitts and Nevis, Hurricane Luis also impacted neighbouring Saint Martin/Sint Maarten, an island jointly administered by France and the Netherlands. Interestingly, there were clear differences in the amount of damage on the two sides of the small island, and there was a reason for this. As it happened, the French side fared much better than the Dutch and it was suggested that this was due, at least in part, to the French custom of using bureaux de contrôle to monitor design and construction of infrastructure. In fact, based on the apparent success of this approach in Saint Martin, the use of independent check consultants has become a standard recommendation with respect to the design and construction of retrofitting and new health facility projects.

A check consultant was also used during the rebuilding of the JN France paediatrics unit. A consultant reviewed the design in terms of the disaster mitigation and other risk reduction measures proposed for natural hazards and provided supervision and advice during construction. An initial report was provided to the architects early in the process and modifications were made to the designs. Site visits during construction were carried out and reports submitted to the architects and the Ministry of Health and Environment.

Lessons learned

1. The redevelopment of Joseph N. France Hospital was already underway and an overall master development plan for the site had been prepared when Hurricane Georges struck St. Kitts and Nevis in 1998. The subsequent decision to rebuild the paediatrics ward, and the speed at which it was developed and implemented, illustrated the importance of having such a master plan in place to coordinate multiple projects and funding sources.

2. The main project partners, national and international, were based in different countries. A Project Steering Committee representing all interested parties met regularly and this was important to monitor timelines and facilitate communication and decision making.

3. The use of an independent check consultant engineer to review the designs and audit the construction with regard to natural hazard mitigation ensured, to the extent possible, the construction of a health facility safe from natural hazards. This approach continues to be promoted in the Caribbean with governments and funding agencies. Fortunately, the measures incorporated into the construction of the paediatrics unit—primarily to reduce the risk and impacts of hurricanes and earthquakes—have not yet been tested in an actual disaster situation.

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Nepal

Awareness triggers action at a major public hospital

The event that prompted action

Nepal is highly prone to disasters, particularly to earthquakes, which claimed more than 11,000 lives in the 20th century alone. Data suggest that earthquakes of the magnitude of the Great Bihar Earthquake in 1934 occur approximately every 75 years and although this is only a statistical estimate, a devastating earthquake is inevitable in the long run and likely in the near future. This is particularly troublesome because the Kathmandu Valley Earthquake Risk Management Action Plan suggests that as many as 60 per cent of buildings in the area are likely to be heavily damaged if the ground motion of the 1934 earthquake is repeated today.

How would Nepal's health services cope with such an event? To find out, an earthquake mass casualty scenario was used for Kathmandu Valley to estimate the number of people that would require hospital services, based on: (1) expected damage to buildings; (2) a one-to-five ratio of deaths to injuries; and (3) the Kathmandu Valley's population of 1.5 million (in 2002).). The estimates ranged as high as 22,500 dead (up to 1.5 per cent of the population), with up to 112,500 injured.

Even the best of health systems would be hard pressed to deal with this scale of injury. And in the most severe intensity earthquakes, chances are that even the combined capacity of all emergency departments in Kathmandu Valley would only be able to serve a fraction of those requiring care. The limited number of patient beds and the fact that hospitals would be damaged, unable to function or even collapsed are aggravating factors that would put thousands of patients and health workers at risk.

Action taken

Recognizing the gap between current hospital capacity and predicted medical needs in a post-earthquake scenario, a seismic assessment of 14 hospitals was conducted in 2001 in Kathmandu Valley, including Patan Hospital. Subsequently, Patan was one of four priority hospitals to undergo a more rigorous study. Unlike most other hospitals in Nepal, Patan Hospital's earthquake resilience was considered relatively good. Nonetheless, it was almost a foregone conclusion that a major earthquake would leave the hospital unable to function due to structural and non-structural damage . Therefore, the study recommended a detailed structural analysis to assess how the hospital would fare during high-intensity earthquakes. It also called for backup generators with an adequate fuel supply to provide an uninterrupted supply of electricity if external power is interrupted, response scenarios that simulate handling at least 200 casualties (the potential consequences of mid-scale earthquakes) and plans and procedures that contemplate a hospital that has been out of service.

Hospitals are more than concrete blocks and steel beams. They are made up of people and services and systems, all of which go into making a safe hospital. Patan Hospital was one of the first hospitals in Nepal to develop a hospital emergency plan, and so it is not surprising that it became one of the first health facilities to take part in a mass casualty mock drill. Civil society organizations and

health officials worked together in a simulated rescue chain, from incident site to emergency ward, thus strengthening the links between community and hospital, including the critical pre-hospital response. Equally important, the mock drill created awareness of the need for mass casualty management in host communities and among community-based organizations. Since that first drill in 2002, Patan Hospital has conducted annual drills to test and refine its emergency plan.

Patan Hospital has also taken measures to reduce seismic risk. The hospital abandoned its original plan to expand the maternity wing by adding an extra floor to existing buildings when the roof was deemed structurally too weak to carry the extra load during earthquake ground motion. Instead, a new maternity wing is being built as a separate structure, in compliance with earthquake-resistant standards. The new maternity wing will be completed next year and will add 120 beds to the present 320 beds.

Snapshot of Patan Hospital

- Type and Size: A General Public Hospital that annually treats 300,000 patients
- Staff: 60 doctors and 250 nurses
- Critical and essential facilities: Emergency department (5 beds, 100 % occupied), operating theatre (4 beds, 30 surgeries daily)
- Other facilities: ICU, maternity unit, gynaecological unit, radiology, pathology
- Total number of beds: 320
- Bed occupancy rate: 90–100 %
- Ambulances: none
- Annual patients seen in Emergency Department: 33,000

The 2001 assessment included rough cost estimates and plans for priority retrofitting. Subsequently, Patan Hospital submitted to donors a detailed funding proposal for a comprehensive structural assessment and design drawings needed to accurately estimate the cost of retrofitting existing structures so they would be functional after moderate to severe earthquakes. While the hospital itself made some of the required modifications, they were less successful in securing the needed financial support, pointing to the need to increase awareness of investing in safety measures before disaster events occur rather than undertaking costly rebuilding projects afterwards.

The WHO has worked with the National Society for Earthquake Technology-Nepal (NSET) to raise awareness of the need to incorporate seismic mitigation measures in hospitals in Kathmandu Valley, conducting ongoing assessments since 2001, disseminating their results and developing hospital vulnerability assessment guidelines. In 2006-2007, assessments were made of six Red Cross blood banks, the National Public Health Laboratory and the Epidemiology and Disease Control Division of the Department of Health Services. High-level meetings between senior health policy makers, the donor community and international banks have helped to keep the issue of disaster-resilient hospitals and health facilities on the agenda.

Lessons learned

1. Studies have shown the economic and social returns of improving the structural and non-structural behaviour of vulnerable hospital buildings. Structural retrofitting and non-structural measures can save lives and significantly increase the reliability of health services when they are most needed.

2. Even when there is a strong evidence base and a high level of earthquake risk, health planners and policy makers do not put seismic assessments and risk reduction measures at the top of their list of concerns. Often, buildings are viewed as "completed projects" that should not be modified; reconstruction is considered to expand space. Convincing health professionals of the need for seismic assessments and retrofitting is a long-term process, unless it is directly linked to disaster rehabilitation, as was the case following the 2001 Gujarat earthquake or the 2006 Kashmir earthquake.

3. In Nepal, concerns about disaster risk reduction in the health sector had their origins in local institutions, and this may be one of the key factors in the subsequent success achieved. Support from WHO helped to consolidate many initiatives taken over the previous 15 years. Health officials came on board when it was clear that risk reduction in health was a mutual concern of WHO, external development partners and civil society.

4. One of the key reasons that Patan Hospital was so receptive to the recommendations stemming from assessments and other initiatives (mass casualty drill, triage, etc.) was that it was – and still is - a well-functioning facility with close links to the surrounding community, which helped to create the necessary support base and sustainability for pursuing seismic safety.

Although there is still a long way to go, the hospital has taken steps and proved that awareness can trigger assessments, assessments result in planning and planning in mitigation; a cycle that ultimately helps minimize the consequences of living with earthquake risks in Nepal.

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Mexico

How safe is your health facility? The "Hospital Safety Index"

The event that prompted action

How can you determine if a hospital or health facility is safe when faced with the threat of disasters? And what exactly does "safe" mean? What can be done when health facilities are deemed not safe? For many years, the issue of hospitals safe from disasters has raised more questions than it has answered.

The job of developing indicators, providing baseline data and measuring progress has also proven difficult, given the diversity in size, location, staff, operating budget and vulnerability to natural hazards and crises. As not all hospitals face the same risks, nor are they built using the same methods, a wide range of elements needs to be taken into consideration to help give a snapshot of where the facility stands.

Action taken

The above-mentioned issues are being tackled by the Disaster Mitigation Advisory Group (DiMAG), a group of expert engineers, architects, health services administrators and disaster specialists. The DiMAG is developing a low-cost, easy-to-use tool called "Hospital Safety Index". This tool will allow countries to quickly measure and rank a health facility's level of safety, prioritize actions that would improve safety and monitor progress.

How does the Hospital Safety Index work? First, general information is gathered on each facility's level of complexity, the population it serves, the number of health staff it has, natural hazards prevalent in the area, and disaster history. Evaluators then use a checklist to measure aspects that contribute to the facility's safety: structural components (load-bearing walls, foundations, columns, etc.), non-structural components (architectural elements such as laboratory equipment, furnishings, ventilation or electrical systems) and organizational/functional elements such as the emergency operations centre, contingency plans, backup systems for water and electricity. Each component's safety is ranked as high, medium or low, following a series of pre-determined standards. These scores are weighted according to the importance of the aspect being evaluated. A programme automates and standardizes the assessment and evaluation phase, reducing bias and lessening the chance of mathematical error.

Applying the Hospital Safety Index takes very little time (several hours) and gives an accurate although general idea of which safety level the facility falls into and what improvement measures are recommended. However, this tool does not replace an in-depth vulnerability assessment conducted by experienced engineers.

Mexico, a large country with more than 3,000 public and private hospitals, offers an interesting example of how this process works. In 2006, Mexico created a "National Committee on Safe Hospitals,"

made up of representatives from a variety of institutions such as the Mexican Hospital Association, the Social Security Institute and the Secretary of Health.

More than 400 people have been trained to use the Hospital Safety Index, which classifies the hospital's safety level into categories A, B or C according to a numerical ranking. What does this score mean?

Hospital Safety Index Score	Necessary Measures
C = 0 – 0.35	Urgent measures must be taken immediately, as the health facility's current level of safety is insufficient to protect patients and staff during and after a disaster or emergency.
B = 0.36 – 0.65	Short-term measures are required, as the health facility's current level of safety could potentially put patients, staff and the facility's ability to function at risk during or after a disaster or emergency.
A = 0.66 – 1	Although it is likely that the hospital will continue to function in emergency situations, it is recommended that measures continue to be taken in the medium and long term to reduce risk and incorporate mitigation measures particularly for structural safety.

The Index was then applied in more than 100 health facilities, which were determined to be at risk, either because of their geographic location or due to their critical importance in the health network. The results showed that more than 60 per cent of these hospitals were classified as "safe" in terms of structural and non-structural components. However, almost the same percentage was deemed to require improvements in the functional/organizational aspects (disaster planning, organization, training, critical resources, etc.) After reviewing the results, the coordinator of the Mexico's Civil Protection System committed to include "Safe Hospitals" as a national disaster reduction priority, for which he received the backing of the country's president. Mexico is committed to applying the Hospital Safety Index to all high-risk facilities (slightly over 1,000) in 2007 and to begin the process of certifying those facilities with an "A" rating.

In the Caribbean — where a single hospital can be of vital importance, as it may be the only one in a country, additional considerations have been added to the required survey form to measure the degree of disruption to a health facility if the recommendations are implemented, and the cost associated with doing so. Authorities can appreciate at a glance that, with limited funds and minor disruption, their safety score can be improved. The box to the right shows a sample of this expanded form.

Although the Hospital Safety Index is just getting off the ground, it has proved to be a powerful instrument for rallying country support around the issue of safe hospitals. Rating the safety of a health facility (as opposed to focusing on vulnerability) requires

Next steps

striking an appropriate balance between providing a secure environment for the patients, making health care accessible and factoring in economic considerations. This is a complex process and the Hospital Safety Index is only one of a variety of tools that managers can use to gather the information they need for sound decision making.

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Pakistan

Rebuilding better through compulsory risk reduction designs

The event that prompted action

A 7.6 magnitude earthquake struck a wide region of South Asia on the morning of 8 October 2005, affecting parts of Afghanistan, India and northern Pakistan. The epicentre of the earthquake was located 95 km northeast of the Pakistani capital, Islamabad. In a matter of seconds, 85 per cent of the infrastructure in towns such as Balakot was destroyed. Other cities such as the Kashmiri capital, Muzaffarabad, lost between 40 to 50 per cent of its buildings. Strong aftershocks threatened structures already damaged by the initial quake.

More than 73,000 people lost their lives and at least 150,000 others were injured. Demand for emergency medical care was overwhelming. The earthquake left an estimated 3.2 million people homeless.

At the time of the quake, 796 health facilities — ranging from sophisticated hospitals to small rural clinics — were operating in the area. Of that number, 388 (almost 50 per cent) were completely destroyed. Thirteen of the destroyed facilities were hospitals, and four of these were regional or district referral hospitals[1]. An additional 106 primary health clinics and 50 dispensaries were completely lost — and often these were the only sources of health care within a five-hour walking distance in the affected rural areas. The remaining facilities that were able to continue functioning were overwhelmed. Even if the area had not lost 50 per cent of its capacity, the sheer number of seriously injured people that required medical care would have overwhelmed even the most sophisticated health system. Because of this, more than 14,000 persons were evacuated by helicopter to Islamabad for treatment — about 425 per day in the first month alone. And, in addition to physical damage to health facilities, the health sector itself was adversely affected, as many health professionals suffered direct losses, or worse, lost their lives.

[1]A referral hospital is a facility that can provide a wide variety of health care. Often patients are sent to referral hospitals for specialized treatment or because a smaller facility cannot provide the care required.

Could lives have been saved?

If vulnerability assessments had been systematically carried out, if hospital disaster plans had been better prepared, tested and widely disseminated, and if health staff was better prepared in areas such as mass casualty management, many lives might have been saved and health facilities might have been able to function better, in spite of damage and the impact on health staff. The town of Balakot, which saw 85 per cent of its infrastructure destroyed, including the hospital, is an example. In retrospect, it was learned that the town itself was built on unstable (unsafe) terrain. After the earthquake, the Government of Pakistan declared a 600-hectare area a "red zone", meaning that no construction was allowed. Had earthquake vulnerability assessments been conducted beforehand, the risk would have been known and the existing hospital could have been retrofitted. In other instances, if proper triage systems had been in place, unnecessary evacuations

— which separated many families already in a chaotic situation, forcing them to travel significant distances to search for injured relatives — could have been avoided.

Could lives have been saved? Most of the deaths were instantaneous and only could have been prevented if buildings had not collapsed. The earthquake struck on a Saturday morning, catching many people unaware at home. The majority of the houses that killed the inhabitants were poorly constructed with materials of inferior quality. As in almost all disasters, the majority of the affected people were poor.

Action taken

Rebuilding health facilities became a priority. To help ensure that a future disaster of this magnitude would not cause the same devastation, the Government of Pakistan introduced a series of disaster risk reduction and preparedness measures at local, provincial and national levels. One of these was the creation of the Earthquake Reconstruction and Rehabilitation Authority (ERRA). Under its programme "Knowledge and Capacity Building for Disaster Resilience: Earthquake-Affected Region in Northern Pakistan" UN/ISDR assisted ERRA in designing earthquake resistant buildings. Many of the designs, technologies and techniques introduced by the Citizen's Foundation (a UN/ISDR implementing partner) were accepted and supported by ERRA as a standard to be followed by others. The standards were applicable and are being followed by many for housings as well as critical infrastructure (schools, health facilities, mosques etc). The program was complemented comprehensively by awareness raising (through knowledge centres at grassroots level) and training programs for home owners, craftspeople, village elders, and line departments of the government. The training included guidance on ensuring that heavy equipments or furniture such as racks/cupboards are fixed properly so that in case of earthquake they do not fall and cause damages. In the specific case of health facilities, ERRA looked at the geographical and population distribution of the health facilities that were scheduled to be rebuilt and concluded it was unnecessary to rebuild all pre-existing facilities. Rather, they chose to build back better by providing compulsory earthquake risk reduction designs for the 237 new basic health units, district and tehsil (sub-district) headquarter hospitals and rural health centres that are being rebuilt (the designs can be viewed on the Internet at http://www.erra.gov.pk/Reports/Construction_Guidelines_26may06.pdf). Another 105 health facilities have been or will be repaired using safety and seismic retrofitting.

However, the construction and retrofitting of earthquake-resistant buildings require much more than building codes and guidelines. Enforcement measures are critical to ensuring that health facilities are actually built according to seismic standards rather than simply conforming to a "paper" design. Enforcement implies meticulous control of ongoing construction and retrofitting projects by an independent agency.

Lessons learned

The South Asia earthquake of 2005, like all disasters that cause massive damage and great human losses, created a real window of opportunity in terms of raising the awareness of national authorities on the need for disaster risk reduction in the health sector. In Pakistan, members of civil society also demanded that national, regional and local disaster mitigation and management strategies were developed based on lessons learned. The lessons learned include:

1. Lack of public awareness about hazard risk management leads many people to react inadequately in the immediate aftermath of an earthquake. Training and capacity building for health staff in crisis situations increases the chances of saving lives and allowing health services to remain up and running. Health personnel at all levels must become agents of risk reduction, helping to identify health risks and promoting strategies to minimize the impact of disasters on the affected population.

2. A decentralized disaster management plan needs to include all health facilities at the local level and provide them with the necessary means to ensure that health services remain functional in emergency and disaster situations.

3. The design and construction of all new hospitals and health facilities must be earthquake proof as well as for other hazards. Almost 50 per cent of health facilities in the October 2005 earthquake affected area in Pakistan were totally destroyed, causing a serious gap in health care delivery immediately after the earthquake, and in the medium to longer term.

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Grenada

Making homes for the elderly safer following back-to-back hurricanes

The event that prompted action

Hurricane Ivan was one of the most intense storms of the 2004 Atlantic hurricane season, at one point reaching category 5, with hurricane winds in excess of 248 kph. As the massive storm passed near the small Caribbean nation of Grenada in September, the sustained wind speed in the eye wall was 193 kph, with a degree of wind pressure 30-60 per cent greater than prescribed by the Caribbean Uniform Building Code (CUBiC). Fortunately, Hurricane Ivan was a fast moving storm. Had it lingered over Grenada, there would have been more structural damage and much greater rainfall. Hurricane Ivan badly damaged Grenada's Richmond Home for the Elderly, which also accommodates psychiatric patients. The entire roof of the three-story main building collapsed (the top floor had housed female patients). When this occurred, the Richmond Home had approximately 100 residents, but over the course of the next six months, some 30 residents died. Although one death was the direct result of collapsing structures during the storm, most of the deaths came about as a result of the increased stress faced by the elderly living in unsanitary cramped conditions following what must have been a traumatic event.

Action taken

Following Hurricane Ivan, a damage assessment of the Richmond Home was conducted. In addition to hurricanes, the study looked at a full range of natural hazards, including earthquakes and torrential rains. The cost of implementing the works recommended by the study was estimated at US$1 million. In the meantime, as an emergency measure, the roof of the main building was replaced to permit female residents to reoccupy the upper floor. Volunteers and military personnel from a neighbouring country, without formal engineering input, carried out the roof replacement.

Ten months later, on 13 July 2005, Hurricane Emily (a category 1 event) struck Grenada, causing significant damage to the temporary roof that was installed after Hurricane Ivan. A post-Emily assessment revealed damage to the roofs of the main building and the physiotherapy room and water damage to floors, walls and electrical distribution systems. When Emily struck, not all of the damage from Hurricane Ivan had been repaired. In particular, the nurses' quarters had not been returned to full use, and the repairs that had been made, were emergency repairs and not intended to withstand future hurricane events.

At this point, there was general agreement that future repairs and retrofitting should aim to meet standards for a geriatric home to retain its functionality for the medium term (5 to 10 years). These standards should also be suitable for the long-term alternative use of the facility for other institutional purposes after the geriatric home is relocated to a more suitable site.

Synergy between design, checking and quality control

When repairs began to the Richmond Home in September 2005, a check consultant was recruited to review the design and make recommendations for improvements. The check consultant also was to review the construction quality control procedures and make occasional site visits to see whether the procedures were being followed.

Optimally, a check consultant should begin work when a design team is appointed, in order to avoid delays in the review and approval processes and the need to redo much of the work. However, in this case, Grenada's Agency for Reconstruction and Development was well advanced with its work before the check consultant was appointed. And so, when an initial review of the plans revealed that the conceptual design would replicate what was there before Ivan and Emily, it was clear that the drawings were far from complete for construction purposes. No calculations had been presented. The specifications required a great deal of revision. Much information remained to be completed before construction began.

Time was becoming a major issue, as the occupants of the Richmond Home needed to be accommodated in safer living quarters as soon as possible. In the best case scenario, there was a clear division of work: the designated engineer was responsible for the design and the check consultant for reviewing it.

The checking process involves a degree of assistance, guidance and transfer of knowledge. Indeed, check consultants help develop the construction industry by improving the design process and quality assurance systems. There is a real opportunity for technology transfer in this method of building standards control and the process works best if the designer does his/her part before submitting it for review. During this process the designer may seek information and guidance from the checker but the checker should not become the designer!

During the course of construction, the check consultant made four site inspections to review quality control mechanisms, observe the progress of the works, review proposals for works not yet defined in documents and address administrative matters. A little over a year from the time work began, the Richmond Home was re-commissioned, providing a structurally and functionally safe health facility for its vulnerable occupants who are even more at risk in emergency situations.

Lessons learned

1. Repairs made to buildings — particularly critical health facilities — damaged by the effects of natural hazards should aim to meet standards prescribed in current national codes, where these are available. Otherwise, the advice of specialists should be sought regarding appropriate standards.

2. Facilities that house confined or non-ambulatory persons require higher standards of safety than conventional buildings.

3. Check consultants should be employed for all major healthcare work projects. The checking consultant should be an engineer (or engineering firm) with considerable knowledge and experience in designing facilities to withstand natural hazards common to the geographic location of the project. The check consultant should commence work at the same time as the design team and carry out the checks in tandem with the design process.

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