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**Exploring The Relationship Between Development And  
Disasters: Bir Hospital As A Microcosm Of This  
Relationship**

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requirements for the degree of**

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# **Chapter 1**

## **Introduction to the Project**

### **Identification of the Problem**

An increasing problem worldwide is the escalation in the frequency and magnitude of disasters and the corresponding need for disaster relief (Cardo 1997:14, Stenchion 1997:40). In the decade preceding 1997 the number of major disasters was four times higher when compared with the 1960s. During this period of time the number of people affected by disasters grew by an average of 6% per year (Boulle 1997:3). Of these people a disproportionate number were in developing countries. Over the last three decades approximately 90% of disaster victims have been in Africa and Asia (Yuanchang 1996:6). From 1997 to 1999 the international community spent in excess of US\$7 billion on relief aid in response to disasters (Guha-Sapir et al 1999:1649). A direct outcome of this increased spending on relief is that less investment is made in development. In 1970 1.5% of overseas development assistance from the Organisation for Economic Cooperation and Development (OECD) was spent on disaster relief. In 1990 this had risen to 6.5% and today is much higher again (Stenchion 1997:43). The World Bank acknowledge that loans given for development purposes are re-directed into disaster relief at times (Gilbert et al 1999:20).

Some key questions arise from this introductory information. Obviously, disasters are having an impact, at least financially, on development. Is this the only relationship between disaster and development or are there other factors? It is a worrying trend that the frequency and magnitude of disasters is on the increase and that as a result funds are being diverted from development to meet relief needs. Can this increase be halted and reversed and as a result ensure funds are not diverted from development? This paper will explore these questions and present information gathered from literature on these topics to assist with answering the questions. In addition, a case study will be presented of Bir Hospital, Kathmandu, as a microcosm of the relationship between disaster and development.

### **Key Disaster-related Definitions**

As a basis for the following discussion a number of definitions will first be given. A hazard is defined in the Australian and New Zealand Risk Management Standard (Australian/New Zealand Standard 1999:Section1.3) as being "a source of potential harm or a situation with

a potential to cause loss". Vulnerability is described as being the attributes of a person, household or community which give them the protection and coping abilities to meet and recover from the impact of a hazard (Stenchion 1997:41, Vrolijk 1997:6). A phrase that has reached prominence in emergency management circles in New Zealand recently is that of "creating resilience in the community" to hazards. It is the same concept that should be applied to any community worldwide when trying to reduce vulnerability to a hazard.

In simple terms, a disaster can be considered to be the outcome of the interaction between a hazard and a community's vulnerability. It is the impact the hazard has on the community or individual households, which is the disaster (Vrolijk 1997:6). Stenchion (1997:40) puts it this way; if the community's resources cannot meet the demands of the hazard the result is a disaster. Although there are many definitions of "disaster", most do communicate these key elements; an event that affects people or communities in some way, either by injury or death, loss or damage to property and that social functioning is disrupted (Auf der Heide, 51:1989, Smith, 5, 20:1996). Bolin and Stanford (1998) extend the understanding of a disaster further by writing "... an... event is the trigger, but the disaster that follows is the product of political, social and economic forces in everyday life". This is echoed by Stenchion (1997:42) who identifies the main factors that contribute to a community's vulnerability as being poverty, inequality, environmental degradation and population growth among the poor. It is recognized that within these communities there are often groups of people who are more vulnerable than others, for these very reasons. To illustrate this, it was identified after the Northridge earthquake, that of the total population group who were exposed to the same earthquake, some were better able to withstand the losses and burdens than others. In fact, those who were most vulnerable at the time of the earthquake still had unmet needs long after the response phase had ended and much of the population had recovered from the earthquake. It was emphasised that pre-disaster vulnerability played a key role in the response to and recovery from the disaster, and that often this left the vulnerable group even more vulnerable to the next disaster that may happen, thus creating a vicious cycle (Bolin and Stanford 1998:23). Although a person or community's vulnerability may be largely beyond their control a number of writers do add the perspective that humans are not totally helpless or blameless but that it is their actions which often contribute to disasters (Boulie 1997:3, McEntire 1998:52).

Many of the hazards which present to communities have always existed. However, these communities are dynamic, constantly growing and moving, creating larger groups of people

who are exposed to these hazards. Within communities, especially large cities, there is a growing problem of poverty and inequality. These large numbers of people have a greater negative impact on the environment. All of these factors combine to create a vulnerable population. This then provides some understanding as to the reasons why disasters and their impact are increasing. Potentially, something can be done about it.

Stenchion (1997:40) identifies that a misconception often exists regarding disasters. People are heard to remark that the earthquake or the cyclone or the drought are disasters. As has been explained above, these events themselves are not the disaster but the interaction with a vulnerable community. The point to be made here is that with this misconception nothing may be done to reduce the likelihood of a disaster because what is termed as "the disaster" is seen as inevitable. If people's thinking is changed to see that it is the inevitable event plus other factors, which can be altered, then the impending disaster can be managed. This is a key point; disasters can be managed before they occur.

### **The Relationship Between Disaster and Development**

Let us now consider if the relationship between disasters and development is more than just financial. Although a formal discussion on this will follow in the immediate paragraphs, throughout this paper discussion and illustrations of this relationship are a recurring theme.

The relationship between disaster and development can be considered in two ways; what is the impact that development can have on disasters and vice versa. The key to answering the first question, what impact development has on disasters, lies in the vulnerability of a community to the hazards around them. Development can be viewed as having opposing contributions to the incidence of disasters; one being that development can make people more vulnerable (McEntire 1998:53) and the other that development can make them less vulnerable. In many parts of the world communities have co-existed with natural hazards for hundreds of years with no adverse effects. With development comes change and often the introduction of technology. Sometimes these changes, which can be rapid, make a community more vulnerable (Stenchion 1997:41). One example relevant in an earthquake-prone area is that building materials may change from lightweight, easily rebuilt materials to heavier, longer-lasting materials which will inflict more harm to the occupants of the buildings in an earthquake and then leave them without a dwelling much longer as the rebuilding time is much greater. On the contrary, if this change is managed well and cognizance taken of the local natural hazards, then the new building materials combined

with appropriate construction techniques can ensure a safe home and shelter during and after an earthquake.

Cuny (quoted in Lewis 1999:130) raises a number of pertinent questions with regard to the relationship between development and disasters: what kind of development made things worse and what development would have made things better. Ultimately, the question should be: what development is required for disaster reduction?

Now to look at the impact disasters can have on development. The most obvious and one that is felt very quickly, has already been identified; that of funding being diverted from development to meet relief needs. This is compounded by the fact that donor countries are generally contributing less in development assistance than they have in the past. According to an OECD Development Assistance Committee (DAC) report overseas development assistance from member countries is at its lowest level for twenty years (Stenchion 1997:42). Another impact of a disaster on development is that years of development work may be destroyed. A variation of this may be that the disaster destroys the resources required for future development.

This discussion leads into a recommendation that many writers have made; that disaster managers and development practitioners should work together in a partnership (Boulle 1997:4, Stenchion 1997:40, Voelker 1998:1898, Vrolijk 1997:6). This partnership would be mutually beneficial. The design phase of all development projects should include hazard and vulnerability assessments unique to the project location and activity (Stenchion 1997:44). Strategies for hazard and vulnerability reduction are then written into the design of the project. In this way the project and its outcomes are protected for the future.

An outcome of any disaster situation is the provision of relief. Relief can be viewed as the very antipathy of development. The outcomes of relief are largely palliative; they meet an immediate problem but do not treat the root cause of the problem, thereby maintaining the status quo and not changing anything. In some instances relief can make the situation worse in that it can create dependence (McEntire 1998:52). Fortunately, over the last twenty years there has been a strong move away from managing disasters by only providing relief post-disaster to one of preventing the disaster in the first instance. It is through this realignment that the links with

development have progressed and become clearer. As identified above, a disaster is as a result of a hazard impacting upon a community, which is vulnerable to that hazard. If the vulnerabilities of a community are reduced or even eliminated completely, then there would be no resultant disaster when the hazard occurs. Therefore, a key role of a disaster manager is to identify the vulnerabilities of a community and develop an action plan for reducing those vulnerabilities. Stenchion (1997:41) asserts that much of development activity is in actual fact vulnerability reduction in a community and yet the connection between disaster management and development work is tenuous at best.

As early as 1974 the General Assembly of the United Nations was "... convinced that disaster prevention and pre-disaster planning should form an integral part of international development policy of Governments and of international organizations" (quoted in Stenchion 1997:43). The same body recognized in 1979 that the effect of natural hazards was detrimental to development programmes in developing countries (quoted in Stenchion 1997:43). McEntire (1998:50) asserts that the primarily relief-based disaster management of twenty years ago has shifted to one today where the focus is largely that of disaster prevention. Like many things, he considers that the pendulum may have swung too far one way and there needs to be a readjustment. There are two main points which he raises. The first is that with an over-emphasis on disaster prevention there may not be enough attention given to preparation for relief activities which are bound to be required (McEntire 1998:53). The other is that disaster prevention can be very costly to implement and that it may not be possible for developing countries, where the greatest likelihood of a major disaster exists, to invest what is required into preventative work and that if they do other areas of development may suffer (McEntire 1998:53). The pertinent point is made that although the United States and Japan have invested a large amount of resources over the years into disaster prevention, they still suffered huge losses from the Northridge and Kobe earthquakes respectively and a response and relief programme was required (McEntire 1998:53). Although it is acknowledged there has been a strong move towards disaster prevention not all writers are as convinced as McEntire that enough is being done (Cardo 1997:14, Guha-Sapir 1999:1649, Stenchion 1997:41).

### **The Kathmandu Valley Earthquake Risk Management Project**

In recognition of the need for disaster management and development activities to be more closely aligned a project was developed that focused on disaster reduction in Nepal and

was funded by the United States Agency for International Development (USAID) in 1998. This project was initiated in recognition of the fact that the Kathmandu Valley is vulnerable to major earthquakes. The last major earthquake to occur in the Kathmandu Valley was in 1934. It is estimated that the return period for an earthquake of this magnitude is approximately 75 years. This is based on seismic records for the region which extend back to 1255 AD (Dixit et al, 1999:8).

In the mid-nineteen nineties a group of Nepali professionals formed a society, the National Society for Earthquake Technology - Nepal (NSET – Nepal). The main goals of this society are to promote awareness of earthquake risk, at all levels from government to the community, and to implement seismic risk reduction projects in Nepal. The society is a member of the International Association of Earthquake Engineering.

NSET-Nepal, in association with Geohazards International USA, implemented the project funded by USAID. This was done under the umbrella of the Asian Urban Disaster Mitigation programme being executed by the Asian Disaster Preparedness Centre in Bangkok. The project was titled the Kathmandu Valley Earthquake Risk Management Project (KVERMP). The prime objective for this project was to complete a vulnerability study of the Kathmandu Valley and identify what impact an earthquake of a similar magnitude to the 1934 one would have on modern day Kathmandu. From this work an action plan would be developed to reduce the vulnerability of the Kathmandu Valley and its inhabitants to earthquakes.

### **The Outcome of the Project**

The specific and detailed findings of the project were that it is likely that up to 60 per cent of all buildings in the Kathmandu Valley would be heavily damaged and that half the bridges in the valley could be impassable. Approximately ten per cent of roads would have moderate damage, such as deep cracks or subsidence. Of major significance, especially for outside assistance, is that all roads to the international airport are likely to be impassable as liquefaction prone areas surround the airport (Dixit et al 1999:9).

Approximately 95 percent of water pipes and 50 percent of other water system components, such as pumping stations and treatment plants, could be severely damaged. Almost all telephone exchange buildings and 60 percent of telephone lines are likely to be damaged. About 40 percent of electric lines and all electric substations are likely to be also damaged. It is expected that it could take a month to get these utilities basically operational

and that some parts of the valley could be without these utilities for up to a year (Dixit et al 1999:9).

Using the death and injury figures from the 1934 earthquake and extrapolating these purely on the basis of the percentage increase in the population indicates that an earthquake of a similar magnitude today will result in 22,000 deaths and 25,000 injured persons who would require hospitalization. Another estimation for death and casualty figures was calculated using figures from more recent earthquakes in cities comparable to Kathmandu. This projected that the numbers of deaths and injured could be as high as 40,000 and 95,000 respectively. Currently, the total number of government hospital beds in Kathmandu is 2,200 and these are all full under non-emergency conditions. In addition to the numbers of dead and injured it is expected that between 600,000 and 900,000 residents of the Kathmandu Valley would be left homeless (Dixit et al, 1999:9-10).

One of the major findings of the project was that hospitals generally had done little, if anything, to mitigate the impact of an earthquake or prepare for a response to a major earthquake; they were very vulnerable if an earthquake were to occur. It had been identified that there would be large numbers of injured people. Generally, there is an expectation of the public that following an earthquake hospitals will be able to provide a service to the injured and sick (Bolt, 1999:274). The KVERM Project clearly indicated that the Kathmandu Valley hospitals were unlikely to meet the public's expectations.

### **The Bir Hospital Project**

This identification of the vulnerability of the hospitals in the Kathmandu Valley was the impetus for the initiation of a project at Bir Hospital, the largest government hospital in Nepal. The primary focus of the project was to conduct a detailed vulnerability study to identify what needed to be done to ensure that the hospital would be more resilient to the impact of an earthquake and be able to continue to function. A major effect of a project such as this is that the hospital does not need to wait for an earthquake to realize the benefits; all of the steps taken to create resilience also increase the reliable functioning of the hospital on a daily basis to ensure a safer and better service at all times.

As I have a hospital-based background in disaster management for the health sector and a keen interest and past experience in development issues, I was ideally suited to lead the Bir Hospital project. I saw this as an opportunity to develop a small project of manageable

proportions which would be of value to Bir Hospital and provide up-skilling for some of their staff and potentially provide a template for other hospitals in Nepal to base their vulnerability reduction on. It would also allow me to further explore the relationship between disaster management and development where I could endeavour to apply principles of development within the context of a disaster management project. In addition lessons learnt elsewhere could be gathered and shared and applied at Bir Hospital.

To ensure the success of the Bir Hospital Project a logical approach was used, with the different stages of the process generally following the research process. These stages are identification of the research problem, review of relevant literature and consultation with experts, identification of the objectives of the research, design of the research and choice of methods, funding requirements and sources, ethical considerations, communication to all key people concerning the research, construction of tools, data collection, analysis of data and presentation of findings (Reid and Boore 1987:14). The organization of this paper and the presentation of information will generally follow this process. This first chapter identifies the problem and the resultant project.

The following chapter will provide information from experts concerning core principles and concepts related to disaster management, risk management and the measurement of the intensity of an earthquake. These topics are integral to the project at Bir Hospital. They will be described, with the information primarily coming from current literature on the topics, representing mainstream thinking. Next, there is a review of relevant literature, primarily identifying lessons learned, based on the experiences of other countries and hospitals, following major disasters and their application to the unique situation of Nepal.

The aims and objectives of the project are identified at the beginning of Chapter Four, followed by a description of the methodology used in the project. Included in the methodology section is information pertaining to the assessment tools used and how the data was collected.

The project was largely self-funded, though recognition of some donations and fund-raising is given in the acknowledgements at the beginning. As this project was focusing on the impact of an earthquake on an institution and it was primarily the structure and infrastructure of the institution being assessed rather than research involving individuals or groups of people, there was no need to gain ethical committee approval.



Although there is a distinct stage labeled "communications" in the research process identified above, this component of the process effectively occurred throughout the whole sequence of the different stages. Rather than detail the communications related to this project together at one point in this paper, all pertinent communication which took place from the initiation of the project through to the conclusion of the project is described within the section to which it relates.

Two chapters of this paper will present the project findings and an analysis of the vulnerability assessment with associated recommendations. In the process of conducting the project at Bir Hospital and researching current literature on related topics, I developed a needs assessment model which is presented in this paper as an original concept. This is presented in Chapter Seven.

Although the primary focus of this paper appears to be the vulnerability assessment of a large government hospital in Nepal, the main purpose is to use this project and what was learnt during its implementation to illustrate the relationship between disaster management and development and to demonstrate that there can be a synergy between the two. This relationship and the description of the Bir Hospital Project as a microcosm to illustrate this relationship is given in Chapter Eight. The main point to be made is that disasters can be managed before they occur and development activities can play an integral role in this.

## **Chapter 2**

### **Baseline Principles**

#### **Overview of the Chapter**

It was essential that the basis for the project at Bir Hospital and the information given to Bir Hospital personnel be accepted as being best practice for the hospital. To ensure this an extensive literature search was conducted to identify the processes to be used for disaster management. An integral and large component of this process includes disaster planning. Much of this chapter is devoted to current thinking on the development of disaster plans.

The application of the risk management process to disaster management has gained prominence recently in disaster management publications. This concept is also presented in this chapter and was applied to the project at Bir Hospital.

To be able to effectively conduct the vulnerability study at Bir Hospital there needed to be some definition of the intensity of earthquake against which Bir Hospital's vulnerability could be determined. The intensity of the event was defined as being equivalent to the last major earthquake in 1934 of which the intensity was measured using the Modified Mercalli Intensity Scale (MMI). A description of this scale is given at the end of this chapter.

#### **The Disaster Management Cycle**

Planning for emergencies and disasters has, for many years, been guided by the emergency or disaster management cycle. Britton (1993:134) identifies the four phases of the cycle as mitigation, preparedness, response and recovery. Each of the phases of the disaster management cycle are related. The whole process should be dynamic and continually evolving. In recent years there has been a trend to use risk management principles and overlay them on the disaster management cycle (Buckle, 2000:8, Helm, 1996:6). In this way disaster planning becomes more robust and comprehensive.

#### **Mitigation Phase**

The first phase of the cycle, mitigation, focuses on all the elements of eliminating or reducing the risk and impact of a disastrous event. As new information and technology

becomes available this is applied to further mitigate the potential event. In this way it is never static. An important aspect to note is that there are two factors upon which mitigatory actions can focus; the risk of the event happening and the impact of the event on a community. With earthquakes the risk of them occurring cannot be eliminated or reduced, however the impact can be reduced in many ways. For example, in earthquake prone areas there should be town planning so that buildings are not erected in areas likely to place the buildings at risk, such as where there is predicted to be ground liquefaction or failure of high land resulting in landslides. Impact can also be reduced through the development and implementation of building codes which will ensure a standard of building which is likely to remain either intact or, at least, protect the inhabitants from serious injury or death during an earthquake. It is not only the collapse of buildings which can cause harm to the occupants but also the furniture and fittings within a building. During an earthquake these items may, if not restrained or fixed correctly, fall or become projectiles, inflicting injury or death. Good design and the application of modern techniques to infrastructural elements such as telecommunications and utility supplies will lessen the impact an earthquake will have on a city and its inhabitants (Helm 1996:10, Kaufman 1996:1746).

Another example of mitigation for a different natural hazard relates to heavy rainfall. The risk of heavy rainfall in prone areas cannot be reduced or eliminated. However, the impact of this can be modified. In many countries hillsides have been stripped of vegetation. As a result, during heavy rainstorms, mudslides are precipitated and flow into populated valleys with catastrophic effects. The likelihood of this happening can be virtually eliminated by either stopping the denudation of the hillsides or by replanting already bare hillsides.

### **Preparedness Phase**

Once all practical mitigatory steps have been taken planning and preparation activities commence to identify how the remaining or residual risk will be managed. An integral part of the preparedness phase is the development of a plan detailing how a community, agency or organization will respond to an adverse event. The development of this plan is not completed in isolation but is part of an overall process. The plan should be based on vulnerability assessments which have been completed and identify the necessary components of the plan. During the development of the plan actions will be identified which need to be completed in preparation for the response to a disaster situation. Some

examples are training and exercises to test the plan. These actions can only be completed once a plan has been finished. For truly effective plans Richardson (1994:52) considers there should be two plans; one for the preparation before and one for the response during and after the emergency event. The planning and preparation of a community or organization will reduce the impact a disaster will have on them and their ability and subsequent efficacy of response (Carley et al, 1996:1242).

The development of a disaster plan should be conducted as a discreet project in itself (Solovy, 1999:34, WHO, 1999:73). The phases of this project should include defining the project and identifying a planning group. This group will then analyse the potential problems which the vulnerability assessment identified, analyse what resources are available and what are required and manage the difference, if any. The core of the plan is then constructed by describing key roles and responsibilities of personnel, the management structure and develop strategies and systems for the response to and recovery from the emergency event (WHO, 1999:73-74). Once the plan is completed it should be tested by an exercise and reviewed based on the outcomes of the exercise. This then completes all phases of the disaster plan project.

The principles upon which this plan is constructed are similar to the principles for development. The plan should be developed in response to identified needs. After a vulnerability assessment has been completed it is known to which adverse events the organization may be exposed and how it will impact on them. Plans are then developed to detail how the community or organization will respond when the identified event occurs. The creation of these plans should be accomplished by working and consulting with the very people who will be affected by the potential event. Logue (1996:1208) advocates that disaster prevention planning should begin at the community level. Edwards (Schuurman 1993:87) identifies that "when people are fully involved in development programmes... there is a much greater chance that these programmes will be relevant to their real concerns, accurate, usable and empowering." This is equally applicable to the development of disaster response plans. Making people aware of the hazards and then working with them to find the best way to respond to the event will ensure that any concerns they have about the hazards are addressed. The response plans should be accurate and implementable as the very people who know the local resources and capacity have been involved in their development. The people are also empowered as

they are better prepared and know what to do when something does happen if they have been included in the process.

An important concept, which Logue (1996:1208) recommends, is bringing together academic institutions, government agencies and other institutions to form a partnership for disaster preparedness activities. This will then ensure an interdisciplinary approach. In the context of the earthquake preparedness project at Bir Hospital academics from the disciplines of seismology and engineering, for example, could meet with the staff of Bir Hospital. The academics can explain what the impact of an earthquake would be on the hospital facility and the staff can find acceptable and workable solutions based on their practical and intimate knowledge of the hospital. This concept is also supported by Edwards (1989) who cites an example in Mexico City where a forum of residents of inner-city tenements and members of local universities joined together in a common search for solutions to the problems which confronted them. Although this is in the context of development it holds equally true for disaster management.

A disaster response plan cannot be developed in isolation. As Boughton (1997:19) pointed out, hospitals do not function as an island; they form an integral part of a community. Therefore, for an organization's plan to be fully effective there must be disaster plans for the local community in which the organization is situated, also for the regional area and a national emergency plan. All of these plans must link with each other to ensure a comprehensive and coordinated response to the disaster situation. There are often standards or criteria set for plans. For instance, in the United States there is a hospital accreditation board which sets standards that hospitals must meet, one of these standards being for disaster planning. Within the international arena there are standards for disaster response, a code of conduct for NGOs in disaster relief and an NGO Field Cooperation protocol. Well-known international standards related to disaster response are those of the Sphere Project. The outcome of the Sphere project was a document detailing a Humanitarian Charter for persons affected by disaster and Minimum Standards for basic needs during disaster response. The areas for which standards have been set are for water and sanitation, nutrition, shelter and site planning, food aid and health services.

Many organizations are large and complex. Hospitals are no exception. They are comprised of many, diverse departments, all having a unique and necessary role to play

in the overall functioning of the hospital. When developing disaster plans for a large organisation consideration must be given to each department developing their own unique emergency plan (Pateman, 1993:808). The impact of an emergency will affect each department differently and the way they respond will be unique to their function and the resources they rely on. For example, a power failure in a major hospital will have an impact in the kitchens if they rely on electricity for cooking. If the power failure is for 10 minutes this will most likely have little impact on the production of meals. The meals may be delayed by a few minutes but that may be all. In contrast, a power failure in an operating theatre lasting just a minute or so can have life threatening implications. When planning, each department should also consider what impact the failure of another department would have on them and vice versa. An example of this is the impact of failure of the central sterilizing department (CSD) on the operating theatres that are reliant on CSD for a continual supply of sterilized items. In turn CSD is reliant on a continual supply of steam to be able to sterilize items. In totality each department within a hospital is dependent, in one way or another, on many other departments and the same in return.

Based on the experience of communities and organizations who have been through an emergency situation a couple of key elements emerge as being critical in the preparation and planning for a disaster event. Of top priority is to ensure effective and reliable communication (Kaufman, 1996:1746, Pateman, 1993:808, Sharp et al, 1994:387, PAHO/WHO, 1999:6). This communication is not only within the organization but is also inter-agency (Auf der Heide, 1989:96, Sharp et al, 1994:388). An important but often neglected area of communication preparation is how to deal with the media during and after a disaster. Managed wisely, the media can be used positively to allay public anxiety and to communicate important public announcements (Hudson, 1998:48, Solovy, 1999:34). A poignant point was made by Hudson (1998:48) when he commented that a hospital was prepared for many casualties but not for the media deluge. Another key element in planning is ensuring there is a command structure with roles clearly documented and who will fill each role (Pateman, 1993:808, Sharp et al, 1994:388, Paho/WHO, 1999:10, WHO, 1999:79). For each role there should be visible identification (Kaufman, 1996:1746). The identification of required resources and where to reliably access them is also an important aspect of disaster planning (Auf der Heide, 1989:35, Kaufman, 1996:1747).

Although much emphasis is often placed on planning it should always be remembered there are limitations to plans for the effective response to a disaster. De Boer (1997:16) highlights that a plan is only one aspect of the capacity of a hospital to respond to a disaster. In his model for the assessment of a hospital's disaster preparedness he identifies three prime aspects; the number of trained personnel available, the amount of equipment and supplies available and whether there is a documented and tested plan. The point is made there only needs to be a deficiency in one of these areas and the capacity to respond is reduced. Auf der Heide (1989:33-48) identifies a problem he calls the "paper" plan syndrome. A written plan may exist but this will not necessarily guarantee an efficient, effective or appropriate response at the time of a disaster. The plan may, in reality, have a detrimental effect as there is an illusion of preparedness creating a level of false security. For a written disaster plan to be effective it must be "based on valid assumptions about human behaviour, incorporates an inter-organizational perspective, is tied to resources, and is known and accepted by the participants" (Auf der Heide, 1989:35). Auf der Heide then goes on to emphasise the need for staff to be trained in the implementation of the plan.

An effective and time proven way to develop disaster plans is that of scenario setting (Bloom 1994:225). For each identified hazard a scenario is developed outlining realistically what could happen. Using this as a base, disaster response plans can be developed. It is important that the scenarios and the subsequent disaster response plans are for events which are likely to occur in that area and that the scenario set is not unrealistic (Dunn 1997:40). Often the approach of setting a 'worst-case scenario' is promoted for scenario setting. The main difficulty with this approach is that the people involved in developing the plan cannot perceive such an event and feel overwhelmed and therefore are unlikely to be able to progress with the planning process.

For the ultimate success of the planning process senior and line managers need to be involved. Eric Auf der Heide (quoted in Dunn 1997:40) says "disaster preparedness is difficult when a hospital's administration is not committed to it."

Both of the first two phases of the disaster management cycle, mitigation and preparedness, are crucial to the successful outcome of the third and fourth phases. If mitigation has been done adequately then the response and recovery needs will be less.

Good planning and preparation will ensure an efficient and effective response, thereby shortening the recovery period.

There are two documented converse events that effectively illustrate what mitigation activities and planning can achieve and the impact these stages can have on the response and recovery stages. The first was in Northern Peru where there were predictions that the El Nino effect during 1997 - 98 would result in flooding, mudslides and sea surges. Mitigative action was taken by dredging canals, cleaning and expanding drainage systems, building retention walls, reinforcing bridges and constructing dykes. This averted a disastrous situation in Northern Peru. Based on historical data, Southern Peru expected the El Nino effect would result in drought conditions and so took no mitigative action. However, heavy rain did fall in parts of Southern Peru resulting in several cities being affected by floods and, as a result, many homes were either damaged or destroyed leaving many people homeless (McEntire, 1999:15).

The second event was the initial management of the response to the Papua New Guinea tsunami disaster and illustrates well what can happen when there has been very little or no preparation prior to a disaster. It also confirms the interrelationship between the different phases of the cycle.

Although Papua New Guinea had a written disaster response plan it was out-of-date and not well known. Training of local personnel in disaster management had been limited. Contrary to the requirements of the existing plan, the Police Commissioner was appointed controller. This resulted in extremely poor communication between the controller and the National Disaster and Emergency Services who were to implement disaster management activities and made overall coordination of the response difficult. The problem was further compounded by the assistant controller, also a police officer and based in Aitape, closer to the scene of the disaster, treating the disaster response as a police operation rather than a disaster requiring coordination across a range of sectors.

No planned or coordinated needs assessment was done in the disaster area. As a result several groups were doing needs assessments at the same time, using different approaches and getting different results. Consequently, an overwhelming amount of relief



supplies were sent in from both national and international sources, some of them inappropriate to the needs.

Inadequate pre-disaster planning and preparation resulted in a lack of lines of authority and poor communication which hindered coordination and adversely affected the efficiency of the disaster response. The flow-on effect was that decisions on recovery issues were delayed (Stenchion, 1999).

### **Response and Recovery**

As defined earlier, an event only constitutes a disaster when communities and people are affected. It is therefore, important to consider the role that communities play in the response to a disaster. However, as stated before, the response phase cannot be considered alone; it must be discussed within the context of all phases of disaster management. The planning and preparedness of a community prior to an event will influence the impact of a disaster on the community and their ability and subsequent efficacy of response. During the recovery phase the extent and pace of recovery is often directly dependent on pre-disaster conditions. In addition, what happens during the recovery phase sets the basis for the resilience of the community to future disasters and their capacity to respond. An underlying and integral factor in all of this is the level of developmental activities in the community prior to the disaster and then initiatives for longer-term development arising out of the disaster recovery phase.

The efficiency and effectiveness of the disaster response is determined by the maturity of development in the other phases of the cycle. McEntire (1999:15) believes that a nation's mitigative and preventative measures are always tested when calamity strikes. Bolin and Stanford (1998:34) further add credence to the interrelationship between the phases of the cycle by noting that many of the recovery problems experienced by the affected community are related to problems that were evident long before the trigger for the disaster presented. In addition, the severity of the disaster is also related to the problems of the community pre-event. Therefore, the extent of the disaster and the likelihood of a successful recovery are directly related to the levels of hazard reduction and planning done prior to the event.

It is encouraging to note that the World Bank is beginning to recognize the value of investing funds in disaster mitigation before a disaster strikes, to reduce losses rather than approving huge loans for reconstruction projects after the disaster has struck (Gilbert et al, 1999:2), although it is stated that disaster mitigation projects are "...not conventionally regarded by Bank staff as being related to disasters...." (Gilbert et al, 1999:2).

The benefits of disaster prevention are often difficult to quantify as future potential events, which may impact on all aspects of society, provide challenges to calculate. Yuanchang (1996:6) has identified that in China flood control measures which cost US\$3.15 billion to implement has prevented estimated losses of US\$12 billion, though he acknowledges that disaster reduction benefits are not that simple to calculate as direct and indirect economic, social and environmental factors have to be taken into consideration.

Disaster preparedness and planning, as part of the development of a community and their subsequent response can, in some instances, avert a disaster and, at the very least, lessen the impact of a disaster. A good example of this was in Rabaul, Papua New Guinea. During the 1980s a volcanic emergency plan was developed for Rabaul under the guidance of United Nations Disaster Relief Office (UNDRO). When a major volcanic eruption occurred in 1994 the implementation of this plan (response phase) was largely responsible for the effective evacuation and low loss of life (Smith, 1996:105).

Although after such an event planning and preparation can be shown to be cost effective, there is often apathy in communities and at a national level to this sort of activity. Auf der Heide (1989) writes of the 'apathy factor', identifying that disasters are often perceived as "low probability events". The reality is that the priorities of everyday living, and in the case of many developing countries, everyday survival, compete for valuable time and resources. Consequently, disaster preparedness falls to a low priority.

### **The Risk Management Process**

One of the limitations of the disaster management cycle is the tendency for one agency or group to focus on a single event and conduct all their planning around this. However, no agency or group functions in a vacuum and when an emergency occurs it tends to be complex. Adding risk management principles to this process has addressed this problem.

Simply, the risk management process identifies what could happen (risk), the impact this will have and the development and implementation of a plan to minimize or prevent the potential event. The process is cyclic and once the risk has been treated as per the plan a reassessment is conducted to ensure that any residual risk is tolerable or acceptable.

The first stage of the process is to identify all the actual and potential risks. There are many ways to assess the risks. Helm (1996:8) identifies different approaches which may be used for assessment. These include utilizing local experience to identify serious risk, the use of records and expert views and the experience and practices from elsewhere where similar risks exist. The credible boundaries for any potential event are to be considered as this will assist with identifying the maximum credible event. Outside specialists may be required if expertise is not available locally. The application of these ways to assess risk in the Bir Hospital project is given in Chapter Four.

One of the outcomes of conducting a vulnerability / risk assessment is that communities and groups of people may be identified as being more vulnerable than others. Within the context of development certain groups of people are already categorized as being vulnerable, for example women, children and the elderly. Within the context of disasters these groups are often more vulnerable but care must be taken to just not focus on these groups to the detriment of other individuals or groupings of people. Often, especially with regard to natural disasters, all people within a certain location may be equally vulnerable. For example, it is noted by Milsten (2000:32/40) that when a disaster strikes a hospital all patients and staff are equally at risk, regardless of sex, age or socio-economic status.

Once the risks have been identified they are analysed and assessed, setting priorities for order of treating the risks. To set priorities the risks must be quantified so that they can be ranked. A simple way to do this is to take a combination of two key factors in risk; the chance or likelihood of an event happening and the consequences or impact of this event. The likelihood of an event happening can range from 'happens frequently' through to 'it hasn't happened yet'. A score can be allocated to each of the likelihood statements within the range. The consequences of an event can be measured in many ways, such as the loss of property in monetary terms or the loss of life and the number of people injured. However, care must be taken as most often the scale of a disaster is measured in terms of loss of life and the number of those injured. What is often not taken into account are all

the other aspects that make up a disaster; the number of people who are made homeless and hungry, the loss of infrastructure and the impact this has on the population, the mental health of the victims and the impact on the economy (Sundnes 1996:17/83, Dodson 1997:47). Once terms for measurement of impact on a given population have been agreed upon a score can be allocated to each level of impact, ranging from 'catastrophic' through to a 'barely noticeable' impact. The score for each identified risk can now be calculated by the equation  $R = P \times C$  where R is the risk score, P is the probability or likelihood of the event happening and C is the consequences following the event. However, it must be stressed that this simplistic calculation does not fully describe the real risk but can provide a reasonably accurate basis on which to prioritise risks for severity and order of treatment (Helm 1996:8).

### **The SMUG Risk Prioritisation Model**

Another risk prioritization model, which has been modified and recommended by the New Zealand Ministry of Civil Defence and Emergency Management, is the SMUG prioritisation model where the letters of this acronym stand for seriousness, manageability, urgency and growth. The definitions for each of these criteria are given in Table 1.

Criteria	Definition
Seriousness	The relative impact in terms of people and/or dollars.
Manageability	The relative ability to mitigate or reduce the risk (through managing the hazard, or the community, or both)
Urgency	The measure of how imperative or critical it is to address the risk (associated with the probability of the risk of the hazard)
Growth	The rate at which the risk from the hazard will increase (through either an increase in the probability of the extreme event occurring, an increase in the exposure of the community, or combination of the two).

Table 1: Definitions for terms used in the SMUG Prioritisation Model  
(Ref: [www.hemnz.org.nz/pdf/47.pdf](http://www.hemnz.org.nz/pdf/47.pdf))

For each of the criteria a score is given (see Table 2). Each identified hazard is then rated against the criteria and the scores added. This then provides a quantitative measurement of risk for the purposes of comparing risks and prioritizing for urgency of attention.

Criteria	High Score	Medium Score	Low Score
Seriousness	3	2	1
Manageability	3	2	1
Urgency	3	2	1
Growth	3	2	1

Table 2: Score for each criteria used in the SMUG Prioritisation Model  
(Ref: [www.hemnz.org.nz/pdf/47.pdf](http://www.hemnz.org.nz/pdf/47.pdf))

Once the risks have been identified and prioritised a plan is then developed, identifying how each risk will be treated. This plan is implemented and the results monitored. This is effectively a re-assessment of the risk level once treatment has been implemented, beginning the risk management cycle again. Where this process adds value to the emergency management cycle is that all risks are thoroughly assessed and the interrelationship between them examined and then they are put into priority of order, based on the likelihood and consequences of the identified risk. As noted earlier, in many instances the likelihood of a natural hazard cannot be reduced but the impact or consequences can be.

For the treatment of identified risks there is always going to be the constraint of limited resources. In part this is why a prioritization of the risks is done to identify those which are most critical. In addition to this the cost of treating risk has also to be taken into consideration. The cost of treating the risk may either outweigh the benefits gained or the cost may just be too prohibitive. This then raises the concept of tolerable risk; the risk that will be accepted. The risk may be tolerable for varying reasons. It may be that the risk has been reduced through treatment, but not entirely eliminated; there remains a residual risk. This residual risk may be assessed as a low risk and therefore the risk will be accepted. Often, to remove risk totally is either impractical or too costly. There may be, in contrast to this, a risk which is calculated to be a high risk but any form of treatment is prohibitively expensive and exceeds the available resources. In this instance the risk may be accepted purely for those reasons only. However, all possible options should be explored to identify how the risk could be mitigated in some way.

A simple illustration of this is the town which is located on the slopes of a volcano. The risk of the volcano erupting with catastrophic loss of life and property is assessed as

being high. The best treatment option would be to eliminate the risk totally by permanently relocating the whole town to a safer location. This will most likely be considered to be impractical and the cost prohibitive. However, a risk mitigation strategy is the installation of monitoring devices to give early warning of an impending eruption, the development of a community-wide disaster response plan consisting primarily of evacuation and preparedness of the community through regular training and awareness campaigns. In this way the residual risk, which in simple terms, would be loss of property but not life, may be acceptable to the community as opposed to moving permanently to a completely new site.

### **Measuring The Size of an Earthquake**

As identified by Helm (1996:8) it is important that when assessing risk the credible boundaries for any potential event be identified. This was done for the Bir Hospital project, which was primarily focused on an earthquake event.

There are two ways to measure the size of an earthquake. The first is by measuring the magnitude of an earthquake based on instrumental readings taken from seismographs. The magnitude is a measurement of the amount of seismic energy released by an earthquake but does not indicate the level of death or destruction which may have been caused by the earthquake. There may be a large earthquake centred on a remote part of the ocean floor, which is not felt by any human, and there is no observed damage. In contrast, an earthquake of a similar magnitude occurring in a densely populated area will cause loss of life and substantial damage to property. The magnitude of an earthquake is measured on the Richter Scale, developed in 1935 by Charles F. Richter of the California Institute of Technology. The scale uses whole numbers and decimal fractions and there is no upper limit. For example, the 1995 Hanshin-Awaji earthquake measured 7.2 on the Richter Scale. The second measurement of earthquakes is the Modified Mercalli Intensity Scale (MMI), developed in 1931. This scale measures the intensity of earthquakes based on the qualitative effects of an earthquake as either felt or observed by humans at the time. This scale can be used to rate pre-instrumental earthquakes. The scale assigns Roman numerals, ranging from I – XII, with each number allocated to a description of the impact of the earthquake (see Table 3). Nepal has developed a chart to portray the MMI Scale with illustrations appropriate for the Nepali environment (see Illustration 1).

There are a number of variables which will affect the assigning of an MMI value. This is a qualitative assessment that measures different phenomena within the one scale. The lower values address human responses to ground motions, the intermediate values record the response of simple structures to the earthquake and the upper values describe ground failure processes. Different values can be assigned to various locations, as the intensity of the earthquake will be different, either because of the distance from the epicenter of the earthquake or soil characteristics. For example, during an earthquake, water saturated soil may change from a firm material to a semi-liquid material, a phenomenon known as liquifaction. This change means that the ground is unable to support structures, which stand upon it, resulting in greater damage.

Kathmandu city is located on the site of a prehistoric lake which has been filled with soil sediments. Soil sediments of this type tend to amplify the shaking of an earthquake and are more susceptible to liquifaction. During the 1934 Kathmandu earthquake liquifaction was observed throughout the Kathmandu Valley. It is anticipated this will occur again with an earthquake of a similar magnitude. The highest level of intensity recorded following the 1934 earthquake was X MMI (Dixit et al, 1999:9).

### **The Relationship of Development to the Disaster and Risk Management Cycles**

A component of this chapter has been devoted to describing the disaster and risk management cycles. As I reviewed the literature containing information pertaining to these topics I noted there was no mention of development or linking with development activities and yet development was going on in the very communities which either had been affected by a disaster or had the potential for a disaster situation to arise. As identified in Chapter One, there is a definite relationship between disaster and development. Lewis (1999:129) expresses his opinion that there has been for too long two cycles working independently of each other; the disaster cycle and the development cycle. As a consequence there are often two separate organizations working in each of these areas. To back up his statement that there are relief agencies and development agencies as separate entities he cites an example from the United Nations where there is the United Nations Office for the Coordination of Humanitarian Affairs (OCHA), the United Nations Disaster Relief Office (UNDRO) and there is the United Nations Development Programme (UNDP) (Lewis 1999:131). In publications put out by the United Nations there is reference that the different sectors (relief and development) can be viewed as being a sequence,

Intensity Value	Description
I	Not felt except by a very few under especially favourable circumstances
II	Felt by only a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.
III	Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing automobiles may rock slightly. Vibration like passing of truck. Duration can be estimated.
IV	During the day felt indoors by many, outdoors by few. At night some are awakened. Dishes, windows, doors disturbed; walls make creaking sound. Sensation like a heavy truck striking building. Standing automobiles rocked noticeably.
V	Felt by nearly everyone, many awakened. Some dishes, windows, and so on broken; cracked plaster in a few places; unstable objects overturned. Disturbances of trees, poles and other tall objects sometimes noticed. Pendulum clocks may stop.
VI	Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster and damaged chimneys. Damage slight.
VII	Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving cars.
VIII	Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stack, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving cars disturbed.
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out-of-plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed, slopped over banks.
XI	Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in the ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent easily.
XII	Damage total. Waves seen on ground surface. Lines of sight and level distorted. Objects thrown into the air.

Table 3      Modified Mercalli Scale (Bolt, 1993:323)



commencing with disaster and ending with development (Lewis 1999:131). Lewis (1999:129) contends that development is occurring throughout the disaster cycle and that each can impact on the other; one does not follow the other. This same concept was put forward by Cuny and Beaumont (quoted in Kelly 1999:25) where the disaster cycle was shown in the form of a Mobius strip showing development as an integral or underlying component in all phases of the cycle.

A summary of what has been discussed in this chapter can be illustrated by a recent event which I was witness to soon after it occurred. In the early hours of the last day of July 2001, very heavy rain fell in the hills in the centre of Nias Island, off the coast of North Sumatra, Indonesia. Most villagers were sleeping, oblivious to imminent disaster. Suddenly, a huge wall of water poured down a number of river valleys. No one knows exactly how high the initial wall of water, mud and debris was but locals described it as looking like a mountain with even higher waves behind it. Estimates are that it was at least 5 metres in height. Within a few minutes whole villages were totally destroyed; 700 houses in all were rendered uninhabitable. The official death toll stands at 109 with 196 people unaccounted for.

According to the locals, this type of disaster had never happened before; no one could remember such a thing. It was unexpected and they were not prepared. On analysis, after the event, the risk factors could be seen and the vulnerability of the community recognized. Nias Island is prone to torrential downpours of rain. For a number of years the jungle-covered hillsides had been cleared to make way for the planting of neem trees, providing much needed income generation. Villages were established and grew rapidly in size along the fertile river valleys where food crops were easily grown and there was easy access to water supply. Put these ingredients together and you have a recipe for disaster. There are two things this event highlights; the value of prevention and the need for vulnerability assessment. If these communities had had the opportunity for their vulnerability to be assessed this disaster may have been foreseen and remedial actions taken. But let's go back a step further and consider prevention. When analysed, this disaster was basically caused by human actions; clearing of hillsides and settlement in areas potentially prone to flooding. Both the clearing of hillsides and settlement could be termed as new development. All proposed developments should be assessed for risk

factors and appropriate risk management strategies implemented, thereby preventing a disaster. Linked with this thinking is the need for early warning systems to identify when risk factors are increasing making the likelihood of a disaster greater. In this situation it was heavy rainfall.



## **Chapter 3**

### **Lessons Learnt Elsewhere**

#### **Overview of the Chapter**

In preparation for the project visit to Kathmandu I conducted an extensive literature search to seek lessons from the experiences of hospitals in other under-developed countries following earthquake events. I discovered there is a paucity of documentation of the effect earthquakes have had on hospitals in under-developed countries. This chapter will provide a summary of the findings of the literature search and their application to the Kathmandu Valley. At the end of the chapter my findings and observations of the impact the Gujarat earthquake had on hospitals will be given. This earthquake occurred after the project visit to Bir Hospital. However, I forwarded these findings to the Director of Bir Hospital, the Secretary General of NSET-Nepal and the Technical Officer for Emergency and Humanitarian Action, WHO, Kathmandu, to further raise their awareness to the impact earthquakes can have on hospitals and the health sector.

#### **The Impact of Disasters on Hospitals Reported in the Literature**

Over the last twenty years there have been many earthquakes in both under-developed and developed countries. Despite the large number of major earthquakes in under-developed countries, which generated many deaths and casualties and had an impact upon hospitals, there has been very little reporting of the effect the earthquakes have had on the hospitals. There is far greater reporting of the impact on hospitals and healthcare services in developed countries. This lack of reporting through the literature is verified in a paper written by Milsten (2000:32/40) where an extensive review and analysis of literature was conducted, reporting hospital responses to disaster situations over the period of 1977 to 1999. This review was conducted by using the computerized databases Medline and Healthstar. Articles were selected if they contained information related to hospitals' responses to a disaster situation or data on specific disaster injury patterns. In Milsten's paper there is minor reference to the experience of hospitals following the 1991 Costa Rica and 1988 Armenian earthquakes but no other references to the experience of under-developed countries. In contrast there are multiple references to the lessons learned following the Loma Prieta, Northridge and Great Hanshin-Awaji earthquakes.

Milsten's paper does provide a useful overview and general picture of the problems hospitals are likely to face following a disaster. Most of these problems are generic to hospitals in both under-developed and developed countries. The findings of Milsten's paper were that following any disaster, including earthquakes, problems can be expected with communications, power loss, water loss, physical damage to the facility, exposure to hazardous materials, evacuation of buildings, resource allocation and personnel issues. Based on Milsten's paper these problems will be discussed in more detail, identifying what are likely to be key issues for Bir Hospital when planning and preparing for the impact of an earthquake.

Following an earthquake there is commonly a loss of both internal and external communication. This can be as a result of the earthquake directly affecting communication systems or a supporting system such as power supply. It was reported after the 1989 Loma Prieta earthquake 80% of the information hospital-based nurse coordinators received about the disaster was from radio and television broadcasts, including the estimated numbers of victims. Internal communication was also disrupted with many hospital staff not knowing their disaster plan had been activated, nor that an emergency operations centre had been established for overall coordination of the hospital's response (Milsten, 2000:41/33).

Another common problem is that of loss of power supply. As so many other systems are dependent on electricity there is often a compounding effect with power-loss. This was well demonstrated following the Northridge earthquake where battery packs for medical equipment could not be accessed as electronically operated supply doors could not be opened (Milsten, 2000:34/42). The most critical impact of power-loss in a hospital is the consequent failure of life support machines.

Water supply problems can be many faceted. During the Loma Prieta earthquake there was loss of hot water, damage to water tanks and cooling towers and a contaminated city water supply (Milsten, 2000:34/42). The disruption to the water supply also has a flow-on effect within hospitals, impacting on sterilizing, laundry and kitchen services to name a few.

Physical damage to the hospital facility falls into two categories; structural and non-structural damage. Structural damage refers to the impact on the physical building and non-structural to the contents within the building. The two major outcomes of physical damage is injury to staff and patients and a facility which is unusable. There have been estimates that following an "earthquake in the San Francisco Bay area, 13 – 34% of all serious injuries or deaths would be caused by damage to hospitals." The same study concluded that after a large earthquake 25% of hospital beds in Los Angeles would not be available (Milsten, 2000:43/35). As the building codes for construction of hospitals in the United States are more clearly defined and enforced than in Nepal it is anticipated that the estimates for injury and deaths from damage to hospitals and the loss of hospital beds after an earthquake in California would be conservative compared to what may be experienced in Kathmandu hospitals.

In the Armenian earthquake the most significant factor in the 25,000 deaths was building collapse. Although not formally identified in the literature, the same could be said for the more recent 1999 Turkey and 2001 Indian earthquakes. An analysis of the most injured patients in the Hanshin-Awaji earthquake established that building damage and collapse was the primary cause of injury (Milsten, 2000:43/35).

Although a hospital may be seismically safe, this does not necessarily ensure that the occupants will be safe and that the facility can continue to function. Equally important are the non-structural elements of the building. Following the Northridge earthquake a number of hospitals sustained very little structural damage but were totally incapacitated by the loss of essential supplies and equipment such as food, laboratory equipment, chemicals and pharmaceuticals which had crashed to the floor. Other non-structural elements that caused major disruption to hospital services were unrestrained generators which moved, communication equipment which fell over, ventilation fans which toppled over and damage to radiological units which moved (Milsten, 2000:43/35).

Following a disaster of any type, evacuation of a hospital is difficult. After an earthquake this is intensified by structural damage, the likely loss of elevators and damage to infrastructure such as roads, which will hamper the transfer of patients to unaffected facilities. Most patients are dependent for mobilization and, in the extreme case, on equipment for life support. The key issues which were identified around evacuation of a

hospital facility included who will make the decision to evacuate, how will the evacuation be done, how will critically ill patients be managed outside of the infrastructure of the hospital and where and how will patients be transferred. It is worth noting that an analysis of patients transferred to unaffected hospitals during the Great Hanshin-Awaji earthquake showed they had a lower mortality rate than those kept in the affected hospitals (Milsten 2000:36/44).

The experience of most health-care facilities following a disaster is that of surplus staff rather than a shortage as qualified personnel tend to converge to their nearest hospital to volunteer their services. This can create problems of increased traffic flow and the overall management of these volunteers, such as their registration, identification and allocation to appropriate working areas. This is an additional burden for a facility already busy with a response to the disaster and the influx of casualties. In some instances, despite the influx of volunteers, there are reports of staff shortages, often due to either the inability of staff to get to the hospital or their return to their homes to ensure the safety of their family. However, Auf der Heide (quoted in Milsten 2000:45/37) points out that it is not typical of staff to abandon their medical role during a disaster response.

One of the biggest factors affecting staffing and resources for hospitals in a disaster is the loss of flexibility in the usual day-to-day functioning. This is as a result of reduced availability of professional staff and the implementation of "just-in-time" delivery of supplies as a means of managing the huge financial cost of storing supplies. Effectively this results in less reserve and capacity following a disaster when demands may be high and usual delivery systems either disrupted or non-functioning. Often supplies are donated, though their arrival is not until some time after the initial event. To be effective these donated supplies must be received quickly, matched to the needs of the hospital and a system in place to manage their receipt, storage and distribution. A plan for the management of donated supplies and a projected needs assessment should be completed before a disaster occurs to facilitate this. This concept is discussed in more detail in Chapter Seven.

Generally, hospitals can expect that the first patients to arrive will be the "walking wounded". The more seriously injured patients tend to arrive later. The hospitals closest to where the casualties are usually receive the most patients. In the event of an



earthquake the closest hospitals are usually the most damaged. Children and the elderly are commonly more vulnerable than other age groups. The types of injuries from earthquakes are typically crush syndrome, injury to vital organs, severe chest trauma and multiple traumatic injuries. Following an earthquake the number of people presenting to hospital Emergency Departments has been shown to increase up to 50% with an admission rate of 1%. Within five days the number of presentations to Emergency Departments returns to pre-earthquake baseline volumes (Milsten 2000:38/46). I also observed this trend following the 2001 Gujarat Earthquake while I was there as a member of a needs assessment team.

The findings of Milsten's extensive literature search and subsequent summary of hospital responses to disaster situations, including earthquakes, provided a valuable basis from which to identify the problems that hospitals in the Kathmandu Valley could experience following a major earthquake. Each of the key problems Milsten identified were considered and related to the unique situation of Bir Hospital when the vulnerability assessment was completed. This is fully reported in Chapter 5.

### **Lessons Learned and Subsequent Recommendations From Hurricanes Georges and Mitch**

In addition to the paper written by Milsten (2000), there is a comprehensive report which was written in 1999, based on the experiences of Central and South America following two hurricanes which had swept through the year previously (PAHO/WHO 1999). Many lessons were gained from their experiences, and from these lessons recommendations were made for the future.

In late 1998 two devastating hurricanes, Georges and Mitch, ripped across Central and South American countries. Three months later the Pan American Health Organisation and World Health Organisation convened a meeting of key players who responded to these disasters to evaluate their preparation for and response to these hurricanes. From the collective experience of those attending a report was prepared (PAHO/WHO 1999), which identified key components of disaster management, the lessons learned from this experience and recommendations for the future.



Although this report was developed from experiences specific to hurricanes, many of the findings and recommendations of the report are applicable to any natural disaster that may occur in an under-developed country and can be applied to the health sector and hospitals specifically. The following paragraphs take cognizance of this and apply the specific lessons learnt from hurricanes Georges and Mitch to the Kathmandu Valley.

The report identified that early warning systems should be in place to give as much warning as possible of an impending disaster-producing event (PAHO/WHO 1999:6). Although a natural hazard such as earthquakes cannot be predicted or forecast, much research has been done in identifying the potential for an earthquake, the likely impact zones and the magnitude of future earthquakes. Therefore, in the situation of Nepal there should be earthquake monitoring by seismographs locally in Kathmandu, nationally and internationally. This will ensure that any scientifically recognised changes in seismic patterns that indicate the likelihood of increased seismic activity are noted and appropriate actions taken. It is recommended that a single national agency should be responsible for providing integration and cooperation with all parties interested in monitoring of earthquakes. It is the responsibility of the national government to issue warnings to the public as appropriate.

Local communities need to be made familiar with the hazards to which they are exposed. They should be involved in local capacity building programmes to ensure they are more resilient to these hazards (PAHO/WHO 1999:7). This strategy applies to hospitals. As a member of their community, hospital must know to which hazards they are prone and what steps need to be taken to mitigate any impact these known hazards may have on them.

From historical and scientific data it is known that the Kathmandu Valley is prone to earthquakes. Hospitals within the Kathmandu Valley should complete a hazard assessment related specifically to earthquakes. Once the outcome of the assessment is known management and staff need to be made aware of the hazards and planning begun to specifically meet the findings of the assessment. The Bir Hospital Project, outlined in chapter 1 and detailed in chapters 4 and 5, begin this process for Bir Hospital.

Hospitals do not function nor operate as an island, distinct and separate from the community within which they are located. Any planning which is done must take into account what is happening elsewhere in the community. For this reason the Government of a country should accept responsibility and take a leading role in disaster planning. This will ensure appropriate and coordinated actions are taken across the whole country.

The impact of any natural or man-made event can be reduced by prior planning and preparation. Disaster preparedness should be a part of an overall disaster management programme, not completed in isolation. In the event of an earthquake hospitals would be expected to continue to provide a medical service to the surrounding populations. Therefore, there should be efforts to create and strengthen disaster management capacity. All disaster mitigation and preparedness should be incorporated into the everyday management of the hospital. Coupled with disaster preparedness should be comprehensive training programmes in disaster management. This should be provided for all levels of management.

Central and local government should provide support for disaster management. Communication media should be involved so that the awareness of the population at large is increased and therefore better prepared for a disaster event. The MoH and hospitals should provide training for their staff who are likely to interact with the media before, during and after a disaster. The management of media and communication with the media during and after a disaster should be documented in each respective organisation's disaster plan (PAHO/WHO 1999:14).

Following a disaster a needs assessment should be done to identify what is required to ensure all assistance is useful and relevant. Before a disaster occurs, hospitals should, at the least, develop a needs assessment tool and ensure appropriate people are trained in the use of the tool. It must be clear in the development of this tool that it is for the identification of immediate needs and should not be confused with damage assessment which relates to mid- or long-term recovery needs. Ideally, a needs assessment should be completed before a disaster. This is achieved by scenario setting for the different disasters which are likely to occur and predict what would be required following a disaster of varying magnitudes. Then, after the disaster, the needs assessment only requires validation, which can be completed much more quickly than if it was to be done from

scratch. The medical response of the International donor community should be based on reliable and verified needs assessment (PAHO/WHO 1999:8). Chapter Seven of this paper provides detailed information on needs assessment with a focus on completing a preliminary assessment before a disaster occurs.

Trained people should do the needs assessment on-site. This is essential to ensure reliability. The process for a needs assessment should be written into hospital disaster plans. Central Government should support and take responsibility for ensuring needs assessment tools and training in the use of them is available and provided (PAHO/WHO 1999:8).

In the event of a disaster there should be a single point for coordination of the identified needs of hospitals (PAHO/WHO 1999:10). It is suggested this should be the responsibility of the Ministry of Health (MoH) in consultation with the Ministry for Civil Defence / Emergency Management. To facilitate this there needs to be communication between the hospitals and the coordinating office to both supply and collect information. The means of communication must be robust and reliable throughout the disaster period.

Damage assessment should not commence until after the emergency phase ends. The information from 'damage assessment' is used to make decisions on projects and financing sources for reconstruction strategies and then to set reconstruction priorities. Before a disaster, Government and civil society should develop a Damage Assessment tool and ensure appropriate people are trained in the use of the tool. This assessment tool should incorporate methodologies for estimating indirect costs to social, environmental and other informal sectors (PAHO/WHO 1999:10).

For the success of any disaster response coordination is essential. The MoH should coordinate disaster planning for the health sector. This will ensure that not only is the response in the disaster area coordinated but that resources from outside the area can also be managed efficiently. The MoH should develop a framework and guidelines for health sector disaster planning. This will ensure that individual hospitals will respond in a unified way rather than independently. Any disaster planning done by hospitals should be within the framework and guidelines set by the MoH. When completed the plan needs to be communicated to the MoH. In addition, the Ministry for Civil Defence / Emergency

Management should develop a national response plan for a disaster. Health sector disaster planning must be recognised within this national plan and link with this plan.

Before a major disaster the military should clearly develop rules for their engagement in a humanitarian response. Military and civilian response organisations should understand and know the role which each take during the response to a disaster. Any disaster planning undertaken by the health sector and hospital will involve liaison with the military. Any exercises undertaken to test hospital disaster plans should involve the military (PAHO/WHO 1999:12).

The use of the internet as a way to manage information during a disaster is recognised. It is recommended that prior to a disaster communication links via the internet be established (PAHO/WHO 1999:12). An important facet of this is to maximize the use of two internet-based communication facilities; ReliefWeb and the Global Disaster Information Network (GDIN).

ReliefWeb is a web-site that provides global information on complex emergencies and natural disasters, primarily for humanitarian professionals. It was launched in 1996 by the United Nations Department of Humanitarian Affairs (DHA), now called the United Nations Office for the Coordination of Humanitarian Affairs (OCHA). Since its launch ReliefWeb has continued to develop and the amount of information available from this site has increased dramatically. Two OCHA teams manage the web-site, one in New York, and the other in Geneva, providing updates on unfolding disasters and the subsequent response to keep all agencies briefed. As long as relevant information is being released, information will continue to be added to each disaster's page ([www.reliefweb.int/library/descript.html](http://www.reliefweb.int/library/descript.html)).

Testimony to the success of ReliefWeb is demonstrated by the use of this site to report on natural disasters. In the last 12 months ReliefWeb has reported on the responses to 75 different natural disasters ([www.notes.reliefweb.int/websites/rwdomino.nsf/-VNaturalDisastersTheLatest](http://www.notes.reliefweb.int/websites/rwdomino.nsf/-VNaturalDisastersTheLatest)). The documentation for each of those disasters comprises of reports from many different organisations and agencies. In addition, ReliefWeb also follows complex emergencies, such as the Balkans Crisis. Two of the developers of this web-site view it as being "indispensable for emergency response" and "the nucleus of a

command centre for field operations" ([www.reliefweb.int/library/pressrel.html](http://www.reliefweb.int/library/pressrel.html)). ReliefWeb is an ongoing project of OCHA.

The GDIN is a new initiative still at the concept stage, but with very strong support internationally. The aim of GDIN is "to get the right information to the right people in the right form at the right time" (Abrahams, 1999:1). The idea is to build on existing systems and networks to create an integrated information source that can be easily accessed by all interested parties in any country. It has been recognised, for instance, that ReliefWeb provides an excellent interchange of information as disasters unfold and during the response and recovery phases. This would be complemented, not replaced, by GDIN. The greatest benefit of this system is perceived to be in the prevention and recovery phases of a disaster. While the system could be utilised during the response to a disaster, in this acute phase the meeting of physical needs of the affected population is foremost. However, this work could be enhanced by the ready availability of information pertinent to the relief effort.

The eruption of a volcano in Eastern Zaire in December, 1996, illustrates the potential use of such an information system. A United Nations Agency in Zaire asked the U.S. Department of State to create computer generated maps showing the volcano's active vents and lava flows. The maps created enabled danger areas to be quickly identified and evacuated, thereby averting loss of life ([www.state.gov/www/issues/relief/jul6.html](http://www.state.gov/www/issues/relief/jul6.html)).

It is well documented that medical supplies donated following a disaster are often inappropriate or out-of-date (Editorials, 1976:1395, 1990:845, 1996:1393). The management of medical supplies should be written into MoH disaster plans. Hospitals should write into their disaster plans how the receipt of medical supplies will be managed. MoH and hospital plans for supply management should take cognizance of the recommendations of the WHO regarding donations of medical supplies and equipment and the list of emergency medicines (PAHO/WHO 1999:15). As mentioned above, hospital planning and preparation will include 'needs assessment'. Correctly done this will ensure accurate requests for medical supplies are sent to donors. All personnel likely to be involved in supply management should have training prior to a disaster (refer to Chapter Seven).

The magnitude of a disaster can often be related to environmental degradation (PAHO/WHO 1999:16) e.g. in the event of an earthquake landslides are likely to occur where there has been deforestation and or the construction of roads through mountainous areas. Disaster prevention and environmental issues should be considered with all development projects.

An assessment should be done in the surrounding areas of hospitals to identify if there are any hazardous substances stored or manufactured which, in the event of a disaster-producing event, could be spilled and cause problems for the hospital e.g. a toxic gas cloud. Zoning for land use near to hospitals should be part of local government policies and planning. The MoH should work with other government departments when drafting development policies.

The MoH, together with institutions of the health sector, should strengthen the development, dissemination and implementation of contingency plans which define the precise participation of each player. Planning should link primary health care with emergency hospital care. MoH disaster plans should set criteria for initiating the calling of foreign medical teams and health personnel and the criteria which the foreign teams and personnel must meet to enter Nepal. The plan should also clearly state that foreign teams and personnel will carry out activities under the coordination of the MoH and how this will be communicated and managed (PAHO/WHO 1999:17).

Following a disaster there is a need for communicable disease surveillance and control and monitoring and prevention of food and water borne diseases and also vector-borne diseases (PAHO/WHO 1999:18, 19). The recommendations given for this do not relate directly to the hospital environment. However, this is an important consideration for the health sector generally and if not managed well will ultimately have an impact on hospitals. Therefore, the MoH should consider this aspect in their pre-disaster planning and hospitals need to link their planning with the primary health sector.

During an earthquake it is expected that water supply systems will be damaged. Prior to an earthquake vulnerability studies for water supply to hospitals should be assessed and appropriate mitigation activities commenced. Disaster planning for hospital should include contingencies for loss of water supply and waste disposal (PAHO/WHO 1999:20).

Although the reference article on which this information is based mentions only the utility of water, all other utilities should also be included in hospitals contingency plans e.g. loss of electricity, medical gases, etc.

Throughout the disaster response and recovery period food supply and the nutrition status of the general population needs to be considered (PAHO/WHO 1999:24). More specifically, hospitals need to plan for this as they effectively have a 'population' of people for which they have responsibility to provide adequate nutrition. In addition, this is an important consideration for the health sector generally. The MoH should also consider this aspect in their pre-disaster planning.

Following a traumatic event such as an earthquake, it is expected that people will be affected psycho-socially. Therefore, the MoH should include mental health care in their disaster plans (PAHO/WHO 1999:25). At a local level hospital may have staff who are affected psycho-socially by an earthquake and also people presenting to and admitted to the hospital who may exhibit signs of mental distress following an earthquake. Therefore, hospitals should also include mental health care in their disaster plans.

Once the initial disaster response period is over there is the transition from the emergency situation to the reconstruction phase. This is an important phase as the hospital and community recovers and returns to a level of normalcy following a major earthquake. It is through this phase of reconstruction that lessons learnt from the impact of the earthquake can be put into practice to prevent the same problems happening again. Ideally, before a disaster actually occurs, assessment should be done to predict what the impact would be and that remedial work is done beforehand. Once the potential impact is known it is much easier to prioritise what remedial work should be done and plan to do this within certain timeframes which are realistic and achievable. In this way hospitals can be better prepared for when the next major disaster strikes and be able to continue to provide the health service which the people would expect (PAHO/WHO 1999:26, 27).

### **Health Related Lessons From the Gujarat Earthquake**

The aforementioned recommendations from the PAHO/WHO report (1999) are broad-based and generally applicable to all disasters. This is in addition to the scant amount of information available relating specifically to earthquakes and the impact on hospitals and health services. To provide further relevant information I will include my observations and

comments, based on my experience after the Gujarat earthquake. I was a member of a needs assessment team to visit the area immediately following the earthquake.

On January 26, 2001, an earthquake measuring 7.7 on the Richter Scale jolted the earth beneath the state of Gujarat in Western India. The shaking lasted for around 45 seconds. The result of this massive earthquake was a swathe of near-total destruction of buildings for about 80 kilometres along the fault line, which had ruptured, with decreasing levels of destruction away from the fault line. Accompanied with this destruction was catastrophic loss of life, estimated in the tens of thousands with many more injured.

Immediately following the earthquake there were over 150,000 people with injuries, many of them requiring hospital treatment. Hospitals still able to function were soon overwhelmed. However, very quickly medical teams from many parts of India and some international teams converged on the Kutch region of Gujarat. In less than one week after the earthquake, all the injured had been treated and there were many medical teams with nothing to do. There was no evidence of any disease outbreaks. This is consistent with findings reported in the literature (de Ville de Goyet 2000:28, Milsten 2000:45/37)).

About 1.2% of the affected population were either killed or injured in the earthquake. This is approximately the expected figure, based on figures from developed countries. When planning for an earthquake this can be used as a rough guide of what to expect in a similar magnitude earthquake. The majority of the deaths and injuries occurred within the first hour of the earthquake, which is the findings following other earthquakes (Milsten 2000:38/46). Medical teams from outside of the region started to arrive about 24 hours later. Within 3 – 4 days of the earthquake the majority of injuries had been dealt with and the number of presentations to hospitals fell to either equivalent to or below what was the normal rate. This was consistent with what Milsten (2000:38/46) found reported in the literature. It should be noted that medical teams might not always be able to quickly access the area. The geographical location needs to be taken into consideration. For example, after a major earthquake the Kathmandu Valley could well be cut off due to landslides on approach roads through the mountains to the valley and the runway at the airport damaged.



It appeared that after the initial rush to treat all the wounded there was a lull period. Then, about 10 days later, came huge demands for nurses, physiotherapists and others involved in the care of the thousands that were treated earlier. In the days after the earthquake thousands of amputations were done, primarily to manage crush injuries which were predominant. What is often forgotten is the follow-up treatment and rehabilitation of these people further down the track. Similarly, the thousands who had fractures set will also require intensive rehabilitation if they are to resume normality. The huge demand made by those groups of injured comes as the country and the world start to forget there was an earthquake and the media have all gone home.

Figures from developed countries suggest that after an earthquake of this magnitude you can expect less than 2% of the population to be injured or killed. In the Gujarat earthquake about 1.2% of the population fall into this category. However, where the startling difference occurs is with regard to the number killed. Developed country figures indicate that the mortality rate should be about 1% of the number injured. In the Gujarat earthquake the death toll is at least 16% of the number injured. I suggest that the reason for the greater death rate is due to poorly constructed buildings which collapsed killing many people. Most developed, earthquake-prone countries have stringent building codes. The buildings are designed to not necessarily remain undamaged following a major earthquake but to at least protect the inhabitants and allow them a safe egress. A caution should be added with regard to examining statistics too closely. It is helpful, when planning for an expected event, to have an idea of what to expect. However, the end results can vary dramatically. For example, the Latur earthquake in 1993, also in India, killed about 20,000 people and yet the number of injuries requiring treatment was only 200. The earthquake occurred at 4am. It was a hot night. People were either sleeping indoors or outdoors. Those who were indoors died, those who were outdoors survived. Very few were injured. I was a member of a medical response team sent to Latur immediately after the earthquake and gathered these figures at that time.

I visited one hospital in the earthquake-affected area of Gujarat. This was the Civil Hospital in the town of Rapar. The damage to the building was extensive with whole walls collapsed and the roof smashed onto the floor in places (see Appendix G Photos 1 and 2). The hospital had been evacuated straight after the earthquake, with those patients still requiring hospitalization being transferred to hospitals outside of the earthquake zone.

This was done by road transport. A number of tents were erected in a children's playground one kilometer from the damaged hospital. From here a basic first aid and outpatients service was established with teams of doctors and nurses going out to rural health clinics to provide the same service there (see Appendix G Photo 3).

Following an earthquake damaged hospitals may have to be evacuated and temporary services established from an alternative location. These temporary services may be limited to primary health care service only. Before an earthquake, hospitals should identify where they would relocate to, what level of service they believe it would be reasonable to provide from there and what supplies and equipment would be required. This then enables the hospital to respond much quicker and in an organised and orderly fashion. Patients requiring hospitalisation will need to be transported to functioning hospitals. As part of their preparation, hospitals should develop likely scenarios for the natural hazards in their area and then plan accordingly. It is much easier to plan without the stress of a disaster situation. Back-up hospitals should be identified and planning completed with them before a disaster.

Sitting one night in a base camp, I listened to a veterinary doctor from the Punjab announce how he had detected an outbreak of foot and mouth disease in the cattle of the area. He then proceeded to ensure the attention of his listeners by telling them that this disease would spread rampantly through the animal population and that it would very quickly be transmitted to humans and that it was extremely deadly; that it was to be even more feared than HIV infection. As can be imagined this created much fear and potential panic and certainly did not help the already stressful situation. Along similar lines, a Sadhu predicted another huge earthquake would hit the area 8 days after the initial event. This too caused much anxiety and panic amongst the population. These two situations highlight the importance of managing carefully the information which is released to the public following major disasters. This sort of information is counter-productive to the relief effort and the rehabilitation of the population. Hospitals and health services need to ensure they have a well documented communication plan and that an excellent rapport is developed with the media.

As a result of the literature search and my observations from being involved in the response to two earthquakes in India, lessons from the experiences of other countries

were identified and analysed and used as a basis to help identify key elements to be considered in the vulnerability assessment of Bir Hospital. The information that was accessed and documented also provided important guidelines for hospital staff and administrators when planning and preparing for disasters. The recommendations identified in this chapter were shared with the Bir Hospital senior management, NSET-Nepal Secretary General and the Nepal MoH.

## **Chapter 4**

### **Bir Hospital Project Design and Methodology**

#### **Overview of the Chapter**

In this chapter the process for the design of the Bir Hospital Project will be outlined and the methods used for data collection described. The design of this project was no different to that for other projects. Reid and Boore (1987:18) identify there is a "circularity about the setting up of a research project"; each stage in the research process is affected by previous stages and vice versa. As progress is made there is an ongoing and continual reassessment throughout the whole process. Much of this refinement process is not detailed in this chapter, but it is mentioned to raise awareness to an integral part of the process in formulating the final project design. A late project design change was necessitated and the reasons for this are given at the end of the chapter.

An underlying principle considered during the design of the project was that of encouraging participation by the local people in the project. I viewed this project as being the first step in a developmental process for Bir Hospital and the Nepali health sector at large. Chambers (1997) defines development simply as "good change". The vulnerability assessment of Bir Hospital will provide baseline information recommending what change should happen for the good of Bir Hospital and the ultimate flow-on to the population they serve.

In the context of development activities today, participation is viewed as a must. The top-down approach to development has been shown to have shortcomings (Brohman 1996:251). It is with this background that the Bir Hospital project was designed and implemented. However, the concept of participation is not necessarily easily applied. With relation to this Brohman (1996:252) asks some probing questions; who participates, what are they participating in, how do they participate and why are they participating? He then goes on to explore the definitions for community participation which range from "voluntary contributions to projects without any local influence over their shape" to "an active process to increase local or community control". The point is also made that any participation should be spontaneous, not coerced in any way (Brohman 1996:252). The primary reason for ensuring community participation is that the outcome of projects are likely to be better

and more sustainable, more people will benefit and the outcomes of the project will better meet the needs and priorities of the beneficiaries. The United Nations Centre for Human Settlements (quoted in Brohman 1996:252) adds that "people have the right and duty to participate in .... projects which profoundly affect their lives". This then leads to one of the key outcomes of participatory development; empowerment. Through the process of involving people they will be given the ability and means to take direct actions themselves to meet their own needs (Allen & Thomas 2000:35).

### **Proposal And Approval For The Bir Hospital Project**

In preparation for a detailed vulnerability assessment at Bir Hospital I communicated via e-mail with NSET - Nepal during the 12 months prior to the site visit. Over this time I developed the scope of the project, primarily in consultation with Amod Dixit, Secretary General NSET - Nepal, who discussed the project concept and scope of work with Dr. Ram Shrestha, Director Bir Hospital. As a result I developed a definitive proposal for the Bir Hospital Emergency Disaster Management project for presentation to the Board of Directors of Bir Hospital for their support and approval (see Appendix A for a copy of the proposal).

The proposal clearly identified the need for the project based on the findings of the vulnerability study of the Kathmandu Valley, which was completed in 1999. The aims of the project and a scope of work were given in the proposal. The two main aims of the project were to develop a framework for a disaster management plan for Bir Hospital and to empower managers and staff at Bir Hospital to be able to develop and take ownership for their disaster management plan. Also included in the proposal was a summary of the actions required to complete the project, identifying who was responsible for each action and by when each action would be completed. It was proposed that myself and Ben Thomas, Risk Management Practitioner, visit Bir Hospital 11 – 22 September 2000, to develop an emergency management planning framework for Bir Hospital, based on a vulnerability study we would conduct. The proposal identified what was required of Bir Hospital to ensure that the project would be successful. The benefits of the project were also outlined in the proposal. The proposal was presented to the Board of Directors by NSET – Nepal, approved by them and written consent given.

Upon our arrival in Kathmandu there was a preliminary meeting with Dixit and Shrestha to confirm the parameters of the project. The purpose of the project was agreed to be a review of the level of earthquake preparedness and response planning at Bir Hospital. Whilst the emphasis was to be on an earthquake event the project would also address emergencies arising from other natural and manmade disasters where appropriate. The core component of the project, to meet the stated purpose, was to carry out a vulnerability assessment of Bir Hospital. A meeting was also held at the Ministry of Health with the Health Minister, Dr. Rambaran Yadav, to explain the project and its purpose. The Minister gave his full support for the project. Throughout this process the Nepali Ministry of Health was also included in the discussions and they gave their support for the project.

### **Vulnerability Assessment Tool**

Helm (1996:8) identifies a number of strategies which may be used for assessing vulnerability and risk. Most of these were utilized in the vulnerability assessment conducted at Bir Hospital. Helm first lists the use of local experience and knowledge. This is very important, especially when those conducting the vulnerability assessment are not from the local area. Throughout the process used at Bir Hospital there was much consultation with local people. This included staff of Bir Hospital, local and national government officials, national experts and officials representing international agencies with a disaster response mandate. Next Helm gives records of observations of past events and the input of expert views as being highly valuable in assessing risk and contributing to a more accurate vulnerability assessment. Past event information was accessed from the Kathmandu Valley Earthquake Risk Management Project (KVERMP) document (see Chapter One). Within this publication expert opinion was also documented. This was supplemented by on-the-spot advice from Amod Dixit, a civil engineer who has been involved with NSET-Nepal since its foundation. He has also been actively involved in all the earthquake vulnerability work conducted thus far in Nepal. Helm then goes on to identify the importance of identifying the maximum credible bounds for any event. This then enables worst-case but realistic scenarios to be determined to define the parameters for vulnerability and therefore the level of planning and preparation which is required. The basis for the maximum credible earthquake event that Bir Hospital would face was determined as being equivalent to the 1934 earthquake using the MMI Scale (refer to Chapter Two for a description). The KVERMP document identified the likely impact on the surrounding community, such as numbers of injuries and loss of

infrastructure, damage to bridges and roads and main utilities such as electricity and water supply. This then helped to determine the scenario for Bir Hospital following an earthquake of this magnitude. Helm also identifies the value of using outside specialists who may be brought in to help determine risk and vulnerability. The assessment team from New Zealand were outside specialists who contributed to this project.

Helm (1996:8) identifies bringing in outside consultants to assist with the vulnerability assessment if expertise is not available locally. Helm also underscores the importance of involving local staff with the consultants to ensure that “the knowledge remains in-house”. A key concept in the approach to the Bir Hospital vulnerability assessment was to involve local staff in the assessment to raise their understanding and knowledge of the processes used so that in the future they would be able to review and update the initial assessment, as well as to guide similar assessments at other hospitals as part of an overall plan to increase the ability of Nepali hospitals to be prepared for an earthquake. In utilizing this concept the capacity of local staff would be increased. Two engineers from NSET were allocated to the assessment team for two primary purposes; to give them the knowledge and skills for assessing the vulnerability of a hospital and for them to carry out a visual assessment of the structural and non-structural vulnerability of the hospital to form part of the overall report.

A generic framework for the vulnerability assessment of Bir Hospital was developed prior to traveling to Nepal. This framework provided triggers for the questions that would be asked to elicit the appropriate information to enable an assessment of vulnerability to be made. Within this framework there were three broad categories of areas to be assessed; utilities, buildings and key departments. Utilities can be defined as being those core services upon which most hospital departments are dependent to perform their function. Examples of utilities, within this context, are electricity, water, waste disposal, steam, medical gases and communication systems. Key departments within the hospital include areas such as the Emergency Department, theatres, Intensive Care, laboratories and the Central Sterilising Department (CSSD). The detail of this framework can be found in Appendix B.

The experience of disasters elsewhere, particularly those involving hospitals and developing countries, is to be considered when conducting a vulnerability assessment so

that lessons learned can be applied. In addition, these experiences may raise awareness to points to which may not have been otherwise considered. An outline of the lessons learned elsewhere is given in Chapter Three.

### **Building The Capacity Of Local Staff**

It was recommended to Bir Hospital that at least two “champions” be identified for the project and be released from their usual duties for the duration of the time the vulnerability assessment was conducted. The primary role of the champions was to gain knowledge and skills during the assessment process, which would then enable them to continue the process in the future. In addition, the champions would provide an advisory role to the external specialists who did not have an in-depth and working knowledge of Bir Hospital. Two champions were identified by the Director of Bir Hospital and allocated to the assessment team. One was a senior doctor and the other a junior doctor, both working in the emergency department. Their selection was determined purely on the basis that they worked in an emergency response department (see Chapter Six for further discussion on this).

A regular meeting was scheduled with Shrestha each morning to brief him on the work completed the previous day and to outline what was planned for that day. Dixit agreed to attend each of these meetings. These meetings were important for two primary reasons. The first was that feedback could be obtained on the previous day’s work to ensure the accuracy of information gained and to confirm the work being done was meeting the needs of Bir Hospital. The second reason was that through discussing the plan of work for the day any necessary support and arrangements to facilitate the assessment team’s progress could be identified and organized by Shrestha. Integral to these meetings was to, as much as possible, actively involve Shrestha and Dixit in the process that was going on.

### **Data Collection**

The methods used for data collection for the vulnerability assessment were a mixture of inspections of the buildings from both inside and out, observation of equipment and the set up and layout of each department. This was augmented by discussions with Bir Hospital staff. Discussions were also held with the Emergency Response Planner for the World Health Organisation’s office in Kathmandu, recognising that in a major disaster Bir



Hospital would not be responding in isolation. The structural assessment completed by the NSET engineers used the methodology described in the “NEHRP Handbook for the Seismic Evaluation of Existing Buildings FEMA-178”, adapted for Nepalese conditions. Due to time constraints only the building known as the “new building” was assessed structurally. There was an earlier structural report on the Surgical Block (old building), completed by the US Army in collaboration with NSET-Nepal. Information from this report was drawn upon for this vulnerability assessment.

The overall approach was to first review the current status for each key utility and identify what reserve capacity there was and what back-up systems were in place. The list of utilities included water, electricity, sewerage, gas, medical gases, communication systems, steam and heating and cooling systems. Throughout this process key personnel such as the electrician, plumber, engineer and maintenance man were consulted. Following this the structure of the buildings was assessed. The NSET engineers primarily did this. Once this baseline assessment of utilities and buildings was completed individual departments were visited, a visual inspection conducted and staff working in the area interviewed. The visual inspection looked primarily at the physical set up of the department, the positioning of equipment and supplies and the impact that an earthquake would have on these. The interview with staff was completed using a formal questionnaire identifying baseline questions (see Appendix C). These questions focused on identifying what the role or function of the department was, which other departments were they dependent on to perform their role, which departments did they consider were dependent on them and which utilities did they require to continue to function. They were also asked if they had experienced any problems in the past that prevented them performing their function, what had caused this and how was it managed. A grid listing key departments on one axis with departments and utilities they may be dependent on listed on the other axis was developed to document the overall dependence of the key departments visited and assessed (see Appendix D).

### **Data Recording**

Written notes were taken during the day while on-site at Bir Hospital. These were then transcribed each evening into a word processing programme on a laptop computer. Many photographs were taken during the inspections of the buildings and departments to

augment the written notes. These photographs were taken on two cameras; one containing photographic film and the other was a digital camera.

A draft copy of the vulnerability assessment and accompanying report was completed at the end of the two week assignment. While the assessment team were still in Kathmandu copies of the draft report were given to the Director of Bir Hospital and the General Secretary for NSET – Nepal for their review and comment. A meeting was convened after they had had an opportunity to read the report. Their feedback on the report was given at this meeting. They recommended some minor changes be made to increase the accuracy of the report. The bulk of the report was accepted as being a fair and honest representation of the findings of the assessment team. The assessment team returned to New Zealand and finalized the vulnerability assessment report of Bir Hospital. The final report was printed and copies sent to both Bir Hospital and NSET – Nepal.

### **Change To The Design Of The Project**

At the outset of the vulnerability assessment it very quickly became clear that the infrastructure of Bir Hospital was not adequate to support an emergency preparedness plan at this stage. The current infrastructure provides Bir Hospital with little resilience to withstand a major disaster and it was the assessment team's opinion that a natural disaster on a relatively modest scale would result in the entire hospital becoming dysfunctional. It was also considered that in the event of an earthquake on the scale of the 1934 earthquake, the hospital would be totally unusable. This cannot be changed without extensive and expensive retrofitting to the structure. The aim of the project, therefore, was modified to read "to improve the resilience of the infrastructure to enable the hospital to survive a lesser event". The focus of the project therefore changed. The vulnerability assessment highlights the perceived weaknesses in the hospital infrastructure and makes recommendations on how these might be addressed. When the resilience of the hospital is improved, the framework for responding to and recovering from a disaster can be developed.

There was a special request put to the assessment team to review and comment on the Bir Hospital ED mass casualty response plan, which was already in existence. This request was honoured and the plan reviewed. The review of the plan was primarily done by comparing it against accepted standards in other countries for mass casualty response

plans and talking with staff in the Emergency Department to validate the appropriateness, practicality and implementability of the documented plan. The responses of the staff were mostly based on their experiences of mass casualty events they had been involved with. On average, the mass casualty plan is implemented at Bir Hospital twice a month. A report on the findings of the assessment of the plan was written and presented to the Director of the Emergency Department.

## **Chapter 5**

### **The Results Of The Bir Hospital Project**

#### **Overview Of The Chapter**

The contents of this chapter are primarily limited to the findings of the vulnerability assessment conducted at Bir Hospital, with some analysis of these findings. The implications and recommendations, which arise from these findings, are mainly detailed in the next chapter, Chapter Six.

At the beginning of this chapter a description of Bir Hospital is given to familiarize readers with the key characteristics of the hospital being assessed. Following this the findings of the assessment of the key utilities of electricity, water, sewerage, steam, communications, medical and energy gases and air conditioning are documented. The content for this section is guided by the vulnerability assessment tool that I developed prior to the assessment being done at Bir Hospital (see Appendix B).

The results of a visual inspection of the construction and physical characteristics of the main buildings comprising Bir Hospital is then given. The content for this section was primarily provided from a report completed by two NSET-Nepal engineers who accompanied me as I completed the vulnerability assessment.

I visited key departments at Bir Hospital as part of the assessment and the findings of my visits are recorded towards the end of the chapter. I also met with disaster response people working at UNDP and WHO and have noted my findings from these meetings.

In addition to the vulnerability assessment of Bir Hospital I was also requested to review the Emergency Department mass casualty response plan. My review of this plan concludes this chapter. The comments and recommendations I made as a result of reviewing this plan are given in Chapter Six.

#### **Description of Bir Hospital**

Bir Hospital is the largest and oldest hospital in Nepal and is funded by the Nepal Government. Located in Kathmandu it serves a population of over one million, with an

annual population growth of 2.93%. About 25% of the 9,000 admissions per year come from outside the Kathmandu Valley. The area surrounding the hospital is one of the busiest and most congested areas of Kathmandu with a high population density. The hospital provides a full range of secondary and some tertiary services with 390 inpatient beds. Because it is a public hospital services are generally free and there is the expectation that anyone attending will receive treatment and care. The hospital tends to attract the poorer members of the community whilst the wealthier population groups use private health facilities. The bed occupancy rate is normally at 90%, however 100% occupancy rates are not uncommon.

All these factors place extreme pressures on the hospital's facilities everyday. In the event of a major earthquake in the Kathmandu Valley Bir Hospital will be required to play a key role in the reception and treatment of casualties as well as being a focal point for the many who will be without shelter.

Bir Hospital has a total of 1012 staff with approximately 200 of these being clinical staff. The minimum numbers on duty are 10 to 15 doctors and 30 nurses at night. Additional staff can be called from the adjacent residence. The majority of the remaining staff live within a 5-km radius of the hospital. Following an earthquake it is anticipated there could be considerable travel problems, even for staff living relatively close. This statement is based on two prime factors. The first is that many of the roads leading to Bir Hospital are very narrow, lined with three to four storey buildings that are highly likely to collapse in an earthquake of a similar magnitude as the 1934 earthquake (Dixit et al 1999:9). The second factor is that almost half the bridges in the Kathmandu Valley could be impassable and 10% of paved roads could have deep cracks and subsidence (Dixit et al 1999:9).

There has been a hospital on this site since 1889. The oldest buildings on the site date from about 1960. In 1985 a new block was built housing the emergency department (ED) and some other departments. However, many of the critical services such as operating theatres, ICU, CCU, and radiology are located in the older buildings. The pressures on the hospital are illustrated by the growth in demand for ED services rising from 25,000 presentations to ED in 1985 to a current figure of 62,000 per year. Over 300,000 people are seen in the outpatients department each year.

## **Electricity Supply System Assessment**

The findings of the vulnerability assessment on the electricity supply system at Bir Hospital were that the current system does not provide adequate supply to the hospital under normal operating conditions, that the hospital is reliant on all of the current system so that there is effectively very little, if any, redundancy. In addition, there are little or no back-up systems in place and no documented disaster response plans. Maintenance of the system is either unknown or non-existent. As a result, the overall conclusion of the assessment team is that the electricity supply system is extremely vulnerable under normal operating conditions and that an earthquake of just a moderate intensity, or any other event which may impact on the electricity supply system, would most likely leave the hospital without any power supply at all. Critical areas such as theatre and intensive care unit do not have any uninterrupted power supply (UPS) systems. In the event of loss of electricity from the main supply there is a total loss of electricity to those areas until the generator can be manually started. The only equipment observed to have a UPS was the PABX. Total loss of electricity to these critical areas could have life threatening implications, not just in an extended electricity outage but with one of a short duration only. This is discussed in more detail in Chapter Six.

The assessment conducted of the electricity supply system found that electricity is supplied to Bir Hospital via two independent 11kV cables that connect to two 250kVA transformers. These transformers are located within the Bir Hospital site. In the event of one cable failing the second cable can automatically maintain the electricity supply to the hospital. Local residents and the staff at Bir Hospital informed me that the public power supply in Kathmandu cannot be considered stable; there are frequent electricity outages.

The transformer that supplies the old hospital buildings with electricity is about 13 years old. The transformer supplying the central hospital block is about six years old and replaced a 750kVA transformer which burned out. It was not known why a 750kVA transformer was replaced with only a 250kVA one, especially as it was known that the hospital's requirements for electricity exceed the capacity of the two transformers. Bir Hospital owns the transformers but the maintenance of them is the responsibility of the electricity supplier. It was unknown by Bir Hospital staff if and when the transformers had last been serviced.

The hospital's demand for electricity peaks at about 750kVA. On this basis, the total capacity of the two transformers of 500kVA is well short of what is required. The outcome of this is that at the time of peak electricity usage some hospital departments, or areas of departments, have electricity supply cut to them. However, the reality is that the transformers are being pushed to their maximum limit almost continuously. Ideally, transformers should not be operated for long periods at greater than 75% of their capacity. To do so greatly increases the risk of transformer malfunction.

In the case of the transformer serving the central block this excessive load has resulted in the failure of the cable insulation (see Appendix G, Photo 4). There was no evidence of maintenance on the transformers and it did not appear that the transformer oil had ever been tested or changed. Considering the maximum load to which the transformers are subjected there are doubts over the condition of the oil. Loads of this intensity will cause increased degradation of the oil. The accumulation of debris on the transformers (see Appendix G, Photo 5) would also inhibit the ability of the transformers to dissipate heat, further compounding the degradation of the oil. The consequence of this could be a catastrophic failure of a transformer. Transformers with poor oil quality or low oil levels have an increased risk of either a transformer fire, or worse, an explosion of the transformer that could potentially shower hot oil over a large area. If a transformer was either malfunctioning or destroyed so that it required replacing it is expected that replacement would take about one week. In the intervening period the power supplier would loan Bir Hospital a generator. This is based on the assumption that the power supplier either had one available or was able to quickly access one from somewhere else.

All of the main switches adjacent to the transformers appeared to be of a standard design. The maintenance regimes and the availability of replacements and spare parts were not known by any of the engineering department staff.

The transformers were inspected for resilience to the impact of an earthquake. They were found to be bolted to the concrete pads they were sitting on. This would prevent their displacement during an earthquake. The transformer serving the central block is housed in a separate building that appeared to be constructed of reinforced concrete. It is expected this building may withstand a moderate sized earthquake. The other transformer is situated between two of the oldest buildings on the site. It is expected that a minor

earthquake would result in severe damage to this transformer from falling debris from the adjacent buildings.

There are two emergency generators to provide essential electricity supply when the external source is disrupted.. One of these has been out of action for the last four years. The functioning emergency generator will only supply 25% of the hospital's electricity needs. The current system in place does not permit power switching between different areas. Therefore, it is fixed as to where this limited supply of electricity can be supplied and there is absolutely no flexibility in the system to meet different demands at various times of the day. The functioning generator is about 13 years old and is rated at 160kVA with a diesel motor power source. The diesel for the generator is stored in a separate diesel tank holding about 200 litres with two x 200 litre drums in reserve. The generator consumes 40 litres of diesel per hour, therefore it could run for about 15 hours on the diesel immediately available.

A daily off-load test of the generator is conducted and fully documented. While I was there the generator was run on load for a short period when the external electricity supply failed. Before that the generator had been run for two hours on load about two months prior. The longest on-load run has been 4 – 5 hours. This was achieved without any major problems. On this basis there is some confidence that there will be limited back-up electricity in the event of loss of the external source of electricity. However, if anything was to go wrong with this generator there is no back-up. It was estimated that the non-functioning generator, which is rated at 125kVA, would cost Rs100, 000 (NZ\$3,000) to repair.

It was not clear what the maintenance regime of the generator and motor were but they were clean and the batteries visually appeared to be in good condition, which is evidence of some maintenance having been carried out.

The generator is started manually and there are six electricians employed by Bir Hospital who understand the operating procedure and at least one is on-site at all times. Because of the distance from the generator room to the electricians' office it may take up to 10 minutes for the generator to be started once the electricity supply fails. This may be critical in the case of the operating theatres in the absence of any UPS for the theatre lights or any other equipment. This is discussed in more detail in Chapter Six.



The generator is bolted to a concrete pad but ancillary equipment, notably the diesel tank and drums are unrestrained which would result in the loss of the generator in even a moderate earthquake. In addition, there is the potential hazard of spilled diesel. The generators are located in buildings, which could be regarded as seismically weak and unlikely to withstand an earthquake of a moderate intensity.

### **Water Supply Assessment**

For a number of years Bir Hospital has functioned with what could be termed as an inadequate and sub-standard water supply. Everyday the hospital is faced with a water crisis. Hospital wards reported that they often only receive water supply for one hour in a twenty-four hour period. This creates major problems for preventing cross-infection by means of hand washing. Infection control, generally, is compromised by affecting the ability of hospital staff to keep the hospital clean. There are no water reserves or back-up systems available. There are no contingencies for a total loss of water, which could happen at any time. An earthquake of a moderate intensity would render the hospital without any water almost immediately. Attempts have been made to rectify this situation but have not been realised and are unlikely to be within the next 12 months.

The water needs of Bir Hospital were assessed at 250m<sup>3</sup> per day. Because of low water pressure in the city reticulation system the water is delivered to Bir Hospital by water tankers. This provides about 100m<sup>3</sup> per day, less than half the actual water needs, at a cost to Bir Hospital of between 20 – 30,000 rupees (NZ\$1000) per day. This shortage of water is exacerbated by a large number of leaking pipes within the hospital plumbing system. At the rear boundary of the hospital site a 300m bore has been sunk to access an aquifer, which can deliver 400 litres of water per minute. This water, however, is heavily contaminated by iron, ammonia and iodine and cannot be used. The director and hospital board are well aware of the water problem and the solution is likely to be the installation of a water treatment plant for the bore water. Final plans with the estimated costs were before the Board for their consideration at the time of the visit to Bir Hospital. One previous attempt to install a water treatment plant was abandoned after the contractors absconded with the money for the project after making only a rudimentary start on construction.

There is a 150m<sup>3</sup> reinforced concrete (RIC) water storage tank in the middle of the hospital site, mainly above ground. It is into here that the water tankers deliver the water. Water is then pumped by three electric pumps from this tank to 12m<sup>3</sup> water tanks on the top of each hospital building. The water pumps were said to be connected to the emergency power supply but this was not demonstrated. The roof tanks appear to be of RIC supported on RIC columns. There is also an HDPE water storage tank which supplies the water for use in the haemodialysis unit. It appeared likely that a moderate earthquake would result in failure of the water supply system within the hospital. This would be a combination of breakage of pipes and collapse of storage tanks, assuming that water tankers could still deliver water to the hospital, that the ground tank was still intact and that there was an electricity supply to pump the water into the roof tanks.

### **Sewerage System Assessment**

The hospital is connected to the town sewer system and it appears to function adequately for Bir Hospital's needs. The only problem that was noted was that of items being put down lavatory pans, blocking the pipes. This occurred primarily in the public toilets on the ground floor of the hospital. The reliability of the waste water system is outside the control of Bir Hospital, though if there was a problem the hospital can raise this with the city corporation and apply pressure for the rectification of the problem. The KVERMP report identified that almost all sewerage pipes would be damaged in an earthquake of moderate intensity. This would create a problem of waste disposal for the hospital. The hospital has not developed contingency plans to deal with a failure of wastewater from the hospital.

### **Steam Supply Assessment**

In most hospitals there is usually a central steam production unit. In a hospital steam is normally used for sterilizing equipment and supplies, cooking, laundry services, heating of buildings in cold weather and heating the hot water supply. At Bir Hospital there is no central steam production unit or boiler house. Electric steam generators that are attached to autoclaves in the central sterilising supply department (CSSD) and the emergency department operating theatre provide steam for sterilisation. The electric steam generators are connected to the emergency power supply. Visual inspection suggested that these units were in satisfactory condition. The sterilising units were bolted to the floor, thereby reducing the likelihood of movement during an earthquake. There was no documented maintenance programme for these units. Generally, they were serviced when

a noticeable problem occurred. Steam was not used for cooking purposes, there was no laundry service on-site, the buildings were not heated and there was no hot water supply.

### **Communication System Assessment**

Integral to the ability of a hospital to respond quickly and efficiently to a disaster is an effective communication system. The communication systems at Bir Hospital were assessed and found to range from functional to totally inadequate. There was also an emergency call system in the Emergency Department that was untested.

Bir Hospital has a PABX system, which consists of 16 lines, 13 of which are direct lines into specific departments and the remainder via the switchboard. There was a total of 250 extensions with the capacity for 200 internal calls that can be made at any one time.

There is a paging system that was designed to support 200 pagers but only 10 pagers can now be used as the remainder have either been lost or are malfunctioning. These remaining pagers are allocated to key on-call and duty staff. It is planned to install a new pager system but no timeframe could be provided for this. The hospital does have an intercom that is installed throughout the hospital. However, this system is non-functional and there are no plans to repair it.

The PABX equipment is located in an unventilated room with a defunct air-conditioning unit. There were no immediate plans to repair the unit. The temperature and humidity levels in this closed room were high, which will increase deterioration of the equipment and therefore the likelihood of failure. The PABX is connected to a 30 minute UPS. The building in which communications equipment is located is one of the old buildings and seismically suspect.

Located within the emergency department is an audible alert system for summoning staff from other parts of the hospital in the event of a mass casualty event. We received conflicting information on when this was last used with one suggestion being that it had not been used for four years. The alarm had not been tested and there was no recorded maintenance of the system. A number of the staff were unsure what the alarm sounded like. It was also reported that the last time the alarm had been activated there was confusion amongst staff as many thought it was a fire alarm. It was also noted that no one

recalled if and when the fire alarm had last been tested nor was anyone able to identify what the fire alarm sounded like.

For effective communication not only communication systems within Bir Hospital need to be functioning but also the systems external to the hospital and the linkages between them. The KVERMP report identified that following an earthquake much of the telephone system in Kathmandu would be inoperable. This, though, would not affect the internal phone system at Bir Hospital if there was a robust system in place. However, the building which currently houses the PABX is likely to be badly damaged in a moderate earthquake. The ability of Bir Hospital to call staff in, even in a small to moderate event, is very limited given the gross inadequacies of the paging system.

### **Medical Gases Assessment**

Another utility which was assessed was that of medical gases. The gases which are used within the hospital are oxygen, medical air, suction and nitrous oxide. There is a central medical gases room which supplies oxygen to the operating theatres, ICU, CCU and the cardio-thoracic unit. Two large banks of oxygen cylinders provide the piped oxygen supply to the hospital. As one bank of cylinders is depleted of oxygen the supply is switched over to the second bank of cylinders. A small to moderate earthquake could cause disruption to the oxygen supply as the cylinders are not restrained and due to their size and shape will topple very easily.

Also in this central room there are two medical air and suction units. Air and suction are supplied to the operating theatres, ICU and CCU only. In the case of ICU the medical air provides the power for the suction units, although ICU staff appear unaware of this and equipment fittings are incompatible with the wall fittings. This suction system is not used by ICU staff as they rely on portable electric suction units. However, this is a valuable back-up system for in the event of failure of the portable electric suction units, for whatever reason. Until the fittings are changed and staff are trained in their use it is not available.

Oxygen in all other areas of the hospital is provided from cylinders that are delivered to each area. These large oxygen cylinders are placed beside the bed of the patient requiring the oxygen. They are not restrained in anyway. The same system is used in the

Emergency Department with a large cylinder standing beside each bed. Electrically operated portable suction units provide suction facility in the areas not supplied by the piped facility. It was not established where the store for nitrous oxide was located.

The central gas store is located in the old building and the supply pipes run through the building. It is anticipated that this building would be damaged in a moderate earthquake, therefore disrupting the supply of oxygen, medical air and suction to all hospital departments.

### **Energy Gas Assessment**

LPG (propane) is used for cooking and heating water for washing kitchen utensils. LPG cylinders are located in a room attached to and behind the inpatient kitchen. There are two banks of four cylinders, with four in use and four on standby. In addition to these there were 17 cylinders spare in the room. All cylinders were full. The usual consumption rate of the LPG is one cylinder per day. When four cylinders are empty they are sent away for immediate refilling while the second bank of four cylinders are utilised.

The system for ensuring continual supply of LPG works well. There is more than adequate redundancy within the system to allow for an extended period of non-supply of LPG, especially if some form of rationing was implemented. However, it was noted that none of the cylinders were restrained and they were stacked up to three high.

### **Air-conditioning Assessment**

There are a number of areas with air conditioning units but many are inoperative. The principal air-conditioned area is the operating theatre. The most likely factor to impact on the air-conditioning after an earthquake will be the loss of electricity to operate them.

Although the assessment is primarily focused on the vulnerabilities of Bir Hospital should an earthquake occur, it should be noted that the air conditioning units for operating theatres should follow a rigorous maintenance, cleaning and testing for bacterial infection programme to ensure the safest possible environment for patients receiving surgical interventions. There was no documented evidence of any of these programmes and no one was able to authoritatively comment on this.

### **Lift Assessment**

There are a total of five lifts and it is understood two of these can be operated on emergency power. All of these lifts are situated in buildings which are expected to be damaged following a moderate sized earthquake and therefore they would not be usable. This would have an impact on the ability to move patients between floors and for the evacuation of the building.

### **Equipment and Plant Assessment**

One of the major concerns arising out of the site inspection was the amount of equipment and plant not working. The reasons for failure included lack of available expertise, absence of spare parts and equipment unsuited for the purpose. The ultimate result of this was often a valuable resource that was sitting idly and, in some instances, taking up valuable floor space in departments short of operating room. To compound the problem often the equipment deteriorated further while it sat idly. A good example of this was the CT Scanner. The tube in the scanner required replacement. A replacement was sought from India along with the technical expertise to fit it. The whole process took six months. When the new tube was finally installed they found that the wiring to and within the scanner had been destroyed by rats that had had undisturbed access to the scanner during the period of inactivity. This further delayed the return of the scanner to active use.

Generally, the source of the problem appeared to be twofold; brand new equipment was purchased for which spare parts and technical expertise were not available in Nepal and used equipment donated, often not working and in a poor state of repair, without any prior consultation with Bir Hospital. The most dramatic example of this were three large x-ray machines from Germany, cluttering up an already crowded radiology department. They were non-functioning when they arrived and there was no expertise in Nepal to assess or repair the machines.

### **Building Structure Assessment**

The seismic vulnerability assessment of Bir Hospital buildings was conducted by two NSET-Nepal engineers appointed to our assessment team. Their seismic assessment was limited to a visual assessment only of the structure and non-structural elements of the New Hospital building. This was primarily due to time constraints. The outcome of their assessment is presented in the following paragraphs.

The U.S. Army, in collaboration with NSET-Nepal, completed a seismic structural assessment of the Surgical (Old) Hospital buildings in 1998. That assessment identified the building to be an un-reinforced brick masonry construction with some steel bracing. Internal walls, both load and non-load bearing, are of un-reinforced masonry. Their conclusion was that the building was unlikely to withstand a relatively minor earthquake. The recommendation was made that the building should be strengthened to withstand the likely seismic load.

The structure of the New Building (see Appendix G, Photo 6), which houses the emergency department and supporting services such as x-ray, laboratory and minor operations theatres, the haemophilia care centre, an observation ward and the disaster management unit was visually assessed. The building is a Concrete Moment Frame with un-reinforced masonry infill. There is no apparent connection between the masonry infill and the frames. It is considered that the main structural frame of the building would withstand a moderate seismic event. However, material strength was not tested so this cannot be given as a definitive statement. The height thickness ratio of the un-reinforced masonry walls does not meet the minimum standard for areas of high seismicity. It is anticipated that in a moderate seismic event the infill walls would fall. This conclusion is further supported by the presence of severe diagonal cracks in the infill walls.

Generally, the buildings were poorly maintained and there was much evidence of severe spalling on the outside of the buildings (see Appendix G, Photo 7), cracking in both load and non-load bearing walls and degradation of masonry. Leaking water pipes in all of the service ducts running throughout the buildings further damages and weakens the structure of the buildings (see Appendix G, Photo 8).

There are two further buildings on the hospital site which have had an additional storey added to each with no consideration given to the structural ability of the respective building to take this increased loading. These two buildings are considered to be at high risk for severe damage in a moderate sized earthquake. The neuro-surgical ward is housed in one of these additional floors and the burns unit in the other. The ICU/CCU is situated in the ground floor of one of these buildings. The impact of a collapse of these buildings would be major.

None of the utility and gas pipes running through the buildings were observed to have seismic joints, therefore making them more vulnerable to fracturing during an earthquake. Seismic joints in utility pipes were observed at another major hospital in Kathmandu, the Tribhuvan University Teaching Hospital (see Appendix G, Photo 9), therefore the technology is available and known in Nepal. Building movement during an earthquake will cause fracture of rigid pipes running through the building unless flexible joints, at regular spacing, are inserted into the pipes.

The superficial structural assessment, which was done on the buildings comprising Bir Hospital, suggests that it would not require more than a minor to moderate earthquake to make all or part of Bir Hospital unusable. An event producing a felt intensity of MMI 7 is likely to cause significant damage to the non-structural elements of all the buildings with structural damage to the older buildings.

### **Departmental Assessment**

As part of the final stage of the vulnerability assessment at Bir Hospital a visit was made to key departments. The departments located in the New Building that were visited were the Emergency Department (ED), ED observation wards, ED minor operations theatre and attached CSSD unit, ED radiology unit, disaster management unit, laboratory and the Haemophilia Care Centre. The departments located in the Old Building that were visited were the operating theatres, main radiology department and the communications center.

As each department was visited we requested to meet with the departmental manager or their designee. A series of questions were put verbally to them (see Appendix C). One of the outcomes of this questionnaire was a grid which identified the key dependencies for each department (see Table 4). From this simple grid it can very quickly be identified that most key departments are dependent on electricity, water and sewerage. This then underscores the importance of these utilities and the need to create reliability and resilience to ensure availability at all times. It can also be noted that the utilities of which there is least dependence are energy gases and air conditioning. On this basis these would be given lowest priority to ensure continuity of supply.

The grid also identifies that the emergency department is the department most dependent on other departments and utilities while the communication center has the least



dependence. This identifies that the emergency department is more vulnerable to having their ability to function disrupted as potentially they are exposed to more risk through their greater dependency.

In all of the departments visited no equipment was restrained, all cupboards and storage units were free standing and bottles and other items were stored on open shelving (see Appendix G, Photos 10 & 11). Temporary plywood partitioning had been erected in a number of departments. These partitions were not firmly fixed to the frame of the building. In the event of a minor earthquake there is the potential for loss of expensive equipment, injury to personnel from falling objects and major disruption to services caused by chaos from uncontrolled movement of non-structural items. There is also the increased risk from spilled hazardous substances in areas such as the laboratory. Also noted generally in all departments visited was the poor level of maintenance and repair. An example was the electrical wiring in one of the departments that was exposed (see Appendix G, Photo 12). This increases the risk of utility failure on a continual basis without any other event and will be likely to exacerbate the problem if there was an event such as an earthquake. Another factor to be considered is the health and safety of staff and patients in these areas on a daily basis.

Of all of the departments visited, the Emergency Department was the only department which had a documented disaster response plan and this plan was limited to mass casualty.

### **Visit To Outside Agencies**

To conclude the vulnerability assessment of Bir Hospital a visit was made to two international organisations who have offices in Kathmandu and play a key role in both disaster preparedness and disaster response. Boughton (1997:19) makes the point that hospitals do not function as an island or independently. Although this comment was made specifically in relation to the infrastructure of the community, such as power supply systems and transportation networks, it also applies that a hospital as an organization does not function alone but is dependent on other organizations. In recognition of this the vulnerability assessment extended to meeting with and interviewing The National Programme Manager for the Disaster Management Programme at the United Nations

<div> <div>Department</div> <div>Dependency</div> </div>	Emergency D.	ED Obs Ward	ED Minor Ops	ED Radiology	Disaster M. Unit	Laboratory	CSSD	Haemph. Care C.	Main Ops Theatre	Radiology	Comms. Centre	Electricity	Water	Sewerage	Steam	Communications	Medical Gases	Energy Gases	Air -conditioning	Lifts
Emergency D.	O	√	√	√	√	√	√	X	√	X	√	√	√	√	X	√	√	X	X	√
ED Obs. Ward	√	O	X	√	X	√	X	X	√	X	√	√	√	√	X	√	√	X	X	√
ED Minor Ops.	√	√	O	√	X	√	√	X	√	√	√	√	√	√	X	√	√	X	√	√
ED Radiology	√	√	X	O	X	X	X	X	X	√	√	√	√	√	X	√	X	X	X	X
Disaster M. Unit	√	√	√	√	O	√	√	X	√	√	√	√	√	√	X	√	√	X	X	X
Laboratory	X	X	X	X	X	O	X	X	X	X	X	√	√	√	X	√	X	X	X	X
CSSD	X	X	X	X	X	X	O	X	X	X	X	√	√	√	√	X	X	X	X	X
Haemph. Care C.	X	X	X	X	X	√	√	O	X	X	X	√	√	√	X	X	√	X	X	√
Main Ops. Theatre	X	X	X	X	X	√	√	X	O	√	√	√	√	√	X	√	√	X	√	√
Radiology	X	X	X	X	X	X	X	X	X	O	√	√	√	√	X	√	√	X	X	√
Comms. Centre	X	X	X	X	X	X	X	X	X	X	O	√	X	X	X	√	X	X	X	X

Table 4: Key Departments Dependency Grid

Development Programme (UNDP) and the Technical Officer for Emergency and Humanitarian Action at the World Health Organisation (WHO).

Both organizations have been active in Kathmandu for a number of years, working with key organizations in emergency preparedness. They have completed their own assessment of the impact an earthquake of the magnitude of the 1934 earthquake would have in Kathmandu, based on the earthquake scenario developed by NSET. Their primary focus was how the event would impact upon their organizations and their staff and consequently developed contingency plans based on this.

From their perspective much of the attention in the past has been given to the response to an earthquake, though now the focus is starting to shift to mitigation and preparedness. As part of this process a number of working groups have been established, the relevant one being a Health Working Group made up of hospital directors, senior clinicians, government representatives and UNDP / WHO personnel. Although established, the working group has been dormant for a while but efforts are being made to reactivate it.

### **Proposed Trauma Centre**

There are plans for a new 200-bed trauma centre, funded by the government of India, to be built on a street corner adjacent to Bir Hospital. It is anticipated this will be completed within three years and will replace the existing ED and support services. The hospital management is currently finalizing building design and floor plans. Initial discussions have indicated that the proposed building will be built to appropriate building codes. As Nepal does not have any approved building codes it is proposed that the Indian building codes for earthquake prone zones be used.

The new trauma centre presents Bir Hospital with the opportunity to have a facility that will not only serve the community long into the future but also a facility that can be designed to resist a major earthquake and continue to provide services in the aftermath of one.

It should be noted that building codes are a minimum standard only. Building Codes in most countries recognise the strategic importance of institutions such as hospitals and impose higher standards for such buildings. However building codes in any country are primarily designed as a means of minimising injury and loss of life should an event such

as a fire or an earthquake occur. Compliance with building codes does not offer assurance that the facility will be usable after the event. It may be recalled that after the Northridge (US) earthquake in 1994 many healthcare facilities suffered relatively minor structural damage but were unusable because of damage to non-structural elements such as services, equipment and fittings.

It is essential that the design of the trauma centre be such, that there will be reasonable assurance that the facility will be able to function after a major earthquake. To achieve this the design stage needs not only to consider the seismic integrity of the structure, but the seismic resistance of the non-structural elements such as fixtures, services and equipment. There also needs to be consideration given at an early stage to the expertise of those undertaking the building work and the supervision required to ensure that the special seismic requirements of the design are properly implemented.

### **Review of the Mass Casualty Disaster Response Plan**

In addition to the vulnerability assessment of Bir Hospital, I was requested to review and comment on the Emergency Department (ED) mass casualty disaster response plan. I agreed to do this. The following paragraphs summarise the current ED plan and compares this with what is considered to be a basic benchmark internationally for a mass casualty plan. The recommendations arising from this review will be presented in Chapter Six.

A mass casualty event is one that involves an influx of casualties from an accident or disaster external to the hospital. This may be a bus crash, fire, explosion, stampede, or building collapse to name a few. Whatever the reason, the numbers of casualties are greater than those the hospital is normally prepared to manage. Without prior planning and a system in place to manage the increased numbers the resources of the hospital may be overwhelmed and the treatment of casualties inefficient.

The current mass casualty planning is based on a document titled "Disaster Management Plan for Bir Hospital" dated 2049/6/15 (October 1992 by the Gregorian calendar) prepared by Dr. R.P. Shrestha. This plan is mirrored by a shorter version held in the ED. My assessment of the document is that it covers the essentials of the process well and what is needed is some fine-tuning of detail. It should be noted that Bir Hospital and its emergency staff have everyday practical experience of mass casualty management to a

far greater degree than staff in a western hospital. On average, Bir Hospital responds to two mass casualty events per month. An examination of their record book for mass casualties showed that the majority of mass casualty incidents arises from road traffic accidents and tend to involve about 35 injured at a time. Of these about five have serious enough injuries to warrant admission into the hospital. This ratio of minor to serious injury appears to be constant for road traffic accidents. In addition to road traffic accidents there are sporadic events of mass food poisoning following a function such as a wedding, alcoholic poisoning from illicitly brewed liquor and one mass casualty event followed a tiger attack in a village.

Bir Hospital has set guidelines for the activation of their mass casualty plan. If there are fewer than 15 casualties at one time then normal operating procedures continue and no additional staff are called in. If there are 15 – 50 casualties additional staff are mobilized, mostly from the staff residence adjacent to Bir Hospital. In addition, public access to the hospital is restricted by the security guards closing the entrance gates to the hospital. For more than 50 casualties the mass casualty alarm in the ED would be activated. In theory, this results in staff reporting from different parts of the hospital to the ED. Off-duty staff may also be recalled. In practice there had been no recent experience of the alarm being used (refer to my comments earlier in this chapter under the heading Communication System Assessment).

These aspects of the Bir Hospital mass casualty plan are consistent with the key principles and components of a disaster response plan as identified by Auf der Heide (1989) in his book "Disaster Response: Principles of Preparation and Coordination". In his book he identifies the need for disaster plan activation levels (1989:74), recognition that everyday procedures will alter (1989:55), the need for calling in off-duty personnel (1989:54) and the importance of security at the receiving hospitals (1989:66).

Bir Hospital is usually notified of a mass casualty event by the Police at the scene who radio through to Police based at the hospital. These Police officers are stationed in a room adjacent to the ED at all times. The notification will include an estimate of casualty numbers and the expected time of arrival but not the type of injuries.

The Police at the hospital will then notify an on-duty doctor who will inform the ED nursing sisters. Depending on the casualty numbers the ED Director may be informed and the process may be initiated of calling in additional staff. Many of the additional staff requirements would be met from on-call staff in the staff residence, less than five minutes walk from the main hospital buildings. If the incident was sufficiently large staff from other parts of the hospital would also be called. We did not establish how staff were called from their homes but it is assumed that telephone contact would be used where possible. It was acknowledged that for a major accident the telephone system would quickly become overloaded and unusable for effective communication. Effective communication is essential for an efficient and timely response to a disaster event (Kaufman, 1996:1746, Pateman, 1993:808, Sharp et al, 1994:387, PAHO/WHO, 1999:6). In the review of disaster events almost all identify communication difficulties as being the biggest problem (Auf der Heide 1989:80).

In addition to calling in clinical staff, housekeeping staff would also be called. A member of the housekeeping staff is responsible for putting out the mattresses in the area designated for treating the casualties. This area is in a wide corridor adjacent to the ED, which can be utilized without major disruption to hospital pedestrian traffic flows through the hospital. This is Bir Hospital's prime strategy for increasing the number of casualty treatment beds. This area is called the disaster management unit. Nursing staff are responsible for preparing the emergency cupboards and emergency storeroom. The laboratory, Blood Bank and Radiology departments are notified of the mass casualty event. The main operating theatres will not be advised until the situation is clearer and it is known potentially how many will require surgical intervention and treatment. The Director of ED will assume the role of overall coordinator of the response and, except where his advice is requested, will not generally be directly involved in treatment.

One of the characteristics of a good disaster response plan is that it will clearly identify how both multi-organisational and multi-disciplinary coordination will be managed (Auf der Heide 1989:78). The Bir Hospital plan includes detail on multi-disciplinary coordination but very little on multi-organisational.

At any one given point in time there are usually a number of people waiting to be seen in the ED who could not be classed as requiring urgent attention. There is no documented

procedure for clearing the emergency department of these non-urgent waiting cases. There is also no process for notifying ward areas that there may be the need to make bed space available by discharging patients who could be sent home. This is important when considering Bir Hospital is usually operating at 100% bed occupancy. As noted earlier, Auf der Heide (1989:55) points out that everyday procedures may need to be altered.

The casualties will normally arrive at the hospital by bus. At the scene of the accident the casualties are put onto a bus with no assessment or treatment and transported to the hospital. In Kathmandu there is no organized ambulance service for emergency response. Generally, there are a few ambulances owned and operated by hospitals, primarily for the general transport of patients rather than for emergency response. Once the casualties arrive at the hospital they are taken straight to the disaster area where Paramedics are responsible for identifying and tagging casualties. Paramedics will notify medical staff of any casualties in obvious distress needing urgent attention, otherwise the casualties wait until a doctor or nurse is free to see them.

Casualties are triaged by medical staff. The documented triage system for Bir Hospital is a five colour triage system made up of red to indicate that immediate care is required, yellow for delayed care, green for minimal care, blue for casualties requiring reassessment and black is reserved for the dead.

None of the triage tags seen in the ED conformed to this system. The tags, which are tied onto casualty wrists, have spaces for information relating to the age and gender of the patient and details of the triage diagnosis but no colour designation. Casualties are allocated a number from the disaster register where all casualties are listed. This number is noted on the ED ticket, which the casualty retains on discharge.

Triage is a procedure that determines "priorities for treatment and transport" (Auf der Heide 1989:66). Ideally, triage of casualties will first be done at the scene of the incident so that casualties requiring priority treatment are transported first. An important outcome of triaging should be the determination of the destination of casualties. Casualties requiring specialized care, for example those with burns, should be sent to a hospital having the appropriate facilities. Casualties should also be distributed equitably between

receiving hospitals to minimize the likelihood of over-loading any one hospital (Auf der Heide 1989:66).

Although the use of triage tags and colours to denote the priority of treatment of casualties is common practice internationally and recommended, there is no universal agreement on the design of the tags or the allocation of colours to each priority level (Auf der Heide 1989:187).

It is recommended that a casualty list be compiled (Auf der Heide 1989:66). There are two main reasons for this. The first is that it provides a basis from which to manage the influx of calls from people enquiring as to whether their loved one has been involved in the incident. The second is it provides a base document from which it may be identified if there are any missing victims and also for the reconciliation of casualties who arrived at the hospital and those who were actually treated and either admitted or discharged. The disaster register at Bir Hospital fulfills the function of a casualty list.

One of the strategies Bir Hospital employs to manage family enquiries is to compile a casualty list, which is posted on the notice board attached to the hospital fence. Generally, families are kept outside the hospital and rely on these casualty lists for information. Relatives of casualties will only be allowed into the hospital in ones and twos.

An important, but often neglected component of a disaster response plan, is the management and handling of the dead. This component is not addressed in the Bir Hospital plan.

Clinical staff are assigned responsibilities on the instruction of the senior doctor on-duty. There is no formal process for documenting roles or for forming clinical teams for dealing with specific casualties or groups of casualties. Casualty allocation appears to be very much on an ad hoc basis.

A disaster response plan should clearly identify the roles required for the response and there should be a job description for each role (Pateman, 1993:808, Sharp et al, 1994:388, Paho/WHO, 1999:10, WHO, 1999:79). The role should designate a position rather than a person (Auf der Heide 1989:43). The reasons for this are that personnel



often change within a hospital and therefore the plan becomes outdated quickly and the specific person may not always be available at the time of a disaster. What is important is that a role has been identified within the overall design of the plan and that the role will be filled by the most appropriate and available person at the time. The ED disaster response plan clearly does not meet this standard.

After assessment and treatment has finished in the ED each casualty will either be discharged, transferred to the main operating theatres or admitted to a ward. The destination of each patient is marked in the Disaster Register. On admission to the hospital the casualty is issued with a new ticket and a different identification number, and a bed number.

In the old building, adjacent to the trauma ward, is a six-bed ward reserved at all times for mass casualty admissions. Staff are taken from other departments to manage this ward. If the hospital is full arrangements can be made to transfer casualties to other hospitals but this process is not documented. It is at this stage there may be communication with other Heads of Departments to see whether ward space can be made available by discharge of existing patients. In practice some casualties discharge themselves without waiting for treatment and these are marked in the Disaster Register as "absconded".

For the overall management of and responsibility for casualties it is important that casualties be "tracked". The base document for this is the casualty list. For completeness the movement of casualties must be recorded beyond just the next destination after ED. This process is important so that casualties are not unaccounted for and so that casualties can be located if either medical personnel or family or the Police need to locate a casualty urgently for some reason. In practice this is often very hard to manage accurately.

Generally, the management of the media at the time of a disaster is considered to be of major importance when developing a disaster response plan. There are many reasons for this with the main one being that, if managed well, the media can assist with the response, primarily communicating information. The type of information they could convey which would be helpful is the need for personnel and supplies, warnings to the public so as to minimize the likelihood of further casualties and through information reduce the number of

enquiries being handled at the hospital. Auf der Heide (1989:215 – 250) indicates the importance of media management by devoting a complete chapter to this topic.

The Director of ED assured me that the media, and also VIPs who may arrive following a disaster do not present any difficulties. The media tend to arrive with the Minister and only in small numbers. The only way this might change would be an event attracting international media attention. However, there is no information contained in the plan outlining how media and VIPs are to be managed.

Training of staff appears to be informal. Staff beginning work in ED receive some verbal briefing of mass casualty responsibilities. Staff outside ED seem to receive no training at all. There are no exercises, although the frequent occurrence of mass casualty incidents probably compensates to some extent. After the event the management of the incident is discussed amongst senior staff but this appears to be an informal process.

Primarily, one individual, based on what was happening in practice, developed the plan. Auf der Heide (1989:42 – 47) recommends some key factors for the development and maintenance of a disaster response plan, which are practical and implemental. The first is that the likely users of the plan do the planning. The actual process of planning, involving the users, is one of the best ways to ensure your staff know the plan, will accept the plan, and that it will be practical and workable. Once the plan is completed it should be tested with an exercise. All new staff should receive training in the plan and at least annually there should be an exercise to ensure all staff have a current knowledge of the plan and this will also provide an opportunity to re-assess and update the plan. Actual events also provide a good opportunity to review the plan and update accordingly.

## **Chapter 6**

# **Implications of the Bir Hospital Project Results and Subsequent Recommendations**

### **Overview Of The Chapter**

In the previous chapter the results of the vulnerability assessment conducted at Bir Hospital were presented along with some analysis of these findings. This chapter will explore the implications of these findings and make recommendations to address the problems identified. As this chapter is related to and arises from the previous chapter, similar section headings will be used and the same order of presentation will be followed. The format for each section will be to first present a summary of the findings, which will then lead into the implications of these findings and then the recommendations will be given.

Throughout the process of the vulnerability assessment and the final formulation of recommendations, staff at all levels of Bir Hospital were consulted and their ideas sought. The assessment team considered it extremely important that the recommendations, or solutions, were not just their ideas, but that the local people, familiar with their working environment, had input and that their ideas and solutions were sought. The recommendations contained in this chapter, then, are reflective of the people who work at Bir Hospital along with some input from the team who conducted the vulnerability assessment. The final recommendations were honed and agreed upon as being realistic and able to be implemented by senior management at Bir Hospital before being recorded in this document.

The two NSET-Nepal engineers who conducted the building assessment primarily made the recommendations relating to the building structure. In making their final recommendations they sought advice from senior personnel at NSET-Nepal and consulted with key maintenance and engineering staff at Bir Hospital.

Overall, the findings of the Bir Hospital vulnerability study are that Bir hospital has little resilience to withstand a major disaster and that a natural disaster on a relatively modest scale would result in the whole hospital being dysfunctional. An event on the scale of the

1934 earthquake would render the hospital totally unusable. This situation cannot be changed without extensive and expensive retrofitting to the hospital buildings. Therefore, the aim in the short to medium term is to improve the resilience of the infrastructure to enable the hospital to survive a lesser event. The recommendations contained within this chapter are designed to achieve this.

### **Recommendations For Electricity Supply System**

On a day-to-day basis, the major problem with the electricity supply to Bir Hospital is the inadequacy of the supply resulting in power cuts to some departments. The potential for a prolonged and major outage of electricity is increased due to lack of maintenance of the system. There is no redundancy within the system or back-up systems if such an event were to occur. Critical areas such as ICU and operating theatres are not guaranteed a continuous supply of electricity, thereby jeopardizing patient lives.

As the two transformers are functioning at, or even beyond, their maximum capacity on a daily basis, this exposes the hospital to the risk of a prolonged power outage as a result of transformer failure. The likelihood of this is further increased by the lack of maintenance of the transformers. To mitigate this, Bir Hospital should discuss with the Power Company the possibility of installing higher rated transformers. If peak demand is 750kVA it is recommended that transformers rated at 1,000kVA should be used. The same principle should be applied to the new trauma centre where transformer capacity should exceed peak demand by 33%. Whatever transformers are used there must be a regular maintenance programme that includes cleaning of the transformer and dissolved gas analysis of the transformer oil with appropriate replacement of the oil when indicated. The maintenance programme should be documented and strictly adhered to. Notwithstanding these actions, power outage may still occur and appropriate steps should be taken to ensure that a reasonable level of back-up electricity is available to the hospital. Therefore, the broken generator should be repaired to provide greater resilience in the event of a power failure. With the repair and commissioning of the second generator there will be more emergency electricity available. Therefore, there should be a review of where the emergency generators supply electricity and ensure there is prioritization of supply. This should be done at two levels of prioritization; for when both generators are available and for in the event that only one generator is available.

Although preliminary investigation indicated that seismic restraint on the switchgear, transformers and generators was satisfactory it is recommended that the seismic resistance of the switchgear be reviewed and, if required, be strengthened. Although the transformers and generators are bolted to concrete pads a detailed examination should be carried out to determine the adequacy of the arrangement and determine whether improved seismic isolation is required. The unrestrained oil tank and drums supplying the generator should be provided with seismic restraints as soon as possible. A minor to moderate earthquake would render the generator useless due to loss of fuel supply.

When the mains power supply to Bir Hospital fails there is a delay, which could be as much as 10 minutes, before the generator is started manually by the electrician. During this period of time there is total loss of electricity to the hospital. In an area such as the operating theatres it is critical that there be no interruption of power. A power interruption may even occur where the generator starts up automatically. For this reason an uninterruptible power supply (UPS) is desirable in critical care areas such as operating theatre and intensive care unit.

Of particular vulnerability are the special theatres, due to the type of operations being carried out, particularly open-heart surgery where a heart-lung machine is in use. Power failure will not only leave the theatre in darkness but also cause the life support equipment to stop, immediately endangering the life of the patient. It is recommended that the hospital board seriously consider providing the theatres with battery powered UPS of at least 30 minutes duration for theatre lights and life support equipment. Theatre nursing staff reported there have been occasions where there has been an emergency theatre case during the night, such as a caesarean section, and there has been a power failure, with a consequent loss of all lighting. Torches are then used until the generator has been started. The inadequate lighting provided by torches places the patient at risk.

### **Recommendations for Water Supply**

Continually Bir Hospital suffers from an inadequate and sub-standard water supply. The lack of water supply is made worse by leaking pipes within the hospital plumbing system. There are no water reserves or back up supply systems. There are no developed or documented contingency plans for a complete loss of water supply, of which there is a high risk.

There are basically three options open to Bir Hospital for water supply; continue as they currently are with water tankers, or rely on the municipal water supply or install a water treatment plant and access the water from the bore at the rear of the hospital. The first option is currently not meeting their demand for water and is very costly on a long-term basis. There is also a high risk of failure due to the complexity of providing water by tankers. The second option is not viable as the water pressure from the municipal water supply is so low that it could not meet the water requirements of the hospital. On this basis, the installation of a water treatment plant would appear to be the obvious solution to Bir Hospital's water problems. However, it will only meet the water requirements of Bir Hospital and therefore be successful if, at the planning and design stage, a number of issues are addressed. It is recommended that the hospital seek independent advice to confirm that the proposed plant will do what is claimed and that it will meet the hospital requirements for water. For example, it should be verified that the plant is capable of treating at least 250m<sup>3</sup> of water per day. This is the assessed current daily requirements for the hospital, however the requirements for water are likely to increase rather than diminish. The likely needs of the new trauma centre should also be considered so that the needs of future development can also be met. The operating costs of the planned water treatment plant and the availability of supplies required for ongoing functioning should be identified. The maintenance costs, availability of spare parts and technical expertise should also be established. There is little point in proceeding with a project where it takes either six months to repair the plant if it breaks down or it cannot be repaired at all. As part of an evaluation process Bir Hospital should seek information on similar installations and obtain data on matters such as reliability and running costs from the operator of the plant. Bir Hospital should be cautious about adopting new and unproven technology.

As part of the installation process a member of Bir Hospital staff should be trained in routine operational and maintenance procedures including monitoring of quality of water supply. The plant should come with a detailed user guide and maintenance schedule. There should be a contractual requirement of a minimum support period during which the manufacturer will undertake to hold spare parts for the plant. The assessment team suggest a minimum 15-year period. The treatment plant should have a separate power feed to avoid placing additional strain on the hospital supply, unless the transformers are replaced. The water treatment plant should be connected to a generator and designed in

a way that the power supply will be maintained following an earthquake. The plant design should incorporate seismic protection, including the use of flexible joints in pipe work to prevent sheering in an earthquake.

It is recommended that an urgent programme of pipe renovation be undertaken to stop water leaks. Apart from the obvious loss of valuable water the leaks are causing serious damage to the building structure and could result in high cost remedial work and reduce the seismic strength of the building structure.

It is likely that an earthquake would damage the water tanks on the roof and strengthening of these tanks may not be practical. The main water storage tank at the ground level should be inspected and assessed on its seismic integrity and whether any work could be done to strengthen the tank. If the tank can be strengthened to survive a major earthquake the hospital is at least assured of 150m<sup>3</sup> of water, which with rationing, could be made to last for a while.

### **Recommendations For Sewerage System**

The main, ongoing problem faced by Bir Hospital is the putting of items down the lavatory pans resulting in a blocking of the pipes. Following an earthquake of moderate intensity it is expected that the city-wide sewerage system would be non-functioning, which would have an impact on Bir Hospital.

There is very little Bir Hospital can do about the loss of the city-wide sewerage system following an earthquake. However, some thought should be given to how Bir Hospital will manage such an event and develop contingency plans for the management and disposal of sewerage generally at Bir Hospital. As it is unlikely that the sewerage pipe system within Bir Hospital will remain intact following a moderate sized earthquake these contingency plans should extend to each department, detailing how they will manage the sewerage from their area. These departmental contingency plans must link into the overall plan for Bir Hospital.

### **Recommendations For Steam Supply Assessment**

The electrically generated steam supply at Bir Hospital appeared well-maintained, no major problems had been experienced with the system and they were connected to the

emergency power supply. The only recommendation to be made was that there should be a regular maintenance programme for these units, which is documented. This will ensure that the units are in the best possible operating condition at all times, thereby ensuring the greatest level of resilience possible for when a disastrous event does happen.

### **Recommendations for Communication System**

The PABX system was adequate to meet the needs of Bir Hospital. However, this system was at risk as the communication installations were kept in a non-ventilated, non-air conditioned room. The aged paging system had limited functionality and an intercom system, which could have been used, at least internally for paging, was totally non-functional. The audible alert system in ED was untested.

All of the communication installations are in the PABX room which has lack of ventilation. This means that both temperature and humidity levels are high. Over a period of time this will result in the degradation of the circuitry, probably resulting in major failure and high repair costs. It is recommended that the air conditioning unit in the PABX room be repaired and maintained. In addition, seismic restraint should be provided for PABX equipment to ensure the integrity of the equipment following an earthquake. It is also recommended that the non-functioning intercom system be repaired and brought back into service. This would then improve quick access to staff within the hospital, especially until a new paging system is purchased. Once a new paging system is installed the intercom system would then provide some back up for in the event of a failure of the paging system.

It is recommended that the mass casualty alarm in the emergency department be serviced and tested not less than monthly. There should be a training programme to ensure that all staff know what the alarm sounds like and clearly understand what their response should be. It should also be ensured that there is no confusion between the mass casualty alarm and the fire alarm.

### **Recommendations For Medical Gases**

The major problem noted with the supply of medical gases was the widespread use of unrestrained cylinders, both in the central medical gases room and at the patient bedside. The use of unrestrained gas cylinders is extremely hazardous. Cylinders can be knocked



over at any time, not just during an earthquake, with obvious risk of injury to people and the rupturing of the cylinders. Where individual cylinders are used, chains anchored securely to walls should be used to restrain them. In the central medical gas room and the main bottle store the form of restraint should be more substantial and it is recommended these barriers be constructed from tubular steel.

### **Recommendations For Energy Gas**

Continuity of supply of LPG is almost certain, for up to 25 days. However, none of the cylinders were restrained. In an earthquake of just moderate intensity the spare cylinders would fall with the potential to rupture, creating an explosion hazard, especially as it is immediately next to the kitchen where naked flames are often in use. In addition, the unrestrained banks of cylinders may damage the pipes lines as they fell, resulting in disruption to the supply of LPG to the cooking burners. It is recommended that both the banks of cylinders and the spare cylinders be restrained.

### **Recommendations For Air-conditioning Units**

A number of areas have air-conditioning units but many of them are inoperative. The main area of concern where there are air-conditioning units is the operating theatre.

The majority of areas that have inoperative air-conditioning units house electrical equipment which would benefit from a controlled environment. It is recommended that these units be repaired. The cost of repairing and maintaining the air-conditioning units is considered to be less than the potential cost of repairing or replacing expensive medical electronic equipment. This does not take into consideration the inconvenience caused by breakdowns in medical electronic equipment.

The major vulnerability of the air-conditioning units following an earthquake is loss of electricity. It is recommended that a review be done of the emergency electricity supply, rationalizing its use. Generally, air-conditioning units would not be viewed as a priority for emergency electricity supply. The one exception to this would be the operating theatre. However, this would need to be considered in the overall context of the review, balancing priority needs against the actual amount of emergency electricity available.

It is also recommended that a rigorous programme for the maintenance, cleaning and testing of operating theatre air-conditioning units be developed and implemented. Without this the likelihood of infection of surgical wounds is increased. The treatment of an infected wound is costly in terms of increased hospital stay, use of expensive medicines and increased time lost by the greater period of incapacitation of the patient. In addition, the likelihood of other complications is further increased.

### **Recommendations For Lifts**

It was identified that although two of the five lifts can be operated on emergency power it is unlikely they will be serviceable following a moderate sized earthquake due to the damage expected to the buildings within which they are located. Short of expensive retrofitting of the buildings with particular attention to the lift shafts, this cannot be easily rectified. Therefore, it is recommended that all those areas above the ground floor, especially those areas with dependent patients, develop disaster response plans which include how to evacuate without the aid of the lifts. These plans should be practiced so that all staff know what to do if the lifts are unusable and the building needs to be evacuated.

### **Recommendations For Equipment And Plant**

In response to the large number of equipment and plant found to be not working it is recommended that Bir Hospital develop an overall asset management programme that includes maintenance schedules for plant and equipment. Before acquiring any equipment, whether directly or by donation, a number of key questions should be asked. Will the existing infrastructure support the equipment, i.e. adequacy of water and power? Is the equipment appropriate to the skills within the hospital? Have initial and ongoing costs been considered such as any additional costs likely to be incurred as a result of installation, what are the running and maintenance costs and what are the likely costs in the event of breakdown? There are also the considerations of what is the availability of spare parts, who will provide service and maintenance, can Bir Hospital staff be trained in repair and maintenance? In essence, Bir Hospital should be seeking technology solutions that can be supported by the resources and expertise available, rather than 'state of the art' equipment that may fail after 12 months because of lack of servicing.

Some of the problems with donated equipment arise because donors do not understand the needs of Bir Hospital and the limitations within both the hospital and Nepal. We suggest that some effort be made to 'educate' donors on the problems of Bir Hospital and the type of equipment that is suitable. We also suggest that donors be asked to donate 'expertise' as much as equipment to ensure that existing equipment can be properly maintained. The process of donating expertise is not to create dependency but to transfer the skills of that expertise to local staff, thereby creating self-sufficiency and independence.

Given the limited healthcare resources available within Nepal, we suggest there is a case for pooling of training resources rather than each hospital seek to train its own staff in equipment maintenance and bio-medical technology. It is recommended that an approach be made to the Ministry of Health to determine the feasibility of setting up a central training establishment for health technology supported by the expertise of donor countries and organisations. This would be of far greater value to Nepal than having machinery donated that then fails because of inadequate servicing and lack of spare parts. This is just one way of helping reduce Nepal's dependency on external assistance.

### **Building Structure Recommendations**

The outcome of the visual assessment of the New Building and general assessment of other buildings on the Bir Hospital site was that most, if not all, buildings would be unusable following a minor to moderate earthquake.

The recommendations that the NSET-Nepal engineers made fall into two broad categories; the need for planning and the need for a detailed and systematic vulnerability assessment of all buildings on the Bir Hospital site.

The building structure assessment showed there to be great vulnerability in minor to moderate earthquakes. Minor to moderate earthquakes are likely to be more frequent events than large earthquakes. There is an obvious lack of disaster planning at Bir Hospital. Based on these points the first recommendation was that, beginning immediately, earthquake scenarios should be developed for moderate earthquake intensities of MMI V – VII and planning based on these commenced. This planning is to

be followed by further scenario setting and planning based on maximum credible events, equivalent to the level of shaking experienced in the earthquake of 1934.

The detailed and systematic vulnerability assessment of all buildings should include both a non-structural vulnerability assessment and a structural vulnerability assessment. The non-structural assessment should include an overall assessment of each building, taking into account both the interior and exterior of the building and each room or space within the building. Once the initial assessment has been completed potential damage reduction measures should be identified, estimates for the cost of implementing these measures calculated and a detailed implementation plan prepared. This plan should be incorporated into Bir Hospital's overall development and strategic plan.

The structural vulnerability assessment should also assess all buildings on the Bir Hospital site to provide a detailed report of their structure. Based on this information the impact on the buildings of earthquakes of varying intensities can be identified. Methods for the reconstruction and or retrofitting of the buildings should be identified, cost estimates done for completing this work along with an implementation plan. This plan should also be incorporated into Bir Hospital's overall development plan.

### **Departmental Recommendations**

None of the departments visited had a documented disaster response plan. It is recommended that each department develop a plan by working through a logical sequence. Using the Key Departments Dependency Grid (see Table 4) each department can identify which utilities and services they are most dependent on for the continuation of the service they provide. This then identifies the priority areas for which to develop contingency plans for in the event of failure of these utilities and services. The next step is to identify what events could realistically happen, such as an earthquake or a fire, and to set scenarios of what the likely impact would be in their department. The planning for this component falls into two broad categories; how to prevent or minimize the impact of the event and what specific actions staff are to take at the time of the event. For example, an event such as fire can be prevented or the impact minimized by ensuring flammable items are reduced or stored safely, electrical wiring and appliances are well maintained and smoking is restricted to certain areas of the department. The specific actions staff may take at the time of a fire are to raise the alarm, close doors and windows in the area of the

fire and then attempt to extinguish the fire. By following this sequence of planning, simple but effective disaster response plans, specific to each department, can be developed by each department.

### **Outside Agency Recommendations**

It is recommended that Bir Hospital establish contact with and work closely with representatives of UNDP and WHO to further the initial project that has been started by the vulnerability study. It is also recommended that there be liaison with these organisations during the design phase of the Trauma Centre since they will be able to provide on-the-spot technical support and advice in ensuring the emergency preparedness of the facility.

In order to accelerate the process of assessment amongst other hospitals it is suggested as part of the Health Working Group that a small sub group be set up, comprising of senior representative from each hospital in the Kathmandu Valley. The purpose of this group would be to determine whether each hospital could carry out a preliminary self-assessment of their preparedness.

### **Recommendations For The New Trauma Centre**

The proposed trauma center provides a prime opportunity for Bir Hospital to ensure that from the design phase through construction to outfitting of the building all necessary steps are taken to build in resilience to the effects of an earthquake, similar in magnitude as the 1934 earthquake.

It is recommended that the structural and non-structural design of the proposed trauma center allow for the facility to remain functional after an earthquake that produces intensities on the scale of the 1934 earthquake. This should be the minimum standard although there may be grounds for imposing even higher standards. The costs obviously increase as the standard is set higher, but when the major earthquake occurs and the facility remains functional, that cost has been repaid many times over.

In order to function after an earthquake the unit will need to be self-sufficient in power and water. This will require the site having its own generator and stored water supply. Particular attention will need to be paid to the restraint of the generator, switchboards and

cabling. Any generators should be fully automatic to remove the reliance on trained personnel to start and stop the generators. The water storage tanks will require seismic design and all pipe work will need to be designed so that it does not rupture during an earthquake. Particular attention will need to be paid to joints in the pipe work and connections to the tank incorporating flexible joints. Because of the problems with local water supplies it is recommended that the design incorporate facilities for the collection and storage of rainwater. Non-structural elements within the building such as ceilings and internal walls and partitions should be designed to eliminate the risk of collapse.

A critical element of emergency preparedness is ensuring that the resources needed to function after a disaster are maintained in a good state of repair at all times. The design of the facility should consider the maintenance requirements for buildings, equipment and plant. Bearing in mind the limited technical resources available to Bir Hospital, the design must incorporate technology solutions that are within the capacity of Bir Hospital to operate and maintain. Consideration should be given to the availability and cost of spare parts, length of supplier support, availability of personnel, warranty periods, and the ability of hospital personnel to maintain equipment. Wherever possible, critical spare parts should be held on-site and Bir Hospital staff trained in simple repair procedures. Technology where spare parts are only available after long delay should be avoided.

During the design stage clear and concise maintenance schedules should be developed for buildings, equipment and plant. Training should be given to Bir Hospital staff to enable them to maintain the facility and plant adequately.

The opportunity should be taken to build in the means of restraining key equipment in the facility. Simple examples of these measures include restraints for gas cylinders, bench-top restraints for equipment, lips on bench-tops and shelves to stop items sliding off. In the case of the most critical equipment more specific restraint designs would be desirable. All designs for restraint of equipment should be incorporated at the building design stage in consultation with Bir Hospital.

The completion of the building will also offer the opportunity to design and implement an emergency response plan from the beginning for dealing with major emergencies affecting the facility. This would include preparing a fire evacuation plan, and the design stage of

the building should consider carefully the need for protected evacuation routes with clear signage. The planning process will also need to incorporate a training programme for staff including training for trainers.

To facilitate the process of implementing these recommendations and recording progress, the recommendations discussed in this chapter have been summarized and put into a table format. Also included in the table is the facility to document priorities for each of the recommendations, the costs for meeting each of the recommendations, for budgeting purposes, and listing actions that need to be taken for meeting the recommendations. This table can be found duplicated in Appendix F.

### **Recommendations For The Mass Casualty Disaster Response Plan**

The Bir Hospital Emergency Department mass casualty disaster response plan contains most of the basic elements of a good plan. All that is required is some more detail, which is documented, follow-up staff training and a system for the maintenance and updating of the plan.

The staff of ED have considerable practical experience of handling large numbers of casualties arriving at the hospital simultaneously. Out of this the department has established a practical system that clearly works for them. Because it works I don't wish to try and change this but to merely offer some ideas on how the system might be improved, based on internationally recognized standards. However, the key to a successful plan is that the staff who are going to use the plan have input into its development and maintenance.

When more than 50 casualties are to be received, the plan identifies the use of the alarm in ED for calling staff. In the absence of very careful planning and training I believe that there is the potential for confusion, which may reduce the efficacy of this action. For maximum effectiveness of the current system, all staff throughout the hospital need to know clearly what the alarm sounds like, where they are to report to and what their exact role is. The overall response should be managed to ensure that some areas are not overstaffed at the expense of other areas.

On this basis, it is recommended that the ED, as part of the planning process, should determine what the staffing requirements might be for any given event. A core response team should be established and these should be the first responders from outside ED. They should be summoned by either telephone, pager or intercom, when it is repaired. The team's precise role should be clearly documented in advance in consultation with team members, matching their skills with the anticipated need.

It will become much easier to call staff when a new pager system is put in place, especially if the system can be programmed to page groups of staff. In this way different groups can be programmed into the system for different types of event. This should be considered as one of the criteria for the purchase of a paging system.

The current plan details how some departments within Bir Hospital are communicated with and how the overall coordination of the response will occur. For a fully effective response, the ED needs to identify all those departments they are likely to interact with and identify how they will communicate and what they will communicate. One area that was identified as missing in the current plan was that of notifying the wards in advance that extra beds might be required so that some preparatory work could be done. In addition to internal communication, it is recommended that the plan identify how Bir Hospital will interact with other organizations such as bus companies for transport, medical supply companies for sudden and unexpected demands and other hospitals and healthcare providers to name a few. It is recommended that all organizations that potentially may need to be contacted and liaised with during a mass casualty event be listed and key contact people in these organizations identified. The relationship between the two parties needs to be established and procedures for facilitating the relationship documented in the plan so that all staff have access to this information as required. It was specifically noted during the review of the ED plan that, although Bir Hospital may transfer patients out to other hospitals if there are no beds available, this was not documented anywhere, nor the process which should be followed. This is an example of inter-organisational planning which needs to be done to ensure a good understanding between the two parties before an event, rather than try and organize this during a disaster response when time and personnel are limited.

The triage system that is documented in the plan should match the triage system in use. Since no coloured tags appear to be available it would be better to document what is



actually used. The same categories can be retained as is documented in the plan and on triaging the casualty the triage category allocated clearly marked on the tag. This could be done using coloured marker pens so that the category can be easily seen rather than having to be read.

Rather than sending all casualties direct to the disaster area on arrival at the hospital I suggest that a triage station be set-up at the entrance to the hospital and casualties split into three streams. Those casualties requiring urgent treatment can be sent direct to the disaster area and placed on mattresses. Those with minor injuries and capable of walking could go to an area where they could wait on chairs, and be periodically re-assessed whilst awaiting treatment. The dead should be laid out in a pre-designated area. If this suggestion is seen as having merit and was to be implemented, then three triage categories could be adopted. It is suggested that red could be used to denote those casualties who had serious injuries and required immediate attention. Green would indicate those with minor to moderate injuries and required attention when medical personnel were available, but they would be subject to regular reassessment. The third colour of black would be given to the dead. By separating the serious and minor to moderate casualties, immediately the job of clinical staff in prioritising treatment becomes that much simpler.

With any mass casualty event there is the potential for many dead bodies. The management of this should be clearly identified in a mass casualty plan. A hospital needs to clearly identify where the dead will be kept, especially if the numbers exceed normal capacity. Facilities will also need to be established for the identification of bodies by family. A record system for when bodies are collected is also required.

I recommend that a team approach be adopted in the management and treatment of casualties. Within the ED teams should be established. The minimum requirements for each team would be a doctor, at least one nurse and a paramedic. Additional team members may be added for particularly heavy workloads or for specialist skills required by that team as demanded by the casualties assigned to them. Each team would be allocated to either a specific casualty or group of casualties, depending on the size of the incident. The benefit of this approach is that all patients would be equally cared for, there is less risk of a patient being overlooked and a team accepts responsibility for a specific

casualty or group of casualties ensuring accountability. This approach would also ensure that the workload is evenly distributed. In addition to these designated teams, a doctor and nurse need to be allocated to the triage station, and a nurse or paramedic to the minor injuries area for reassessment purposes. The responsibilities of teams and individuals should be documented and followed up with training so that all potential team members are clear on what their role would be.

I suggest that Bir Hospital should develop, as an integral part of their disaster response plan, an overall chain of command specifically designed for and to be used in response to a disaster. This chain of command should incorporate all key positions required for an effective disaster response. For each of these key positions a job or role description would be completed. Commonly, this type of planning is referred to as the incident command system (ICS) (Auf de Heide 1989:136). The original concept for ICS was developed in the United States and has been adopted, with modifications, in many countries. The benefits of using a system like this are that it facilitates unity of purpose amongst different departments and agencies responding to the disaster, it enhances communication by using common terminology and it is modular in design and therefore can be adapted and used for any disaster of any size. It also ensures there is comprehensive and efficient use of all resources (Auf der Heide 1989:138-141). The suggestion for the formation of medical teams given above would become just one of the modules within the overall incident command system for Bir Hospital.

Although the media do not pose any particular problem for local events I do recommend some planning be done on how the media would be managed in a larger event attracting international attention. Some of the key aspects of this planning will include where the media will be able to access, where press releases will occur and who will be the media liaison person. One approach, which I can recommend as having worked well in other places, is that of appointing one local media organization who will have controlled access to the inside of the hospital primarily for filming purposes. This film then is distributed to other media organizations for their use. This does not stop other media organisations from filming around the perimeter of the hospital, it just manages and limits media attention inside the hospital where the priority is for the treatment of casualties. This approach also allows Bir Hospital to work with the local media agency before a disaster so that planning and preparation can be done together.

As has been mentioned briefly in previous paragraphs, training is a very important element in the planning and preparation for managing mass casualty disaster events. No matter how much practical experience ED staff have in dealing with mass casualties the system can only achieve full efficiency with proper training and exercises. It is recommended that the training process be comprehensive and capture all staff throughout their employment at Bir Hospital. The first step in this process is to ensure all new and existing ED staff are aware of the documented process for handling mass casualties. All new staff should receive an orientation to the mass casualty plan within one week of their arrival in ED. Those staff elsewhere in the hospital likely to be called into ED must be aware of their role and the reporting point for briefing to the event. The briefing point should be in an area separate to where the primary response is happening as chaos will result from large numbers of staff charging into the ED. When an efficient communication system has been established for calling staff, the system and the response of staff should be regularly tested to ensure the process works effectively. This should not be less than every three months. Although staff receive regular practical experience, time should be found to conduct an exercise at least once a year. The exercises should be modelled upon more serious events that staff may not normally encounter say for 100 casualties or more. A major reason for exercises is to allow peer review of the processes. This does not happen during real events.

After any real-life mass casualty event a debrief process should be followed to determine how well the event was managed, what could be improved and on this basis modify the existing plan as appropriate. Currently this is an informal process involving senior staff. The process should involve all staff. Junior nurses, housekeepers and paramedics may all have valuable contributions to make and these should not be lost by focusing on seniority.

## **Chapter 7**

### **Needs Assessment Model Presented**

#### **Overview Of The Chapter**

Soon after a disaster has happened two assessments are usually completed. The first is a situation assessment to identify what has happened, the impact it is having on the local population, what is already being done and it projects what the ongoing situation is likely to be. The second is a needs assessment to identify accurately what the most appropriate help would be for the affected population. This chapter will only provide an outline of what is included in a situation assessment. The main focus of the chapter will be on needs assessment, primarily because planning and preparation for a disaster situation should include, at the very least, development of a needs assessment tool. The successful completion and appropriate follow-up to a needs assessment has a positive outcome on the response and recovery stages of the disaster management cycle. This then indicates that a needs assessment is not just a one-off action at a given point in time following a disaster, but should be a process which is closely related to the disaster management cycle. To recognize this I have developed a model to illustrate this relationship. The model is presented and explained in this chapter. The chapter concludes with the presentation of a needs, demand and supply model which provides an understanding of the factors which interplay when meeting the perceived and actual needs of a population following a disaster.

#### **Situation And Needs Assessment**

When a disaster happens it is important that both situation and needs assessments are done to ensure that the response of aid agencies is appropriate, efficient and timely. Both these assessments are usually conducted concurrently, although most often by different teams. What is important is these assessments are coordinated and carried out by appropriately trained personnel. Following the Papua New Guinea tsunami disaster there was no coordinated needs assessment done. As a result there was an overwhelming amount of relief, some of it inappropriate (Stenchion 1999).

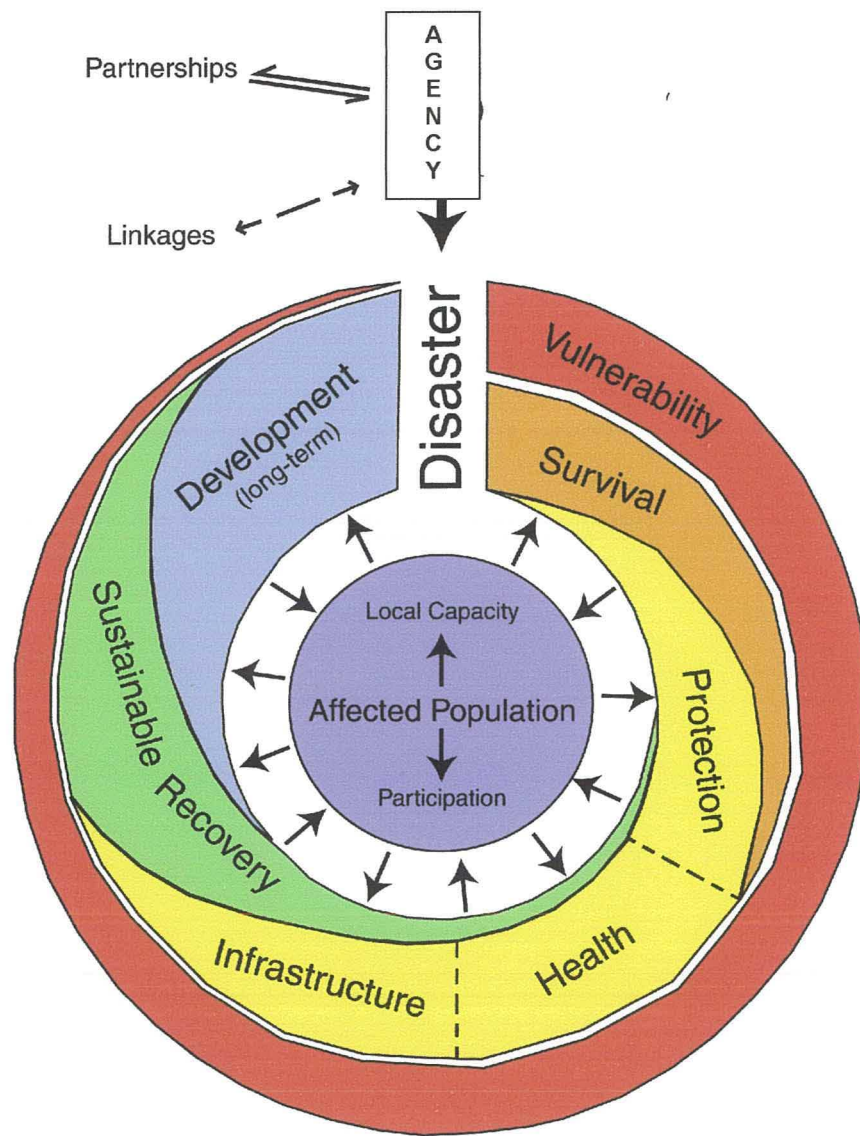
For each of the assessments there is usually an overall assessment completed and then specialized assessments. For example, an overall situational assessment may be

completed giving the big picture of what has and is happening. In addition, a specialized medical situation assessment may also be completed. Both are important. One gives a summary of what the situation is overall which is valuable to all responders, whereas the medical situation assessment primarily has great relevance to the medical personnel who are responding to the disaster. Auf der Heide (1989:115) identifies that one of the problems, which arises when an overall situational and needs assessments are not completed, is that different agencies tend to do the assessments themselves with the result that they only look at what pertains to them and their activities. This information is not usually shared to the other responding agencies resulting in biased information and duplication of response. Auf der Heide (1989:176) writes that the root cause for an overall assessment not being completed is lack of coordination of the disaster response and lack of communication. These were the very reasons cited by Stenchion (1999) as leading to the uncoordinated assessments following the Papua New Guinea Tsunami disaster.

A situation assessment primarily ascertains the area and population affected by the emergency, the number of deaths and the number and type of injuries and illnesses. It will also identify the impact the emergency has had on the infrastructure such as electricity, water, communications, roads, private and commercial buildings, food and agriculture, financial and social organization. The level of response from the country internally and the level of response from donor countries and NGOs will also be recorded. The final component of a situation assessment projects the vulnerability of the population from both an expansion and continuation of the emergency event. A needs assessment will identify the specific resources and services required by the affected population to maintain and save lives (OFDA 1998:II 4 – II 5). Appendix E provides a simple guideline for conducting both a situation and needs assessment. An important aspect of the initial assessment is that it provides baseline data against which to monitor the situation and determine whether it is improving or worsening.

Both types of assessment will be ongoing and will change over time. With the needs assessment there will also be varying levels at which the assessment is conducted. For instance, an initial needs assessment may be conducted quickly, identifying the immediate survival needs of the affected population. As time permits a more comprehensive needs assessment will be completed, providing a basis for future recovery

# NEEDS ASSESSMENT MODEL



**Figure 2** Needs Assessment Model

and development. A model has been developed by the author to illustrate this process (see Figure 2).

### **Needs Assessment Model Explained**

The Needs Assessment Model (see Figure 2) was developed to illustrate how a needs assessment is an integral part of a process which has a relationship to the disaster management cycle and incorporates development strategies. Essential and central to all of this is the vulnerable community which is faced with a disaster situation.

Following a disaster it is recommended that the needs assessment of a community be completed by one agency only (Auf der Heide 1989:115, Stenchion 1999). This single agency is shown at the top of the model. The agency should have well developed partnerships with other agencies to strengthen their ability to conduct an accurate needs assessment. This is represented in the model by solid lines with arrows at each end. In addition, they will have forged links to other agencies. While this will give them additional flexibility, these connections are not as strong or well defined as partnerships (OFDA 1998:II 10). These linkages are shown as a dotted line.

Around the outside of the circle in the model it will be noted that vulnerability is depicted as being greatest immediately after the disaster-producing event has occurred. Moving around the circle, as the affected population's needs are met, and more so as sustainable recovery and long-term development begins, the vulnerability of the population will decrease. Ideally, with good, long-term development being achieved, the likelihood of a disaster is reduced.

From the model it will be seen that as the survival needs of the people are assessed and met, survival needs will tend to diminish. At this time the mainstream needs assessment will begin. This component of the needs assessment can be separated into three broad categories; protection, health and infrastructural needs (see Appendix E for a detailed description of these categories). As this part of the needs assessment is conducted, and these needs are met, survival needs of the population will tend to become less prominent. As the mainstream needs are met there will be the beginnings of recovery of the community. Because the population's basic needs are being met they are better able to start to look at how they will begin to reconstruct their lives and return to a level of normalcy.

As the recovery of the population is occurring there should be a progression into further development of the community. For them to have been gravely affected by the initiating event of the disaster implies that they were vulnerable prior to the disaster. The aim of this process is not to just return the community to the same condition it was pre-disaster, but to leave the community less vulnerable, better prepared and more resilient to any future disaster-producing event. Therefore, as recovery strategies become long-term development programmes, the population will become less vulnerable and therefore less likely to face a similar disaster in the future.

It can be noted in Figure 2 that the affected population is central to this whole process. The agency conducting the needs assessment should be using participatory methods to gather information and to find local solutions to meet these needs. An integral part of this is to look for and discover the local capacity. As the arrows indicate on the model, there should be two way communication and interaction between the affected population and the agency conducting the needs assessment.

This model has a wider application than just after a disaster. Based on the definition of a disaster given in Chapter One, the assumption is made that the population must have been vulnerable at the time of the event for the event to have had an impact on them. Therefore, prior to the disaster situation a vulnerability assessment, if completed, would have identified what the population was vulnerable to and why they were vulnerable. Once this was known steps could be taken to reduce the likelihood and the impact of the identified event(s) on the population.

At this point a different perspective of needs assessment can be used and guided by the model. When a disaster strikes a community, it is usually sudden and without warning. The needs of the community are immediate. However, it will be some time before a needs assessment team can be mobilized and begin their work, therefore delaying the assessment and subsequent meeting of needs. The response lead-in-time could be reduced if a needs assessment had been completed prior to a disaster. Based on the vulnerability assessment, the needs of a given population can be projected for any event which they are likely to face. For example, in Kathmandu a vulnerability assessment has been completed, focusing specifically on the natural hazard of earthquake. A component of this assessment has identified which road bridges are likely to be unusable following



earthquakes of varying magnitudes (Dixit et al 1999:9). Likewise, water supply and electricity reticulation systems have been assessed and their vulnerability documented (Dixit et al 1999:9). Using this data, it can be projected what the probable needs of that population are likely to be after an earthquake. With this information plans can be developed on how those needs would be met. Consequently, the response at the time of an emergency can be much faster.

This does not negate the need to conduct a situation and needs assessment at the time of a disaster. These assessments still need to be done. The key point is that the assessments can be completed quickly and be more accurate, as much of the base data has been collected at a time when there was little stress, more flexible timeframes and time to consult with appropriate people and organisations.

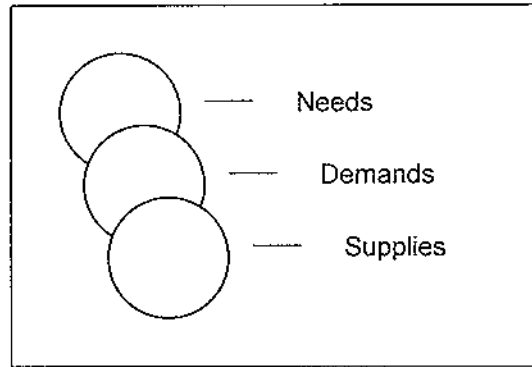
The assessment model can be used to identify the different stages of assessment which should be planned for. The model also highlights the need for development projects prior to a disaster situation to reduce the vulnerability of the population. In this way, the process can be viewed as cyclic. A key point embodied in the model, which applies equally to the work done prior to a disaster, is the involvement of the population in all of the assessing and planning.

### **Needs, Demands And Supplies Model**

There are three main factors to consider when conducting a needs assessment and planning for the subsequent meeting of the identified needs. These factors are the needs and demands of the affected population and the actual supplies provided. Ideally, the needs and demands of an affected population should equate and the supplies provided should match them exactly. Rubin et al (2000:4/12) have diagrammatically depicted this as three equal sized and concentric circles (see Figure 3).

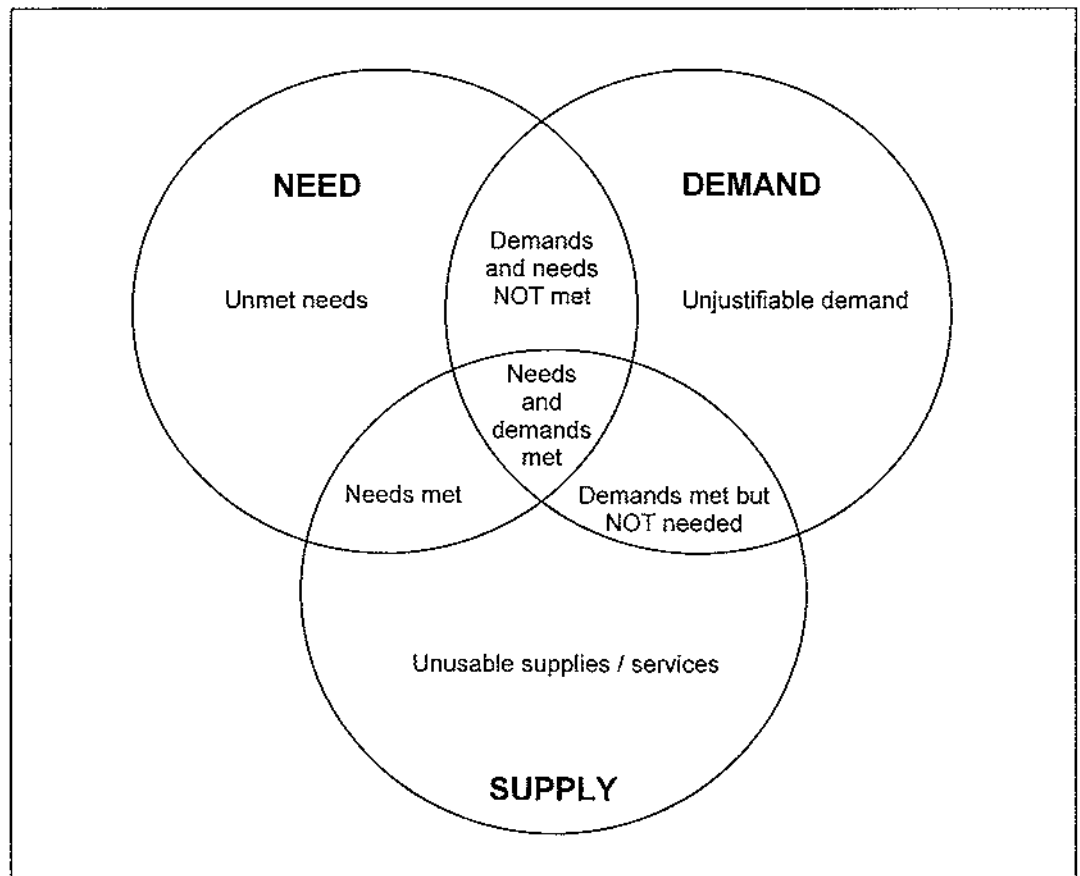
There can be different perceptions for each of these three factors. For example, the affected population, local NGOs, government representatives and international agencies may all have different perceptions of need. Rubin et al (2000:13/5) have taken the three circles and diagrammatically shown what happens when there is not congruence between the three factors (see figure 4). Only the small triangular shape in the middle portrays supplies meeting the needs and demands of the affected population.

**Figure 3** The Domains of Needs, Demands and Supplies



Source: Rubin, M., Heuvelmans, J., Tomic-Cica, A. & Birnbaum, M., (2000) Health-Related Relief in the Former Yugoslavia: Needs, Demands, and Supplies. *Prehospital and Disaster Medicine* 15(1)

**Figure 4** The Relationships Between The Domains of Needs, Demands and Supplies



Source: Rubin, M., Heuvelmans, J., Tomic-Cica, A. & Birnbaum, M., (2000) Health-Related Relief in the Former Yugoslavia: Needs, Demands, and Supplies. *Prehospital and Disaster Medicine* 15(1)

Pre-planning and preparation can reduce the likelihood of non-congruence of these factors. This again highlights the need to move the focus of needs assessment away from after a disaster to before the disaster situation. In this way the response will be quicker, more appropriate and have increased efficiency for the benefit of the affected population.

## **Chapter 8**

### **Conclusion And Evaluation**

#### **Overview of the Chapter**

The purpose of this paper is to explore the relationship, if any, between development and disasters. This was achieved in two ways; the first being a literature search to identify information to support the proposed relationship and the second being a project at Bir Hospital which would endeavour to illustrate this relationship in a tangible way.

This concluding chapter will first summarise the findings of the literature search. Then the case study undertaken at Bir Hospital will be analysed to identify how the development-disaster relationship may be demonstrated. The last part of this chapter will briefly evaluate the project which was undertaken at Bir Hospital to seek areas upon which learning and improvement can be based.

#### **Summary of the Relationship Between Development and Disasters**

At the outset of this paper it was identified that the most obvious link between development and disasters was a financial one; funds are being diverted away from development activities to provide relief for people following disasters. It is not only the diversion of funds which has an impact on development but also the provision of relief in itself. McEntire (1998:52) identifies that in many ways relief is the very opposite of development. Relief does not identify and solve underlying causative factors but is purely palliative and encourages a dependence rather than independence. Another financial relationship between disasters and development is that development investment in a community is often destroyed by a disaster, meaning that it is either lost or reinvestment is required again, effectively reducing the amount of development funds available to a community.

Fundamental to the discussion concerning the relationship between development and disasters is the definition of what is a disaster. In simple terms a disaster is defined as the impact of an event on a vulnerable community (Vrolijk 1997:6). It is important this is understood if any discussion about the relationship between development and disasters is to be advanced. If a disaster is the interaction of two factors, an event and the vulnerability

of a community to that event, then it stands to reason that if either of those factors can be modified then it will have an impact on the resultant disaster. A number of writers have clearly identified that disasters are the result of communities made vulnerable by poverty, inequality, environmental degradation and population growth amongst the poor (Bolin and Stanford 1998, Stenchion 1997:42). This, then, begins to identify another aspect of the relationship between development and disasters. Development activities are often targeted at reducing poverty, inequality, protecting the environment and managing population growth. Development activities can reduce the vulnerability of a community to the impact of a disaster. Equally, though, development activities can also increase a community's vulnerability to disasters (Lewis 1999:130, Stenchion 1997:41).

Essentially, the relationship between development and disasters is either financial or contributory. The important distinction, which must be drawn between the two, is that the financial aspect is as a result of a disaster as opposed to the contributory aspect which is as a result of either an activity or non-activity prior to the disaster contributing to the actual disaster. From this premise a conclusion can be drawn that if there was enough investment in development to reduce the vulnerability of a community then the likelihood of a disaster would be reduced, thereby preventing either the diversion of development funds into relief or the loss of development funds which have already been invested. This could be considered to be a win-win situation, to use popular terminology, as a community will have been developed, thereby reducing their vulnerability and increasing their likelihood to be spared a disaster with resultant losses and the subsequent diversion of future development funds. However, it must be recognized that this is the ideal and is unlikely to be reached. The example of the United States and Japan supports this statement, where a large amount of resources over the years have been put into reducing community vulnerability to earthquakes and yet huge losses were suffered from the Northridge and Kobe earthquakes (McEntire 1998:53). What is important is to acknowledge that there is a definite relationship between development and disasters and that there can be a synergy between the two; investment in development can reduce the need for relief following a disaster and protect past and future development investment. As a result, a recommendation from the literature and endorsed by this writer is that disaster managers and development practitioners should work together in partnership (Boulle 1997:4, Stenchion 1997:40, Voelker 1998:1898, Vrolijk 1997:6). In tandem with

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thesis

this recommendation is one that schools of development studies recognize this relationship and incorporate into their curriculums courses which support this concept.

A common link between development and disaster prevention is that of a vulnerability assessment of communities. For development practitioners this identifies what the key needs of a community are and for disaster managers this forms the basis for identifying the vulnerability of a community to a disaster-producing event. The vulnerability assessment conducted at Bir Hospital is the link with this research paper. Bir Hospital had been identified, in 1998, as being generally vulnerable to the impact of an earthquake. To further define the level of vulnerability a vulnerability assessment was conducted and through this process was able to show, in a practical and tangible way, the relationship between development and disasters. The overall result of the vulnerability assessment of Bir Hospital was that the hospital is extremely vulnerable, not to just an earthquake, but for everyday, normal functioning.

The final report of the vulnerability assessment of Bir Hospital fulfils two important functions. The first is that it identifies the priority needs of Bir Hospital, to ensure it can function everyday. Secondly, there has been identification of what can be done to ensure that Bir Hospital is better prepared and more resilient to an earthquake so that it can continue to function and meet the medical needs of the local community following an earthquake. Moreover, this study of Bir Hospital can be used to illustrate in a very real way the relationship that exists between development and disasters.

### **Bir Hospital as a Microcosm of the Relationship Between Development and Disaster**

Bir Hospital can be considered as a microcosm of the relationship between development and disasters. The definition of a disaster is the impact an event, whether it is of natural or man-made causes, has on a vulnerable community. In this case study, Bir Hospital can be considered as a community. The specific event considered for Bir Hospital was that of an earthquake. An assessment was completed to identify how Bir Hospital may be vulnerable to an earthquake. The findings of the vulnerability assessment and the subsequent recommendations are given in Chapters Five and Six. The following paragraphs explore the findings of the vulnerability assessment and relate them to past, present and future development of Bir Hospital in an attempt to provide a practical illustration of the relationship between development and disasters. In the course of conducting the

vulnerability assessment other areas of vulnerability were identified which were not specifically related to earthquakes. A number of these are also discussed to further demonstrate the relationship between development and disasters.

In Chapter One there were two questions which were posed by Cuny (quoted in Lewis 1999:130) regarding the relationship between development and disasters. These questions were what kind of development made things worse and what development would have made things better. It is interesting to note that the most structurally vulnerable building on the Bir Hospital site is one which was built as a joint development project between the Indian Government and the United States Agency for International Development (USAID). It could be asserted that this development was one which today makes Bir Hospital more vulnerable to the impact of an earthquake.

However, care must be taken when making an assertion that a development project of 40 years ago has today resulted in increasing the vulnerability of the community for which it was provided. Technology and building standards change and improve over time. It is unknown what constraints may have been placed upon both the benefactors and beneficiaries at the time of construction that were beyond their control. New hazards may develop over time. However, the point to be made here is that development done in good faith in the past may in the future add to the vulnerability of a population group. Therefore, all development projects should be carefully designed and implemented to mitigate, to the best of our knowledge, any future risks. This further supports the recommendation given in Chapter One that comprehensive risk and hazard assessments be completed for all development projects and that disaster managers and development practitioners work together in a partnership (Boulle 1997:4, Stenchion 1997:40 & 44, Voelker 1998:1898, Vrolijk 1997:6).

Looking to future building construction planned for Bir Hospital, indications are that the proposed trauma centre will be constructed to meet appropriate building codes. The key point to be made is that there is only one opportunity to construct a building which will be able to function after an earthquake of the size of the 1934 event and that is at the design phase. This is an opportunity to ensure that current development activities will lessen the impact of any future earthquake of a magnitude that can be expected in Kathmandu.

The same principle can be applied to development projects generally; the design phase is extremely important and may be the only opportunity to ensure that the project will reduce rather than contribute to a community's vulnerability (Cusworth and Franks 1993:11). Once a project proposal has been approved by a donor it becomes very difficult to change. Once implementation begins it becomes even more difficult to change what might be a poorly designed project.

Stenchion (1997:42) identified the main factors that contribute to a community's vulnerability as being poverty, inequality, environmental degradation and population growth. These same factors can also be seen as contributing to the general vulnerability of Bir Hospital. The Nepali government grossly underfunds Bir Hospital. The reality of this is that most of the hospital's funding goes into operational costs and very little, if any, into repairs, maintenance or renovation. This creates an environment of increased vulnerability. The lack of funds is further compounded by other factors. One of these is that the main users of the hospital are the poor who receive a free service. Those who could generate an income for the hospital, the wealthier members of the community, tend to use private facilities and thereby financially support them. It is this inequality that contributes further to the vulnerability of Bir Hospital. Another factor is the tremendous growth in the numbers of patients (population) using Bir Hospital without a corresponding growth in funding. Over the fifteen year period from 1985 to 2000, the number of patients presenting to the Emergency Department increased by 148%.

When electricity was first introduced to Bir Hospital, this would have been seen as a "good change", to use Chambers (1997) definition of development. McEntire (1998:53) identifies that development can make people more vulnerable and that it can also make them less vulnerable. The supply of electricity to Bir Hospital can show this very clearly. The use of electricity by the hospital ensures that modern methods of medical prevention, diagnosis and treatment can be used and reduces the risks of delivering these services. However, the use of electricity, if not managed correctly, can increase the vulnerability of the hospital to disaster. The vulnerability assessment conducted at Bir Hospital identified that the current electricity system does not provide adequate supply to the hospital. The primary reason for this is that the electricity requirement of the hospital exceeds the capacity of the two transformers via which the electricity is supplied. This, plus little or no maintenance to the system, greatly increases the likelihood of either a transformer fire, or



worse, an explosion of the transformer that could potentially shower hot oil over a large area. It is not just the potential for human injury in this scenario but also the loss of electricity. By supplying electricity this creates a certain level of dependence.

The vulnerability assessment I conducted of Bir Hospital confirmed what had already been identified; that most of the buildings on the hospital site are structurally unsound and are unlikely to survive an earthquake of the magnitude of 1934. There are two primary solutions to this problem; either retrofit the existing buildings to make them able to withstand a major earthquake or totally rebuild the buildings to meet stringent seismic building codes. Both of these options are not feasible, at least in the short to medium term, primarily due to financial constraints. On this basis it could be very easy to say that little can be done to ensure that Bir Hospital survives and can function following a major earthquake and that if the buildings cannot be protected there is very little point in doing anything else. However, it is not only intact hospital buildings which are required for a hospital to function. In Milsten's paper (2000:32/40), which was referred to extensively in Chapter Three, it was identified that following the Northridge earthquake in California a number of hospitals, although remaining structurally sound, were rendered inoperable by the loss of essential supplies and equipment which had crashed to the floors. Some of the other key factors, which Milsten identified as impacting upon a hospital's ability to function post-disaster, were communication facilities, power loss, water loss and personnel issues. It is all of these things together that enable a hospital to function effectively. Many of these things, such as the restraint of supplies and equipment, can be done with a minimum of cost and time. Although this alone will not ensure that Bir Hospital can continue to function following a major earthquake, it will minimize the likelihood of service disruption following a small to moderate earthquake and overall reduce the vulnerability of Bir Hospital to not only earthquakes but to other events which may disrupt the functioning of the hospital. In other words, this will create a hospital which is more resilient to the impact of disaster-producing events. As was pointed out earlier, huge investment in disaster mitigation does not necessarily ensure total immunity to the devastating effects of an earthquake. Part of the disaster management process is to identify potential hazards, eliminate those you can, reduce the likelihood of those which cannot be eliminated and develop contingency plans for any residual hazards. The point to be made here is that what may appear to be large, insurmountable problems should not be reason for inactivity. Small, progressive and realistically achievable actions will result in an overall reduction of Bir Hospital vulnerability

and a greater resilience to meet future crisis. The same principle applies in development. A major need may be identified within a community. The initial response may be that it is too big or too costly to be dealt with and that everything else hinges on this. By taking small, planned steps, much can be achieved to reduce the overall vulnerability of a community to disaster.

A finding, which is not related to earthquake vulnerability but demonstrates clearly the relationship between development and potential disasters, is that of open heart surgery being conducted at Bir Hospital. When development is being proposed for a community it is essential to consider both the reasons for the development and the existing facilities or infrastructure to support that development. I was told that the primary motivating force for the implementation of open-heart surgery at Bir Hospital was political. The government wanted it to be seen that the government hospital was the first to provide this type of surgery in Nepal. In addition, there was some public pressure as the more informed people clamored for this type of surgery to be available. The identified risks with the surgery were all due to lack of financial resources to fund the set-up adequately. It is interesting to note that Bolin and Stanford (1998) wrote that “.. an.. event is the trigger, but the disaster that follows is the product of political, social and economic forces in everyday life”.

Briefly, open-heart surgery was commenced at Bir Hospital, but without the necessary capacity to reduce the likelihood of a disastrous outcome. This surgery is performed in an operating theatre which has no reliable and continuous supply of electricity. During the surgical procedure the life of the patient is dependent on an electrically operated heart-lung machine. If the power were to fail for just a couple of minutes it is highly likely the patient would die. This is an example of where development has been introduced for political and social reasons and in the process increased the vulnerability of Bir Hospital (the community) to a disaster. There are other factors in this scenario which also increase the vulnerability of Bir Hospital and illustrates the lack of capacity. The surgeon who performs the open-heart surgery received his training in the surgical procedure in Sydney six years prior to actually commencing the procedure in Kathmandu. His training in Sydney was limited to less than twelve months and he assisted the surgeon but never took the lead role under supervision. This reinforces the need stated in Chapter One of this paper where the design phase of all development projects should include hazard and

vulnerability assessments (Stenchion 1997:44) to ensure the long-term viability and success of the project.

Increasingly the importance of participatory development has been emphasized (Brohman 1996:252, Allen & Thomas 2000:35). The primary reason for fully involving any community in the process of development, from the conception stage through to full implementation, is that the outcome of development projects are likely to be better and more sustainable, more people will benefit and the outcomes of the project will better meet the needs and priorities of the beneficiaries (Brohman 1996:252, Allen & Thomas 2000:35). In the context of this paper I would also add that without community participation in development activities the vulnerability of the community may be increased and therefore the likelihood of a disaster at some future point in time is greater. This can be illustrated at Bir Hospital by the donation of used equipment without any consultation with Bir Hospital. While conducting the vulnerability assessment it was noted that there were three large x-ray machines from Germany cluttering up an already crowded radiology department. These machines were sent to Bir Hospital as the donor in Germany perceived there was a need for such machines at Bir Hospital. When the machines arrived they were not functioning and there was no expertise in Nepal to assess or repair the machines. A further contribution to the negative impact that this type of development has is that when the equipment arrives it raises false hopes and expectations of the staff. To try and repair the machines diverts valuable resources of time, energy and money from other areas.

Closely related to the aforementioned problem is the large amount of equipment that had been purchased new by Bir Hospital and was found to be in a state of disrepair, primarily because there was either no spare parts available in Nepal or the expertise was not available. The purchase of this equipment, in the first instance, had been a decision made by Bir Hospital but with very little apparent forethought given to the future repair and maintenance of the equipment. This highlights again the need for a full assessment in the design phase of all development projects. Although the purchase of an item of equipment may be viewed as a minor development activity, the same principles apply to ensure that the investment that has been made is maximized to the fullest potential and is sustainable. One particular item of equipment that was out of use at the time of the vulnerability assessment demonstrates well the compounding effect that one unavailable spare part can have.

The tube in the CT Scanner required replacement. The part was not available in Nepal and so was sought in India along with the technical expertise to fit it. The whole process took six months. During this time all patients requiring a CT Scan were sent to a nearby private facility, diverting much-needed operational funds away from Bir Hospital. When the new tube was finally installed it was discovered that the wiring to and within the scanner had been destroyed by rats that had had undisturbed access to the scanner during the period of inactivity. This then further delayed the return of the scanner to active use. In an analysis of this situation to relate it to development and disasters, the event was the loss of the tube. This event is inevitable; at some point in time it is known that the CT Scanner tube would fail. But it is not this event alone which is the disaster. It is the combination of this with the unavailability of a replacement tube and local expertise which resulted in the inability of Bir Hospital to provide a service and the subsequent loss of funds. If there was a replacement tube and local expertise available then there would have been an inoperable period of just a few days, whereas in reality it was in excess of six months. Careful planning and preparation could have avoided this "disaster". The same principle applies to communities and disasters. The event that precipitates the disaster may be inevitable, such as an earthquake. However, it is the combination of this event and the vulnerability of the community that eventually results in the disaster. At the time of the planning and design stages of the development project to purchase a CT Scanner, a vulnerability and hazard assessment would have identified the potential problem and planning could have been completed to prevent long outages.

### **Evaluation of the Bir Hospital Project**

At the completion of any research or project it is important to critically appraise what was achieved, whether it met the objectives and was it the best way to achieve these objectives or were there alternatives which were not considered but through the implementation process were identified. With respect to the Bir Hospital Project the question could be asked, was the vulnerability assessment and the methods appropriate?

A thought provoking paper by Arturo Escobar (Corbridge 1995:64-77) identifies planning as a process "of domination and social control", "not a neutral framework" and that it "bears the marks of the history and culture that produced them" (Corbridge 1995:64). These comments are made specifically in the context of social planning and the imposing

of this planning onto societies, especially planning processes developed in Western, developed nations and then deployed in under-developed countries. This raises the question for me of how appropriate is the assessment and subsequent planning for Bir Hospital using methods developed and tested in modern, developed countries? I suggest the question could be answered that it is appropriate in the context that Bir Hospital is designed, set-up and operating similar to a modern, developed-country hospital. Although the question asked is outside the stated scope of this paper it is a subject that is worth further research and discussion.

A similar question can be asked with regard to the standards against which the vulnerability of Bir Hospital was measured. The standards used were ones which originated in Western, developed countries. Using these standards the overall, finding was that Bir Hospital is vulnerable to many potential events every day, which could result in a disaster. My response to this is the same as above; that the design and operations of Bir Hospital have been modelled on the same hospitals for which the standards were developed.

At the completion of this project, along with the associated literature research, I would ask the question as to whether completing a vulnerability assessment and making recommendations to Bir Hospital management is enough, or even the right approach to reducing vulnerability? I suggest that the vulnerability assessment and subsequent report will have a positive impact on reducing Bir Hospital's vulnerability, but only in part. The report has identified deficits in past development activities at Bir Hospital and made recommendations on how these same errors can be prevented in the future. This is part of a learning process. However, some of the root causes of the vulnerability of Bir Hospital have not been addressed, such as the level of funding of Bir Hospital by the Nepali Government. Another issue not addressed but which will potentially have an impact on planned development is that Nepal does not have an approved building code. Therefore the proposed trauma center does not need to necessarily comply with any standard. These two examples are given to highlight in a limited way the many interrelationships and factors which influence the vulnerability of Bir Hospital. This same principle applies to any community.

In conclusion, there is a definite relationship between development and disasters. This relationship can be divided into two broad categories. The first category is financial. Primarily, disasters divert funds away from development. Secondly, development can either reduce or increase the likelihood of disasters. These relationships are supported from current literature and have been illustrated through the findings of the vulnerability assessment project at Bir Hospital. The key conclusion of this paper is that disasters need not happen; they can be managed before they occur through well-designed development activities. This can be facilitated by development practitioners and disaster managers working closely together.

# **A Proposal to Bir Hospital for Hospital Emergency Management Project**

**Prepared by:**

Robert Patton  
Risk Management Practitioner  
Tauranga  
New Zealand

**Submitted by:**

National Society for Earthquake Technology - Nepal (NSET-Nepal)  
Kha. 2- 731, Mahadevsthan, Baneshwor  
Tel: 977-1-474 192  
Fax: 977-1-490 943  
e-mail: [nset@nset.org.np](mailto:nset@nset.org.np)

**Katmandu, Nepal**

**April, 2000**

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## **1. Introduction**

This proposal is being submitted by the National Society for Earthquake Technology Nepal in co-operation with a group of New Zealand specialists, to the management of Bir Hospital for the implementation of an Emergency Management Project.

## **2. Background**

The Kathmandu Valley is susceptible to earthquakes. Historically, the Valley experiences two major earthquakes a century. The last major earthquake was in 1934. It is estimated that if a similar intensity earthquake shaking were to occur today in the valley, it would result in 40,000 deaths, 95,000 injured and leave 600,000 to 900,000 residents of the Kathmandu Valley homeless.

The results of a study completed by the Kathmandu Valley Earthquake Risk Management Project by the National Society for Earthquake Technology- Nepal (NSET- Nepal) determined that none of the 12 hospitals in the Valley had identified what their vulnerabilities would be in an earthquake. Failure to identify vulnerabilities links to a failure to identify dependencies and the resources that would be required to manage a major earthquake or any other disruptive event. The conclusion was that not one hospital was appropriately prepared for an earthquake. Therefore their response and recovery capabilities would be severely limited.

Such revelation led, in the past couple of years, to the realisation of need to improve the emergency response management capability of hospital system. Accordingly, Bir Hospital approached the National Society for Earthquake Technology- Nepal (NSET- Nepal) to assist the hospital in this endeavour.

NSET wished to respond to this request positively as the proposed activity confirmed to the intent of the Kathmandu Valleys Earthquake Risk Management Action Plan (See initiative 01 & 02, page 28, and "More Endorsed initiatives", page 33 of the Action Plan). During the course of exploration, we could fortunately contact Mr. Robert Patton, who not only has the required expertise the experiences of working in Nepal, but also can mobilise resource for such technical assistance. Further dialogue between NSET - Nepal and Robert Patton led to the formulation of the project concept, which was always endorsed by the management of the Bir Hospital.

### 3. Aims

By consulting widely with Bir Hospital staff and relevant local experts:

- develop the framework for an emergency management plan for Bir Hospital,
- empower managers and staff at Bir Hospital to be able to develop and take ownership of this emergency management plan.

### 4. Scope of Work

- 1) Conduct a literature search into the experiences of developing countries following a major earthquake, with special emphasis on the delivery of health services after the event.
- 2) Develop and present to the Ministry of Health (Nepal) recommendations for earthquake preparedness and planning based on the findings of the literature search.
- 3) Identify project “champions” at Bir Hospital and involve them throughout the project.
- 4) Develop impact analyses of three earthquake scenarios on Bir Hospital. The scale used is Modified Mercalli Intensity scale:

i)	Scenario 1	MMI V – MMI VI	(Impact Low)
ii)	Scenario 2	MMI VII – MMI VIII	(Impact Medium)
iii)	Scenario 3	MMI IX – MMI X	(Impact High)
- 5) With staff at Bir Hospital identify the vulnerabilities and dependencies of the hospital and its departments. Discuss with staff possible means of minimising the risks to those services. From this identify the level of service achievable after each of the scenarios and the minimum resources required to deliver that service.
- 6) Develop a planning framework based on the findings of objective 5.
- 7) Run a workshop for Bir Hospital “champions” to enable them to implement the framework for the development of earthquake preparedness, response and recovery plans.

## **5. Project Implementation**

### **5.1 Literature Review**

- Robert Patton will conduct the literature search and write the report on the search before 1 August 2000

### **5.2 Presentation to the Ministry**

- Before arriving at Kathmandu Robert Patton and Ben Thomas will prepare and develop the PowerPoint presentation to be delivered to the Ministry of Health. NSET will liaise with the Ministry on arrangements.

### **5.3 Establish contact & Selection of Bir Hospital Personnel**

- NSET will liaise with the Director of Bir Hospital for the selection and appointment of the project "champions" at Bir Hospital. These "champions" should:
  - Be volunteers
  - Have the respect and liking of other staff
  - Have the enthusiasm and willingness to give up their time to follow this project through.

### **5.4 Site Inspection and Interviews**

- The initial stage of the project at Bir Hospital will consist of site inspections and interviews with heads of key departments to identify the key vulnerabilities and dependencies. NSET will liaise with Bir Hospital to make arrangements for the site visits.
- Interviews will be held to identify the likely impact on the hospital in terms of damage and casualty inflows in the event of an earthquake.

### **5.5 Workshop**

- A workshop will be held with key members of the hospital to agree on the initial framework of the plan and to agree to subsequent stages in the process. NSET will liaise with Bir Hospital to make arrangements for this workshop.

## 5.6 Summary of Actions Required

By Whom	What Action	By When
Robert	Report on results of literature search	1 August
Robert & Ben	Prepare presentation to MoH	1 August
NSET- Nepal	Liaise with MoH for presentation by Robert & Ben	1 August
NSET- Nepal	Liaise with Bir Hospital to identify "champions"	1 August
NSET- Nepal	Liaise with Bir Hospital to make arrangements for site visits	1 August
NSET- Nepal	Liaise with Bir Hospital to arrange workshop details	1 August
NSET- Nepal	Access data on key departments, services and patient numbers at Bir Hospital	1 September
NSET- Nepal	Access Bir Hospital plans and summaries of key utilities	1 September
Robert & Ben	Develop impact scenarios x 3	15 September
Robert & Ben	Develop planning framework	20 September
Robert & Ben	Prepare and facilitate workshop at Bir Hospital	22 September

It is proposed that Robert Patton and Ben Thomas travel to Kathmandu for two weeks (11 – 22 September 2000) to assist to develop an emergency management planning framework specifically for Bir Hospital. When implemented, this will prepare the hospital for an earthquake of varying intensities. It will begin a process that will result in plans which will give staff the confidence of knowing that they are prepared for and able to manage any event that disrupts services, mainly earthquake but equally storm, flood etc. This framework can be modified and, as appropriate used by other hospitals in the Kathmandu Valley to improve their preparedness for earthquakes. It can be a link in the chain of regional and national response plans to be developed in the future.

## **5. 7 Requested Assistance from Bir Hospital**

- Establish in advance who will 'champion' the project.
- Determine the formation of the project team within the hospital.
- Provide advance data on key departments, services and patient numbers.
- Have available for the project, plans of the hospital and if possible summaries of key utilities and how they serve the hospital.

## **6. The Benefits**

Realistically, if there is an event in the region of MMI X, there is a limit even to what a good emergency plan can do. The hospital will probably be unusable and at best will be operating in survival mode until help arrives. Therefore any planning must be linked into regional, national and international plans.

We see a far wider goal of the planning process: to ensure that hospital services do not collapse in a lesser event. We want the planning process to be robust so that if there were an event of MMI VII VIII or IX, the hospital and staff would be prepared and maintain the best level of service that is practical.

We envisage the long-term benefits of the project to the community, staff of Bir Hospital and the Nepalese Government to be:

- Hospital staff having confidence in their own abilities to handle a major disruptive event
- continuity of hospital services following an earthquake
- a reduction in suffering and death following an earthquake
- overseas governments and aid agencies seeing that Nepal is taking proactive steps to mitigate the effects of an earthquake.
- by planning and identifying problems in advance, greater opportunity and willingness for overseas agencies to help mitigate those problems.
- by pre-planning, overseas governments and aid agencies can determine quickly the help that is required after an earthquake and where it is best directed,

- minimising the risk of inappropriate assistance after the event
- by pre planning, and efficient response the reputation of Nepalese agencies and officials is enhanced.
- The project can be used as the first stage of a plan involving other hospitals and eventually linked into a national recovery plan
- better able to respond to **any** emergency

## **7. Person Specifications (New Zealand)**

Robert Patton

Robert has worked in the health sector for over twenty years. For the last six years he has specialised in emergency management for hospitals and completed post-graduate studies in emergency management and disaster medicine. He is currently completing his Masters in development studies, focusing on emergency management.

Ben Thomas

Ben has 30 years experience in loss control work. In the past eight years his work has been specifically in the area of risk management. In 1998 he undertook a project to develop Business continuity and Recovery Plans for a tertiary hospital in New Zealand. In 1999 he worked with another tertiary hospital in developing Y2K contingency planning strategies. His work in emergency and business continuity planning extends to the commercial sector including the dairy industry.

NSET - Nepal will field Mahesh Nakarmi or other civil engineers for this job. Amod Dixit will provide the oversight.

## **APPENDIX B**

### **Framework for Vulnerability Assessment of Bir Hospital**

#### **Utilities**

- Describe the utility system
- Does it meet the current needs of the organization?
- Detail any current deficiencies in the utility
- Is there a back-up system in place?
- Describe the back-up system?
- Is the back-up system adequate to meet the minimum requirements of Bir Hospital?
- Have emergency procedures been developed for failure of the utility and are these documented?
- Identify the maintenance schedule for the utility
- Identify a regular testing schedule for the functionality of the utility
- Identify the impact of a loss of the utility on key departments
- Identify the expected impact an MM10 earthquake would have on the utility
- Identify what problems have occurred in the past with the utility
- Identify how these problems were managed
- Identify if any dependence on external providers for the utility

#### **Buildings**

- General visual assessment of the building
- Construction type
- Any earthquake protection features
- Maintenance / repair of the buildings
- Expected impact of MM10 earthquake on the building
- Impact building design / construction may have on utilities
- Restraint of fixtures and fittings within the buildings

#### **Key Departments**

- Identify the impact loss of each utility would have on the ability of the department to continue to provide their core service
- Identify the dependence of each key department on other departments
- Does the department have an emergency response plan which is documented?

## **Appendix C**

### **Departmental Questionnaire**

Name of Department:

Primary service/ function of the department:

What utilities does the department depend on to provide their service/function:

What other departments are they dependent on to provide their service/function:

What other departments are dependent on them to provide their service/function:

Problems experienced in the past which affected their ability to provide their service/function:

What was the cause of this problem:

How was the problem managed:

What was the outcome:

What equipment is critical for them to provide their service/function:

Is equipment and supplies restrained/constrained:

Do they have a written disaster response plan:

**Person completing Questionnaire:**

**Date:**



Appendix D

Departmental Dependency Grid

Department \ Dependency	Emergency D.	ED Obs Ward	ED Minor Ops	ED Radiology	Disaster M. Unit	Laboratory	CSSD	Haemph. Care C.	Main Ops Theatre	Radiology	Comms. Centre	Electricity	Water	Sewerage	Steam	Communications	Medical Gases	Energy Gases	Air -conditioning	Lifts
Emergency D.																				
ED Obs. Ward																				
ED Minor Ops.																				
ED Radiology																				
Disaster M. Unit																				
Laboratory																				
CSSD																				
Haemph. Care C.																				
Main Ops. Theatre																				
Radiology																				
Comms. Centre																				

## **APPENDIX E**

### **Situation and Needs Assessment Guide**

Notes:

- The local people must be consulted throughout the process
- Information may already exist and can be gathered from this source
- An assessment is only a “snapshot” in time
- Standardised terminology and procedures should be used to ensure it is understood by all reading the report and also for future re-evaluation
- Need to distinguish between emergency and chronic needs
- Look for patterns and indicators of potential problems
- Initial Needs Assessment identifies the immediate resources and services required to save and sustain the population
- Situation and needs assessment can be done simultaneously

### **Survival**

An assessment of the immediate life threatening needs of the affected populace.

Priority assessment required for:

- Water (especially for the young and old)
- Protection from
  - weather
  - hostility
  - animals
  - unsafe environment
- Food (especially for the young and old)

Are the problems any different or worse than before the disaster

What is currently being done?

Who is currently doing this?

What is the local capability / capacity to do it?

What is the capability / capacity of ADRA to do it?

What other organization might be used as a partner?

Constraints / risks to meeting needs (e.g. too many people, not enough resources, problems of access)

Recommendations:

## **Protection**

- Damage to private and public buildings
- What type of building has been damaged
- How many (%) of buildings damaged / destroyed
- Estimate the number of people in need of shelter
- What type of shelter is required (weather, cultural considerations)
- What are local solutions to shelter
- Are people living at home, at a central building or campsites

Are the problems any different or worse than before the disaster

What is currently being done?

Who is currently doing this?

What is the local capability / capacity to do it?

What is the capability / capacity of ADRA to do it?

What other organization might be used as a partner?

Constraints / risks to meeting needs (e.g. too many people, not enough resources, problems of access)

Recommendations:

## **Health**

- Number dead, where are they, how are the bodies being managed
- Number injured, where are they being treated, what is the range of injuries
- Number missing / unaccounted for, how this is ascertained
- Potential disease risks, what is being done to prevent / control
- Who is affected (children, adults, elderly)
- Is there loss of food (destroyed, contaminated)
- Medical facilities (size, proximity, ability to provide a service)

- Water (contamination, colour, smell, quantity, reliability of supply, storage facilities, is there an education programme, how much water is available per person)
- Sanitation (is there overcrowding, human waste management, is the sewer system intact)
- Has the affected populace lost its supply of cooking, cleaning and storage utensils

Are the problems any different or worse than before the disaster

What is currently being done?

Who is currently doing this?

What is the local capability / capacity to do it?

What is the capability / capacity of ADRA to do it?

What other organization might be used as a partner?

Constraints / risks to meeting needs (e.g. too many people, not enough resources, problems of access)

Recommendations:

## Infrastructure

Extent of damage / what is not working:

- Electricity
- Water
- Telephone / communication
- Sewerage
- Gas
- Roads
- Bridges
- Railroad
- Airports
- Seaports
- Schools
- Banks
- Shops
- Hospitals
- Medical centres

Are the problems any different or worse than before the disaster

What is currently being done?

Who is currently doing this?

What is the local capability / capacity to do it?

What is the capability / capacity of ADRA to do it?

What other organization might be used as a partner?

Constraints / risks to meeting needs (e.g. too many people, not enough resources, problems of access)

Recommendations:

## **Recovery**

Expected time for partial to full re-instatement:

- Electricity
- Water
- Telephone / communication
- Sewerage
- Gas
- Roads
- Bridges
- Railroad
- Airports
- Seaports
- Schools
- Banks
- Shops
- Hospitals

- Medical centres

Main source of income

Impact of event on future income

## **Development**

Long-term projects

Adapted from:

McConnan (2000) Sphere Handbook

OFDA (1998) The Field Operations Guide for Disaster Assessment and Response



## APPENDIX F

### Action Plan For Bir Hospital

Ref No.	ISSUE/PROBLEM	RECOMMENDATIONS	PRIORITY	COSTS	ACTION	DATE COMPLETED
1	New Trauma unit	Design of structure to consider earthquake potential and need for hospital to function post-earthquake.				
2		Self-sufficiency in utilities after an earthquake and seismic protection of utilities				
3		Seismic restraint of non-structural elements				
4		Develop maintenance schedules for buildings, equipment and plant and provide training				
5		Seismic restraint of contents and equipment				
6		Development of emergency response plan for trauma centre, including fire evacuation plan				

Ref No.	ISSUE/PROBLEM	RECOMMENDATIONS	PRIORITY	COSTS	ACTION	DATE COMPLETED
7	UNDP and WHO	Develop liaison with UNDP and WHO				
8		Development of healthcare emergency preparedness group				
9	Power	Replacement of transformers and maintenance programme				
10		Repair of generator				
11		Strengthen seismic integrity of switchgear. Review adequacy of seismic isolation of transformers and generators.				
12		Brace oil tank and drums				
13		Provide UPS in theatres				
14	Water	Design of water treatment plant – aspects to be considered				
15		Repair and renovation of leaking pipe work				
16		Strengthen main water storage tank				

Ref No.	ISSUE/PROBLEM	RECOMMENDATIONS	PRIORITY	COSTS	ACTION	DATE COMPLETED
17	Communications	Repair of air conditioning in UPS room				
18		Seismic restraint for PABX equipment				
19		Repair intercom				
20		Service and test of mass casualty alarm and staff training				
21	Medical gases	Restraint of gas cylinders				
22	Emergency planning	Inventory of emergency cupboards and audits				
23		Develop fire evacuation programme with appropriate staff training				
24		Repair and bring into service fire protection and alarm system				
25		Reinstate fire fighting equipment and provide training in use of "first aid" fire fighting equipment				
26		Provide fire training for staff				

Ref No.	ISSUE/PROBLEM	RECOMMENDATIONS	PRIORITY	COSTS	ACTION	DATE COMPLETED
27	Building and plant maintenance	Develop asset management programme and maintenance planning				
28		Matters to be considered prior to equipment acquisition				
29		Centralised technology training				

## Appendix H



Photo 1: The outside of Rapar Civil Hospital



Photo 2: The entrance foyer of Rapar Civil Hospital.





Photo 3: Rapar Civil Hospital was evacuated to a nearby children's playground



Photo 4: Bir Hospital Central Block Transformer with failure of cable insulation



Photo 5: Accumulations of dirt impede the ability of the transformer and cable to lose heat and poses a fire hazard



Photo 6: The outside of the New Building, Bir Hospital





Photo 7: Severe spalling on the outside of the Surgical (Old) Building, Bir Hospital



Photo 8: A service duct is examined. Evidence of major water leaks in the service duct.





Photo 9: Seismic joint at Tribhuvan University Teaching Hospital, Kathmandu.



Photo 10: Unrestrained equipment in the laboratory, Bir Hospital.



Photo 11: Unrestrained shelving with supplies on open shelves, Bir Hospital

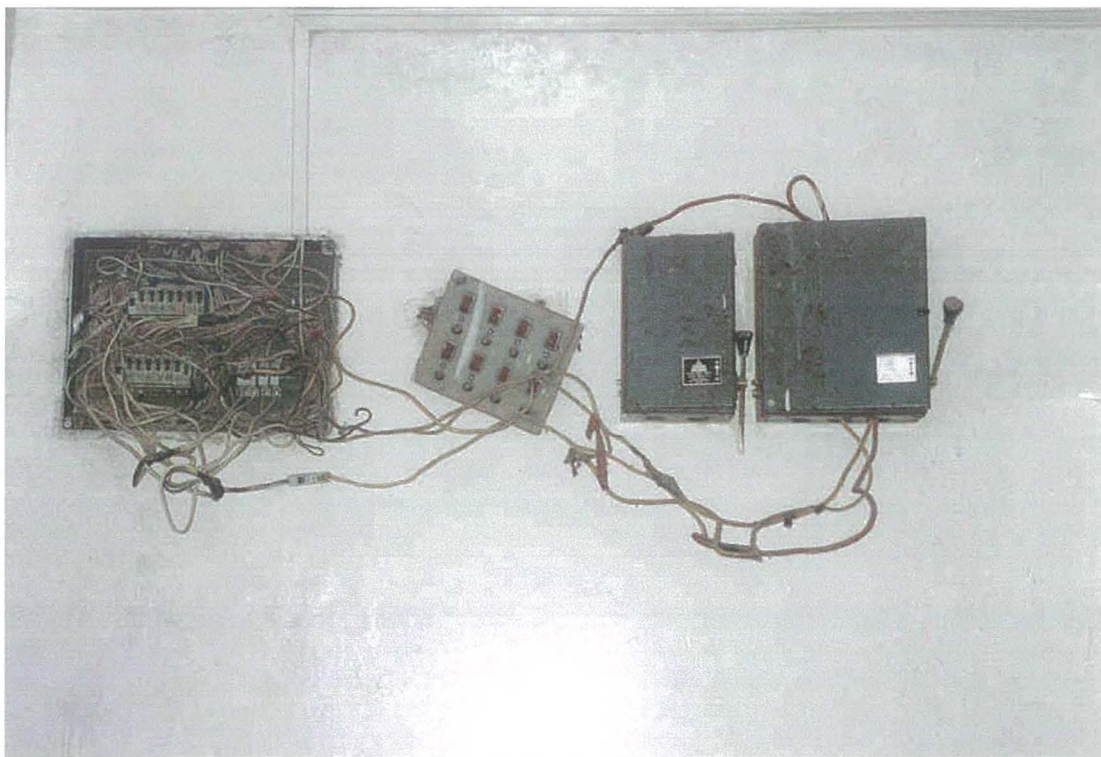


Photo 12: Electrical wiring and switch board in a patient-care area, Bir Hospital

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